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## *Pitcairnia calcicola* (Bromeliaceae), a New Species from the Tropical Dry Forest of Costa Rica

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**ABSTRACT.** *Pitcairnia calcicola* is described as a narrow endemic of the low limestone hills in the tropical dry forest of central Guanacaste Province, Costa Rica. It belongs to *Pitcairnia* subg. *Pitcairnia*, and appears to be most closely related to *P. flagellaris* L. B. Smith of Guatemala.

***Pitcairnia calcicola*** J. R. Grant & J. F. Morales, sp. nov. TYPE: Costa Rica. Guanacaste: Parque Nacional Barra Honda, Sendero Las Cavernas, bosque secundario en la cima y falda sur del Cerro Barra Honda, 10°09'52"N, 85°21'45"W, 420 m, 8 Sep. 1993, Morales 1659b, Reyes, & Lepiz (holotype, INB; isotypes, CR, MO, US). Figure 1.

A *Pitcairnia flagellari*, cui affinis, sed foliis longioribus et latissimus, scapus lepidotis, bracteis scapigeris internodia longioribus, pedicellis brevior, sepalis longioribus, et petalisque sin appendicibus differt.

Plants acaulescent, terrestrial, epilithic on limestone outcrops (calciphilic), stoloniferous, 120–170 cm tall in flower. Leaves grass-green, dimorphic, persistent, spinose, not petiolate; outer leaves reduced to short spinose-serrate spines, 7–18 mm long, the sheaths ovate, 2.5–4.0 cm long, 3.0–4.5 cm wide, slightly inflating the base of the plant, the blades linear-long, 4.5–14.0 cm long, 2–4 mm wide; inner leaves foliaceous, the sheaths scarcely defined as they merge into the blades without differentiation, the blades narrow, linear-long, 50–125 cm long, 8–10 mm wide at base, 14–18 mm wide at the middle, and 18–25 mm wide at their broadest above the middle, acuminate, narrowing toward the apex; spines usually antrorse (rarely retrorse),

0.25–1.0 mm long, roughly spaced every 2 mm on the outer leaves and sheaths of the inner leaves, sparse and usually absent on the blades of the inner leaves. Scape reddish, erect, thinly white to greenish white flocculose, 41–57 cm long; scape bracts grass-green, linear-triangular, filiform, 25–36 cm long, 7–9 mm wide at base, 2–3 mm wide at the middle and 0.50–1.0 mm wide at the apex, lepidote. Inflorescence paniculate, diffuse, bipinnate to tripinnate, 45–135 cm tall, lepidote, the rachis reddish; primary bracts (those bracts that subtend branches) linear-long, acuminate, erect to spreading, never decurrent, 18–79 mm long, 2–5 mm wide, grass-green, lepidote, decreasing in length toward the apex of the inflorescence, those of the lower branches exceeding the length of the sterile portion of the branch it subtends, while shorter when subtending the branches near the apex of the inflorescence; primary branches 2–6 in number, 18.5–26.5 cm long, lepidote; secondary branches 8–10 cm long. Flowers pedicellate, trigonal. Floral bracts (those bracts that subtend pedicels) triangular and pungent to ovate and acute, lepidote, shorter than the pedicels, 5–17 mm long, 2.5–3.5 mm wide, decreasing in length toward the apex of the inflorescence. Pedicels slender, 5–16 mm long, 0.75 mm wide, longer than their subtending floral bract, lepidote, reddish. Sepals bright red, narrowly triangular in outline, acuminate, firm, pungent, lepidote, 33–36 mm long, 5–6 mm wide at base, 3–4 mm wide at the middle, and less than 1 mm wide at the apex. The adaxial sepal and petal pairs are arranged on the upper side of the flower, while the abaxial sepal and petal are on the lower side of the

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Figure 1. *Pitcairnia calcicola* J. R. Grant & J. F. Morales. A, B from the holotype, C–G from the paratypes. —A. Lower habit. —B. Upper portion of inflorescence. —C. Entire habit. —D. Lateral view of flower showing the upper position of the abaxial petal and sepal pairs, and the lower position of the adaxial petal and sepal. —E. Lateral internal



view of flower showing the position of the pistil and stamens. —F. Capsule tightly bound within the firmly dried calyx (one sepal removed to show the carpels). —G. Bicaudate seed.

flower. Petals bright red, linear-obovate, apically obtuse, glabrous, unappendaged, 46–52 mm long, 2.0–3.5 mm wide at base, 4–5 mm wide at the middle, and 6–8 mm wide at their broadest toward the apex, exceeding the sepals, stamens, and pistil. Stamens included, 45–49 mm long, shorter than the pistil; filaments slender, 37–41 mm long, 0.25 mm wide; anthers linear, 7–8 mm long, 0.5 mm wide, basifixed. Pistil included, 46–48 mm long, longer than the stamens; ovary 3-carpeled, 3-loculed, ovate, superior, 6–7 mm long, 2–3 mm wide at anthesis; style 37–40 mm long, 0.5 mm wide; stigma 2.0 mm long, 1.0 mm wide, with the conduplicate-spiral type morphology (i.e., the three lobes twist spirally). Capsules ovate, trigonal, septicial, 8–18 mm long, 5–7 mm wide, tightly bound within the firmly dried calyx and lined by the dried petals, stamens, and pistil to form a “shaker-like” capsule-calyx from which the seeds are dispersed, light to dark brown at maturity, dehiscing along an inward-facing suture; carpels three, 2.5–3.0 mm wide. Only when the carpels open resulting in the spreading of the sepals may seeds may fall out. Seeds bicaudate, “s” shaped, 3.0–4.1 mm long in total length; embryo reniform to obovate on its side and linear-thin from above, burnt-orange to rust in color, 0.9–1.2 mm long, 0.25–0.35 mm wide, and 0.10–0.18 mm wide from above; endostome extending linearly from diagonally opposite ends of the embryo, each 1.0–1.5 mm long, 0.05–0.10 mm wide, ivory-white to buff in color.

*Paratypes.* COSTA RICA. **Guanacaste:** Parque Nacional Palo Verde, Area Conservación Tempisque, Estación Palo Verde, Sendero Cactus, 10°20'00"N, 85°21'10"W, 100 m, 12 Dec. 1990, *Chavarria 191* (CR, INB, MO); Peninsula de Nicoya, 10 km S of Santa Cruz near Vista al Mar, 17 July 1992, *Grant 92-02008 & Rundell* (CR, SEL, US); Parque Nacional Palo Verde, Area Conservación Tempisque, Estación Palo Verde, Sendero Cactus, 10°20'00"N, 85°21'10"W, 100 m, 11 Jan. 1994, *Grant 94-02307 & Rundell* (CR, US); Parque Nacional Palo Verde, Valle del Tempisque, Sendero Guayacan, 10°21'00"N, 85°21'00"W, 10 m, 8 Sep. 1994, *Chavarria 1034* (CR, INB, MO); Parque Nacional Barra Honda, Sendero Las Cavernas, bosque secundario en la cima y falda sur del Cerro Barra Honda, 10°09'44"N, 85°21'31"W, 390 m, 1 Oct. 1994, *Lepiz, Fernandez & Reyes 556* (CR, INB, SEL, US).

#### TAXONOMY

*Pitcairnia calcicola* belongs to *Pitcairnia* subg. *Pitcairnia* because of its bicaudate seeds. It appears to be most closely related to *P. flagellaris* L. B. Smith of Guatemala, from which it differs in its longer, wider leaves, lepidote scape, longer scape bract internodes, shorter pedicels, longer sepals, and petals without appendages. The new species

also shows similarities to several other bright red-flowered species with paniculate inflorescences including *P. angustifolia* Solander of the Greater and Lesser Antilles, *P. integrifolia* Kew-Gawler of Trinidad and Venezuela, *P. ruderalis* L. B. Smith of Peru, and superficially to *P. valerii* Standley of Costa Rica and Panama.

Of the species of *Pitcairnia* in Costa Rica, *P. calcicola* appears in gross morphology to mimic *P. valerii* through its similar bright red flowers and paniculate inflorescence. However, *Pitcairnia valerii* belongs to a different species complex: it is a larger plant with a huge inflorescence (140–260 cm tall); it has entire, narrowly lanceolate leaves and smaller flowers; and it is found in premontane rainforests and cloud forests. These two species do not appear to be related, but rather exhibit convergent characteristics in order to attract a similar group of pollinators, likely hummingbirds.

Fruiting material of the red-petaled *Pitcairnia calcicola* may be confused with two other species found in Costa Rica, the yellow-petaled *P. halophila* L. B. Smith and white-petaled *P. megasepala* Baker. They may be distinguished from one another by the length of their sepals: 23–29 mm long in *P. halophila*, 30–35 mm long in *Pitcairnia calcicola*, and 35–40 mm long in *P. megasepala*.

#### PHENOLOGY

*Pitcairnia calcicola* flowers from late August through mid-September during the rainy season. By December and January, the plants have finished flowering and die back to stolons that remain viable until the rains of April and May stimulate sprouting. The seeds are distributed mainly by wind or by adherence to small animals.

#### HABITAT

Plants are terrestrial on exposed limestone hills in the lower Tempisque basin of the tropical dry forest of central Guanacaste Province, Costa Rica. The hills on which the plants occur are 100–200 m in elevation and generally lack soil. The surface rock consists of a “hard, porous Eocene limestone” that when exposed on the ridges and upper slopes becomes sharp and deeply creviced (Hartshorn in Janzen, 1983: 129). This is a transition zone between the tropical dry forest typical of northern Guanacaste and the premontane wet forest of the southern Nicoya Peninsula. It has a mean annual biotemperature of 23–24°C, and 1500–1900 mm of rainfall annually (Rodríguez & Estrada, 1994). The area supports a rich ecosystem with a larger number of species than northern Guanacaste, which is

the driest region of the country. The bromeliad flora of the tropical dry forest of Guanacaste is a type that extends south from Mexico along the Pacific Coast. With few exceptions, they are primarily xeric species unknown to mesic and wet Costa Rica.

#### DISTRIBUTION

*Pitcairnia calcicola* is a narrow endemic of the limestone hills in the tropical dry forest of central Guanacaste Province, Costa Rica. Although it has only been collected once outside the Parque Nacional Palo Verde and Parque Nacional Barra Hon-

da, it is likely to be found in adjacent areas of similar-type geology and vegetation.

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