A New Species of *Browneopsis* (Leguminosae, Caesalpinioideae) from the Cauca Valley, Colombia

Philip A. Silverstone-Sopkin
Departamento de Biología, Universidad del Valle, A.A. 25360, Cali, Colombia.
pasilverstone_sopkin@yahoo.com

Abstract. A new species of Leguminosae (Caesalpinioideae), *Browneopsis sanintiae* Silverst., is described from the northern end of the Cauca Valley in the department of Risaralda, in western Colombia. It resembles the Amazonian species *B. ucayalina* Huber, but differs in having one vestigial petal or lacking petals (vs. three to four vestigial petals in *B. ucalayina*), fewer stamens, and pollen usually monoporate (vs. tetraporate in *B. ucayalina*). This is the first report of the genus *Browneopsis* Huber from the Cauca Valley.

Resumen. Una nueva especie de Leguminosae (Caesalpinioideae), *Browneopsis sanintiae* Silverst., se describe del extremo septentrional del valle geográfico del río Cauca, en el departamento de Risaralda, en la parte occidental de Colombia. La especie nueva se asemeja a la especie amazónica *B. ucayalina* Huber, pero difiere en la presencia de un solo pétalo rudimentario o la pérdida total de los pétalos (vs. tres a cuatro pétalos rudimentarios en *B. ucayalina*), menos estambres, y polen usualmente monoporado (vs. tetraporado en *B. ucayalina*). Este es el primer reporte del género *Browneopsis* Huber del valle geográfico del río Cauca.

Key words: *Browneopsis*, Caesalpinioideae, Cauca Valley, Colombia, IUCN Red List, Leguminosae.

Huber (1906) separated the genus *Browneopsis* Huber from *Brownea* Jacq. and recognized two species, *Browneopsis cauliflora* (Poepp.) Huber and *B. ucayalina* Huber. Subsequent botanists, such as Macbride (1943), reunited *Browneopsis* with *Brownea*, but Klitgaard (1991) justified the separation of the two genera, noting that *Browneopsis* differs in lacking bracteoles, in having some or all of the petals reduced in size, in the color of the perianth (white, cream, or rarely pale pink vs. red, orange, or pink [white in one species] in *Brownea*), in the shape of the inflorescence bud (globose vs. ellipsoid to ovoid in *Brownea*), and in the shape and exine ornamentation of the pollen grains (oblate spheroidal and verrucate vs. prolate and reticulate or striate in *Brownea*). She also noted that differences between the two genera in perianth color and pollen exine ornamentation are correlated with differences in pollinators: bats and/or moths in *Browneopsis* versus hummingbirds in *Brownea* (except the white-flowered *Brownea leucantha* Jacq.). Klitgaard recognized 12 species of *Brownea* and six species of *Browneopsis*.

The six species of *Browneopsis* currently recognized are *Browneopsis cauliflora*, known from the Amazonian lowlands of Peru; *B. disepala* (Little) Klitg., known from the southern end of the Chocoan lowlands in northwestern Ecuador; *B. excelsa* Pittier, known from the Darién lowlands of Panama, the Chocoan lowlands and Magdalena Valley of Colombia, and the Amazonian lowlands of Peru and Brazil; *B. macrofoliolata* Klitg., known from a small area at the southern tip of the Chocoan lowlands of Ecuador, possibly extinct; *B. peruviana* (J. F. Macbr.) Klitg., known from the Amazonian lowlands of Peru; and *B. ucayalina*, known from the Amazonian lowlands of Ecuador and Peru. There are more collections of *B. ucayalina* than of all the other species combined. All species are found in lowlands, with altitudinal records ranging from 30 to 850 m.

Since 1986, botanists from the Universidad del Valle have carried out floristic inventories of the few small patches of forest that remain in the Cauca Valley (fewer than 500 ha of forests survive in a valley of 400,000 ha). In 2004, the owner of one of these forests, Hilda M. Sanint-Salazar, collected a specimen that we believed at first to be a species of *Brownea*. After examination of the pollen and floral morphology of this and another specimen collected from the same tree in 2005, we realized that this tree belongs to an undescribed species of *Browneopsis*. This collection represents the first record of this genus from the Cauca Valley.

Browneopsis sanintiae Silverst., sp. nov. TYPE: Colombia. Risaralda: Mpio. Pereira, Hda. Alejandría, Km 7 Cerritos–La Virginia Rd., N end of Cauca Valley, 4°51′27″N, 75°52′49″W, 940 m, 16 Oct. 2005, *P. A. Silverstone-Sopkin, H. Sanint, M. E. Cardona et al. 10442* (holotype, CUVC #40030). Figure 1.

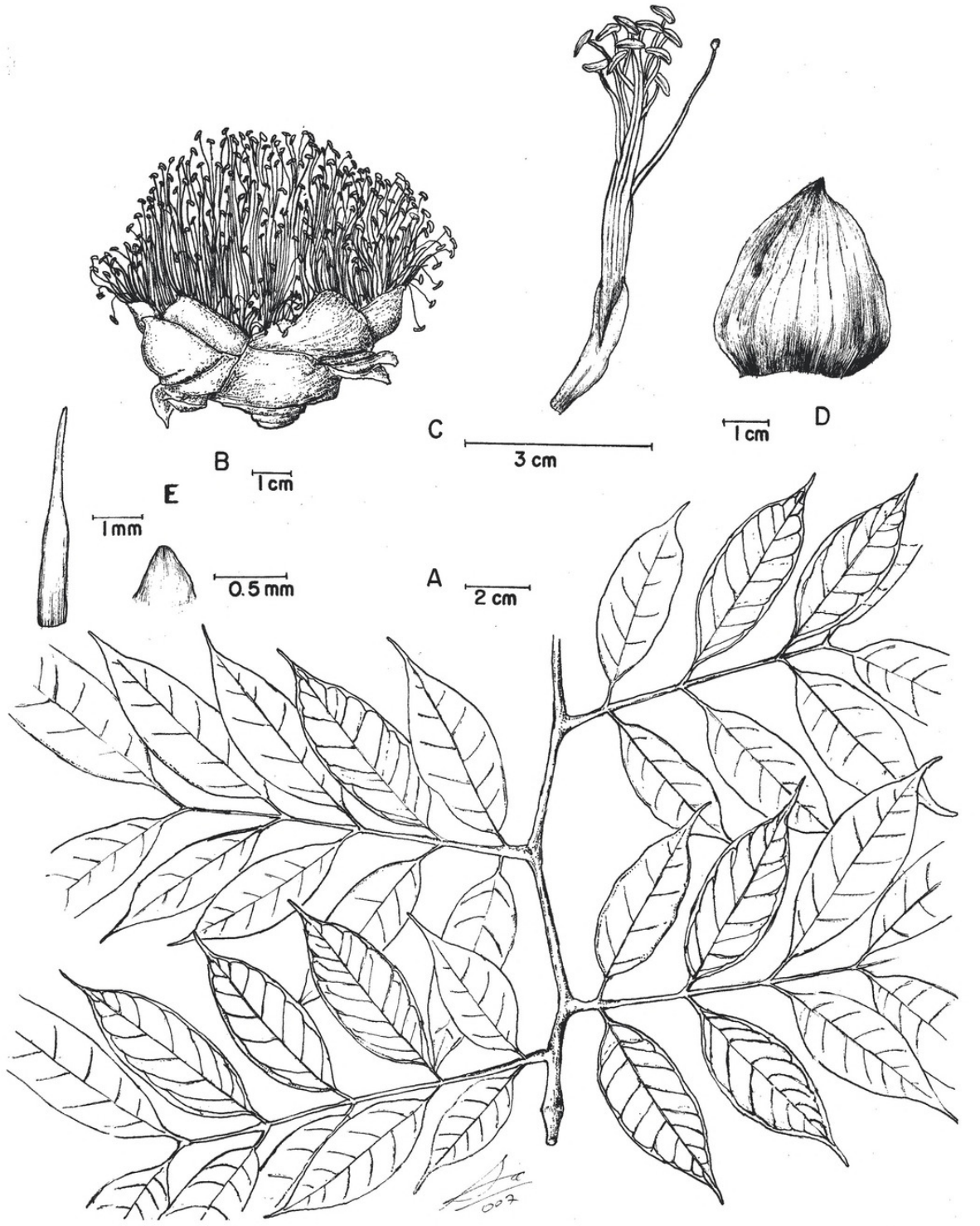

Figure 1. *Browneopsis sanintiae* Silverst. —A. Branch with four leaves. —B. Inflorescence. —C. Flower, showing style, androecium, and sepals attached to the hypanthium (these are not bracteoles). —D. Bract of the inflorescence. —E. Two vestigial petals (from different flowers). Drawn by Silverio Garzón-Gaviria from the holotype, *P. A. Silverstone-Sopkin, H. Sanint, M. E. Cardona et al. 10442* (CUVC).

Haec species a *Browneopside ucayalina* Huber petalo vestigiali uno vel absente, staminibus paucioribus et pollinis granis plerumque uniporis differt.

Trees, 10–15 m tall, 17.5–29 cm DBH; young branches subcylindrical to subquadrangular, with prominent lenticels, youngest parts covered with dense golden tomentum. Leaves alternate, paripinnate, 2- to 5-jugate; petioles 0.3–5 cm, pubescent, rachides 6–52 cm, sulcate on 3 sides (usually not sulcate above), pubescent; leaflets alternate or opposite, petiolules pubescent, 3–12 mm, blades subcoriaceous, progressively longer from proximal to distal pairs, proximal pair 3.8–9.6(–20.5) × 2–3.3(–8.3) cm, other pairs 7.2–12.3(–36) × 2.1–3.9

(–11.5) cm, proximal pair lanceolate to ovate, other pairs lanceolate, elliptic, narrowly elliptic-oblong, or (usually in distal pair) oblanceolate to narrowly obovate, base symmetrical, varying progressively (from basal pair to distal pair) from rounded to obtuse to cuneate, apex caudate, border entire and revolute, adaxial surface with midvein flattened and secondary veins prominulous, glabrous, abaxial surface with midvein raised and prominent, secondary veins prominent, 6 to 13 per side, brochidodromous, midvein golden-villous, blade also golden-villous but trichomes shorter and more scattered than on midvein (blade becoming glabrous in large older leaflets), 1 small flat gland at 1 side of base of abaxial blade surface adjacent to base of midvein or on lateral surface of base of midvein, sometimes obsolete or hidden by dense trichomes. Inflorescence ramiflorous (but not terminal) or cauliflorous, peduncle to 2 cm, inflorescence bud globose, ca. 3 × 3 cm, inflorescence at anthesis a dense capitulum 8–9 × 8–10 cm; bracts 9, white, in 4 series, 50–55 × 30–71 mm, sometimes transversely folded, strongly concave on adaxial surface, ovate to suborbicular, base subtruncate to auriculate (in latter case with subsemicircular sinus), apex acute to rounded, adaxial surface glabrous except scattered pubescence at base, abaxial surface densely pubescent. Flowers ca. 50 to 60 per capitulum, sessile, bracteoles absent, entire flower (to tips of anthers) 58–76 mm; hypanthium 7–14 × ca. 4 mm, pubescent, flat on one side, 4-angled on other side; calyx white, 16–22 mm, partially to completely open on 1 (or sometimes 2) sides, sepals fused in basal 0–11 mm, lobes 2 to 5, unequal, 6–13 × 2–8 mm, adaxial surface partly glabrous and partly sparsely pubescent, abaxial surface densely tomentose; petals 0 or 1, vestigial, ca. 0.5–9 × ca. 0.5–0.8 mm, deltoid to subulate, apex acute to attenuate; stamens 10 or 11, basally connate, tube + free filaments 50–60 mm, filaments fused in basal 16–21 mm, but tube almost completely open on one side (on open side fused in basal 4–5.5 mm), white, glabrous, anthers yellow, versatile, ca. 6 × 1–1.5 mm, glabrous; ovary + style 39–63 mm, ovary pubescent, style and stigma glabrous, stigma subcapitate. Fruit golden brown tomentose, stipe 3–3.5 cm, legume 11.5–25.5 × 3.2–4.4 cm, laterally compressed, not constricted between seeds, both sutures thickened, upper suture with 3 shallow ribs, lower suture with 2 ribs, tip slightly beaked; seeds not seen.

Distribution and habitat. *Browneopsis sanintiae* is known only from small patches of remnant forest at two adjacent haciendas (Alejandría and Córcega) at 940–970 m elevation, at the extreme northern end of the Cauca Valley, near the town of La Virginia. The largest of these remnant forests is only 13 ha. The original forest in this zone was destroyed, beginning in 1915, and was replaced by cattle ranches (Hilda Sanint, pers. comm.).

In the Holdridge system (Holdridge, 1967), this area is classified as Tropical Dry Forest (mean annual precipitation at the adjacent Hacienda La Bohemia is 1764 mm), but this zone is on the border of Holdridge's Premontane Moist Forest. At the highest part of the hill, the forest of Alejandría is secondary, but part of the lower portion (where the type was collected) may be primary forest. This forest was never used as a cacao grove (Hilda Sanint, pers. comm.).

IUCN Red List category. It is probable that *Browneopsis sanintiae* formerly was more widespread in the Cauca Valley and the adjacent piedmont of the Cordillera Central. Because of habitat destruction, it now is extremely rare and should be categorized as Critically Endangered (CR) according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Browneopsis sanintiae* was collected with flowers at anthesis in October and December, with old withered flowers and very young fruits in August, and with large, almost mature fruits in November and December (fruits were collected from different individuals than those from which flowers were collected).

Etymology. This species is named after Hilda M. Sanint-Salazar, owner of the Hacienda Alejandría, in recognition of her contribution to Colombian botany by conservation of the forest of Alejandría, which is the most diverse remnant forest in the Cauca Valley. She has saved several species from extinction; among them are *Bauhinia geniculata* Wunderlin (Leguminosae, Caesalpinioideae; Wunderlin, 2006) and *Plagiolirion horsmannii* Baker (Amaryllidaceae; Meerow & Silverstone-Sopkin, 1995). *Plagiolirion* is the only genus of angiosperms endemic to the Cauca Valley.

Pollen. Pollen of *Browneopsis sanintiae* was observed using both scanning electron microscopy and light microscopy. Grains are in monads and are large and spherical (D1/D2 = 1). Diameters (n = 25) are: D1 = 51.5–57.2 μm (mean 56.1 μm); D2 = 50.4–57.5 μm (mean 56.1 μm). Most grains are monoporate (Fig. 2A), but some are 2-, 3-, or 4-porate. The nexine is 0.8 μm thick, the sexine is 2.7 μm thick, and the total exine is 3.7 μm thick. The surface of the exine is verrucate and is granular between the tubercles (Fig. 2B). Mean measurements of the tubercles are 3.3 μm high and 6.4 μm wide at the base.

In other species of *Browneopsis*, pollen also is verrucate but is 3- or 4-colporate or, in *B. ucayalina*, 4-porate (Klitgaard, 1991).

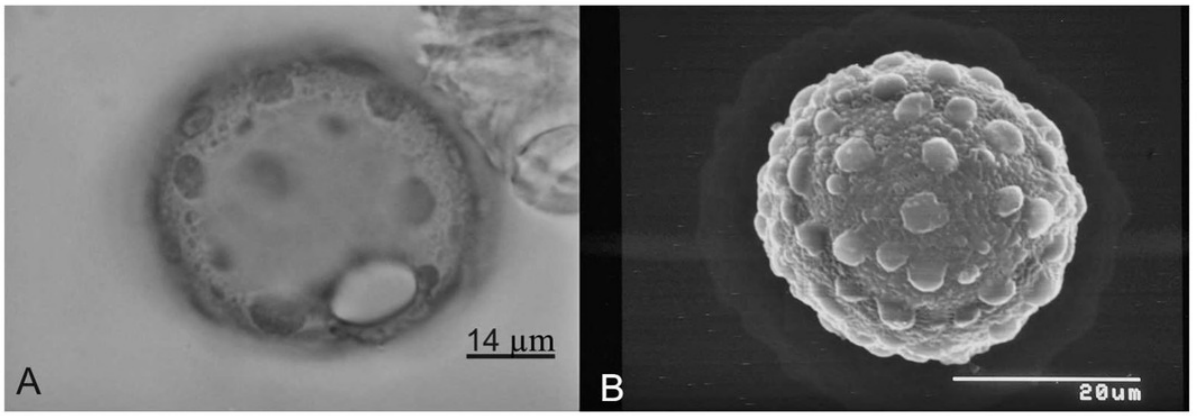

Figure 2. *Browneopsis sanintiae* Silverst. —A. Light micrograph of acetolyzed monoporate pollen grain. —B. SEM micrograph of pollen grain (not acetolyzed), showing verrucate surface of exine. Photographs by Diana Isabel Vergara-Gómez of pollen from the holotype, *P. A. Silverstone-Sopkin, H. Sanint, M. E. Cardona et al. 10442* (CUVC).

Discussion. One of the differences between the genera *Brownea* and *Browneopsis* is the presence of a pair of basally connate bracteoles subtending the flower in *Brownea*, whereas bracteoles are absent in *Browneopsis*. In *Browneopsis sanintiae*, the hypanthium and basally fused sepals resemble the bracteoles of the genus *Brownea*, but the base of the calyx is inserted at the apex of the hypanthium and dehisces circumscissily from the apex of the hypanthium. True bracteoles would insert below the hypanthium and be free from the hypanthium.

Another difference between the genera *Brownea* and *Browneopsis* is the reduction of some of the petals in *Browneopsis*. *Brownea* has five equal, well-developed petals, whereas in most species of *Browneopsis*, the ancestral number of five has been reduced to three or four, at least two of which usually are reduced in length and/or width. In *B. ucayalina*, all remaining petals (three or four) are reduced to tiny vestiges 2–4 mm long (Klitgaard, 1991). This tendency has culminated in *B. sanintiae*, in which only one tiny vestigial petal remains, or in some flowers, the petals have been lost completely.

Klitgaard (1991), Klitgaard and Ferguson (1992), and Knudsen and Klitgaard (1998) noted that pollen grains with a verrucate exine are found in caesalpinioid species that are bat pollinated. Reduction in petal size in *Browneopsis* is probably related to adaptation to a change from diurnal hummingbird pollination to nocturnal pollination (bats/moths), concomitant with a change from red to white flowers and from odorless ornithophily to odoriferous chiropterophily/phalaenophily, as noted in *B. disepala* by Knudsen and Klitgaard (1998). Flowers of *B. sanintiae* are visited by unidentified black wasps by day and by sphingid moths at night (Diana Gamba, pers. comm.).

The only species of *Browneopsis* hitherto reported from Colombia is *B. excelsa*, which differs from *B. sanintiae* in having fewer pairs of leaflets (two or three), usually terminal inflorescences, fewer flowers per inflorescence, at least some petals not reduced in size, flowers sometimes pale pink, more numerous (14 to 16) stamens, and colporate pollen.

Browneopsis sanintiae has fewer pairs of leaflets than *B. disepala* (eight to 11) and more pairs of leaflets than *B. macrofoliolata* (two or three) and *B. peruviana* (one or two); it has fewer stamens than *B. cauliflora* (15 to 20) and *B. disepala* (18 to 26). *Browneopsis sanintiae* differs from five of the six previously described species of *Browneopsis* in the extreme reduction in the number of its petals (none or one) and in its usually monoporate pollen.

Browneopsis sanintiae most closely resembles the Amazonian species *B. ucayalina*, but differs from that species in having the corolla reduced to one vestigial petal or absent (vs. three or four vestigial petals in *B. ucayalina*), fewer stamens (10 or 11 vs. 10 to 18 in *B. ucayalina*), and usually monoporate pollen (vs. 4-porate in *B. ucayalina*).

Paratypes. COLOMBIA. **Risaralda:** Mpio. Pereira, Hda. Alejandría, Km 7 carr. Cerritos–La Virginia, extremo N del valle geográfico del río Cauca, 4°51′27″N, 75°52′49″W, 3 Dec. 2004, *H. Sanint 110* (CUVC), 7 Aug. 1991, *P. A. Silverstone-Sopkin & J. E. Arroyo-Valencia 6247* (CUVC, NY), 15 Oct. 2007, *P. A. Silverstone-Sopkin, H. Sanint, M. E. Cardona et al. 10726* (CUVC); Hda. Córcega, 18 km desde La Virginia por carretera, 7 km W de carr. Cerritos–Cartago por carr. hacia El Trapiche, extremo N del valle geográfico del río Cauca, ca. 4°50′N, 75°53′W, 28 Nov. 1989, *P. A. Silverstone-Sopkin, J. Giraldo-Gensini & H. M. Cabrera 5738* (CAUP, CUVC, NY), 30 Dec. 1994, *P. A. Silverstone-Sopkin & N. Paz 7240* (CUVC).

Acknowledgments. I am grateful to Hilda M. Sanint-Salazar for permission to study the flora at the Hacienda Alejandría and for her aid and encouragement to students and professors of the Universidad del Valle during visits to the hacienda. I thank J. E. Arroyo-Valencia, H. M. Cabrera-Arana, M. E. Cardona, J. E. Giraldo-Gensini, and N. Paz for their

assistance in fieldwork. Photographs and measurements of pollen were made by Diana Isabel Vergara-Gómez at the palynology laboratory of the Universidad de Antioquia in Medellín, under the direction of Ramiro Fonnegra. Other SEM photographs (not shown here) were taken by José Arroyave at the Centro Internacional de Agricultura Tropical (CIAT) near Palmira, Valle. I thank Luis Carlos Jiménez-Bulla for permission to examine specimens at the Herbario Nacional Colombiano (COL) of the Universidad Nacional de Colombia in Bogotá. I also thank Jorge E. Ramos-Pérez, José Luis Fernández-Alonso, Jorge Luis Contreras-Herrera, Michael Hopkins, and Silverio Garzón-Gaviria (who drew Fig. 1). Rainfall data for the Hacienda La Bohemia were provided by José T. Bravo-R. (HIMAT, La Unión, Valle). Fieldwork was financed by the Universidad del Valle and by the Departamento Administrativo de Ciencia, Tecnología e Innovación (COLCIENCIAS; grant #1106-05-014-87) to the Universidad del Valle, "Flora Relictual del Valle Geográfico del Río Cauca," Jorge E. Ramos-Pérez, principal investigator.

Literature Cited

Holdridge, L. R. 1967. Life Zone Ecology, rev. ed. Tropical Science Center, San José, Costa Rica.

Huber, J. E. 1906. Materiaes para a flora amazonica. Bol. Mus. Paraense Hist. Nat. 4: 565–567.

IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.

Klitgaard, B. B. 1991. Ecuadorian *Brownea* and *Browneopsis* (Leguminosae–Caesalpinioideae): Taxonomy, palynology, and morphology. Nordic J. Bot. 11: 433–449.

——— & I. K. Ferguson. 1992. Pollen morphology of *Browneopsis* (Leguminosae: Caesalpinioideae), and its evolutionary significance. Grana 31: 285–290.

Knudsen, J. T. & B. B. Klitgaard. 1998. Floral scent and pollination in *Browneopsis disepala* (Leguminosae: Caesalpinioideae) in western Ecuador. Brittonia 50: 174–182.

Macbride, J. F. 1943. Leguminosae. Flora of Peru. Field Mus. Nat. Hist., Bot. Ser. 13(3/1): 1–507.

Meerow, A. W. & P. Silverstone-Sopkin. 1995. The rediscovery of *Plagiolirion horsmannii* Baker (Amaryllidaceae). Brittonia 47: 426–431.

Wunderlin, R. P. 2006. Revision of *Bauhinia* subgenus *Bauhinia* section *Amaria* (Cercideae: Caesalpinioideae: Fabaceae). Sida 22: 97–122.