
Rubiacearum Americanarum Magna Hama Pars XXIX: Overview of the Neotropical Genus *Schizocalyx* (Condamineeae) and Description of Two New Species

Charlotte M. Taylor

Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166, U.S.A.
charlotte.taylor@mobot.org

David A. Neill

Fundación Jatun Sacha, Casilla Postal 17-12-867, Quito, Ecuador. davidneill53@gmail.com

Roy E. Gereau

Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166, U.S.A. roy.gereau@mobot.org

ABSTRACT. The genus *Schizocalyx* Wedd. was originally monotypic, but has been recently expanded based on molecular analysis to comprise six species, including four transferred from *Bathysa* C. Presl, where they were incorrectly classified, and two transferred from *Phitopsis* Hook. f., which is now a synonym. *Schizocalyx* is now characterized by its calyptrate stipules, corollas with the lobes convolute in bud, capsules that are loculicidal across the apical part, and numerous flattened to angled seeds, as detailed in a revised genus description. This genus is now known from southern Central America through western South America and into central and southeastern Brazil. The nine species keyed here include the seven species previously described, for which nomenclature and range are summarized, and two species newly described here: *S. condoricus* D. A. Neill & C. M. Taylor, found in the eastern Andean foothills of southern Ecuador and previously confused with *S. peruvianus* (K. Krause) Kainul. & B. Bremer; and *Schizocalyx truncatus* C. M. Taylor, found in the eastern Andean foothills of central Peru and previously confused with *S. obovatus* (K. Schum. ex Standl.) Kainul. & B. Bremer. Lectotypes are selected for *S. cuspidatus* (A. St.-Hil.) Kainul. & B. Bremer and *S. multiflorus* (Hook. f.) Kainul. & B. Bremer.

RESUMEN. El género *Schizocalyx* Wedd. originalmente fue monotípico, pero ha sido ampliado recientemente para incluir seis especies, incluyendo cuatro especies transferidas de *Bathysa* C. Presl, en lo cual estaban clasificadas erróneamente, y dos especies transferidas de *Phitopsis* Hook. f., lo cual es actualmente un sinónimo. *Schizocalyx* actualmente se caracteriza por las estípulas caliptradas, corolas con los lóbulos convolutos en la yema, cápsulas loculicidas en la parte apical y semillas numerosas,

aplanadas o anguladas, como se detalle en una descripción genérica actualizada. El género actualmente está registrada desde el sur de América Central a través de Sudamérica occidental hasta Brasil central y suroriental. Las nueve especies indicadas en este sinopsis con claves incluyen las siete especies descritas anteriormente para las cuales se indica su nomenclatura y su rango de distribución, y dos especies nuevas descritas en este artículo: *S. condoricus* D. A. Neill & C. M. Taylor se encuentra en las cordilleras al este de los Andes en el sur del Ecuador, y previamente ha sido confundida con *S. peruvianus* (K. Krause) Kainul. & B. Bremer; y *S. truncatus* C. M. Taylor se encuentra en las cordilleras al este de los Andes en el centro de Perú y ha sido confundida con *S. obovatus* (K. Schum. ex Standl.) Kainul. & B. Bremer. Lectotipos son seleccionados para *S. cuspidatus* (A. St.-Hil.) Kainul. & B. Bremer and *S. multiflorus* (Hook. f.) Kainul. & B. Bremer.

Key words: *Bathysa*, Bolivia, Brazil, Colombia, Condamineeae, Costa Rica, Ecuador, IUCN Red List, Neotropics, Panama, Peru, *Phitopsis*, Rondeletieae, Rubiaceae, *Schizocalyx*.

The genus *Schizocalyx* Wedd. (Weddell, 1854) was described with a single species from Colombia, *S. bracteosus* Wedd., which is a tree with terminal cymose inflorescences, bisexual flowers with calycophylls, tubular corollas with five lobes that are convolute (Lawrance, 1951; i.e., cortorted sensu Stearn, 1983) in bud, and small capsules that are loculicidal across the apical part with numerous small, angled seeds. *Schizocalyx* was included in the tribe Cinchoneae by Schumann (1891), in a subgroup of genera of this tribe with convolute corolla aestivation. *Schizocalyx* was included in the Cincho-

neae also by Robbrecht (1988), but shortly afterward the genera that had been included there were found to comprise a heterogeneous assemblage and several were transferred to other tribes. Based on analysis of morphological characters, Andersson and Persson (1991) transferred *Schizocalyx* to their newly described tribe Calycophylleae. However, after further study of its pollen (Andersson, 1993), seeds, and fruits, Andersson (1995) excluded *Schizocalyx* from the Calycophylleae and considered it to be related instead to *Bathysa* C. Presl, which was then classified in the Rondeletieae (Robbrecht, 1988). Delprete (1997) noted Andersson's observations and synonymized *Schizocalyx* with *Bathysa*, and included *Bathysa* in his revised circumscription of Rondeletieae (Delprete, 1999). Later Rova et al. (2002) studied the various genera that have been included in the Rondeletieae. They used molecular sequence data and included in their analysis two species of *Bathysa*, *B. veraguensis* Dwyer and another species identified only as "*Bathysa* sp."; this second sample is vouchered by the specimen *B. Ståhl* 3272 at GB, for which a species-level identification is still not available. They found the two *Bathysa* species grouped with several other genera that had been variously included in Calycophylleae and Rondeletieae, and their results showed that all of these genera could not be included in Rondeletieae. Subsequently, *Bathysa* and *Schizocalyx* were included in an analysis of the relationships of several systematically problematic Rubiaceae genera by Kainulainen et al. (2010), using both molecular and morphological characters and a more detailed taxon sampling. They found *Schizocalyx* to be distinct from *Bathysa*, and their results showed that these genera are not particularly closely related. Kainulainen et al. included both *Schizocalyx* and *Bathysa* in their newly circumscribed Condamineae; identified some morphological characters that distinguish these two genera; and transferred several species from *Bathysa* to *Schizocalyx*.

Schizocalyx bracteosus is very similar in general aspect and many of its characters to several species that have been included in *Bathysa*, including species that remain in *Bathysa* in Kainulainen et al.'s classification (2010). These two genera were originally distinguished in part by their corolla aestivation, with the lobes imbricate in bud in *Bathysa* (Standley, 1931a: 259) versus convolute in *Schizocalyx* (Standley, 1930: 171); however, this character was overlooked by several authors including Delprete (1997), who incorrectly described the corolla aestivation of *S. bracteosus* as imbricate. Perhaps the first example of this confusion is by

Krause (1908), who described *B. peruviana* K. Krause in *Bathysa* even though its corolla lobes are convolute in bud on his type specimen, and who did not mention the discrepancy between this feature and the morphological characteristics of *Bathysa*. The confusion between these two genera was continued by Standley (1931a, 1936), who described and keyed *B. obovata* K. Schum. ex. Standl. as having the corolla lobes imbricate in bud even though the flowers of his type specimen have convolute lobes, and who also did not mention this discrepancy nor emend the description of *Bathysa* to include convolute corollas. The confusion was continued by Dwyer (1980) and Burger and Taylor (1993), who incorrectly described the convolute corolla aestivation of *B. veraguensis* as imbricate. Corolla aestivation is most often consistent within genera of Rubiaceae, and is one of the characters that distinguishes *Schizocalyx* from *Bathysa*; these are also separated by their stipule form, which is calyptrate (i.e., fused into a conical sheath) in *Schizocalyx* versus interpetiolar in *Bathysa*, and their fruit dehiscence, with the capsules splitting septically for more than half their length in *Bathysa* versus loculicidally across only the apical part of the capsule in *Schizocalyx* (Kainulainen et al., 2010). This difference in fruit dehiscence has also been sometimes overlooked (e.g., Delprete, 1997).

The genus *Phitopsis* Hook. f. was described (Hooker, 1871) with one species from Peru, *P. multiflora* Hook. f., a tree with caducous stipules of unknown form, terminal cymose inflorescences, bisexual flowers, funnelform corollas with five convolute lobes, and capsular fruits with loculicidal dehiscence across their tops and numerous small, angled seeds. A second species was described 60 years later, *P. sterculioides* Standl. of Peru (Standley, 1931b), and apparently the only floristic treatment of *Phitopsis* was provided by Standley (1936). The name *Phitopsis* is an anagram of *Hippotis* Ruiz & Pav. and referred to the similar general aspects of these two genera, in particular their hirsute pubescence and irregularly lobed calyx limbs. However, these genera are not closely related, and Rova and Andersson (1995) excluded *Phitopsis* from the tribe Hippotideae. Schumann (1891) placed *Phitopsis* in his tribe Rondeletieae together with *Bathysa*, as did Standley (1936); however, the genera Schumann placed in that tribe are today considered to be a heterogeneous group and are classified in several different tribes (Robbrecht, 1988; Rova et al., 2002; Kainulainen et al., 2010). *Phitopsis* was considered too poorly known and not classified to tribe at all by some recent workers (e.g., Robbrecht, 1988), but Delprete (1999) included *Phitopsis* in his circumscription of Rondele-

tieae, where he considered it closely related to *Bathysa*. Subsequently, Kainulainen et al. (2010) demonstrated that *Phitopsis* is not closely related to *Bathysa*; however, *Schizocalyx* and *Phitopsis* are not distinguished by any morphological or molecular sequence characters, and they synonymized *Phitopsis* with *Schizocalyx*.

SCHIZOCALYX TODAY

Schizocalyx now includes nine species, including the two newly described here, and is characterized by the combination of its stipules that are calyptrate (i.e., fused into a sheathing cap), caducous, and often well-developed; its subsessile to petiolate leaves that are opposite, ternate, or quaternate in arrangement; its terminal, bracteate, cymose inflorescences that are branched to several orders; its small- to medium-sized flowers; its open and regularly lobed or calyptrate and irregularly lobed calyx limbs that rarely bear petaloid calycophylls; its white corollas with rather stout tubes and the five lobes convolute in bud; its five stamens and two linear stigmas that are all exerted from the corolla; its dry capsular fruits that open loculicidally via a slit across the top, inside the persistent calyx limb; and its numerous small, angled seeds. *Schizocalyx* is found in lowland to premontane wet forests in southern Central America and western South America from Colombia to Bolivia, and into central southeastern Brazil and there sometimes in moist forest or gallery forest. The flowers are reported to be fragrant and are protandrous, with the anthers on herbarium specimens apparently falling off completely before the two stigmas spread to expose their receptive surfaces.

The calyx form varies notably among species of *Schizocalyx*. Several species have the calyx limb similar in form to that of most species of Rubiaceae: tubular, apparently open in bud, and truncate to regularly denticulate or shortly lobed (e.g., *S. obovatus* (K. Schum. ex Standl.) Kainul. & B. Bremer). *Schizocalyx bracteosus* has tubular to reduced calyx limbs and is so far unique in the genus in the petaloid calycophylls that are found on one or more of the flowers in each inflorescence. In other species the calyx tube is rather unusual: it is extended and inflated into a conical structure that is regularly to irregularly lobed and only very narrowly open at the top in bud (e.g., *S. peruvianus*), or in some species the calyx is calyptrate (i.e., fully fused) and completely encloses the corolla in bud, splitting irregularly as the corolla emerges (e.g., *S. sterculioides*). Other genera of Rubiaceae include species both with and without petaloid calycophylls (Delprete, 1996) and with both regularly lobed and

calyptrate calyx limbs (e.g., *Pentagonia* Benth., Rova & Andersson, 1995; *Palicourea* Aubl., Taylor, 1989) and stipules (e.g., *Psychotria* L. subg. *Psychotria*, Taylor et al., 2004; *Ladenbergia* Klotzsch, Andersson, 1997). Thus the variation in stipule and calyx form among closely related species of *Schizocalyx* is not exceptional in Rubiaceae. The calyx limb of some *Schizocalyx* species often continues to elongate and change its form as the fruits mature, in particular splitting irregularly as the capsule enlarges, and interpretation of its morphology can be confounded by these changes.

BATHYSA TODAY

The morphological features cited for *Bathysa* (Germano Filho, 1998; Taylor et al., 2004) have not been emended: this genus is characterized by interpetiolar or calyptrate, caducous or persistent, often well-developed stipules; subsessile to petiolate, opposite or ternate leaves; terminal, bracteate, cymose to thyrsiform inflorescences that are usually branched to several orders; small- to medium-sized protandrous flowers; tubular, truncate to denticulate or lobed calyx limbs that apparently lack petaloid calycophylls; white to pale green, funnelliform to campanulate corollas with the tube pubescent inside at the stamen attachment and the four or five lobes thinly imbricate in bud; the stamens and linear stigmas all exerted from the corolla, with the filaments inserted in the upper part of the corolla tube and pubescent in their lower portion; dry capsular fruits that are septicidal and split for half or more of their length; and numerous, small, angled seeds. *Bathysa* is now known only from South America, where it is found in lowland to premontane vegetation from Venezuela to southeastern Brazil and the Andes of Peru and Bolivia. All of the species transferred from *Bathysa* to *Schizocalyx* by Kainulainen et al. (2010) were inaccurately classified in *Bathysa*.

Kainulainen et al. (2010) noted that two *Bathysa* species were not included in their molecular analysis and are of uncertain classification, *B. bathysoides* (Steierm.) Delprete, found from Venezuela to eastern Peru and northern Bolivia, and *B. perijaensis* (Steierm.) Delprete of northwestern Venezuela, which is closely similar to *B. bathysoides* if not conspecific. These species both have calyptrate stipules, regularly and deeply 5-lobed calyx limbs with the lobes open in bud, corollas with five imbricate lobes, stamens inserted in the corolla throat, and capsules that split septicidally for more than half their length. Thus, these species agree with the features of *Bathysa*

except perhaps in their calyprate stipules, which are not otherwise now known in that genus.

Another species that was included in *Bathysa*, *B. panamensis* Dwyer, was also incorrectly classified and has been transferred to *Simira* Aubl., as *S. panamensis* (Dwyer) C. M. Taylor (Taylor et al., 2011). The name *B. multiflora* L. O. Williams was based on a type specimen from Peru, but was overlooked in the catalogue of Peruvian Rubiaceae (Taylor & Pool, 1993): this name is a synonym of *B. australis* (A. St.-Hil.) Hook. f. ex K. Schum.

METHODS

The calyx limb morphology described below is based on buds and on flowers before or just at anthesis; the irregular changes in calyx limb morphology after anthesis in some species complicate comparisons between different developmental stages of different species. In the English descriptions below, measurements indicate length unless otherwise indicated. Morphological terms follow Lawrance (1951). The new species described here are treated together and arranged in alphabetical order. Commentary is provided for the previously described species to present notable new observations or to correct previously published information.

These new species were discovered among specimens made by various projects focused on floristic study of tropical forest regions that are not well known to science, with most of the collections made within the last 15 years. Additional collection data for the specimens cited here, as well as information about additional specimens not cited here, are available at <<http://www.tropicos.org>>, along with high-resolution digital images of the type specimens or reference specimens of the species newly described here and the previously described species keyed here.

Conservation status assessment methodology. The study presented here is taxonomic and floristic: the objective is enumeration of the species that belong to various Rubiaceae genera, and the species that occur in the area of tropical Central and South America. The methods used here correspond only to this objective; thus, this study is based on survey of specimens collected over a number of years using varied survey methods aimed at various objectives. The specimens used here to delineate the range and commonness of these new species were located through a non-exhaustive survey of several herbaria, and except for some field observations of *Schizocalyx condoricus* D. A. Neill & C. M. Taylor by the second author, no exhaustive field studies have been done targeting the occurrence of these species where they

are known or expected to grow. Thus, the floristic information presented here is a simplified presence report based on incomplete survey of the available data, which are uneven and incomplete for this region (Schulman et al., 2007). Knowledge of the true geographic range and the population size and dynamics of a species are essential to understanding the threats to its existence, and thus to understanding its actual conservation status; documentation of the existence of a species based on one or several museum collections does not provide adequate data to evaluate these factors. Conservation assessments are provided here for these newly described species using IUCN categories and criteria (IUCN, 2001) based on the totality of our current knowledge. The basis for these assessments in the form of a map and the calculated assessment parameters are available under the corresponding species names at <<http://www.tropicos.org>> (assessment parameters for each map can be seen using "Show Detail"). The assessment parameters were calculated using the IUCN Rating tool (Moat, 2007) in ArcView GIS 3.2 (ESRI, 1999), with the grid cell size used for calculating area of occupancy varying between 1 and 3.16 km, depending on characteristics of the species and data (IUCN Standards and Petitions Working Group, 2008). These assessments are not being submitted to IUCN for publication on the Red List (<<http://www.iucnredlist.org>>), and the basis for these assessments should be carefully evaluated by the reader.

TAXONOMIC TREATMENT

Schizocalyx Wedd., Ann. Sci. Nat., Bot., sér. 4, 1: 73. 1854, nom. cons. TYPE: *Schizocalyx bracteosus* Wedd.

Phitopsis Hook. f., Hooker's Icon. Pl. 11: 75. 1871. TYPE: *Phitopsis multiflora* Hook. f. [= *Schizocalyx multiflorus* (Hook. f.) Kainul. & B. Bremer].

Trees and shrubs. *Leaves* opposite or verticillate, isophyllous, entire, without domatia; higher order venation not lineolate; stipules calyprate (i.e., fused into a sheathing cap), conical in bud, entire, splitting along 1 or 2 sides as leaves emerge, caducous. *Inflorescences* terminal, cymose to thyrsiform, multi-flowered, bracteate. *Flowers* bisexual, homostylous, protandrous, sessile to pedicellate, fragrant; *calyx* limb calyprate and splitting irregularly or tubular and truncate to 4- or 5-denticulate, when tubular sometimes with petaloid calycophylls; *corolla* campanulate to funnelform or tubular, pale green, white, pink, or white flushed with purple, internally with tufted pubescence at stamen attachment, lobes 5, convolute, without abaxial appendages; stamens 5, inserted in upper part of corolla tube, filaments

generally glabrous in upper part and pubescent in lower part, anthers narrowly ellipsoid-oblong, dorsifixed, exserted; stigmas 2, linear, stout, exserted; ovary 2-locular, ovules numerous on axile placentas. *Fruit* capsular, loculicidal across apical part, ellipsoid to subglobose or turbinate, 2–10 × 2–10 mm,

chartaceous to woody, with calyx limb persistent; seeds small, flattened to angled.

Schizocalyx includes nine species found in wet to moist forests from low to middle elevations from Nicaragua through Colombia to Bolivia and into southeastern Brazil.

KEY TO SPECIES OF *SCHIZOCALYX*

- 1a. Calyx limb 6–12 mm long, > 6 mm long on at least some flowers; corolla with lobes 6–10 mm long.
 - 2a. Leaves subsessile to shortly petiolate, the petioles to 5 mm long; inflorescences congested to subcapitate, with flowers subsessile to pedicellate, the pedicels to 5 mm long 4. *S. multiflorus*
 - 2b. Leaves petiolate, the petioles 4–20 mm long; inflorescences lax, with flowers pedicellate, the pedicels 1–20 mm long, > 5 mm long on at least some flowers 7. *S. sterculioides*
- 1b. Calyx limb 1–7 mm long, on most flowers < 6 mm long; corolla with lobes 2.5–6 mm long.
 - 3a. Inflorescences with 1 or more flowers bearing a white petaloid calycophyll (these structures often deciduous after anthesis); corolla tube > 2× as long as lobes, the tube 7–8 mm long, the lobes 1.5–3.5 mm long 1. *S. bracteosus*
 - 3b. Inflorescences with no flowers with calycophylls; corolla tube shorter than, equal to, or up to 2× as long as lobes, the tube 1–6 mm long, the lobes 3–6 mm long.
 - 4a. Calyx limb open in bud, truncate or regularly denticulate with teeth up to 0.4 mm long, the limb sometimes tardily enlarging and irregularly splitting (sometimes appearing calyptrate if not observed carefully).
 - 5a. Corolla lobes 6–9 mm long; plants of southeastern Brazil 3. *S. cuspidatus*
 - 5b. Corolla lobes 4–5 mm long; plants of the Andes.
 - 6a. Leaves acute to obtuse at base, with petioles 5–20 mm long; stems and leaves glabrescent to strigose or strigillose (i.e., with appressed pubescence); corolla with tube 2–3 mm long 5. *S. obovatus*
 - 6b. Leaves obtuse to rounded or truncate at base, with petioles 3–13 mm long; stems and leaves pilose to hirsute (i.e., with spreading pubescence); corolla with tube ca. 1 mm long 8. *S. truncatus*
 - 4b. Calyx limb calyptrate in bud (i.e., fused into a sheathing cap), splitting irregularly or sometimes into regular lobes as corolla emerges, lobes 0.6–3.5 mm long.
 - 7a. Flowers arranged in congested to subcapitate groups, all subsessile to shortly pedicellate, the pedicels to 1 mm long (but sometimes elongating as fruits develop); calyx becoming regularly to irregularly lobed 6. *S. peruvianus*
 - 7b. Flowers arranged in rather lax cymes, each cyme with some flowers sessile to subsessile and most flowers pedicellate, the pedicels to 15 mm long; calyx becoming irregularly lobed or split.
 - 8a. Leaves opposite or more often ternate; pedicels 0.5–4 mm long; Ecuador and Peru 2. *S. condoricus*
 - 8b. Leaves opposite; pedicels 5–15 mm long; Costa Rica and Panama 9. *S. veraguensis*

1. *Schizocalyx bracteosus* Wedd., Ann. Sci. Nat., Bot., sér. 4, 1: 74. 1854. *Bathysa bracteosa* (Wedd.) Delprete, Brittonia 49(4): 481, fig. 1. 1997. TYPE: Colombia. Boyacá: Río Mayo, 1844, J. P. Goudot 6 (holotype, P not seen, F photo neg. #37199 at MO).

Schizocalyx hirsutus Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 4: 266. 1929. TYPE: Colombia. Santander: betw. Nariño & El Tambor, 150–300 m, 4 Dec. 1926, E. P. Killip & A. C. Smith 14959 (holotype, US-1350921; isotypes, F not seen, W not seen).

Distribution and habitat. *Schizocalyx bracteosus* is found from northwestern Colombia to central Peru at 300–1000 m (Delprete, 1997).

Discussion. The calyx limbs are tubular in bud, and appear to be closed with the short calyx teeth closely set together or possibly fused. Then as the

corolla emerges, the calyx variously remains tubular and denticulate (e.g., *B. Berlin* 2020, MO; *Gentry* 9059, MO), or splits irregularly into two to five lobes with the denticulate teeth irregularly distributed on them (e.g., *Lawrance* 513, MO; *Cogollo* 402, MO). Some inaccurate morphological observations made about this species are detailed in the introductory portion of this article; several of these are included in the description by Delprete (1997).

2. *Schizocalyx condoricus* D. A. Neill & C. M. Taylor, sp. nov. TYPE: Ecuador. Zamora-Chinchipe: Cordillera del Cóndor, vertiente occidental, cuenca del Río Quimi, formación rocosa arenisca, 3°35'S, 78°25'W, 1180–1400 m, 5 Apr. 2006, W. Quizhpe 2120 (holotype, LOJA; isotypes, HUT, MO-6253358, QCNE-203691). Figure 1D, E.

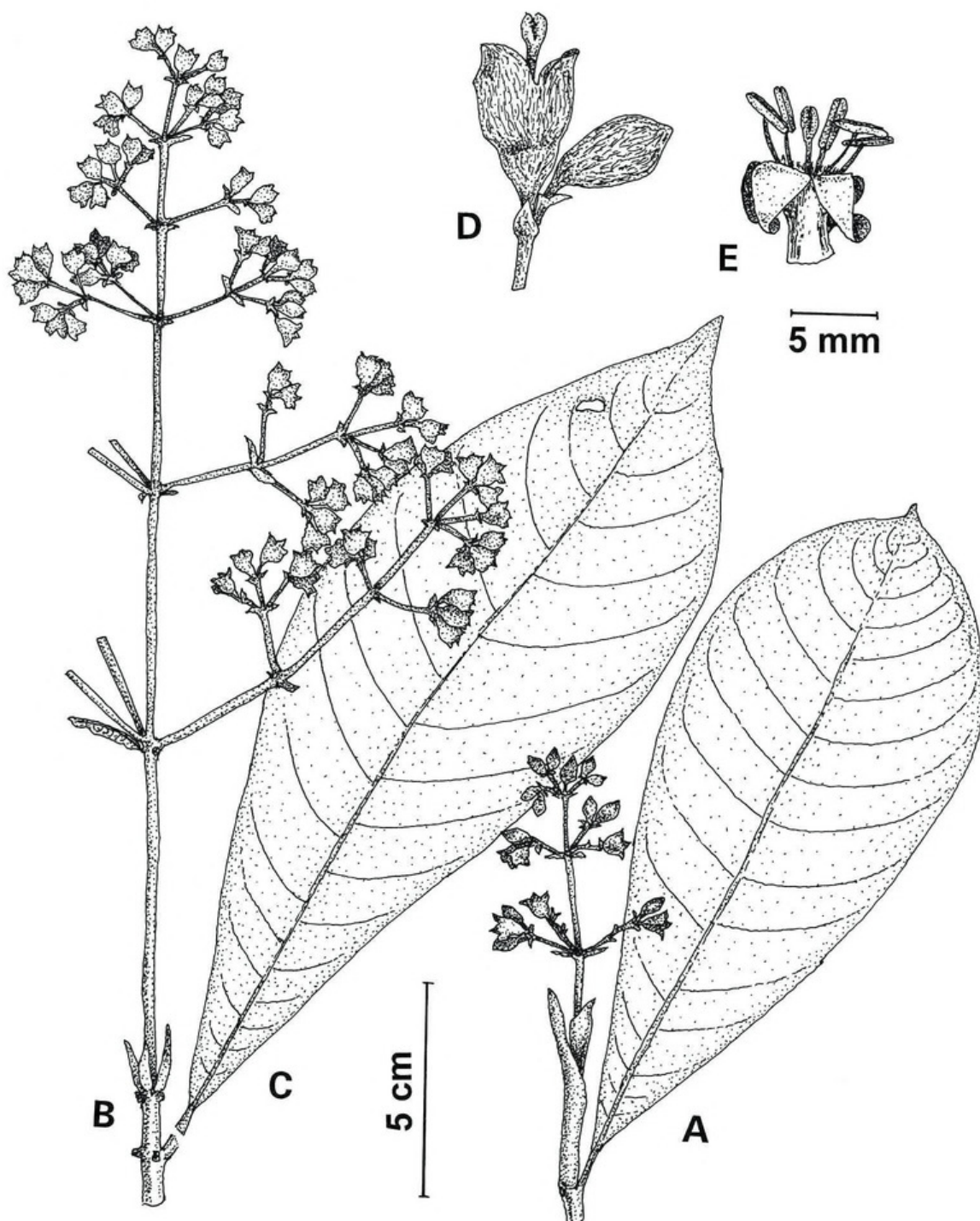


Figure 1. A–C. *Schizocalyx peruvianus* (K. Krause) Kainul. & B. Bremer. —A. Portion of stem with young inflorescence and stipules. —B. Portion of stem with infructescence with young and mature fruits. —C. Leaf (from a different specimen than shown in B). D, E. *Schizocalyx condoricus* D. A. Neill & C. M. Taylor. —D. Small portion of inflorescence with one flower bud (right-hand side) and one mature flower with corolla, anthers, style, and stigmas removed. —E. Portion of flower at anthesis with corolla, anthers, style, and stigmas. A, B based on I. Sánchez V. & M. Dillon 8953 (MO); C based on C. Díaz et al. 8034 (MO); D, E based on D. Neill et al. 15205 (MO). A–C to same 5 cm scale; D, E to same 5 mm scale.

Haec species a congeneris limbo calycino spathaceo interne sericeo 4–7 mm longo, corollae tubo 4.5–5 mm longo lobis 4–5 mm longis atque foliis ternatis coriaceis venatione tertiaria quaternariaque inter sese arcte reticulatis utrinque plana vel leviter elevata distinguitur.

Trees, flowering at 5 m tall, to 15 m tall; stems densely puberulous to strigillose, lenticellate, chan-

neled (at least when dry). *Leaves* ternate or occasionally opposite, obovate to elliptic, 10.5–28 × 5–16 cm, at apex rounded to acute and sometimes shortly acuminate with tips 2–8 mm, at base acute to obtuse, adaxially and abaxially moderately to densely puberulous, drying stiffly chartaceous to subcoriaceous; secondary veins 11 to 14 pairs, tertiary and

higher order venation plane to thinly prominulous on both surfaces; *petioles* 12–30 mm, often thickened at base; stipules calyptrate, in bud slenderly conical, to 35–45 mm, densely strigillose to sericeous, caducous. *Inflorescences* terminal, paniculate, densely strigillose to velutinous-strigillose, branched to 4 orders, sessile or with peduncles 7–11 cm; branched portion pyramidal in outline, 10–30 × 15–25 cm; bracts lanceolate, 2–6 mm, acute, adaxially glabrous, abaxially densely velutinous-strigillose; pedicels 0.5–4 mm. *Flowers* subsessile to pedicellate in dichotomous cymes of 3 to 7; *calyx* densely velutinous-strigillose externally, hypanthium portion obconic, 2.5–3 mm, limb spathaceous and closed in bud, 4–7 mm, splitting irregularly for up to half its length into 2 to 4 lobes, internally densely sericeous; *corolla* salverform, white, externally glabrous, internally glabrous except near base of each lobe with a dense group of straight trichomes 1–2 mm, tube 4.5–5 mm, lobes 5, obovate to oblanceolate, 4–5 mm, rounded; stamens exserted, filaments ca. 4 mm, densely villosulous on lower portion, anthers 2.5–3 mm, dorsifixed a little below middle; stigmas 2, flattened, stout, ca. 2 mm, exserted on styles ca. 7 mm. *Capsules* turbinate, ca. 4 × 4 mm (not including persistent calyx limb), woody, flat on top, opening via a slit across the top; seeds angled, 0.2–0.5 mm.

Distribution, habitat, and phenology. *Schizocalyx condoricus* is known from central through southern Ecuador at 350–2000 m, mainly on substrates derived from crystalline sandstone rocks and in particular rocks of the Cretaceous sandstone Hollín Formation in the Cordillera del Cóndor and the Cordillera del Cutucú to the east of the Andes in Morona-Santiago and Zamora-Chinchipe provinces. It has not been recorded in Peru, but some of the Ecuadorian populations are less than 5 km from the border with Peru and it very likely also occurs in Amazonas Department, Peru. It has been collected in flower in January, March–May, July, October, and December, and in fruit May, July, October, and December, often concurrently with the flowers.

IUCN Red List category. Field observations by the second author indicate that all of the known subpopulations of *Schizocalyx condoricus* occur on substrates associated with the sandstone Hollín Formation, which is found as discontinuous outcrops at 350–2000 m elevation in southeastern Ecuador. The total estimated area covered by this appropriate habitat may thus be taken as the maximum area of occurrence (AOO) of this species, and less than 2000 km² but greater than 500 km². The calculated extent of occurrence (EOO) of the species from herbarium

specimens is greater than 5000 km² but less than 20,000 km². The species occurs mostly in relatively isolated subpopulations, separated by 20 km or more from other subpopulations and thus beyond the normal range of seed dispersal for a small-seeded, wind-dispersed species, so the global population may be considered severely fragmented. This new species is quite common in many sites where it has been found, with some subpopulations protected in forest reserves controlled by local communities, but other subpopulations will probably be eliminated by mining and agricultural activities within the next two decades (D. Neill, pers. obs.). With an EOO and AOO that both meet the geographic range criterion for Vulnerable (IUCN, 2001), a severely fragmented population, and a projected continuing decline in its area of occupancy, area and quality of habitat, number of subpopulations, and number of mature individuals, this species is here evaluated as Vulnerable (VU B1ab[ii,iii,iv,v]+2ab[ii,iii,iv,v]).

Discussion. *Schizocalyx condoricus* can be recognized by its spathaceous, internally sericeous calyx limbs 4–7 mm long, its corollas with the tubes 4.5–5 mm long and the lobes 4–5 mm long, and its ternate, leathery leaves with the tertiary and quaternary venation closely reticulated and flat or only thinly raised on both surfaces. The specific epithet refers to the type locality in the Cordillera del Cóndor.

This new species has been confused with *Schizocalyx peruvianus*; this latter species can be separated by its deciduous inflorescence bracts 4–8 mm long; its sessile to subsessile or very shortly pedicellate flowers borne in congested to subcapitate groups; its calyx limbs that are regularly lobed in bud on many flowers (though irregularly so on some flowers of an inflorescence); its smaller corollas with the lobes similar in size to those of *S. condoricus*, but the tube half as long or shorter; and its pilose to pilosulous pubescence on the stems and leaves.

Paratypes. ECUADOR. **Morona Santiago:** Gualaquiza, Cordillera del Cóndor, Cuangos [sic], 20 km E Gualaquiza, A. Gentry 80273 (MO); valle del río Quimi, W. Quizhpe & A. Wisum 2660 (HUT, LOJA, MO, QCNE); Limon Indanza, end of rd. in construction Limón–La Unión, ca. 10 km from Limón, G. Harling & B. Ståhl 26728 (MO, S); Parroq. Santa Susana, Kuankus, NO comunidad Shuar camino Cerro Chuank Naint, T. Katan, C. Morales & J. Nu 296 (MO); Cordillera del Cóndor, cuenca del Río Coangos, centro Shuar Maikuants, Cerro Wishiwishi Naint, C. Kajekai & grupo Shuar de conservación 315 (MO, QCNE); al O del Río Zamora, parroq. Santa Susana de Chiviaza, alrededores de población El Pescado, C. Morales & D. Reyes 1756 (MO); centro Shuar Yunkumas, Cerro Kunkuk Naint, C. Morales, A. Wisum & C. Kajekai 1586 (MO), A. Wisum & grupo Shuar de conservación 389 (MO, QCNE); Morona, Cordillera de Cutucú, Centro Shuar Uunsuants/Transkutuku, W.

Palacios, N. Jaramillo & F. Nicolalde 15770 (MO); Taisha, Cordillera del Cutucú, parroq. Macuma, en la vertiente NE, Centro Shuar Wisui, cima del Cero Wisui, *A. Wisum & C. Kajekai 1140* (MO); Tiwintza, Cordillera del Cóndor, Cordillera Kampa Naint, Centro Shuar Kaputna, al S del río Santiago, Cerro Kaputna, *C. Kajekai 1117* (MO); Cordillera de Shaimi of the Cordillera de Cutucú, just N of where Santiago–Morona rd. crossed crest, *D. Neill, C. Kajekai & J. Zuleta 16375* (LOJA, MO, QCNE). **Zamora-Chinchipe:** El Pangui, Cordillera del Cóndor, Parroq. Tundayme, valle del río Quimi, *C. Morales & D. Reyes 1919* (MO), *W. Quizhpe & F. Luizier 1997* (HUT, LOJA, MO, QCNE), *W. Quizhpe & F. Luisier 2088* (HUT, LOJA, MO, QCNE), *W. Quizhpe 2818* (LOJA, MO, QCNE), *W. Quizhpe 2716* (LOJA, MO), *W. Quizhpe & R. Steeves 3077* (LOJA, MO, QCNE); valle del Wawaime, afluyente río Quimi, *C. Morales & D. Reyes 2014* (MO), *D. Neill & NSF Dendrology course 15527* (HUT, LOJA, MO, QCNE), *D. Neill, C. Davidson & S. Christoph 15913* (LOJA, MO, QCNE), *D. Neill, O. Montiel, J. Aronson, N. Revelo & D. Cueva 16364* (LOJA, MO, QCNE), *D. Reyes & C. Morales 1204* (MO), *D. Reyes & C. Morales 1235* (MO, QCNE), *W. Quizhpe, C. Juanga & L. Mayacu 2752* (LOJA, MO, QCNE); Nanagaritza, Cordillera del Cóndor, ca. comunidad Las Orquídeas, terraza del río Nangaritza, *C. Kajekai 946* (HUT, LOJA, MO, QCNE); destacamento militar Miazi, río abajo confluencia río Chumbiriatza & río Nangaritza, *J. Jaramillo 14401* (MO, QCA), *W. Quizhpe, F. Santín, O. Jadán & M. Chiunda 698* (LOJA, MO); near Cabañas Yankuam lodge, “Area de Conservación Los Tepuyes,” *D. Neill, M. Asanza & W. Quizhpe 15157* (MO), *D. Neill, C. Davidson, S. Christoph & W. Quizhpe 15767* (MO, QCNE); upper Río Nangaritza, Las Orquídeas reserve on W side of river, *D. Neill, M. Asanza & Univ. Central botany students 15203* (HUT, MO, QCNE), *15205* (HUT, MO, QCNE); ca. 13 km S Guayzimi, silica mine “La Daniela,” *D. Neill, C. Davidson, S. Christoph & W. Quizhpe 15752* (MO, QCNE); valle del río Nanagaritza & faldas Cordillera del Cóndor, Pachicutza, *W. Palacios & D. Neill 6573* (MO, QCNE), *W. Palacios, G. Aymard & E. Freire 8355* (MO, QCNE); parroq. Surmi, comunidad Yawi, *W. Quizhpe, V. Tranda, D. Veintimilla, H. Salas & P. Wampash 1543* (MO); Yacuambi, Cordillera Oriental de los Andes, Parroq. la Paz, Centro Shuar Washikiat, Res. Micha Nunka, *C. Kajekai & A. Wisum 1293* (MO), *A. Wisum & C. Kajekai 1072* (MO); Yantzaza, Cordillera del Cóndor, carr. Los Encuentros hacia Cerro Machinaza, *W. Quizhpe 1665* (MO).

3. *Schizocalyx cuspidatus* (A. St.-Hil.) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Exostema cuspidatum* A. St.-Hil., Pl. Usuel. Bras., 1(3): 1, t. 3A. 1824. *Schoenleinia cuspidata* (A. St.-Hil.) Klotzsch, Getreue Darstell. Gew. 14: t. 15. 1846. *Cinchona cuspidata* (A. St.-Hil.) Brign., Mem. Mat. Fis. Soc. Ital. Sci. Modena, Pt. Mem. Fis. 2, 1: 63. 1862. *Bathysa cuspidata* (A. St.-Hil.) Hook. f. ex K. Schum., Fl. Bras. 6(6): 237. 1889. TYPE: Brazil, Minas Geraes, cueilli dans les bois près Itajura, Cap des Moines, 1816–1821, *A. Saint-Hilaire Catal. B° No. 970* (lectotype, selected here, P-00752481; duplicates of lectotypes, F-0069068, P-00752482, P-00752483).

Distribution and habitat. *Schizocalyx cuspidatus* is found in southeastern Brazil (Germano Filho, 1998), where it grows in mesophyllous forest and gallery forest.

Discussion. There are at least three duplicates of the type collection made by St.-Hilaire at P, two with flowering branches and one with only a leaf. The lectotype specimen selected here has a flowering branch with a mature leaf and two labels, one a handwritten label with the locality information for this collection, and the other a printed label that identifies the specimen as part of the set from St.-Hilaire’s expedition to Brazil and has its catalog number and its scientific name. One of the other specimens has a flowering branch with two leaves, and only the handwritten label with locality information; the other specimen has a single leaf, and only the printed label.

4. *Schizocalyx multiflorus* (Hook. f.) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. *Phitopsis multiflora* Hook. f., Hooker’s Icon. Pl. 11: 75, t. 1093. 1871. TYPE: Peru. San Martín: prope Tarapoto, montis Campana, Dec. 1855, *R. Spruce 4319* (lectotype, selected herein, K-000200475; duplicates of lectotypes, B†, F photo neg. #61 at MO, K-000200474) [Syntype: Peru, Moyobamba, *Mathews 1639*, K].

Distribution and habitat. *Schizocalyx multiflorus* is found in central Peru (Taylor & Pool, 1993), where it grows in wet forests at 900–1600 m.

Discussion. The collection *Spruce 4319* was chosen as the lectotype by Standley (1936: 67), who cited this collection as the type but did not select an individual specimen. His selection was logical, because this collection has two good specimens at K and had another duplicate at B, versus one of the Mathews collection (Peru, Moyobamba, *Mathews 1639*, K). *Spruce 4319* is the only specimen of this species cited by Schumann (1889); a photograph of this specimen was widely available for comparison for some years while the Mathews collection could only be seen by visiting K. Of the two specimens of *Spruce 4319* at K, where Hooker worked, the lectotype specimen designated here is chosen because it has more plant material and extensive analytical drawings of its floral structures.

5. *Schizocalyx obovatus* (K. Schum. ex Standl.) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Bathysa obovata* K. Schum. ex Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 7(3): 280. 1931. TYPE: Peru. Huánuco: Chico-

playa, 1798, *J. J. Tafalla s.n.* (holotype, B†, F photo neg. #33 at MO; isotypes, F not seen, MA not seen, F photo neg. #29653 at MO).

Distribution and habitat. *Schizocalyx obovatus* is known from northern Peru to central Bolivia (Rea Romero, 1993; Taylor & Pool, 1993), in wet forests at 290–1700 m. This species has also been reported from Ecuador (Neill & Ulloa, 2011) based on an identification made in 1999, before *Schizocalyx* had been studied; this report has not been reconfirmed by all of the authors of this article.

Discussion. This species name was first mentioned by Krause (1908), who contrasted his new species *Bathysa peruviana* with a species he called “*B. obovata* (Ruiz & Pavón) K. Schumann,” which was based on his “*Macrocnemum obovatum* Ruiz ex Standl.,” a name that was written on some specimens of Ruiz and Pavón. However, Ruiz and Pavón did not publish the name written on their specimens, and Schumann did not publish his name in *Bathysa*, and Krause did not validly publish this name. This name is not lectotypified here, because further documentation of potential type materials is needed before a selection can be made, but that work is outside the scope of this present review.

Some inaccurate morphological observations made about this species are detailed in the introductory portion of this article. This species as circumscribed here is somewhat variable morphologically, in particular in its opposite versus ternate leaf arrangement and somewhat variable flower and fruit size. The leaf arrangement varies throughout the range of this species, but there appears to be some clinal variation in flower size: the largest flowers are found on plants in Bolivia and southern Peru, while the smallest flowers are found on plants in northern Peru.

6. *Schizocalyx peruvianus* (K. Krause) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Bathysa peruviana* K. Krause, Verh. Bot. Vereins Prov. Brandenburg 50: 96. 1909. TYPE: Peru. Loreto: prope Yurimaguas, Apr. 1903, *E. Ule* 6768 (holotype, B†, F photo neg. #32 at MO).

Distribution and habitat. *Schizocalyx peruvianus* is found from northern Ecuador to southern Peru (Taylor & Pool, 1993; Taylor, 1999), in wet forests at 200–1600 m.

Discussion. Some inaccurate morphological observations made about this species are detailed in the

introductory portion of this article. This species is characterized by its rather dense inflorescences with the flowers sessile to very shortly pedicellate and borne in subcapitate to congested groups. However, the inflorescence axes and pedicels sometimes elongate as the fruits develop, so the infructescences are often laxer than the inflorescences and have the fruits separated from each other, presumably to aid dispersal of the seeds (Figure 1A–C). There also appears to be some clinal variation in degree of expansion of the inflorescences and infructescences, with these shorter and more congested in Ecuador and northern Peru, and often longer and laxer in central and southern Peru. This name is not lectotypified here, because further documentation of potential type materials is needed before a selection can be made, but that work is outside the scope of this present review.

Selected specimens examined. PERU. Amazonas: Bagua, distrito Imaza, Comunidad Aguaruna de Wanás (Km. 92 Carretera Bagua-Imacita), Cerros Chinim, *C. Díaz, A. Peña, L. Tsamajain & M. Roca* 8034 (MO). San Martín: Rioja, Aguas Verdes (Perla del Mayo-Laguna Onarcocha), *I. Sánchez V. & M. Dillon* 8953 (F, MO).

7. *Schizocalyx sterculioides* (Standl.) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Phitopsis sterculioides* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 8: 341. 1931. TYPE: Peru. Junín: dense forest, Pichis Trail, Enenas, 1600–1900 m, 30 June–2 July 1929, *E. P. Killip & A. C. Smith* 25747 (holotype, F-607646 F photo neg. #44915 at MO).

Distribution and habitat. This species is known from southern Ecuador through central Peru (Taylor & Pool, 1993; Neill & Ulloa, 2011), where it is found in wet premontane forests at 1100–1800 m. It has been documented on substrates derived from crystalline rocks (e.g., *D. Neill & Shuar Conservation Interns* 14035, MO) and also on clay soils (e.g., *K. Young & G. Sullivan* 747, MO).

8. *Schizocalyx truncatus* C. M. Taylor, sp. nov. TYPE: Peru. Pasco, Oxapampa, distr. Palcazú, El Paujil, lowland rainforest, 10°10′24″S, 75°15′49″W, 500 m, *H. van der Werff, R. Vásquez & R. Francis* 19999 (holotype, USM; isotype, MO-04824519). Figure 2.

Haec species a *Schizocalyce obovato* (K. Schum. ex Standl.) Kainul. & B. Bremer caulibus foliis stipulisque pubescentia pilosa hirsutave indutis, foliis ad basem interdem obtusis sed plerumque rotundatis truncatisve atque tubo corollino brevioribus distinguitur.

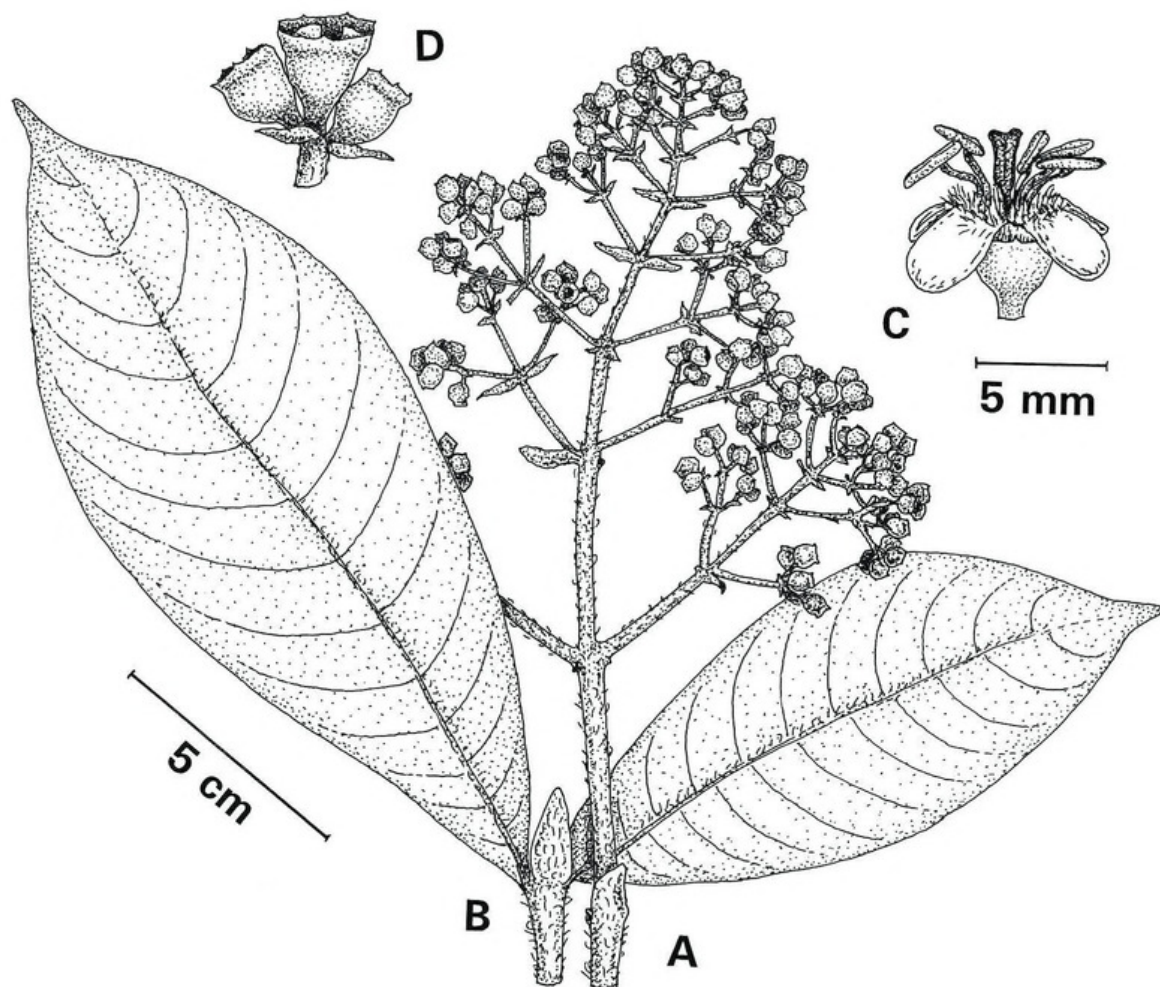


Figure 2. *Schizocalyx truncatus* C. M. Taylor. —A. Portion of stem with infructescence. —B. Portion of vegetative stem with apical stipule present. —C. Flower at anthesis. —D. Portion of infructescence with one mature capsule (center) and two immature fruits (sides). A, B based on W. Pariona & A. Sebastián 60 (MO); C, D based on A. Gentry et al. 25641 (MO). A, B to same 5 cm scale; C, D to same 5 mm scale.

Trees, flowering at 5 m tall, to 16 m tall; stems densely hirsute to pilose. *Leaves* opposite, obovate, 13–31 × 6–16 cm, at apex acute to abruptly acuminate with tips 3–10 mm, at base tapered then shortly obtuse to usually rounded or truncate, adaxially moderately to densely pilose, abaxially densely pilose with trichomes denser and longer on principal veins, drying stiffly chartaceous; secondary veins 13 to 16 pairs, tertiary and higher order veins plane above, prominulous to prominent below; *petioles* 3–13 mm, densely pilose; *stipules* calyptrate, conical to ellipsoid and laterally flattened, 20–22 mm, densely strigose to hirsute, caducous. *Inflorescences* terminal, paniculate, densely velutinous and also sparsely to densely pilosulous to pilose (i.e., with trichomes of two lengths), branched to 3 or 4 orders, sessile or with peduncles 5–7 cm; branched portion pyramidal in outline, 10–22 × 9–21 cm; bracts triangular to lanceolate or ovate, 2–6 mm, acute, adaxially glabrous, abaxially densely strigillose to puberulous; pedicels 0–1 mm. *Flowers* sessile to

shortly pedicellate in dense groups of 5 to 11; *calyx* densely strigillose externally, with hypanthium portion obconic, 1.5–2 mm, limb tubular and open in bud, 1.5–2 mm, internally glabrous, truncate or usually 5-denticulate, with teeth to 0.2 mm; *corolla* salverform, white, externally glabrous, internally glabrous except with a tuft of stiff pilosulous pubescence near base of each lobe, tube ca. 1 mm, lobes 5, ligulate, 4–4.5 mm, rounded; *stamens* exserted, filaments ca. 4 mm, glabrous except with a villous ring of pubescence in basal half, anthers ca. 2 mm, dorsifixed near middle; *stigmas* 2, cylindrical, 1.5–2.5 mm, succulent, exserted, style 2–2.5 mm. *Capsules* turbinate, 4–4.5 × 4 mm, densely strigillose, chartaceous to woody, flat-topped with persistent calyx limb, opening by a slit across the top; seeds angled to somewhat fusiform, 0.2–0.5 mm.

Distribution, habitat, and phenology. This species is known from central Peru, where it is found in wet forests at 350–1185 m; it has been collected in

flower in February, March, May, and June, and in fruit in June.

IUCN Red List category. This species meets the geographic range criterion for an evaluation of Endangered (EN) based on its limited known EOO and AOO. However, it is found in three different legally protected areas, presumably not all under immediate threat. Whether its habitat or populations are in continuing decline is unconfirmed, but this is likely, now or in the near future. This species is here evaluated as Vulnerable due to its few known locations that may have declining habitat (VU D2).

Discussion. This new species can be recognized by its pilose to hirsute pubescence, its leaves that taper to an obtuse or usually shortly rounded to truncate base, and its inflorescences that are branched to several orders with small flowers borne in congested groups. The species epithet refers to the distinctive shape of the leaf bases. This new species is similar vegetatively to *Schizocalyx multiflorus*; that other species differs in its fewer flowers with spathaceous calyx limbs that are ca. 10 mm long and densely velutinous internally (i.e., adaxially). This new species is also similar in its inflorescence and corollas to *S. obovatus*; that other species differs in its shorter, pilosulous pubescence, its leaves with generally longer petioles and cuneate bases, and its densely velutinous to strigillose inflorescence axes with trichomes of generally only one length.

Paratypes. PERU. **Pasco:** Prov. Oxapampa, distr. Iscozacín, Alto, W. Pariona & A. Sebastián 60 (MO); distr. Palcazú, drainage of río Palcazú betw. Km. 51 & 60 of new rd. in construction NW of Villa Rica toward Puerto Bermúdez, A. Gentry & D. [N.] Smith 35998 (MO); Parque Nac. Yanachaga-Chemillén, ca. de la est. biol. Paujil, A. Monteagudo, R. Francis & G. Ortiz 5102 (MO); A. Monteagudo, R. Francis, G. Ortiz & C. Mateo 5139 (MO); Parque Nac. Yanachaga-Chemillén, Cerro Paujil-Ozuz, A. Monteagudo, A. Peña, R. Francis, H. Cristobal, L. Mateo, A. Utani, T. Ciriaco & R. Roca 8470 (MO), A. Monteagudo, A. Peña, R. Francis, J. Mateo & A. Utani 8539 (MO), A. Monteagudo, A. Peña, R. Francis, J. Mateo & A. Utani 8589 (MO); Camino Alto Lagarto a Pozuzo Alto Victoria, R. Rojas & G. Ortiz 5818 (MO); Res. Comunal Yanesha-Sector Azulis, R. Vázquez, A. Monteagudo, A. Peña, R. Francis & L. Mateo 29653 (MO); entre San Pedro de Pichanaz y Puerto Bermúdez, R. Vázquez, A. Monteagudo, A. Peña, R. Francis & L. Mateo 29824 (MO); El Paujil, H. van der Werff, R. Vázquez & R. Francis 19962 (MO); distr. Villa Rica, Bosque de Protección San Matías-San Carlos, Sector Yulculmas, R. Vázquez, A. Monteagudo, A. Peña & J. Mateo 32480 (MO). **San Martín:** Prov. Mariscal Cáceres, distr. Tocache Nuevo, 12 km W Tocache Nuevo, Carr. Marginal, hills overlooking Río Tocache, A. Gentry, J. Schunke V. & J. Aronson 25619 (MO), A. Gentry, J. Schunke V. & J. Aronson 25641 (MO); quebrada Tanata, margen izquierda Río Huallaga, J. Schunke V. 4072 (MO); camino Pushurumbo, 7–8 km E

puente de Palo Blanco, J. Schunke V. 5764 (MO); Pto. Pizana, margen derecha Río Huallaga, J. Schunke V. 6889 (MO); quebrada Challua-Gacu, J. Schunke V. 10805 (MO).

9. *Schizocalyx veraguensis* (Dwyer) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Bathysa veraguensis* Dwyer, Ann. Missouri Bot. Gard. 67: 40. 1980. TYPE: Panama. Veraguas: Cerro Tute, 1200 m, 28 Sep. 1972, E. A. Lao & A. Gentry 531 (holotype, MO-2164349; isotypes, BM not seen, MEXU not seen, NY not seen, PMA not seen).

Distribution and habitat. *Schizocalyx veraguensis* species is found from northeastern Costa Rica through central Panama (Dwyer, 1980; Burger & Taylor, 1993), in wet forests at 500–1000 m.

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