

anthesis; staminodial tubes crenulate or shallowly lobed at the apex, those of non-fertilized flowers not projecting and persistent after anthesis; *fruits* 6.8(5.3–8.3) mm long, 5.7(4.5–6.5) mm in diameter, the bases without a prominent stipe, the apices not conical, the surfaces not splitting at maturity, without fibers emerging, bumpy from the numerous, subepidermal, tangential, short fibers present, these coming to a point at fruit apices; locular epidermis without operculum, smooth or sculpted and then usually also with a raised, meridional ridge, without pores.

Taxonomic notes:—The holotype of *Geonoma brongniartii* at P has not been seen. A specimen from F, labeled “*Geonoma elegans* Mart., Bolivia, Yacapani, 400 m, Otto Kuntze VI 92”, has written on it, apparently in Wessels Boer’s handwriting, “leg. d’Orbigny 39, Type of *G. brongniartii*”. This specimen, clearly not representing *G. elegans*, is referred to by Wessels Boer (1968) as being an isotype of *G. brongniartii*. Although it is not clear why Wessels Boer thought the specimen was an isotype, it is treated as such here.

Subspecific variation:—Five traits (stem branching, leaf division, adaxial veins, inflorescence branching, locular epidermis sculpting) vary within this species. There is evidence of geographic discontinuity, but some of the gaps in the distribution may be a result of insufficient collecting. Leaving aside stem branching, leaf division, and locular epidermis sculpting (for which there are few data), there is no correspondence between geography and variation in adaxial veins or inflorescence branching, except for one subgroup of specimens from sub-Andean Peru. These have raised adaxial veins and mostly branched inflorescences. These specimens differ significantly from all other specimens in eight variables (plant height, number of pinnae, basal pinna width, apical pinna width, rachillae length, rachillae width, fruit length, and fruit diameter)(*t*-test, $P < 0.05$). Based on this, they are recognized as a separate subspecies (subsp. *pascoensis*). All other specimens are included in subsp. *brongniartii*.

Key to the subspecies of *G. brongniartii*

- 1 Inflorescences unbranched; fruits 6.9(5.3–8.3) mm long; widespreadsubsp. *brongniartii*
- Inflorescences unbranched or usually branched 1 order; fruits 5.9(5.7–6.1) mm long; Peru (Junin, Pasco)subsp. *pascoensis*

6a. *Geonoma brongniartii* subsp. *brongniartii*

Geonoma metensis Karsten (1856: 409). Type: COLOMBIA. Meta: Villavicencio, no date, *H. Karsten s.n.* (holotype LE n.v.).

Geonoma cuneifolia Burret (1931a: 199). Type: PERU. Loreto: Rio Ucayali, 215 m, 17 November 1923, *G. Tessmann 3317* (holotype B, destroyed, isotype NY!).

Leaves veins raised and rectangular in cross-section adaxially or not raised or slightly raised and triangular in cross-section adaxially. *Inflorescences* unbranched; *fruits* 6.9(5.3–8.3) mm long, 5.8(4.9–6.5) mm in diameter.

Distribution and habitat:—From 7°14'N–17°50'S and 63°39'–77°20'W in the western Amazon and sub-Andean regions of Ecuador, Peru, Bolivia, and Brazil, with an outlier in Venezuela, at 373(75–1720) m elevation, often in low-lying, flooded areas, in lowland or, less often, montane rainforest (Fig. 10).

In southern Colombia and Ecuador, specimens are relatively uniform and have pinnate leaves, raised adaxial veins, more pinnae than usual, and slender rachillae. There is an absence of specimens from southeastern Ecuador and adjacent Peru. In this area, *Geonoma macrostachys* is abundant.

In northeastern Peru (Loreto) and adjacent Colombia and Brazil, specimens are similar to those from southern Colombia and Ecuador, except pinnae are fewer and some leaves undivided, and rachillae larger. Some specimens are considerably larger than others (e.g., *Vásquez 974f*). *Geonoma brongniartii* is again absent from southwest of Iquitos, where *G. macrostachys* is abundant.

In these northern populations, in Colombia, Ecuador, northeastern Peru and adjacent Brazil, there is geographical variation. Regression shows there are significant associations between longitude and eight leaf variables. Squared multiple *R* for the regression of petiole length on longitude is 0.58, number of pinnae 0.24, basal pinna length 0.50, basal pinna width 0.29, basal pinna angle 0.34, apical pinna length 0.20, apical pinna

width 0.17, and apical pinna angle 0.50. There is a change in leaf shape, from specimens in the east having shorter petioles and fewer, wider and longer pinnae with narrower angles to those in the west having longer petioles, more, narrower and shorter pinnae with wider angles.

In Brazil (Acre) and adjacent Peru most specimens are relatively uniform. There are some specimens (e.g., *Daly 10582, 10947*) with thicker rachillae and the flower pits arranged in closer spirals, as in central Peru (see below).

There is extreme variation in central Peru on eastern Andean slopes and adjacent areas. In Ayacucho, Huánuco, Pasco, San Martín, and Ucayali some specimens have larger leaves and longer, thicker rachillae along which the flower pits are wider and are arranged in closer spirals (*large-sized* morphotype). These larger-sized specimens sometimes occur together with the more usual-sized specimens. Some resemble *G. poeppigiana* and two (*Schunke 16280, 9912*) have bracts more like those of *G. poeppigiana*, and may be hybrids with that species.

Two other specimens (*Foster 7846, Roncal 182*) from Pasco have longer stems. One (*Foster 7846*) has a stem that is reported to be 2–3 m tall, and the other (*Roncal 182*) has cane-like stems with the internodes longer than wide. Both have short inflorescences, and in *Roncal 182* they appear to be pendulous. One other specimen (*Smith 3849*) appears similar. These occur near to an isolated population of *Geonoma deversa* subsp. *deversa, killipii* morphotype, and it is possible they represent hybrids with that morphotype. These and other possible hybrids are excluded from the above description.

In San Martín, one specimen (*Schunke 8080*) has the shortest prophyll (5.7) cm and interbract distance (0.5 cm) of all specimens, and the adaxial veins are not raised. It occurs sympatrically with another isolated population of *G. deversa* subsp. *deversa*, and may also be a hybrid.

One specimen from Huánuco (*Moore 8355*), with branched inflorescences, has unusually short rachillae and comes from an unusually high elevation (1575 m). It may be a hybrid.

Most specimens from southern Peru (Cusco, Madre de Dios, Puno) and Bolivia have non-raised adaxial veins, and thin, elongate rachillae along which the pits may be tricussately arranged, especially in the central part of the rachilla. A few specimens from northern Bolivia (*Moreno 124, Fuentes 3911, Macia 3986, Beck 18258, Croat 51638, Beck 16466, Williams 941, Williams 939*) and southern Peru (*Foster 9721, 9576*) have thicker rachillae and the flower pits arranged in closer spirals, as found in the large central Peruvian specimens. A few specimens (*Moreno 227, Gerlach 214, Foster 13393, Hodge 6079, Plowman 5062*) from southern Peru and Bolivia have exceptionally long interbract distances (10.3–18.5 cm).

There is variation in connectives in this species. Specimens are scored as having the thecae inserted almost directly onto the filament apices, the connectives bifid but scarcely developed. However, in some specimens the connectives appear not to be bifid, and are similar to those of *G. macrostachys*.

6b. *Geonoma brongniartii* subsp. *pascoensis* Henderson, *subsp. nov.* (Appendix IV, Plates 2 & 3)

Geonomae brongniartii subsp. *brongniartii* inflorescentiis saepe ramosis atque fructibus parvioribus differt.

Type: PERU. Pasco: near Pozuzo, opposite the town, steep slope above river opposite margin of Rio Pozuzo, along road that runs south, 11 September 1998, A. Henderson, E. Ferreira & M. Arakaki 3012 (holotype USM!, isotype NY!).

Leaves veins raised and rectangular in cross-section adaxially. Inflorescences unbranched or usually branched 1 order; fruits 5.9(5.7–6.1) mm long, 4.8(4.5–5.2) mm in diameter.

Distribution and habitat:—From 9°37'–10°33'S and 74°55'–75°34'W in sub-Andean regions of Peru (Junin, Pasco) at 417(200–1000) m elevation in lowland rainforest (Fig. 10).

7. *Geonoma calyptrogynoides* Burret (1930a: 223). Type: COLOMBIA. Antioquia: La Mesa, no date. W. Kalbreyer 1398 (holotype B, destroyed). Neotype (designated by de Nevers & Grayum 1988): COLOMBIA. Chocó: Zona de Urabá, Cerro del Cuchillo, sector Cuchillo Blanco, 10–20 m, 15 October 1987, D. Cárdenas 668 (neotype MO!).

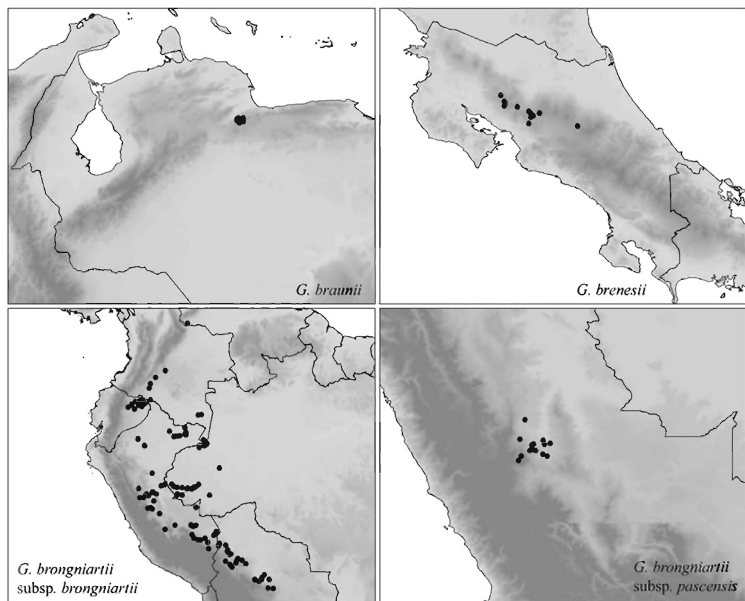


FIGURE 10. Distribution maps of *Geonoma braunii*, *G. brenesii*, *G. brongniartii* subsp. *brongniartii*, and *G. brongniartii* subsp. *pascoensis*.

5. *Geonoma brenesii* Grayum (1998: 322). Type: COSTA RICA. Alajuela: Reserva Biológica de San Ramón, road from Las Lagunas to Colonia Palmareña, 10°04'N, 84°32'W, 850–1100 m, 30 May 1986, *G. de Nevers*, *B. Hammel* & *C. Gómez 7789* (holotype MO!, isotypes CR!, NY!).

Plants 0.8(0.5–1.0) m tall; stems 0.3(0.2–0.4) m tall, 1.2 cm in diameter, solitary, not cane-like; internodes 0.5 cm long, not scaly. *Leaves* 9(8–11) per stem, irregularly pinnate, not plicate, bases of blades running diagonally into the rachis; sheaths 8.2(6.5–10.0) cm long; petioles 31.8(21.0–38.5) cm long, drying green or yellowish; rachis 24.6(18.8–29.8) cm long, 2.8(1.9–4.3) mm in diameter; veins raised and rectangular in cross-section adaxially; pinnae 3(3–4) per side of rachis; basal pinna 28.3(21.5–36.5) cm long, 4.1(2.0–10.2) cm wide, forming an angle of 43(30–53)° with the rachis; apical pinna 16.7(13.5–21.0) cm long, 9.5(6.5–12.0) cm wide, forming an angle of 29(25–32)° with the rachis. *Inflorescences* unbranched; prophylls and peduncular bracts ribbed with elongate, unbranched fibers, both bracts tubular, narrow, elongate, closely sheathing the peduncle, more or less persistent; prophylls 13.5(10.0–17.5) cm long, not short and asymmetrically apiculate, the surfaces not ridged, without unequally wide ridges; peduncular bracts 3.9(1.5–7.1) cm long, vestigial, inserted 4.9(3.4–7.0) cm above the prophyll; peduncles 24.3(15.0–37.5) cm long, 2.1(1.4–2.8) mm in diameter; rachillae 1, 12.5(8.5–16.0) cm long, 3.6(2.8–5.0) 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;