

onto the filament apices, the connectives bifid but scarcely developed; anthers short and curled over at anthesis; non-fertilized pistillate flowers deciduous after anthesis; staminodial tubes crenulate or shallowly lobed at the apex, those of non-fertilized flowers not projecting and persistent after anthesis; *fruits* 7.3(6.4–7.7) mm long, 5.4(4.6–5.9) mm in diameter, the bases without a prominent stipe, the apices not conical, the surfaces not splitting at maturity, with fibers emerging, bumpy from the numerous, subepidermal, tangential, short fibers present, these coming to a point at fruit apices; locular epidermis with operculum, smooth, without pores.

Taxonomic notes:—Closely related to *G. concinna* (which see), differing from that species in its fruit surfaces with emerging fibers.

Subspecific variation:—Two traits (stem branching, leaf division) vary within this species. There is geographic discontinuity, and specimens come from three different areas in Panama; the eastern end of the Central Cordillera; the mountain systems east of the Canal Zone; and the western end of the Serranía de San Blas, with an outlier on the Serranía de Majé. This gives three geographic subgroups, excluding the outlier. ANOVA shows that for pair wise comparison probabilities, 10 variables (plant height, stem diameter, sheath length, number of pinnae, apical pinna length, peduncle length, peduncle width, rachilla length, rachilla width, number of rachillae) differ significantly ($P < 0.05$) between one pair of subgroups, and one variable (rachis length) differs amongst all three groups. Based on these results, the three Panamanian subgroups are recognized as subspecies (subsp. *concinnoidea*, *coclensis*, *jefensis*).

Key to the subspecies of *G. concinna*

- 1 Rachis 28.5(20.0–37.0) cm long; western end of the Serranía de San Blas, with an outlier on the Serranía de Majé... subsp. *concinnoidea*.
- Rachis 17.5(9.6–27.0) cm long; all other areas 2
- 2 Rachillae 1.0(0.8–1.2) mm in diameter; eastern end of the Central Cordillera..... subsp. *coclensis*
- Rachillae 1.4(1.1–1.7) mm in diameter; east of the Canal Zone (Cerro Azul, Cerro Brewster, Cerro Bruja, Cerro Jefe) subsp. *jefensis*

12a. *Geonoma concinna* subsp. *concinnoidea*

Leaves rachis 28.5(20.0–37.0) cm long; apical pinna 16.5(12.3–20.5) cm long. *Inflorescences* rachillae 1.6(1.3–1.9) mm in diameter.

Distribution and habitat:—From 8°50'–9°23'N and 78°25'–79°08'W in Panama on western end of the Serranía de San Blas, with an outlier on the Serranía de Majé, at 401(350–550) m elevation in lowland rainforest (Fig. 12).

12b. *Geonoma concinna* subsp. *coclensis* Henderson, subsp. nov. (Appendix IV, Plate 8)

A subspeciebus altis rachide brevior et rhachillis tenuioribus differt.

Type: PANAMA. Coclé: El Copé, 8°40'N 80°35'W, 724 m, 9 May 1999, A. Henderson & E. Ferreira 3028 (holotype PMA!, isotype NY!).

Leaves rachis 19.9(14.5–27.0) cm long; apical pinna 12.1(9.0–16.2) cm long. *Inflorescences* rachillae 1.0(0.8–1.2) mm in diameter.

Distribution and habitat:—From 8°35'–8°45'N and 80°25'–80°41'W in Panama on the eastern end of the Central Cordillera at 737(500–900) m elevation in lowland rainforest (Fig. 12).

12c. *Geonoma concinna* subsp. *jefensis* Henderson, subsp. nov. (Appendix IV, Plate 9)

A subspeciebus altis rachide brevior et rhachillis crassis differt.

Type: PANAMA. Panama: Cerro Jefe, ca. 1000 m, 25 August 1975, S. Mori & L. Joly 7933 (holotype MO!).

Leaves rachis 15.0(9.6–22.5) cm long; apical pinna 15.0(11.4–18.5) cm long. *Inflorescences* rachillae 1.4(1.1–1.7) mm in diameter.

Distribution and habitat:—From 9°10'–9°28'N and 79°16'–79°33'W in Panama on mountains east of the Canal Zone (Cerro Azul, Cerro Brewster, Cerro Bruja, Cerro Jefe) at 895(800–1000) m elevation in lowland rainforest (Fig. 12).

Subspecific variation:—Most specimens from Cerro Jefe have pinnate leaves.

13. *Geonoma congesta* Wendland ex Spruce (1871: 112). Type: COSTA RICA. Heredia: Río Sarapiquí, between Pedegral and San Miguel, 1857, *H. Wendland s.n.* (holotype K!).

Plants 3.4(1.5–6.0) m tall; stems 4.1(1.0–8.0) m tall, 1.6(1.0–2.7) cm in diameter, solitary or clustered, cane-like; internodes 2.0(0.9–5.5) cm long, yellowish and smooth. *Leaves* 10(6–13) per stem, undivided or irregularly pinnate, not plicate, bases of blades running diagonally into the rachis; sheaths 23.2(15.5–27.0) cm long; petioles 18.7(5.5–51.0) cm long, drying green or yellowish; rachis 66.1(38.8–132.0) cm long, 5.1(2.4–15.2) mm in diameter; veins raised and rectangular in cross-section adaxially; pinnae 4(1–24) per side of rachis; basal pinna 59.2(33.0–82.0) cm long, 18.0(4.5–35.5) cm wide, forming an angle of 25(15–38)° with the rachis; apical pinna 34.9(21.7–48.0) cm long, 20.7(7.1–42.0) cm wide, forming an angle of 26(20–32)° with the rachis. *Inflorescences* branched 1–3 orders; prophylls and peduncular bracts not ribbed with elongate, unbranched fibers, flattened, deciduous or persistent; prophylls 15.9(6.0–29.7) cm long, not short and asymmetrically apiculate, the surfaces ridged with close, equal, parallel, non-dividing ridges, scarcely tomentose between the ridges, without unequally wide ridges; peduncular bracts 16.5(13.0–26.5) cm long, well-developed, inserted 0.6(0.3–1.0) cm above the prophyll; peduncles 7.8(4.2–13.0) cm long, 6.2(3.4–9.8) mm in diameter; rachillae 9(3–16), 12.8(6.0–23.0) cm long, 5.8(4.1–7.2) mm in diameter, the surfaces without spiky, fibrous projections or ridges, drying brown or yellow-brown, without short, transverse ridges, not filiform and not narrowed between the flower pits; flower pits spirally arranged, glabrous internally; proximal lips without a central notch before anthesis, not recurved after anthesis, not hood-shaped; proximal and distal lips drying the same color as the rachillae, not joined to form a raised cupule, the proximal lip margins overlapping the distal lip margins; distal lips well-developed; staminate and pistillate petals not emergent, not valvate throughout; staminate flowers deciduous after anthesis; stamens 6; thecae diverging at anthesis, inserted almost directly onto the filament apices, the connectives bifid but scarcely developed; anthers short and curled over at anthesis; non-fertilized pistillate flowers persistent after anthesis; staminodial tubes crenulate at the apex, those of non-fertilized flowers projecting and persistent after anthesis; *fruits* 12.4(9.7–15.2) mm long, 9.8(8.1–11.7) mm in diameter, the bases with a prominent, asymmetric stipe, the apices not conical, the surfaces not splitting at maturity, with fibers emerging, not bumpy, not apiculate; locular epidermis with operculum, smooth, with pores.

Taxonomic notes:—Henderson *et al.* (1995) included *Geonoma calyptrognoidea* as a synonym of *G. congesta*—see notes under that species.

Subspecific variation:—No trait apart from stem branching and leaf division varies within this species. There is geographic discontinuity and there is an isolated population on the Pacific slope of Costa Rica (Osa Peninsula and adjacent areas). There are thus two potential subgroups.

Specimens from Osa differ significantly from other specimens in 10 variables (plant height, rachis length, rachis width, number of pinnae, apical pinna length, peduncle width, rachillae length, rachillae width, number of rachillae, fruit diameter)(*t*-test, $P < 0.05$). Specimens from Osa have larger mean values for all these variables. Based on these results, and geographic discontinuity, the two subgroups are recognized as subspecies (*subsp. congesta, osensis*).

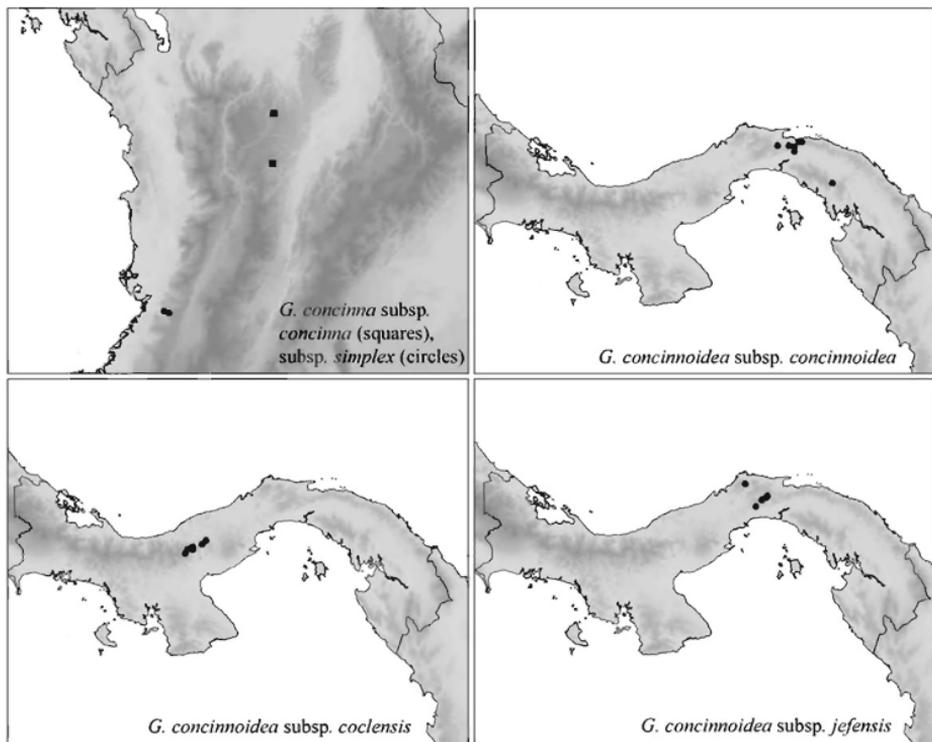


FIGURE 12. Distribution maps of *Geonoma concinna* subsp. *concinna*, *Geonoma concinna* subsp. *simplex*, *Geonoma concinnoidea* subsp. *concinnoidea*, *Geonoma concinnoidea* subsp. *coclensis*, and *Geonoma concinnoidea* subsp. *jefensis*.

Plants 2.0(1.0–3.1) m tall; stems 2.7(1.6–4.0) m tall, 0.6(0.4–1.0) cm in diameter, solitary or clustered, cane-like; internodes 1.8(0.7–4.5) cm long, yellowish and smooth. *Leaves* 6(5–8) per stem, undivided or irregularly pinnate, not plicate, bases of blades running diagonally into the rachis; sheaths 7.5(4.5–12.0) cm long; petioles 9.4(3.0–19.0) cm long, drying green or yellowish; rachis 21.0(9.6–37.0) cm long, 2.2(1.5–3.3) mm in diameter; veins raised and rectangular in cross-section adaxially; pinnae 1(1–3) per side of rachis; basal pinna 23.1(20.0–25.6) cm long, 5.7(3.6–6.8) cm wide, forming an angle of 30(22–44)° with the rachis; apical pinna 14.7(9.0–20.5) cm long, 5.7(3.0–6.4) cm wide, forming an angle of 30(20–37)° with the rachis. *Inflorescences* branched 2 orders; prophylls and peduncular bracts not ribbed with elongate, unbranched fibers, flattened, deciduous; prophylls 5.5(3.0–9.1) cm long, not short and asymmetrically apiculate, the surfaces ridged with close, equal, parallel, non-dividing ridges, scarcely tomentose between the ridges, without unequally wide ridges; peduncular bracts 4.5 cm long, well-developed, inserted 0.2(0.1–0.3) cm above the prophyll; peduncles 4.4(2.0–8.4) cm long, 2.7(1.7–4.2) mm in diameter; rachillae 14(7–24), 9.4(6.0–14.0) cm long, 1.4(0.8–1.9) mm in diameter, the surfaces without spiky, fibrous projections or ridges, drying brown, with faint to pronounced, short, transverse ridges, not filiform and not narrowed between the flower pits; flower pits spirally arranged, glabrous internally; proximal lips without a central notch before anthesis, not recurved after anthesis, hood-shaped at anthesis, sometimes splitting post-anthesis; proximal and distal lips drying the same color as the rachillae, not joined to form a raised cupule, the proximal lip margins overlapping the distal lip margins; distal lips well-developed; staminate and pistillate petals not emergent, not valvate throughout; staminate flowers deciduous after anthesis; stamens 6; thecae diverging at anthesis, inserted almost directly