



The synonymization of *Philodice* with *Syngonanthus* (Eriocaulaceae)

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Abstract

Philodice hoffmannseggii and *P. cuyabensis*, the only species in this genus, are here recognized as a single species and transferred to the genus *Syngonanthus* as *S. cuyabensis*. The taxonomic history and morphology of *Philodice* are reviewed, and infraspecific variation, and affinities within *Syngonanthus* are discussed.

Resumo

Philodice hoffmannseggii e *P. cuyabensis*, as únicas espécies do gênero, são aqui reconhecidas como uma só espécie e transferidas para o gênero *Syngonanthus* como *S. cuyabensis*. É apresentada revisão da história taxonômica e da morfologia de *Philodice*, e discutidas as variações infra-específicas e afinidades dentro de *Syngonanthus*.

Key words: new combination, new synonyms, *Philodice hoffmannseggii*, South America, *Syngonanthus cuyabensis*, taxonomy

Introduction

The Eriocaulaceae have long been recognized as a pantropical family with approximately 1,200 species in 11 genera (Andrade *et al.* 2010). However, molecular studies have resulted in a number of taxonomic changes at the generic level. These include the synonymization of *Blastocaulon* Ruhland (1903: 279) in *Paepalanthus* Martius (1834: 26) (Andrade *et al.* 2011) and the reestablishment of *Comanthera* Smith (1937: 38) (Parra *et al.* 2010). Recent molecular and morphological analyses also support the merging of *Philodice* Martius (1834: 26) with *Syngonanthus* Ruhland (1900: 487). *Philodice* is the older name, but proposal no. 1902 (Giulietti *et al.* 2009) to conserve the name *Syngonanthus* against *Philodice* was approved during the Nomenclature Meeting of the International Botany Congress in Melbourne 2011, based on the report of vascular plants (Brummitt 2011). As a result of these changes, the number of accepted genera in Eriocaulaceae is now reduced to ten.

Andrade (2007) and Andrade *et al.* (2010) presented phylogenetic studies on Eriocaulaceae and indicated *Syngonanthus* as polyphyletic in two different clades: Clade (*Syngonanthus* sect. *Eulepis* + *S.* sect. *Thysanocephalus*), which is monophyletic and distinct from the Clade (*Philodice* (*S.* sect. *Syngonanthus* + *S.* sect. *Carphocephalus*)). These results corroborate previous studies on *Syngonanthus* based on morphology (Parra 2000), chemistry (Ricci *et al.* 1996) and pollen grains (Borges *et al.* 2009).

Parra *et al.* (2010) formally re-established and re-circumscribed the genus *Comanthera*, including *S. sect. Eulepis* (Bongard 1831: 635) Ruhland (1903: 270) and *S. sect. Thysanocephalus* (Koernicke 1863: 429) Ruhland (1903: 276), and restricted *Syngonanthus* to *S. sect. Carphocephalus* (Koernicke 1863: 465) Ruhland (1903: 264) and *S. sect. Syngonanthus*. *Syngonanthus sensu strictu* currently comprises ca. 160 species distributed in Africa and America, especially in Brazil.

Results

Philodice has only two traditionally recognized species and one variety: *P. cuyabensis* (Bongard 1831: 634) Koernicke (1863: 305), *P. hoffmannseggii* Martius (1834: 26, 29), and *P. hoffmannseggii* var. *compacta* Koernicke (1863: 306). In this study, type material of all three taxa was examined, as were specimens determined as *P. hoffmannseggii* from Colombia, deposited in the herbarium COL, from Venezuela, Suriname, Guyana and Bolivia deposited in B, K and U, and from Brazil deposited in B, BM, BR, HUEFS, K, M, R, OXF. The species was found to be continuously variable in the characters used to distinguish taxa, and a single species is here recognized, as discussed below.

Philodice, though unusual in several ways, is difficult to justify as distinct from the large and diverse genus *Syngonanthus*. The new combination, *Syngonanthus cuyabensis* (Bongard) Giul., Hensold & L.R. Parra, represents the oldest available epithet, replacing the widely applied name *Philodice hoffmannseggii*.

Circumscription of *Philodice*

Martius (1835) described *Philodice* to accommodate a single species, and defined it by the reduction of the stamens to two opposite the inner corolla lobes, and by the pistillate flowers with broadly rhombic petals, fleshy and connate in the middle, free at the clawed (unguiculate) base, and with rigid acuminate non-involute lobes.

Kunth (1841, 1842) was the first to note that certain other species included in Martius' concept of *Paepalanthus* showed the same unusual medial fusion of the pistillate flower petals as described for *Philodice*. While he considered both petal fusion and stamen number in *Philodice* to be inadequate for distinguishing the genus, he noted a new character overlooked by Martius, that the anthers of *Philodice* were unilocular, and on this basis provisionally maintained *Philodice* as a distinct genus (Kunth 1842).

Koernicke (1863) comprehensively studied floral morphology, and fully catalogued those species with medially connate corollas in the pistillate flowers. Unlike Kunth, he found this character taxonomically important, and typical of *Mesanthemum* Koernicke (1856: 572), *Philodice*, and five newly described subgenera of *Paepalanthus*. Among these groups, he noted four different characteristic morphologies of the corolla (p. 291), including a unique category for *Philodice*, with the petal apex "rigid and erect, the rhomboidal lamina conrescent in the middle margin." This he contrasted with the petal apices fine, membranous, and involute (rolling inward at the tip after flowering) in *Paepalanthus* subg. *Carphocephalus* Koernicke, *P. subg. Andraspidopsis* Koernicke (1863: 439), and *P. subg. Psilocephalus* Koernicke (1863: 451) (all now included in *Syngonanthus sensu strictu*). (The two other patterns described by Koernicke apply to species now included in *Comanthera* and *Mesanthemum*). However, he did not use this character in the key to genera. Koernicke also transferred *Paepalanthus cuyabensis* (Bong.) Kunth (1841: 520) to *Philodice*.

Ruhland (1903) accepted Koernicke's concept and descriptions, but noted that the reduction of stamens to two in *Philodice* does not always occur, and three stamens may occasionally be present. Stützel & Gansser (1996) confirmed the occurrence of unilocular (monotheous), bisporangiate anthers in *Philodice*, but noted that it is a labile characteristic and that ditheous anthers may also occur. Furthermore, although Kunth (1842) and Ruhland (1903) emphasized the importance of anther locule reduction as a taxonomically meaningful character at the genus level, recent studies in *Paepalanthus* confirm that it occurs in at least three lineages within that genus (Andrade *et al.* 2011), casting doubt on its utility in other genera as well.

Other unusual characters occur in *Philodice* which have not been emphasized in the definition of the genus. First, *Philodice* lacks tubular scape spathes. At first glance, the structure appears to be lacking entirely, but close examination shows that a single unmodified leaf in the approximately adaxial (prophyll) position arises from the scape just above its base, exactly as happens in *Tonina fluviatilis* Aublet (1775: 857). This is an unusual character for species with scapes potentially well-developed, and was noted by Koernicke (1863).

Other salient characters are the presence of floral bracts, known from only about 25% of the species of *Syngonanthus sensu stricto* (Hensold *et al.* 2012), and the purplish color of the pollen, contrasting with the whitish anther sacs, which can be observed in herbarium specimens.

Affinities within *Syngonanthus*

Syngonanthus cuyabensis is very similar to *Syngonanthus xinguensis* Moldenke (1964: 489), a species of Mato Grosso known only from the type and published without sectional designation. *Syngonanthus xinguensis* is a slightly larger plant, with the stem branched near the apex, which also may occur in *S. cuyabensis*. Unlike that species, it possesses normal tubular scape spathes 2 cm long which are tightly appressed to the scape. The involucre bracts are white-hyaline with the outer bracts green-striped down the center, as described for *Philodice cuyabensis*, versus entirely green and foliose as described for *Philodice hoffmannseggii*. The corollas of *S. xinguensis* form a stiff urceolate cup which is constricted over the ovary as in *S. cuyabensis*. We were not able to study the number of anthers or anther locules.

The thick, urceolate, non-involute corollas of *S. cuyabensis* are perhaps its most peculiar feature. Few species of *Syngonanthus sensu stricto* possess thickened corollas, and when so, they are not usually of this nature. However, in addition to *S. xinguensis*, they are also found in *S. fenestratus* Hensold (1991: 434), a stem-dimorphic species of Venezuela and the upper Amazon basin. This species, though distinct in habit and more robust, also occurs in wet habitats, has involucre bracts green-striped along the midvein, and a very similar corolla morphology, especially of the pistillate flower. The staminate corollas are also urceolate but unlike the acutely lobed pistillate corollas, have a rounded, shallowly lobed upper margin (Hensold 1991: fig. 7). In addition, in herbarium material of *S. fenestratus*, the pollen often appears pinkish-purple, as in *S. cuyabensis*. This seems to be an unusual feature as well, but pollen color, normally yellowish, has not been recognized as a character and has not been studied in the genus.

Syngonanthus anomalus (Koernicke 1863: 458) Ruhland (1903: 267), a floating-stem aquatic, and *S. cowanii* Moldenke (1953: 99), another stem-dimorphic species of Venezuela, also have fleshy non-involute corollas, but these lack the distinctive urceolate shape of the other three species. All species here mentioned with non-involute corollas also have floral bracts.

At this time, it is not practical to assign a sectional placement to *S. cuyabensis*, *S. xinguensis*, or *S. fenestratus*, given that the traditional two sections of *Syngonanthus* are probably artificial and are currently under molecular study. However, given the diversity now contained within *Syngonanthus*, and the finding that the character historically used in generic definition of *Philodice*, monothealous anthers, is unstable, it is reasonable to transfer the single species to *Syngonanthus*.

Taxonomic treatment

Syngonanthus Ruhland (1900: 487), *nom. cons.* Lectotype: *Syngonanthus umbellatus* (Lam.) Ruhland (= *Eriocaulon umbellatum* Lam.) designated by Britton & Brown (1913: 455).

Philodice Martius (1834: 26), *syn. nov.* Type: *Philodice hoffmannseggii* Martius.

***Syngonanthus cuyabensis* (Bong.) Giul., Hensold & L.R. Parra, comb. nov.**

Basionym: *Eriocaulon cuyabense* Bongard (1831: 634, t. 10). *Paepalanthus cuyabensis* (Bong.) Kunth (1841: 520). *Philodice cuyabensis* (Bong.) Koernicke (1863: 305). Type:—Brazil. Mato Grosso: Cuiabá, April, *Riedel 946* (holotype LE, isotypes B!, OXF!).

Synonyms:—*Philodice hoffmannseggii* Martius (1834: 26, 29), *syn. nov.* TYPE:—Brazil. Pará: *Sieber s.n.* (holotype BR!, isotype B!).

Philodice hoffmannseggii var. *compacta* Koernicke (1863: 306), *syn. nov.* TYPE:—Brazil. Piauí: Oeiras, July 1839, *Gardner 2749 bis* (lectotype HAL! here selected, isolectotypes BM!, K! [2 exs.]). Koernicke (1863:303) reported that he saw the Gardner collections at W (now mostly destroyed) and in the herbarium Schlechtendal (now at HAL). So we choose to lectotypify *P. var. compacta* with the duplicate at HAL, which is visible online and was annotated by Koernicke.

Note:—Martius' description of *Philodice* and its solitary species, *P. hoffmannseggii*, were first published in the context of a condensed French translation of his more complete (1835) paper. Although Martius' complete publication (1835) provided a full species description and illustration, the description of the monotypic genus in 1834, together with citation of a species name and type, suffices for valid publication of the species (ICBN [Vienna Code], Article 42, McNeill *et al.* 2006).

Koernicke (1863) distinguished the two species principally by the involucre bracts linear-lanceolate, green with white hyaline margins, slightly puberulous, rigid, and surpassing the flowers in *P. hoffmannseggii*, versus ovate or oblong-lanceolate, white-hyaline throughout, glabrous, membranous, and equalling the flowers in *P. cuyabensis*. He also noted a difference in shape of the staminate corolla lobes, with those of *P. hoffmannseggii* being acuminate, and those of *P. cuyabensis* being "*obtusissimas retusas apiculatas*." In addition, *P. hoffmannseggii* was described as having a more lax habit with flaccid leaves, and *P. hoffmannseggii* var. *compacta* and *P. cuyabensis* as being smaller, more erect plants with ascending leaves, and scapes barely surpassing the leaves. This treatment was accepted by Ruhland (1903).

Study of available material showed the following variation in characters:

1. Plant height varying from 12 to 15 cm [*Sieber s.n.*(OXF), *Spruce 964* (K)] down to much smaller plants from 2 to 3.5cm [*Riedel 946* (B, OXF), *Huber 64* (NY, K), *Ule 7666* (K), *Giulietti 2483* (HUEFS)];
2. Leaves glabrous to slightly pubescent;
3. Scapes varying in length from 3 cm [*Sieber s.n.* (OXF)] to 0.3 cm [*Riedel 946* (OXF)]. In several examples, scape length was observed to vary even in the same specimen, in *Ule 7666* (K) from 0.3 to 0.8 cm; *Spruce 964* (K) from 0.5 to 2.5 cm, and in *Gardner 5243* (K) from 1 to 1.5 cm (Fig. 1 A, I);
4. The involucre bracts vary from white-hyaline to green or castaneous with the margin sometimes paler or hyaline;
5. The involucre bracts usually display two series, with the outer smaller, varying from 1.5–1.8 mm in *Riedel 946* to 3.5–4 mm long in *Maas & Westra 4105* (K), either slightly smaller to equalling the length of the flowers in *Riedel 946* and *Gardner 2749* (K) or up to slightly longer to much longer than the flowers to 1.5 mm in *Maas & Westra 4105* (Fig. 1B. JK);
6. The capitula measure between 0.5 and 0.6 mm in diameter, bearing 6–10 staminate flowers and 7–11 pistillate flowers, about 1 mm long. The pistillate flowers are arranged, mixed with staminate flowers, on the periphery of the capitulum, with only staminate flowers in the centre;
7. The staminate flowers are long-pedicellate, with 3 sepals joined at the base; the corolla has three fused petals, ± fleshy, urceolate to infundibuliform, lobes acute to acuminate, usually with one lobe larger than the others; stamens 2, free from the corolla, stamen filament cylindrical, anther linear-oblong, more or less basifixed, bitheous, tetra- to bi-sporangiate, pistillode very small (Fig. 1 C–E; L–N).
- Stützel & Gansser (1995) mention that *Philodice* often has normal bitheous-tetrasporangiate anthers, but these sometimes become irregularly monotheous-bisporangiate due to lateral reduction.

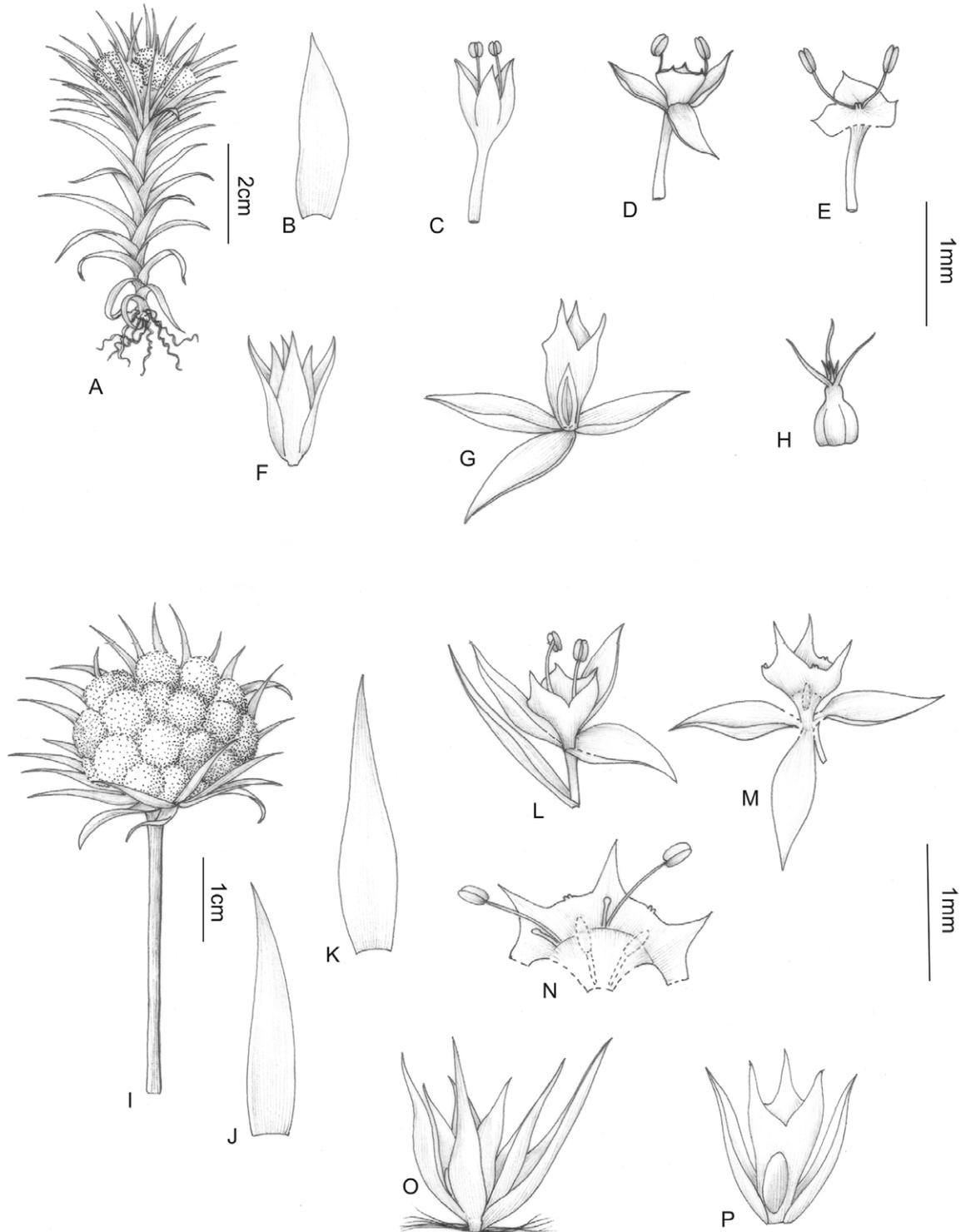


FIGURE 1. *Syngonanthus cujabensis*. A: Habit; B: Involucre bract from the inner series; C–E: Staminate flower; C: Pedicel, calyx and stamens exerted; D: Calyx opened to show the corolla and stamens; E: Corolla, front view, showing the stamens and pistillode; F–H: Pistillate flower; F: Sepals and apices of the petals; G: Calyx opened to show the corolla united in the median region and free at the base and apex; H: Gynoecium (A–H from *Riedel 946*); I: Detail of the inflorescence with the cauline leaves removed; J–K: Involucre bracts; J: Outer series; K: Inner series; L–N: Staminate flower; L: Complete flower with bract, calyx and corolla; (I–L from *Maas & Westra 4105*); M: Calyx opened to show the corolla with a more delicate zone; N: Calyx opened to show the areas of separation between the petals (M–N from *Ule 7666*); O–P: Pistillate flower; O: Complete flower with bract, calyx and corolla (from *Maas & Westra 4105*); P: Calyx with one of the sepals removed to show the corolla united in the median part and free at the base and apex (from *A.C. Smith 2284*). Drawn by Ana Maria Giulietti & Carla Lima.

- Examination of the staminate flower found in material of *Ule* 7666 (K) showed that the corolla has a very delicate zone between the petals in the basal region, but not in the median region, a character also found in the corolla of the pistillate flower (Fig. 1 M–N). According to Koernicke (1863: 289), in both *Philodice* and *Paepalanthus* subg. *Carphocephalus* (= *Syngonanthus* sect. *Carphocephalus*) the petals of the staminate flower tend to separate into rhomboidal segments with age.
- 8. The pistillate flowers are shortly pedicellate, with 3 free sepals, concave, acute to acuminate; petals 3, fused in the mid-portion and free at the base and apex, acute to acuminate, usually one lobe larger than the others (Fig. 1F–H, O–P).

In spite of the observed variation in some characters among the material examined, intermediate stages can always be found, justifying the recognition of only a single taxon.

Habitat:—The plants are annuals of low wet sandy open places, riverbanks, and often in standing water on disturbed ground. The lax habit described for *P. hoffmannseggii* versus the more compact habits of its variety and of *P. cuyabensis* probably correlate with soil moisture differences.

Distribution:—Currently, the species is known to occur in Northern South America (Colombia, Venezuela, Guyana and Suriname) and in Brazil from Pará southward to Piauí, Ceará, Bahia, Minas Gerais, Goiás and Mato Grosso and extending to Bolivia (Giulietti & Hensold 1990, Hensold 1999, Giulietti *et al.* 2009).

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