STRUTHANTHUS (LORANTHACEAE) VARIATION IN VENEZUELA: A NUMERICAL APPROACH

Aniuzka Kazandjián

Centro de Biodiversidad Marina
Laboratorio de Sistemática Molecular
Departamento de Biología de Organismos
Universidad Simón Bolívar
Caracas 89000, VENEZUELA
akazandj@usb.ve

ABSTRACT

Struthanthus Mart. is a large genus in the Loranthaceae occurring in the New World Tropics. Although 12 species are currently recognized in Venezuela, many herbarium specimens are difficult to positively identify because of the ambiguity of some characters that are used to distinguish species. A multivariate analysis of 144 herbarium specimens based on 17 characters recognized the following 5 groups: *S. corymbifer* Rizzini, *S. gracilis* (Gleason) Steyerm. & Maguire, *S. phillyreoides* (Kunth) Blume, *S. syringifolius* Mart. and *S. terniflorus* (Klotzsch) Eichler, plus the discrete *S. martianus* Dettke & Waechter. A key and descriptions for all species recognized in this analysis for *Struthanthus* in Venezuela are provided.

Key Words: Loranthaceae, *Struthanthus*, morphometric, numerical analyses, Venezuelan flora

RESUMEN

Struthanthus Mart. es uno de los géneros más representativos de la Familia Loranthaceae en el Neotrópico. Aun cuando actualmente son reconocidas 12 especies en Venezuela, muchos especímenes de herbario no han sido identificados debido a la ambigüedad que presentan muchos de los caracteres establecidos para identificar las distintas especies. Los análisis multivariantes llevados a cabo en 144 especímenes de herbario y usando 17 caracteres arrojaron los siguientes 5 grupos: *S. corymbifer* Rizzini, *S. gracilis* (Gleason) Steyerm. & Maguire, *S. phillyreoides* (Kunth) Blume, *S. syringifolius* Mart. y *S. terniflorus* (Klotzsch) Eichler, además de la ya descrita *S. martianus* Dettke & Waechter. Se presenta una clave y las descripciones correspondientes a cada especie reconocida en este análisis del género *Struthanthus* en Venezuela.

Palabras claves: Loranthaceae, *Struthanthus*, morfometría, análisis multivariado, flora de Venezuela

INTRODUCTION

Struthanthus Mart. is one of the largest genera in the Loranthaceae in the New World Tropics, with approximately 45 species ranging from NW Mexico to Argentina (Kuijt 2013; Kuijt & Hansen 2015). The genus consists of dioecious plants with mostly indeterminate racemes or spikes of paired triads, that is, three flowers and three bracteoles. The flowers are usually small, and the filaments are slender subtending versatile anthers (Martius 1830; Eichler 1868; Kuijt 2001, 2011, 2013).

The first monograph of *Struthanthus* for Venezuela was presented by Rizzini (1982) who recognized 14 species: *S. corymbifer* Rizzini, *S. dichotrianthus* Eichler, *S. dissimilis* Rizzini, *S. eichlerianus* Rizzini, *S. giovannae* Rizzini, *S. gracilis* (Gleason) Steyerm. & Maguire, *S. phillyreoides* (Kunth) Blume, *S. polystachyus* (Ruiz & Pav.) G. Don, *S. porrectus* Rizzini, *S. syringifolius* Mart., *S. terniflorus* (Klotzsch) Eichler, *S. translucens* Rizzini, *S. trujilloi* G. Ferrari ex Rizzini, and *S. yavitensis* Rizzini. Rizzini (1985) later described another species, *S. pariensis* Rizzini.

Kuijt (2001), in his treatment of *Struthanthus* for the *Flora of the Venezuelan Guayana*, reduced *S. dissimilis, S. terniflorus, S. translucens,* and *S. yavitensis* to synonyms of *S. dichotrianthus*, thus bringing the number of species recognized for Venezuela to 11. This number was further revised by Kuijt (2008) for the *Nuevo Catálogo de la Flora de Venezuela* in which he recognized 12 species: *S. calophyllus* A.C.Sm., *S. corymbifer, S. dichotrianthus, S. eichlerianus*, *S. gracilis*, *S. pariensis, S. phillyreoides, S. polystachyus*, *S. porrectus, S. trujilloi, S. syringifolius,* and *S. vulgaris* Mart ex. Eichler. Since then, *S. callophyllus* and *S. polystachyus* (Kuijt 2011) have been transferred to

J. Bot. Res. Inst. Texas 11(2): 391 – 407. 2017

Peristethium, *S. dichotrianthus* has been found synonymous under the priority name of *S. phillyreoides* (Kazandjián 2011), and *S. vulgaris* has been replaced by the legitimate name of *S. martianus* (Dettke & Waechter 2012). Following these changes, *Struthanthus* in Venezuela is recognized as comprising nine species. Additionally, none of the publications mentioned above, Rizzini (1982) and Kuijt (2001, 2008), considered the two varieties of *S. syringifolius*, *S. syringifolius* var. *longepedunculatus* (Mart.) Eichler and *S. syringifolius* var. *paniculatus* Rizzini. As these two varieties have not been taken into taxonomic consideration in any of the previous publications noted above, it is necessary for completeness to include them in this revision.

For the identification of species of *Struthanthus* in Venezuela, the most practical available resources are the publications of Rizzini (1982) and Kuijt (2001). Both publications include keys for the species and descriptions. However, Rizzini's work includes species that are not currently recognized and some having been reduced to synonymy, while Kuijt's work was restricted to the species found in the Venezuelan Guayana and not the whole of Venezuela.

Despite their differences, both works divided identification of the species into three broad categories, into which their recognized species can be unequivocally accommodated. The categories include (1) pedunculated triads-pedicellate flowers, to include a single species, *S. martianus;* (2) sessile triad-sessile flowers to include only two species, *S. gracilis* and *S. trujilloi;* and (3) pedunculated triad-sessile flowers, to include all the remaining species.

An examination of the specimens of *Struthanthus* held at the Herbario Nacional de Venezuela (VEN, Thiers 2016) indicated that 40% of specimens were identified as either *S. dichotrianthus* or *S. syringifolius*, 15% were placed in some of the remaining species, and 45% were unidentified. When randomly chosen unidentified specimens were checked against keys and descriptions, it was difficult to identify them because most of the diagnostic characters cited by Rizzini (1982) were difficult to apply. In addition, the high degree of variation between and within individual specimens could accommodated by their keys or descriptions, as well there were conflicting discrepancies between the number of species given by each author, i.e., Rizzini (1982) and Kuijt (2001, 2008). The aim of this revision is to clarify the number of species of *Struthanthus* and the characters limiting those species that occur in Venezuela based on a statistical evaluation of the morphological variation using specimens held by various herbaria. For the purpose of this revision, it has been necessary to consider all the species recognized in Rizzini (1982, 1985) and Kuijt (2001, 2008), as it is possible that some of the synonymies may not reflect the variation to be found among all specimens.

METHODS

To gather statistical data, specimens from the following herbaria were accessed: CUM, F, HERZU, K, M, MY, P, PORT, RB, SP and VEN. Digital photographs of each specimen as well as the type of each species were uploaded to the computer, together with information on the geographical location. Measurements were taken using tpsDIG Version 2 program (Rohlf 1998) which was downloaded from the web (http://life.bio.sunysb.edu/morph/morphmet/tspdig2w32.exe).

A total of 221 herbarium specimens were examined, but only 144 were useful for analyses because specimens in which more than 25% of characters were missing were not included. Most of the characters were chosen based on those that Rizzini (1982) used in his descriptions. However, in addition to those, the following characters were also measured: stem width, measured in the middle of the stem between the first three well-developed leaves starting from the top; node width, node width, measured from the point of insertion of the lowest of three well-developed leaves, starting from the top of the shoot; inflorescence pedicel width; and triad pedicel width and calyculus length, as they were considered relevant after examining herbarium specimens because these characters can indirectly express the robustness of the plant, a feature which may have considerable significance. Finally, 17 characters were scored for each specimen: six vegetative and eleven reproductive characters (Table 1). Of these characters, 14 were continuous and were measured in millimeters, one was bimodal (presence/absence of a triad peduncle), and two were multistate (number of triads per inflorescence: one pair, one and two pairs, and more than two pairs; and leaf apex shape: rounded-emarginated,

Table 1. The characters and their correlation coefficient obtained from PCC analysis for each data set. Characters with correlation coefficient of more than 0.60 are **bold.**

Character Name	Abbreviation	Analysis 1 (all data set)	Analysis 2 (partial data set)	Analysis 3 (*S. syringifolius*)
Stem Width	Stem/W	0.603	0.489	0.038
Node Width	Node/W	**0.719**	0.466	0.1
Petiole Length	Petiole/L	0.698	0.582	0.138
Leaf Length	Leaf/L	**0.799**	0.510	0.042
Leaf Width	Leaf/W	**0.7**	**0.617**	0.071
Leaf Apex	Leaf/Apex	**0.831**	0.212	
Triads/Inflorescence	Inf/Tria/N	**0.823**	**0.918**	0.028
Inflorescence Peduncle Length	Inf/Ped/L	0.646	**0.636**	0.079
Inflorescence Peduncle Width	Inf/Ped/W	0.419	**0.676**	0.007
Triad Peduncle Absent/Present	Tria/Ped/A/P	**0.852**		
Triad Peduncle Length	Tria/Ped/L	**0.71**	0.314	0.144
Triad Peduncle Width	Tria/Ped/W	**0.784**	**0.647**	0.051
Central Bracteole Length	Bra/Cen/L	0.662	**0.606**	0.028
Lateral Bracteole Length	Bra/Lat/L	0.671	**0.691**	0.042
Bud Length	Bud/L	0.676	0.376	0.132
Calyx Length	Calyx/L	0.562	0.551	0.077
Fruit Length	Fruit/L	0.466	0.222	0.478

acuminate, acute to acuminate, and strongly acuminate to caudate). Rizzini (1982) consistently used the shape of the lamina to separate species, but Kazandjián (2011) found this character to be highly variable within species and between localities. Hence, it was decided to record the ratio between the length and the width of the leaf, and the results referred to a specific lamina shape based on ratios, as given by Radford et al. (1974), for the final descriptions only and not for the analyses. For each specimen, three measurements of each character were taken and the mean value calculated and used in the analyses. Characters were measured in fully expanded organs.

The data were compiled in a Microsoft Excel spreadsheet. Data were analyzed using the program PATN (Patten Package Analysis) version 3.12 (Belbin 2009a). The data matrix was built using the Gower Metric Distance method (Gower 1971), and cluster analysis was performed using a flexible UPGMA, applying the predetermined 0.1 β-value (Belbin 1995, 2009b). Multidimensional Scaling plot by Semi-Strong Hybrid Multidimensional Scaling (SSH MDS) of Belbin (1995) was carried out to compare groups identified in the cluster analyses, and a stress value was given. A Principal Components Correlation Analysis (PCC) was used to identify characters that were the most influential in separating and differentiating between groups. Correlation coefficients calculated from PCC can be used as an indicator of the significance of each character in the distribution of the specimens (Belbin 1995, 2009b). A character was considered to be influential when PCC's $r2 \geq 0.7$ in the first analysis and when PCC's $r2 \geq 0.6$ in the second and *S. syringifolius* analyses (Belbin 1991).

Three analyses were carried out to quantify the extent of taxa separation. One analysis involved the total data set, a second analysis without *S. gracilis* and *S. syringifolius*-*S. translucens*, and a third analysis with specimens of *S. syringifolius* plus *S. translucens* to test the separation between both species and also the occurrence of the two varieties, *S. syringifolius* var. *longepedunculatus* and *S. syringifolius* var. *paniculatus*. The presence of taxa, clearly distinct for a number of characters, as outlying clusters, can contract the ordination space, consequently suppressing the expression of the other less well-defined groups (Crisp & Weston 1993; Thiele & Ladiges 1994). In consequence, in the first analysis which involved 144 specimens and 17 characters with 15.76% of missing data, *S. gracilis* and *S. syringifolius*-*S. translucens* were the only two groups outlined as well-defined clusters. To maximize the expression of other clusters, the second analysis was carried out with all the remaining specimens not aligned with *S. gracilis* and *S. syringifolius*-*S. translucens* which involved 16 characters, 56 specimens, and 8.59% of missing data. The character presence of a triad peduncle had the same expression for all specimens in the second data set, therefore it was not included in the analysis. The third analysis

involved 64 specimens, 55 specimens identified as *S. syringifolius*, *S. syringifolius* type, *S. syringifolius* var. *paniculatus,* three specimens of *S. translucens*, *S translucens* type, two unidentified specimens aligned with *S. syringifolius,* and one aligned with *S. translucens* in the first analysis. This analysis consisted of 15 characters as leaf apex and presence of a triad peduncle had the same expression for all specimens and 20.83% of missing data.

RESULTS

The UPGMA-dendrogram produced by the analysis of the total data set showed three groups at the similarity level of 0.6341 (Fig. 1a). Two groups were distinct; one with all the specimens of *S. gracilis* (22), *S. gracilis* type, and *S. trujilloi* type and a second group with all the specimens of *S. syringifolius* (55), *S. syringifolius* type, *S. syringifolius* var. *paniculatus, S. translucens* (3), *S. translucens* type, and three unidentified specimens. The third group, however, was less clear and included *S. corymbifer* type, *S. dissimilis* type, *S. eichlerianus*, *S. eichlerianus* type, *S. giovannae* type, *S. pariensis, S. pariensis* type, *S. phillyreoides* (14), *S. phillyreoides* type, *S. porrectus* type, *S. terniflorus* (11), *S. terniflorus* type, *S. yavitensis* type, and 20 unidentified specimens.

The ordination analysis of the same data set showed identical clusters to those resulting from the classification analysis. Figure 1b displays the three group centroids with the character vectors plotted from the correlation coefficient analysis for axil combination 1×2 (stress = 0.0868). There were eight significant characters with $r2 \geq 0.7$: node width, leaf length, leaf width, leaf apex, number of triads per inflorescence, presence of triad peduncle, triad pedicel length, and triad pedicel width (Table 1).

To avoid the influence of the first two well-defined species (*S. gracilis* and *S. syringifolius*-*S. translucens*), a second analysis was carried out to investigate relationships in the third undefined group. The analyses involved *S. corymbifer, S. dissimilis*, *S. eichlerianus*, *S. giovannae*, *S. pariensis*, *S. phillyreoides, S. porrectus, S. terniflorus,* and *S. yavitensis* and the unidentified specimens that aligned with this group in the first analysis.

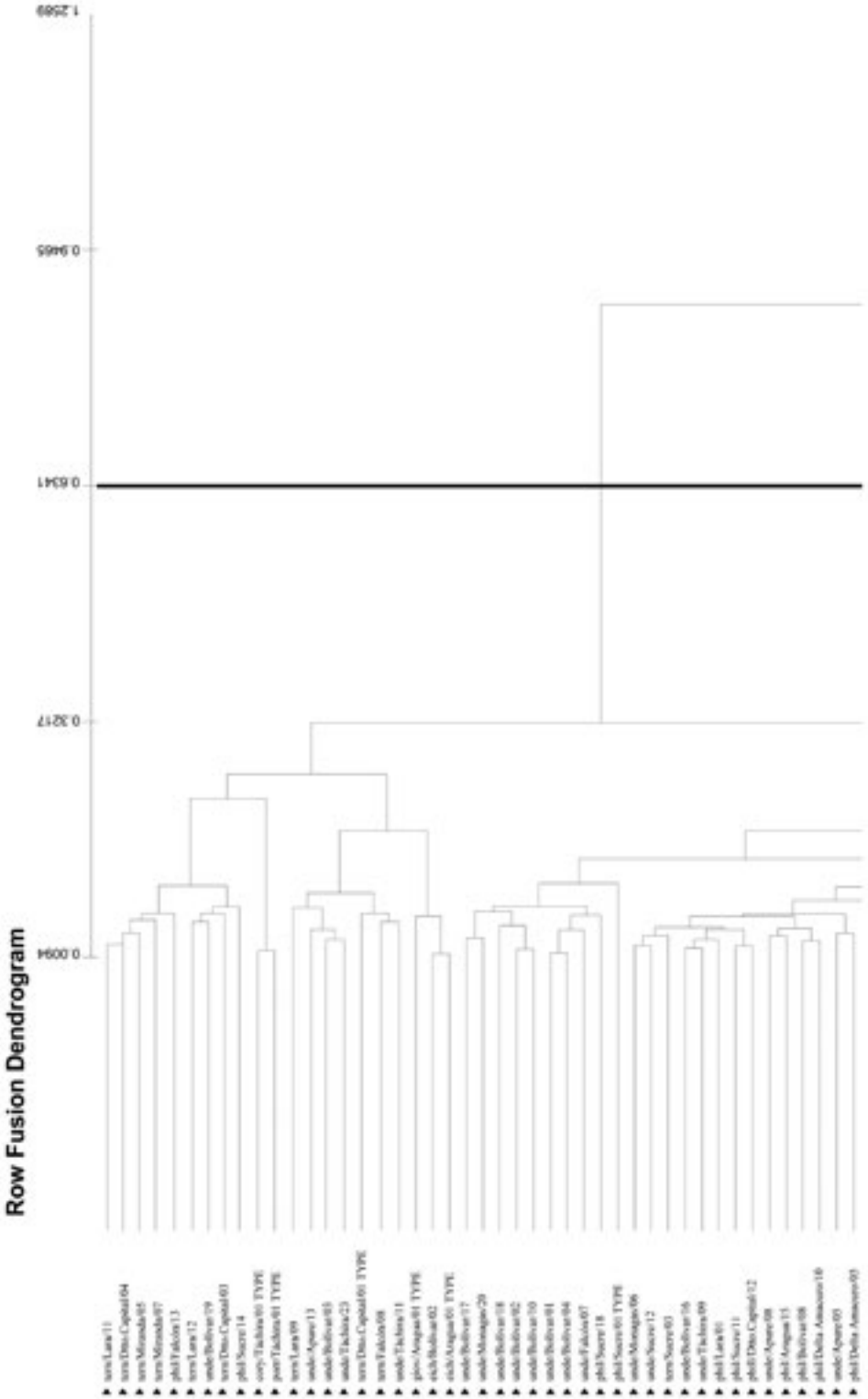
The dendrogram produced by the UPGMA showed three distinct groups at the similarity level of 0.3837—Group 1: *S. corymbifer* type and *S. porrectus* type; Group 2: *S. terniflorus* (2), *S. terniflorus* type, *S. eichlerianus* (1), *S. eichlerianus* type, *S. giovannae* type, and 4 unidentified specimens; Group 3: *S. dissimilis* type, *S. pariensis*, *S. pariensis* type, *S. terniflorus* (9), *S. phillyreoides* (14), *S. phillyreoides* type, *S. yavitensis* type, and 16 unidentified. The same three groups were generated by MDS (stress = 0.1435), and the three centroid groups and the character vectors with $r2 \geq 0.6$ from PCC are plotted in a graph with 1×2 coordinates (Fig. 2a, b). The character vectors with $r2 \geq 0.6$ were leaf width, number of triads per inflorescence, inflorescence peduncle length and width, triad peduncle width, and central and lateral bracteole length. None of the significant characters distinguished *S. corymbifer* from *S. porrectus, S. giovannae* from *S. eichlerianus, S. pariensis, S. dissimilis,* and *S. yavitensis* from *S. phillyreoides*. Specimens identified as S. *terniflorus* were scattered between group 2 and 3, although the *S. terniflorus* type was placed in Group 2.

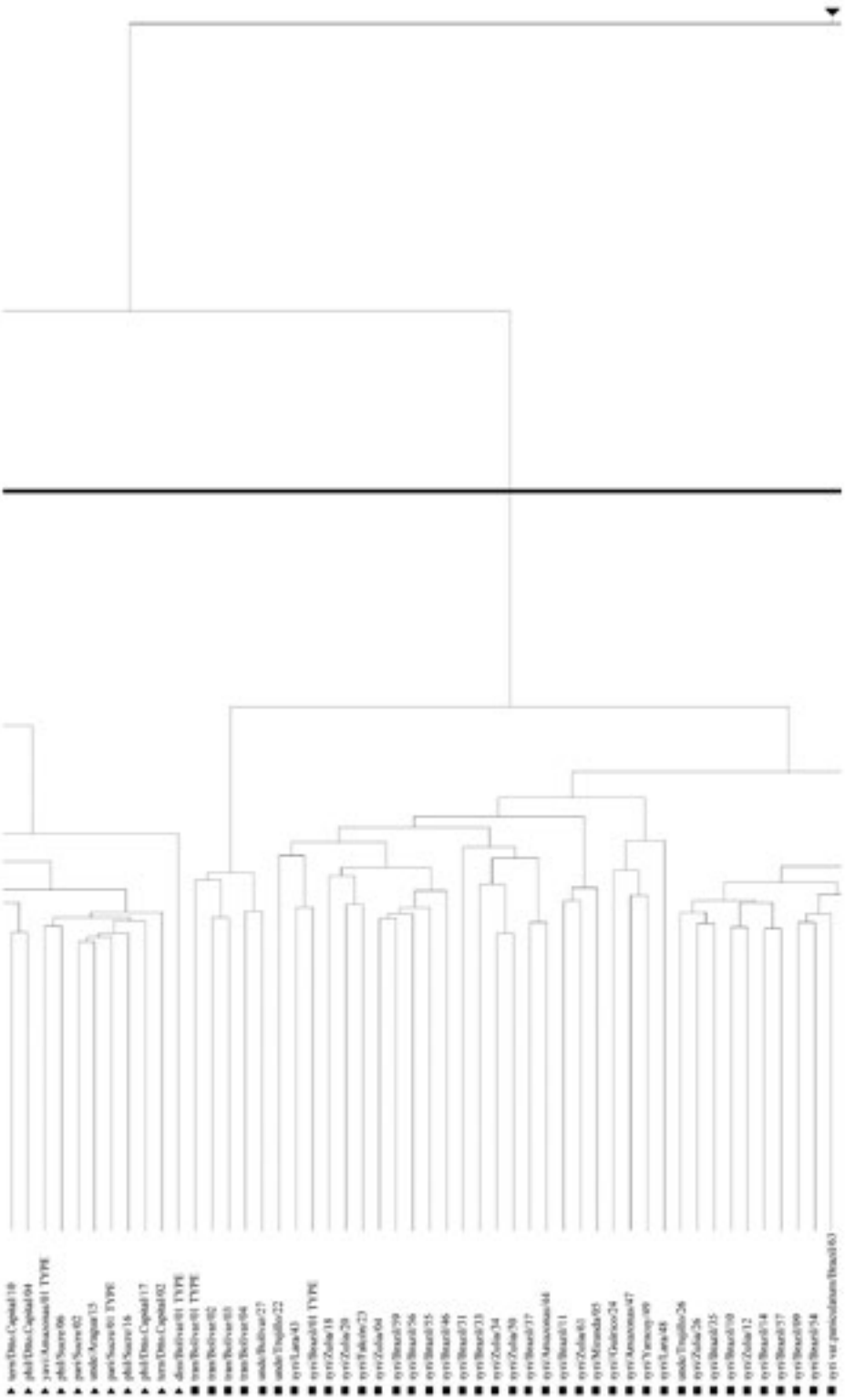
Neither *S. syringifolius* var. *paniculatus* Rizzini nor *S. translucens* were supported when specimens of *S. syringifolius* and specimens of *S. translucens* were analyzed together (results not shown here however available on request).

The classification and ordination analyses from three different data sets generated four groups that represent the following previously described species based on priority of names: *S. corymbifer*, *S. gracilis*, *S. phillyreoides*, *S. syringifolius,* and *S. terniflorus*.

Geographically, *S. corymbifer* is restricted to the western part of Venezuela (Táchira States), *S. gracilis* occurs in southern Venezuela in Amazonas and Bolívar States, but the only specimen of *S. trujilloi* was collected in the central north coast of Venezuela in Aragua State. *Struthanthus terniflorus* has a widespread distribution throughout Venezuela, and *S. phillyreoides* and *S. syringifolius* have widespread distribution in Venezuela and neighboring countries of Brazil, Guayana, and Suriname.

Based on significant characters and their real values represented by the mean and the standard deviation, the combinations of characters that define each species of *Struthanthus* recognized here are shown in Table 2.





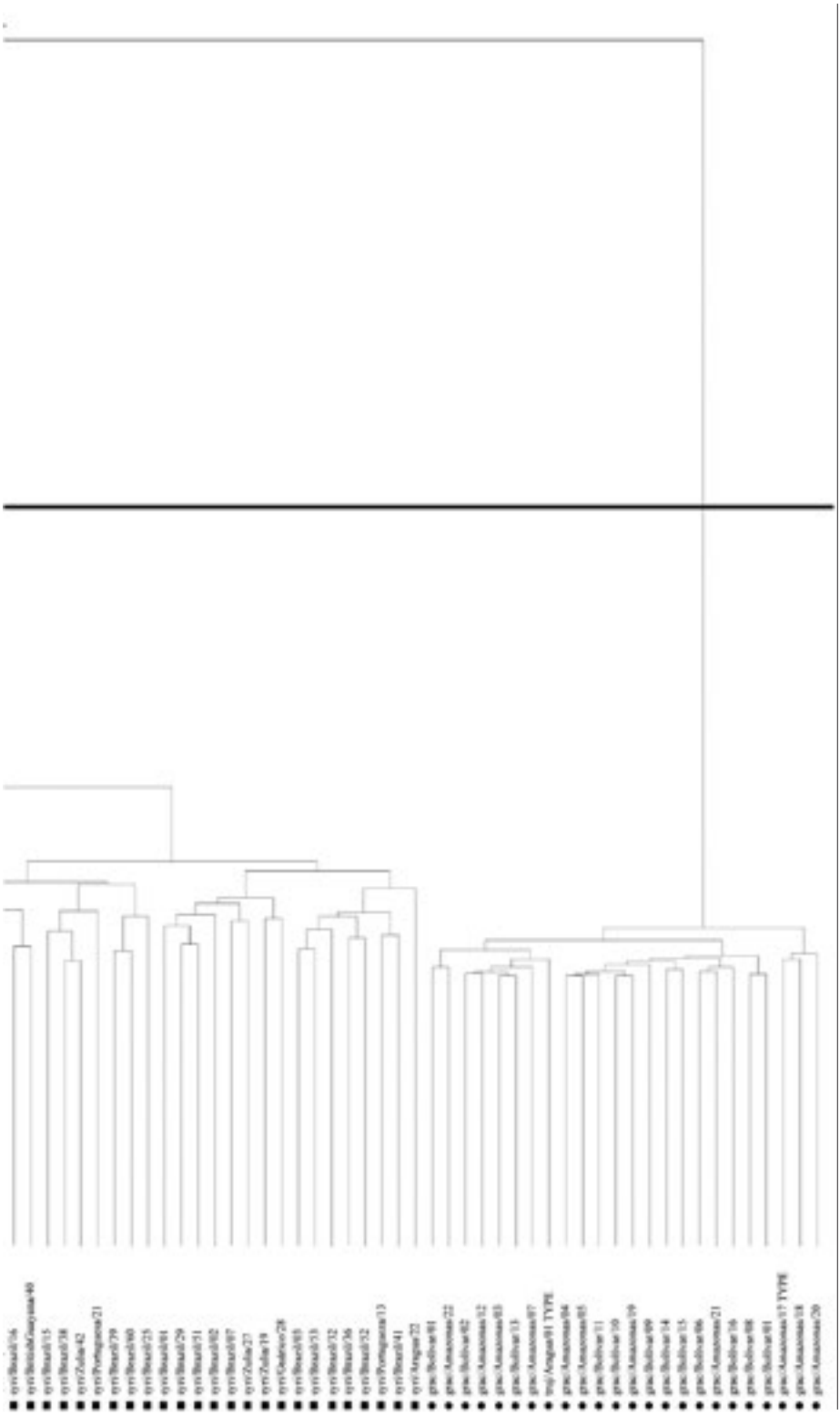


Fig. 1A. Dendrogram resulting from UPGMA classification analysis of 147 herbarium specimens and 17 characters. Group 1: ▶, Group 2: ■, Group 3: ●. Names correspond to the specimen identification: *S. corymbifer* (cory), *S. dissimilis* (diss), *S. eichlerianus* (eich), *S. giovannae* (giov), *S. gracilis* (grac), *S. pariensis* (pari), *S. phillyreoides* (phil), *S. porrectus* (porr), *S. syringifolius* (syri), *S. terniflorus* (ter), *S. translucens* (tran), *S. trujilloi* (truj), *S. yavitensis* (yavi) and unidentified specimens (unid).

Table 2. Mean (mm), standard deviation (SD), minimum (Min), and maximum (Max) values of 17 characters evaluated in 144 specimens.

	Struthanthus corymbifer				*Struthanthus gracilis*				*Struthanthus phillyreoides*				*Struthanthus syringifolius*				*Struthanthus terniflorus*			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Stem/W	5.20	0.14	5.10	5.30	1.81	0.30	1.20	2.28	1.65	0.47	1.00	3.20	4.00	1.63	1.16	8.90	1.40	0.46	0.80	2.10
Node/W	4.75	0.21	4.60	4.90	3.55	0.83	2.00	5.69	2.92	0.83	1.50	5.70	5.42	1.25	2.85	9.09	2.47	0.86	1.60	4.30
Petiole/L	6.25	1.48	5.20	7.30	7.65	1.78	3.80	10.43	5.67	2.15	2.20	11.22	14.03	4.63	5.97	26.07	5.64	2.44	2.70	8.99
Leaf/L	38.40	0.85	37.80	39.00	29.20	5.85	21.10	44.12	36.68	9.14	21.95	62.93	73.99	19.38	41.18	140.00	34.64	6.89	23.70	45.50
Leaf/W	28.15	0.21	28.00	28.30	16.75	3.52	10.20	25.40	18.09	5.65	10.24	40.30	41.22	17.35	20.16	103.00	13.18	3.67	7.70	19.80
Leaf/Shape	1.36	Widely Ovate		1.74		Obovate–Ovate			2.14	Ovate to Lanceolate			1.79	Ovate		2.64		Lanceolate		
Leaf/Apex		Acute to Acuminate				Round-Emarginated			Acuminate				Strongly Acuminate to Caudate					Strongly Acuminate		
Inf/Tria/N		More than three				More than three			One, less common two				More than three					More than three		
Inf/Ped/L	4.75	0.49	4.40	5.10	6.98	3.80	4.52	14.80	5.90	2.38	1.82	13.22	16.14	5.91	4.40	37.85	9.29	1.83	6.40	12.30
Inf/Ped/W	1.03	0.11	0.95	1.10	1.17	0.22	0.90	1.66	0.84	0.25	0.50	1.30	1.30	0.39	0.70	2.33	0.81	0.30	0.40	1.20
Tria/Ped/A/P		Present				Absent				Present				Present			Present			
Tria/Ped/L	2.30	0.14	2.20	2.40					3.25	1.01	1.10	6.10	3.32	0.94	2.10	5.80	4.00	1.83	1.90	7.50
Tria/Ped/W	0.50	0.00	0.50	0.50					0.87	0.25	0.50	1.50	0.88	0.29	0.50	1.45	0.60	0.35	0.50	1.10
Bra/Cen/L	0.70	0.00	0.70	0.70	> 0.5	0.00	> 0.5	> 0.5	1.3	0.22	0.80	2.00	1.96	0.46	1.20	2.90	1.03	0.13	0.80	1.20
Bra/Lat/L	0.60	0.00	0.60	0.60	> 0.5	0.00	> 0.5	> 0.5	1.1	0.17	0.60	1.30	1.30	0.32	0.80	2.25	0.91	0.12	0.70	1.10
Bud/L	1.75	0.07	1.70	1.80	3.36	0.70	2.43	4.69	3.56	0.62	2.60	5.50	6.87	1.44	3.49	9.85	3.42	1.23	2.10	5.20
Calyx/L	1.25	0.07	1.20	1.30	1.22	0.27	0.83	1.65	0.96	0.16	0.60	1.30	1.51	0.33	0.70	2.20	0.81	0.25	0.50	1.10
Fruit/L	No record		4.59		4.59	4.59	5.63	1.44	3.10	7.90	9.54	3.28	4.20	15.50	6.04	1.65	6.20	7.60		

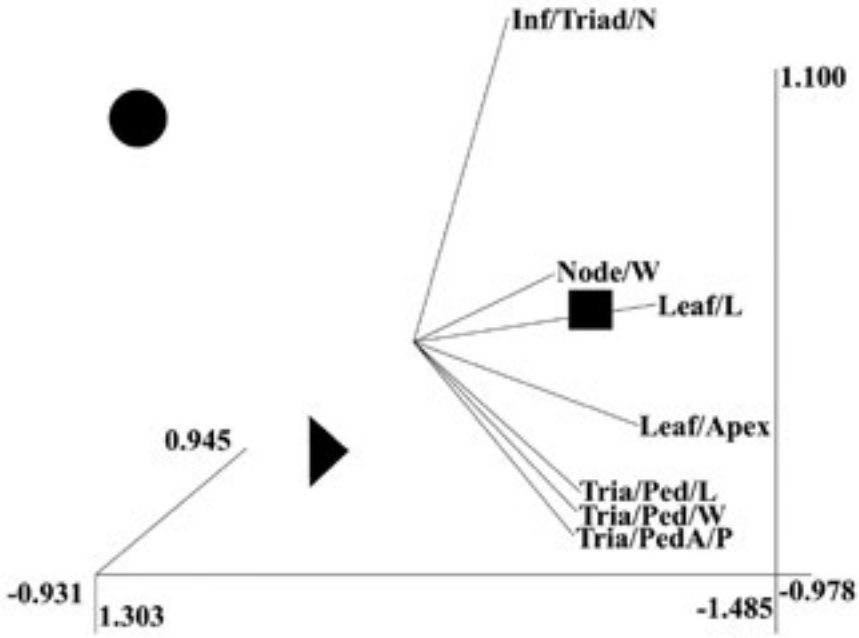


Fig. 1B. Ordination resulting from MDS analysis (axis 1 vs. axis 2). Characters with correlation coefficient more than 0.7 are plotted. Stress = 0.0868.

DISCUSSION

Classification and ordination analyses of the three data sets did not support the 12 species currently recognized by Kuijt (2008). Instead, there was a re-arrangement of the species into five phenetic groups: *S. gracilis-S. trujilloi*, *S. corymbifer-S. porrectus*, *S. eichlerianus-S. giovannae-S. terniflorus*, *S. dissimilis-S. phillyreoides-S. pariensis-S. yavitensis* and *S. syringifolius-S. translucens*. The reduction of 12 to five indicates that considerable variation in some characters occurs within and between species and that these variations may be responsible for the recognition of 14 species by Rizzini (1982) and 12 by Kuijt (2008). High morphological variation has been recognized in the Venezuelan *Struthanthus* by Kuijt (2001) and Kazandjián (2011). These results also showed that some of the characters used by Rizzini (1982) to circumscribe the species of *Struthanthus* in Venezuela have not been useful or properly deliniated for species identification.

Two major groups were shown in the UPGMA dendrogram of the all-data set, one including all the specimens whose inflorescences were racemose and a second group composed of *S. gracilis-S. trujilloi* with spikate inflorescences. *Struthanthus trujilloi* was described as having oblong leaves, an acute apex, and inflorescence peduncles 10–15 mm long. Instead, *S. gracilis* has obovate leaves, a rounded apex, and inflorescence peduncles ca. 3–5 mm long. Although Rizzini (1982) and Kuijt (2011) recognized *S. gracilis* and *S. trujilloi* as two separate species, the analysis has shown that there no support for these characters. Based on the analysis and in the species priority name, it has been confirmed that *S. gracilis* is the only species in the Venezuelan *Struthanthus* with spikate inflorescences. All the specimens identified as *S. gracilis* were collected in the southernmost part of Venezuela (Amazonas and Bolívar States) except for the only specimen of *S. trujilloi,* which was from the central north coast. More collections are needed to verify whether *S. gracilis* has a wider distribution in Venezuela.

In the group with racemose inflorescences all the specimens identified as *S. syringifolius* formed a well-defined group. *Struthanthus syringifolius* has been recognized as one of the most distinctive species within the Venezuelan *Struthanthus* (Rizzini 1982; Kuijt 2001) because of its robustness, large leaves with a strong acuminate to caudate apex, inflorescences commonly with several pairs of triads, long unequal bracteoles, and large

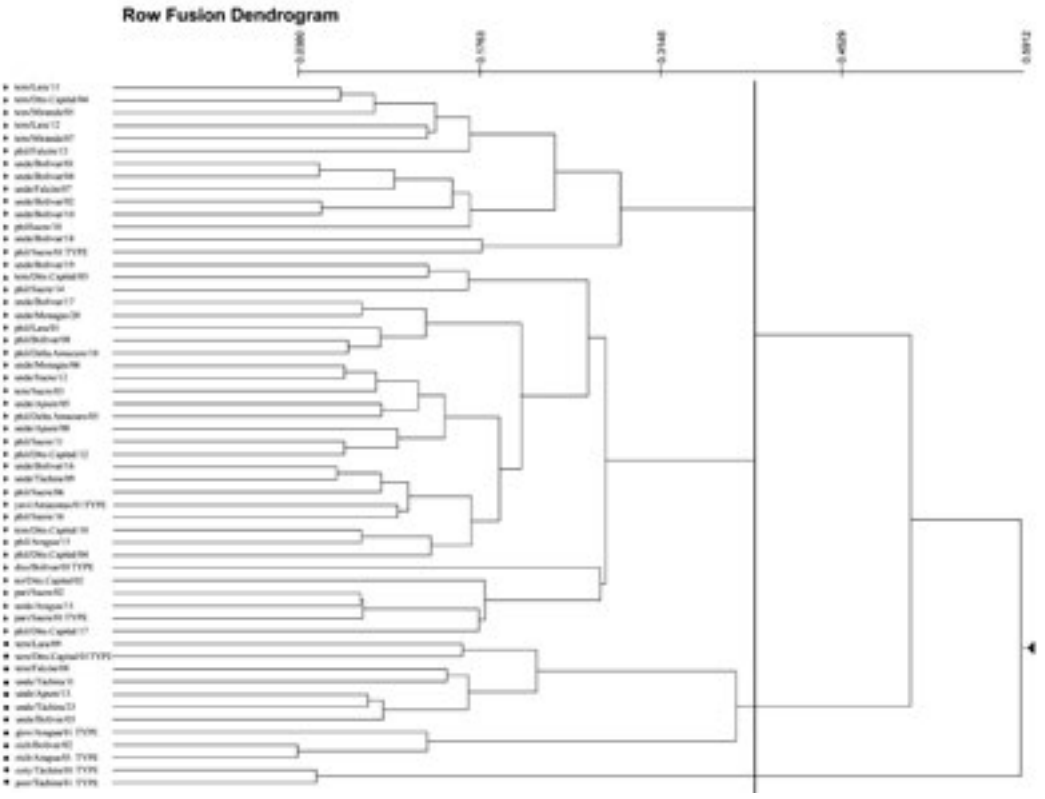


Fig. 2A. Dendrogram resulting from UPGMA classification analysis of 64 herbarium specimens and 16 characters. Group 1: ►, Group 2: ■, Group 3: ●. Names correspond to the specimen identification: *S. corymbifer* (cory), *S. dissimilis* (diss), *S. eichlerianus* (eich), *S. giovannae* (giov), *S. pariensis* (pari). *S. phillyreoides* (phil), *S. porrectus* (porr), *S. terniflorus* (ter), *S. yavitensis* (yavi), and unidentified specimens (unid).

flowers. There was no support for *S. springifolius* var *paniculatus* in the first and third analyses. Although the type specimen of *S. springifolius* var. *longepedunculata* could not be found and therefore not included in the analyses, when Eichler (1868) proposed *Loranthus longepedunculatus* Mart. as a variety, he described it as having racemes up to 75 mm long, inflorescence peduncles up to 50 mm long, and triad peduncles up to 15 mm long. However, none of the specimens of *S. syringifolius* measured had inflorescence peduncles more than 37 mm long, and the longest triad peduncle measured was 5.8 mm long. Similarly, the analysis which involved all the specimens of *S. syringifolius* did not support *S. syringifolius* var. *paniculatus* Rizzini as this specimen did not show any particular grouping by any inflorescence character. *Struthanthus syringifolius* occurs in Venezuela and surrounding countries such as Brazil, Guyana, and Suriname, but is particularly common in southern Venezuela and Brazil.

For UPGMA in the first analysis, *S. translucens* clustered with *S. syringifolius*. Characters used by Rizzini (1982) to describe *S. translucens* overlap with key characters of *S. syringifolius* such as leaf petiole 15 mm long, leaves 40–80 mm long, solitary racemes, long subequal bracteoles ca. 1–2 mm long, and flowers and fruits 5 and 10 mm long, respectively. However, *S. translucens* differs from *S. syringifolius*, which has 3–8 pairs of triads per inflorescence, by having no more than two pairs (Rizzini 1982), a character that is shared with some specimens identified as *S. dissimilis*, *S. pariensis*, *S. phillyreoides*, and *S. yavitensis*. Kuijt (2001) suggested *S. translucens* to be synonymous of *S. dichotrianthus*, perhaps because the inflorescences with one pair of triads. In the third analysis, there was no separation between *S. syringifolius* and *S. translucens*. Based on this result, the close

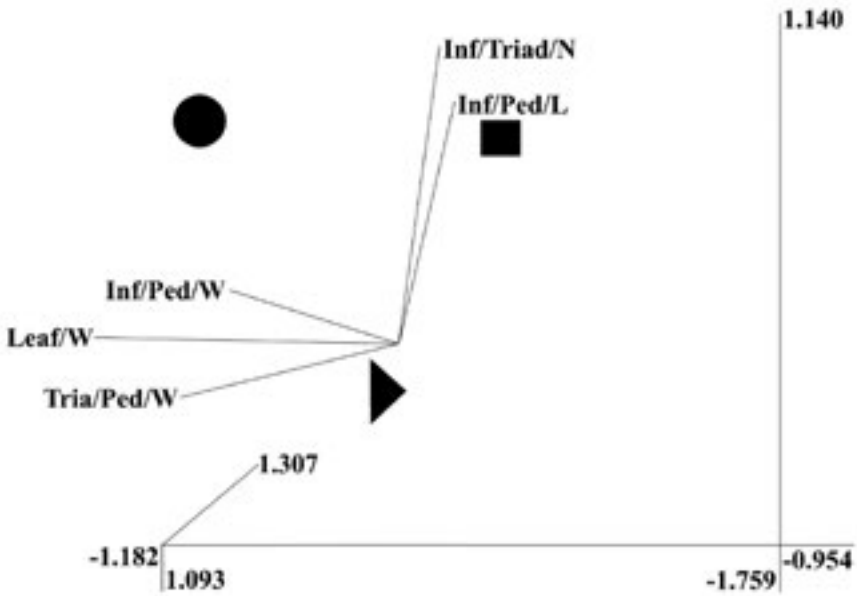


Fig. 2B. Ordination resulting from MDS analysis (axis 1 vs. axis 2). Characters with correlation coefficient more than 0.6 are plotted. Stress = 0.1436.

resemblance between *S. syringifolius* and *S. translucens,* and since all specimens of *S. translucens* were collected in La Gran Sabana National Park in Bolívar State where *S. syringifolius* is common, it is suggested that specimens with 1–2 pairs of triads per inflorescence represent a local variation within *S. syringifolius*.

In the second analysis there were three distinct groups. One formed with 44 specimens grouping *S. dissimilis* type, *S. phillyreoides* type, *S. pariensis* type, five specimens identified as *S. terniflorus,* and *S. yavitensis* type plus 16 unidentified. The second group was formed by *S. eichlerianus* type, *S. giovannae* type, *S. terniflorus* type, and four unidentified, and the third group was the combination of *S. corymbifer* and *S. porrectus*.

Rizzini (1982) stated that *S. yavitensis* had a close resemblance with *S. dissimilis* because the small flowers ca. 2.5–3 mm long, oblong leaves, and inflorescences with two pairs of triads, but both differ because *S. yavitensis* has leaves 30–50 mm long with an acute apex and *S. dissimilis* has leaves 25–45 mm long with a round apex. Kuijt (2001) regarded *S. dissimilis* and *S. yavitensis* as synonymous with *S. dichotrianthus*. Rizzini (1985) mentioned in the description of *S. pariensis* the close resemblance of this species with *S. dichotrianthus* mainly in reproductive characters, but they differ because *S. pariensis* had oblong leaves with acute to slightly acuminate apex and *S. dichotrianthus* had leaves oblong-lanceolate and acute apex. Nine specimens identified as *S. terniflorus* also clustered within this group. Those specimens have in common inflorescences with one and two pair of triads. This result may suggested a misinterpretation when identifying *S. terniflorus* because its description mentions 2–5 pair of triads per inflorescence, and none of the specimens identified as *S. terniflorus* clustered here show more than two pairs. Also leaf shape and apex of those specimens identified as *S. terniflorus* do not resemble the *S. terniflorus* type. Kuijt (2001) placed *S. terniflorus* as a synonym of *S. dichotrianthus*, perhaps for those specimens with one or two pair of triads. Most of the unidentified specimens also clustered within this group as they have similar vegetative and reproductive characters, but most important, they share inflorescences with only one or two pair of triads. Because none of the characters measured were able to separate these four species and the synonymy of *S. dichotrianthus* to *S. phillyreoides* (Kazandjián 2011), this group should be known as *S. phillyreoides*. The wide geographical distribution of all the specimens confirmed the widespread distribution of *S. phillyreoides* throughout Venezuela, but it also has been collected in Guyana, Suriname, and Trinidad (Kazandjián 2011).

From descriptions presented by Rizzini (1976a, 1982), *S. eichlerianus* and *S. giovannae* shared racemes longer than the subtending leaf with numerous pair of triads and small flowers up to 2 mm long. However, they differ because *S. giovannae* has ovate leaves ca. 15–25 mm long and 10–15 mm wide and an acuminate apex. *Struthanthus eichlerianus,* instead, has oblong to lanceolate leaves ca. 30–60 mm long and 10–25 mm wide with a strong acute apex. Together with these two species also clustered two specimens identified as *S. terniflorus, S. terniflorus* type, and four unidentified. The description and the type of *S. terniflorus* show that the number of triads per inflorescence varies from two to five. Rizzini (1982) also mentioned that *S. eichlerianus* differed from *S. terniflorus* because the former has longer inflorescences and smaller flowers. None of the characters analyzed here separated these three species. Nevertheless, these species cluster together as they all share inflorescences with more than two triads and up to seven. Based on this analysis, these three species could represent the same entity with the prior name of *S. terniflorus,* as now circumscribed is widespread in Venezuela.

Rizzini (1975, 1982) described *S. corymbifer* as having dilated nodes, oblong leaves, slightly acuminate apex, 2–4 pairs of triads per inflorescence, and flowers ca. 3–4 mm long. In contrast, *S. porrectus* (Rizzini 1976b, 1982) has non-dilated nodes, oblong leaves, strongly acuminate apex, 3–4 pairs of triads per inflorescence, and flowers 5 mm long. However, none of these characters could be used to separate both species. The type of *S. corymbifer* and one specimen identified as *S. porrectus* (specimen mentioned by Rizzini (1982) but not found for this revision) were collected in a cloud forest of the Páramo Tamá in Táchira State, western Venezuela, close to Colombia. The type of *S. porrectus* was collected in Paraguariba Mountain in La Sierra de San Luis, located towards the north-west area of Venezuela. It is possible that this species has a local distribution around the west part of Venezuela, but more collections are needed to clarify how restricted the distribution could be.

Within those species with racemose inflorescences, *S. martianus* can be distinguished from the five groups recognized here because it is the only species with several inflorescences per leaf axil and pedunculated flowers. *Struthanthus martianus* has a wide distribution in the south of Venezuela and throughout Brazil.

Some vegetative and reproductive characters were variable between and within each group. However, the use of numerical techniques to resolve morphological variation is a useful tool that can evaluate these variations circumscribing characters that help taxonomy to define taxa based on morphology. Consequently, the multivariate analyses presented here recognized five discrete groups that are suggested are the species of *Struthanthus* found in Venezuela*: S. corymbifer, S gracilis, S. phillyreoides, S. syringifolius, S. terniflorus,* and the taxonomically discrete *S. martianus* (Dettke & Waechter 2012).

KEY TO THE SPECIES OF *STRUTHANTHUS* IN VENEZUELA

1. Inflorescences arranged in spikes (triads sessile) ____ **Struthanthus gracilis**
1. Inflorescences arranged in racemes (triads pedunculated).
  2. Flowers pedicellate; numerous inflorescences per leaf axil ____ **Struthanthus martianus**
  2. Flowers sessile; generally one inflorescence per leaf axil.
    3. Inflorescence with one or rarely two pairs of triads; leaves ovate to lanceolate, (22–)28–45(–65) mm long and 11–24 mm wide; apex acuminate ____ **Struthanthus phillyreoides**
    3. Inflorescence with more than 3 and up to 8 pairs of triads.
      4. Flower buds ca. 2 mm long; leaf widely ovate, 36–38 mm long and ca. 28 mm wide; apex acute to acuminate; restricted to western Venezuela ____ **Struthanthus corymbifer**
      4. Flower buds more than 2 mm long; distributed throughout Venezuela.
        5. Leaves ovate, ca. 60–100(–140) mm long and 23–60 mm wide; apex strongly acuminate to caudate; flower buds ca. 7 mm long ____ **Struthanthus syringifolius**
        5. Leaf lanceolate, ca. 28–40 mm long and 10–18 mm wide; apex strongly acuminate; flower buds ca. 3.5 mm long ____ **Struthanthus terniflorus**

SPECIES DESCRIPTIONS

Struthanthus corymbifer Rizzini, Revista Fac. Agron. Maracay 8(3):96. 1975. TYPE: VENEZUELA. TÁCHIRA: selva nublada húmeda, faldas debajo del Páramo de Tamá, arriba de Betania y Tamá, 22–24 Mayo 1967, *Steyermark & Dunsterville 98655* (HOLOTYPE: RB).

Struthanthus porrectus Rizzini, Rodriguésia 41:14. 1976b, **syn. nov.** (type not seen).

Robust plant. Stem width in young stems ca. 5 mm; internode length 28–36 mm; node width ca. 5 mm. Petiole ca. 5–7 mm long. Leaves: l/b ratio 1.36, lamina ovate to wide ovate, ca. 38 mm long and ca. 28 mm wide; base cuneate; apex acute to acuminate. Inflorescence racemes, one per leaf axil; inflorescence peduncle 4–5 mm long and ca. 1 mm wide; 4–6 pairs of triads per inflorescence. Triad peduncle 2–2.5 mm long and ca. 0.5 mm wide. Bracteoles small, triangular, slightly unequal; central bracteole length ca. 0.7 mm, lateral bracteoles slightly smaller. Floral buds length up to 2 mm; flower length 2.5 mm; calyx length ca. 1.2 mm. Fruit unknown. Distribution: In Venezuela: Falcón and Táchira states.

Specimens examined.—**Táchira State:** selva nublada, falda debajo del Páramo de Tamá, cerca de la frontera Colombo-Venezolana, arriba de Betania y Tamá, cerca de la Quebrada Buena Vista, 22–24 May 1967, *Steyermark & Dunsterville 98655* (VEN, isotype of *S. corymbifer*); same locale, 22–24 May 1967, *Steyermark & Dunsterville 98671* (VEN).

Struthanthus gracilis (Gleason) Steyerm. & Maguire, Mem. New York Bot. Gard. 17(1):443. 1967.

Phthirusa guyanensis Eichler, Flora Brasiliensis 5(2):64. 1868.
Phthirusa gracilis Gleason, Bull. Torrey Bot. Club 58:359. 1931.
Struthanthus mucronatus Steyerm., Bol. Soc. Venez. Ci. Nat. 26:418. 1966.
Struthanthus gracilis var. *mucronatus* (Steyerm.) Rizzini, Fl. Venez. 4(2):17. 1982.
Struthanthus chimantensis Steyerm. & Maguire, Mem. New York Bot. Gard. 17(1):443. 1967.
Struthanthus cupulifer Rizzini, Bol. Soc. Venez. Ci. Nat. 32:327. 1976
Struthanthus trujilloi G. Ferrari ex Rizzini, Fl. Venez. 4(2):21. 1982, **syn. nov.**

Slender plant. Stem width in young stems (1.2–)1.8(–2.3) mm; internode length (37–)63(–88) mm; node width 3.5(–5.5) mm. Petiole (4–)7(–10) mm long. Leaves: l/b ratio 1.74, lamina ovate or obovate, (21–)29(–44) mm long and (10–)16(–25) mm wide; base slightly acute; apex variable sometimes round or emarginated with or without a mucro. Inflorescence spikes, one per leaf axil, often longer than the subtending leaf when fully expanded; inflorescence peduncle 4–14 mm long and ca. 1.2 mm wide, 4 and up to 6 pairs of triads per inflorescence. Bracteoles very small, deltoid; central bracteole and lateral bracteoles length less than 0.5 mm. Floral buds length (2.4–)3.5(–4.6) mm; flower length ca. 4 mm; calyx length ca. 1.2 mm. Fruit length 4.5 mm. Distribution. In Venezuela: South, Amazonas and Bolívar states, Central North Coast, Aragua State.

Specimens examined.—**Amazonas State:** forested slopes along trial between camp 2 and camp 3, northwestern part of Abácapa-tepui, 5 Apr 1953, *Steyermark 74816* (VEN, holotype of *S. chimantensis*); cerro La Neblina, río Yatua, 8–9 Dec 1957, *Maguire et al. 42324* (VEN); alrededores de la laguna Asisa, cerro Asisa (la Momia), serranía Parú, 7 Jul 1973, *Hoyos & Morillo 89* (VEN); Neblina base camp on S side of río Baria (=Rio Mawarinuma) SW side of cerro de la Neblina, 28 Jan 1985, *Nee 30583* (VEN); Dept. Atabapo, slope of cerro Marahuaca, steep irregular slope between río Yameduaka arriba and base of cliff, 20 Feb 1985, *Liesner 17757* (VEN); Dept. Atabapo Cerro Arahuaca, riverine forest upstream from sima camp, along branch de Caño Negro, south-central portion of meseta, 24 Feb 1985, *Steyermark & Holst 130640* (VEN); same locale, 1 March 1985, *Steyermark & Holst 130486* (VEN); Dpto. Atures, valley of río Coro-Coro, west of Serranía de Yutajé, 1 Mar 1987, *Holst & Liesner 3231* (VEN); Dpto. Atures, vegetación de laja, en el transecto desde orillas del río Sipapo hasta la cumbre del cerro pelota, aguas debajo de la boca del río Autana, 1 Mar 1987, *Liesner & Holst 21529* (VEN); Río Negro, Cerro Aracamuni parte norte, 18 Oct 1987, *Delascio 13453* (VEN). **Aragua State:** Alto de Choroní, 1600 msnm, 16 Abr 1967, *Trujillo 7667* (MY, holotype of *S. trujilloi*). **Bolívar State:** cumbre de la parte norte de la sección sur (división occidental del cerro) a lo largo del río Churún, vecindad del campamento sur, sureste del "second wall", 3 May 1964, *Steyermark 93282* (VEN); meseta de Jaua, Cerro Jaua, cumbre de la porción central occidental de la meseta 60 Km al noroeste de la misión del campamento sanidad de río Kanarakuni, 27 Mar 1967, *Steyermark 97860* (VEN); selva húmeda de los árboles con promedio de 25–30 m de alto, en el drenaje del río Cuyuní, a lo largo del río Anawaray-parú, vecindades del Km 134 y campamento 134 al sur de El Dorado, 25 Dec 1970, *Steyermark et al. 104465* (VEN); meseta de Jaua, cerro Sarisariñama, porción noreste quebrada baja en selva más alta de promedio 15–20 m de altura, 18 Feb 1974, *Steyermark et al. 109192* (VEN); meseta de Jaua cerro Jaua, cumbre, porción sur oeste entre la sabana y el salto arriba del campamento, al este del tributario del río Marajano, 26 Feb 1974, *Steyermark et al. 109557* (VEN); meseta del Jaua Cerro Jaua, porción suroeste, este del campamento, selva de árboles promedio 20–25 m de alto, este del tributario del río Marajano, 1 Mar 1974, *Steyermark et al. 109825* (VEN); selva enana de la altiplanicie del suelo arenizca-blanco Formación Roraima, en el drenaje del río Cuyuní Km 130–131 al sur de El Dorado, 19–26 Dec 1976, *Steyermark & Dunsterville 104071* (VEN); campamento Parupa CVG Gran Sabana, cerca del río Parupa, 9 Sep 1983, *Morrillo et al. 9414* (VEN); Dtto. Piar, Camarcaibarai-tepui W slope shoulder eastern most tepui of Aparamen-tepui, 23 May 1986, *Holst et al. 2876* (VEN); Municipio Raúl Leoni, vertiente sur de la Cima de Arenizca-tepui, Sep 1986, *Fernández* 3563 (VEN); Dtto. Piar, Auyantepui, summit, in south central region, headwaters of río Churún, 29 Mar 1987, *Holst* 3757 (VEN); s.l., s.d., *Medina* 432 (VEN).

Struthanthus martianus Dettke & Waechter, Phytotaxa 57:7. 2012.

Leafy robust plant. Stem width in young stems ca. 3.5 mm; internode length 24 mm; node width ca. 6 mm. Petiole length 8(–14) mm. Leaves: 1/b ratio 2.2, lamina ovate to lanceolate, (48–)61(–94) mm long and (23–)33(–52) mm wide; base round; apex apiculate to strongly apiculate. Inflorescence racemes, 3–4 per leaf axil; inflorescence peduncle 6–9 mm long and ca. 0.5 mm wide; one pair of triad per inflorescence. Triad peduncle 1(–2) mm long and ca. 0.5 mm wide. Bracteoles bristly, minute, less than 0.5 mm long. Flower pedicel ca. 2 mm long. Floral buds length 3–4 mm; calyx length ca. 0.5 mm. Fruit length 7–8 mm. Distribution: Brazil and Venezuela. In Venezuela: South, Bolívar and Amazonas states.

Struthanthus phillyreoides (Kunth) Blume, Syst. Veg. 7(2):1731, 1830.

Loranthus phillyreoides Kunth, Nov. Gen. Sp. 3:493. 1818.
Struthanthus dichotrianthus Eichler in Martius, Fl. Bras. 5(2):75. 1868.
Struthanthus dichotrianthus var. *lasserianus* Rizzini, Rev. Bras. Biol. 10(4):408. 1950.
Struthanthus granulatus Rizzini, Revista Fac. Agron. Maracay 8(3):1975.
Struthanthus dissimilis Rizzini, Rodriguésia 41:14. 1976b.
Struthanthus yavitensis Rizzini, Rodriguésia 41:28. 1976.
Struthanthus pariensis Rizzini, Ernstia 32:12. 1985, **syn. nov.**

Stem width in young stems 1–3 mm; internode length 20–45(–60) mm; node width (1.5–)3(–5.7) mm. Petiole ca. 6(–11) mm long. Leaves: 1/b radio 2.14, lamina ovate to lanceolate, (20–)36(–63) mm long and (10–)18(–42) mm wide; base mostly rounded but sometimes acute; apex mostly acuminate. Inflorescence racemes, mostly 1 per leaf axil but sometimes more than two; peduncle 2–6(–13) mm long and ca. 1 mm wide; mostly one pair of triads per inflorescence but in some plants racemes can be also of 2 pairs. Triad peduncle 1–6 mm long and ca. less than 1 mm wide. Bracteoles narrowly triangular, unequal; central bracteole length <0.5–2 mm, lateral bracteoles length 1–1.3 mm. Flower buds (2.5–)3.5(–5.5) mm long; calyx 0.5–1.3 mm long. Fruit length (3–)5.5(–10.5) mm. Distribution: Brazil, Guyana, Trinidad, Suriname and Venezuela. In Venezuela: Widespread, Apure, Aragua, Anzoátegui, Bolívar, Delta Amacuro, Distrito Capital, Falcón, Guárico, Lara, Miranda, Monagas, Portuguesa, Sucre, and Zulia states.

Specimens examined.—**Estado Amazonas:** Dpto. Casiquiare, alrededores de Yavitá (río Temi) y cerca de la carretera Yavitá Pichincha, hasta el Km 5 hacia Pichincha, 6–19 Jul 1969, *Bunting et al. 3707* (VEN, isotype of *S. yavitensis*). **Estado Apure:** Dtto. San Fernando, south bank of Río Apurito, ca. 11 Km W of Monagas Coveras in a straight line, 23 Apr 1977, *Davidse & González 12073* (VEN); Dtto. Pedro Camejo ox-bow lake ca. 1 Km SE of Yaruro, 97 airline Km W of Puerto Páez, 28 Feb 1979, *Davidse & González 15895* (VEN). **Estado Aragua:** cerca de los límites con el Dtto. Federal, Pico Codazzi, faldas que miran al sureste, 3 Dec 1977, *Steyermark et al. 115424* (VEN). **Estado Bolívar:** cabeceras de río Paragua (Aguapira), Sierra de Pakaraime, a lo largo de la frontera, 4–8 May 1973, *Steyermark 107215* (VEN, isotype of *S. dissimilis*); Dtto. Piar, La Camilera 40 Km al Oeste de El Manteco, Jul 1978, *Delascio & Leisner 7111* (VEN); 20–25 Km southwest of Manteco on road to San Pedro de las Dos Bocas, 1–3 Aug 1978, *Liesner & González 5982* (VEN); 210 Km S de El Dorado 300 m del Río Yuruaní, 15 Feb 1980, *Morillo 8180* (VEN); Dtto. Heres, Río Carapo, 20–23 Feb 1990, *Delascio & Ortiz 14283* (VEN); Gran Sabana, carretera Luepa-Kavanayen desvío Riwariwo, Parque Nacional Canaima, 22 Nov 1993, *Ramírez et al. 4640* (VEN); Municipio Caroní, cerca de las antiguas misiones, vía Pao, 1 Aug 1994, *Díaz* 2565 (VEN); Municipio Gran Sabana, alrededores del salto sobre el río Yuruaní (en las cercanías del puente sobre el mismo nombre), 11 May 1995, *Benítez de Rojas & D'Arcy 5246* (VEN); Municipio Gran Sabana, Parupa, 5–7 May 1996, *Díaz et al. 2726* (VEN). **Delta Amacuro:** bosque pluvial, este de río Grande 33 Km este noreste El Palmar, cerca de los límites del Estado Bolívar, 7 Feb 1964, *Steyermark* 93068 (VEN); Dtto. Tucupita, along road between Tucupita and the airport along caño Manamorocoa to San Rafael, 23 Oct 1977, *Steryermark et al. 115222* (VEN). **Distrito Federal:** Galipán, cerca de Caracas, 25 Oct 1921, *Pittier 791* (VEN); bosque carretera Caracas-El Junquito, 13 Jul 1952, *Ramia 731* (VEN); cruce del arco de La Colonia Tovar hacia la Hacienda El Limón, Sep 1975, *Benítez de Rojas 1995* (MY); Parque Nacional El Ávila cerca de Las Palmas, entre Los Venados y Fila del Ávila, 22 Dec 1975, *Aristiguieta & Huber 317* (VEN); Parque Nacional El Ávila entre el Teleférico y Papelón, 30 Jun 1977, *Manara s.n.* (VEN); Cordillera de la Costa, Cerro El Ávila, vertiente sur cerca de la pica "Los Pinabetes", 9 Nov 1991, *Meier 728* (VEN); Cerro El Ávila, vertiente sur, selva nublada al este de la línea del teleférico en quebrada, 18 Sep 1992, *Meier 2799* (VEN); Parque Nacional El Ávila, vertiente sur, pica Los Pinabetes arriba de los Venados, 30 Jan 1993, *Meier 3322* (VEN); selva nublada a lo largo del camino entre "Portachelo" y la "Peñita" en las cabeceras del río Chichiriviche entre Geramba y hacienda El Limón, 8–10 Km debajo de Geramba, 12 Feb 1996, *Steyermark 94743* (RB). **Estado Falcón:** entre Churuguara y Mario Díaz, 28 Aug 1952, *Lasser & Foldast 3143* (VEN); 22 Km SSE of Puerto Cumarebo, 0 to 6 Km north and 0 to 6 Km west of Pueblo Zarárida, 9 Aug 1978, *Leisner & González 6022* (VEN). **Estado Lara:** a orillas del río Turbio cerca de Barquisimeto, Sep 1923, *Saer 51* (VEN); Dtto. Morán, selva nublada y quebradas con riachuelos tributarios del Río Tucuyo, 15–18 Km al sur de Humocaro Alto hacia Guaitó, 1 Jun 1974, *Steyermark & Nehlin 109973* (RB); 21.5 Km al sur de Humocaro Alto hacia Guaitó, 13 Oct 1974, *Steyermark & Carreño 111087* (VEN).

Estado Miranda: carretera hacia Laguneta, Los Teques, 9 Jan 1972, *Montes 388* (VEN). **Estado Monagas:** moist open area of floodplains of Río Guarapiche, 2 Km SSW of Jusepín, 22 Feb 1967, *Pursell at al. 8124* (VEN); 94 Km S of Maturín on road to Ciudad Guayana, 19 Mar 1974, *Gentry 10761* (VEN); bushy areas and cut-ones forest on flat llanos, 1–2 Km S of La Pica, along road to Laguna Grande, 12 Km ENE of Maturín, 13 Aug 1979, *Nee 17467* (VEN). **Estado Sucre:** Cumana, s.d., *Humboldt* 64 (MO, isotype of *L. phillyreoides*?)**;** Península de Paria, Ensenada de Patao, este de Puerto Hierro, este de la boca del río Patao orillas del lago de Agua Salada, 24 Jul 1962, *Steyermark & Agostini 91291* (VEN); Península de Paria, cerro Patao, norte de Puerto de Hierro, noreste de Güiria, 25–26 Jul 1962, *Steyermark & Agostini 91354* (VEN); Península de Paria laderas de selvas siempreverdes a lo largo de la quebrada Nivardo afluente del río Caverna afluente del río Oscuro, arriba del Mundonuevo oeste del cerro de Humo, 7 Aug 1966, *Steyermark & Rabe 96099* (VEN); Península de Manare, quebrada de Manare hacia playa Garrapata al sur de Manaroa entre Punta Garrapata y Punta Aguirre, 11 Sep 1973, *Steyermark et al. 108027* (VEN); Península de Paria, cloud forest tributary headwaters of río Cumaná southwest of cerro El Humo, vecinity of Manacal, 15 Km (by air) northwest of Irapa, 20 Nov 1979, *Steyermark & Liesner 120626* (VEN, holotype of *S. pariensis*); Dtto. Cagigal (near border of Dtto. Arismendi), Península de Paria, cloud forest of uppermost slopes tributary to head waters of río Cumaná between El Paujil and El Brasil, 21 Feb 1980, *Steyermark et al. 121440* (VEN); Península de Araya, Dtto. Sucre del Estado Sucre, entre Manicuare y Tacarigua, 30 Jan 1981, *Benitez de Rojas 2936* (VEN); La Llanada, Cumaná, 25 Feb 1983, *Cumaná 1320* (CUM); Península de Paria, 3 Sep 1984, *Milliken et al. 93* (VEN). **Estado Táchira:** Dtto. Lobatera, La Cazadora collect along creek in dry scrub, 24 Jul 1983, *van der Werff & Ortiz 5597* (VEN).

Struthanthus syringifolius Mart. in Martius, Fl. Bras. 5(2):105. 1868.

Loranthus syringifolius Mart., Syst. Veg. 7(1):142. 1829
Loranthus longepedunculatus Mart., Syst. Veg. 7(1):142. 1829
Struthanthus syringifolius var. *longepedunculatus* Mart. in Martius, Fl. Bras. 5(2):79. 1868, **syn. nov.**
Struthanthus syringifolius var. *paniculatus* Rizzini Revista Brasil. Bio. 10(4):408. 1950, **syn. nov.** (type not seen)
Phthirusa ptariana Steyerm. Fieldiana, Bot. 28:224. 1957.
Phthirusa hippocrateoides Steyerm. & Maguire, Mem. New York Bot. Gard. 17:442. 1967.
Struthanthus translucens Rizzini, Fl. Venez. 4(2):30. 1982, **syn. nov.**

Robust plant. Stem width in young stems (1.2–)4(–8.9) mm; internode length (14–)52(–109) mm; node length (3–)5.5(–9) mm. Petiole (6–)14(–26) mm long. Leaves: l/b ratio 1.79, lamina variable in shape but mostly ovate, (40–)74(–140) mm long and (20–)40(–103) mm wide; base rounded to acute; apex strongly acuminate to caudate, the apex variable in length (3–)8(–12) mm. Inflorescence racemes, one per leaf axil, regularly longer that the subtending leaf when fully expanded but varies depending on the number of pairs of triads; inflorescence peduncle (4.5–)16(–38) mm long and 1.3(–2.3) mm wide; occasionally 2 but usually 4 and up to 8 pairs of triads per inflorescence. Triad peduncle 2–6 mm long and 0.5–1.5 mm wide. Bracteoles very unequal; central bracteole triangular-linear, 1–3 mm long, lateral bracteoles triangular-linear, 1–2 mm long. Floral buds length (3.5–)7(–9.8) mm; flowers variable in length when fully 5 to 10 mm long; calyx length (0.7–)1.5(–2) mm. Fruit length (4–)10(–15) mm. Distribution: Suriname, Guyana, Brazil and Venezuela. In Venezuela: Widespread, Amazonas, Aragua, Barinas, Bolívar, Falcón, Guárico, Lara, Miranda, Portuguesa, and Zulia states.

Specimens examined.—**BRAZIL:** In Sylvis ad Manaqueri et Barra de R.N. Provinciae R.N., Brazil, s.d., *Martius* s.n (M, holotype of *Loranthus syringifolius*); Minas de Gerais, 1838, *Claussen 251* (P); environs de Rio de Janeiro, 1843, *Weddel 265* (P); Brazilia, Sello, 1875, *Reeu s.n.* (P); Alto Mahé, 1890, *Glaziou 18211* (P); Alto Mahé, Rio de Jau, 2 Nov 1890, *Glaziou 18271* (P); de d'Alagoas, s.d., *Gardner 1327* (P); Providence de Alagoas, s.d., *Gardner 1328* (P); Province de Ceará, s.d., *Gardner 1683* (P); Province de Ceará, s.d., *Gardner 1959* (P); Province de Ceará, s.d., *Gardner 1982* (P); In Providencia, s.d., *Blanchet 3312* (P); Province de Bahia, s.d., *Blanchet 3575* (P); Cerrado Piata, Triangulo Mineiro, s.d., *Laborain* 787 (RB); Bahia, Municipio Apora, 31 Km S of Olindina along HW BR-116, s.d., *Davidse & d'Arcy 11747* (SP); Estado do Rio Barra des Puoly, 13 April, *Hoehue & Gabet* s.n (SP); Pianí, Mecejana, Municipio Fortaleza, 24 Oct 1935, *Drouet 2647* (SP); Ceará, Coríri. A. Duarte, 6 Aug 1948, *Ivone 1353* (R); Areia- Paraíba, 10 Nov 1954, *Moraes 1531* (RB); Municipio Loreto Ilha de Balsas, region between the Rio Balsas and Parnaiba ca. 300 m E of Mauri house of fazenda "Morros" about 35 Km south of Loreto, 1 Sep 1963, *Eiten & Eiten 5443* (SP); Plants of Planalto de Brazil Drainage of the upper rio Araguaia, Estado de Mato Grosso, 17 Jun 1966, *Irwin et al. 17318* (P); de Caiapo, Estado de Goias, 28 Jun 1966, *Irwin et al. 17959* (RB); Km sul do campamento da expedição ingtêa, 9 Oct 1968, *Sidney & Onishi 1302* (RB); alrededores de Petrolina, 18 Apr 1971, *Heringer et al. 124* (RB); Estado de Bahia coastal zone mouth of the Rio Peixe or Rio Itahen, just south of Porto Seguro, 20 Mar 1974, *Harley 17217* (P); Territorio de Rondonia, Ilha das Flores SD. 20-VB Ponto 02, 6 Jun 1977, *dos Passos 18* (RB); Santana de Pirapama, Minas de Gerais, Luiz de Fora, 18 Nov 1980, *Krieger 10066* (RB); Municipio Sanatana do Riacho, Km 7.5 so longo da rodovia Belo Horizonte, Estado de Minas de Gerais, 1 Jul 1981, *Giulietti et al. 7375* (RB); Rio de Janeiro, Municipio Nova Friburgo, Reserva Ecologica Municipal de Macare de Cima, Picada para Pedra Bicuda, 20 Dec 1989, *Nadruz 557* (RB); Brasilia-DF, Chapara dos Veadeiros ca. 57 Km Goianessa, Municipio Pirinopolis, 7 Jun 1995, *Fonseca et al. 326* (SP). **BRITISH GUIANA:** Cayenne, s.d., *Martin 148* (P); Upper Mazaruni River, Basin Rope on N 43991, Corentine River, Nov 1879, *Jenman 454* (P): Partang River Marume mountains, 3 Jul 1960, *Tillett & Tillett 43992* (P). **VENEZUELA. Estado Amazonas**: Dpto. Atabapo, pequeña sabana ubicada en la punta O de Cerro Yapacana y el Caño Yagua al S, 24 Aug 1978, *Huber 2544* (VEN); Dpto. Atabapo, sabanas de las cabezeras del río Yagua, 29 Aug 1978, *Huber 2703* (VEN). **Estado Aragua:** El

Encanto, 21 Dec 1917, *Pittier 7597* (VEN). **Estado Bolívar:** Chaparral rocoso y abierto Gran Sabana alrededores del Salto Aponguao 42.5 Km al noroeste de la Misión de Santa Teresita de Kavanayen, 22 Feb 1978, *Steyermark et al. 115622* (RB, holotype of *S. translucens*); Dtto. Piar, middle part of río Pur-Pur affluent of Río Ambotuir along trial to Urimán, 30 Nov 1982, *Davidse & Huber 23019* (RB); Dtto. Piar Camarcaibarai-tepui, W slope shoulder, eastern most tepui of Aparamán tepui, 23 May 1986, *Holst et al. 2877* (VEN); Dtto. Piar central and western Camarcaibaral-tepui and Tekeké-Yurén tepui, 23 May 1986, *Liesner et al. 21012* (VEN); Gran Sabana, ca. 10 Km SW of Karaurin tepui at junction of río Karaurín and río Asadón (Río Sanpa), 23 Apr 1988, *Liesner 23694* (VEN); white sand shrubland near Yuruaní Falls NE Puente Yuruaní, Parque Nacional Canaima entering the park by paved highway, 22 Aug 1994, *Salazar 124* (MY). **Distrito Federal:** bosque deciduo secundario y perturbado entre las quebradas afluentes del Río Guairita, al sur del Cementerio Monumental del Este, 17 Aug 1975, *Steyermark & Berry 112070* (SP). **Estado Falcón:** Dtto. Mauroa, vía rumbo al SE desde Mene de Mauroa hacia la represa de El Palmar y Caracolí y Mesa de Burguera, 23 May 1980, *Bunting & Stoddart 9342* (VEN). **Estado Guárico:** Dtto. Miranda, Municipio Calabozo, bosque de galería del río Orituco, sector Laguna de los Patos, 15 Apr 1976, *Castillo 472* (VEN); bosque de Galería del río Orituco, Dtto. Miranda, Municipio Calabozo, 22 Jul 1976, *Castillo 571* (VEN). **Estado Lara:** camino Barquisimeto-Acarigua Km 12, 3 Dec 1967, *Smith 3012* (VEN); El Altar, cerca de Sarare, 3 Aug 1968, *Smith 4210* (VEN). **Estado Portuguesa:** carretera vía El Camburito orillas de la carretera, 23 Aug 1979, *Ortega 801* (PORT); Dtto. Guanare, terrenos de la UNELLEZ, 4 May 1983, *Stergios & Aymard 6501* (PORT); Dtto. Guanare, en terrenos de la UNELLEZ, 6 May 1993, *Stergios 5576* (PORT). **Estado Trujillo:** Dtto. Boconó Parque Nacional Guaramacal selvas nubladas de la vertiente norte, 26 Jul 1995, *Licata & Niño 320* (VEN). **Estado Yaracuy:** Boraure, 2 Dec 1962, *Deslacio 2161* (VEN). **Estado Zulia:** Perijá District +/- 5 Km W of Machiques along road on la hacienda El Capitán, Oct 1966, *de Bruijn 1153* (VEN); Maracaibo, 30 Nov 1967, *López-Palacios 1763* (VEN); Km 24 entre Río Negro y El Tocuyo, 9 Oct 1971, *Benítez de Rojas 1118* (VEN); carretera Maracaibo-Machiques, finca Facultad de Agronomía, Universidad del Zulia, 10 May 1972, *Trujillo 10973* (MY); Dtto. Páez, cerca de la Misión de Guana entre la carretera y el Km 4 del camino que sale rumbo al E de la carretera Carrasquero-Guana-Guerrero, 5 Jul 1977, *Bunting 5122* (HERZU); Dpto. Perijá, Carretera Maracaibo-Perijá, 24 Km al SO de la Villa del Rosario, 10 Sep 1977, *Bunting 5423* (VEN); Dpto. Páez, alrededor de la Laguna de Sinamaica, 11 May 1978, *Aristiguieta et al. 12505* (RB); Dpto. Miranda, entre vía El Consejo-El Pensado y el límite con el Estado Falcón, 21–22 May 1978, *Bunting 9229* (HERZU); Dtto. Perijá, 9 Km S of the Machiques intersection along the Maracaibo-La Fría hwy, 20 Jun 1980, *Dadvise et al. 18357* (RB); Dtto. Perijá, carretera la Villa de Rosario-Machiques, en aprox. en la mitad del trayecto en la finca de la Universidad del Zulia, 21 May 1981, *Bunting & Clausnitzer 9870* (RB); Dtto. Bolívar, vía entre Quiroz y el río Cocuiza (límite del Estado Falcón) entre el Árbol de Mene y Km 5 del trayecto, 30 Dec 1981, *Bunting & Alfonzo 10604* (VEN).

Struthanthus terniflorus Reis., Br.-Guiana (Ri. Schomburgk) 3:978. 1849 [1848 publ. 7–10 Mar 1849]; vol. 3 is titled: "Versuch einer Fauna und Flora von Britisch-Guiana."

Struthanthus eichlerianus Rizzini, Rodriguésia 41:29. 1976, **syn. nov.**

Struthanthus giovannae Rizzini, Rodriguésia 41:29. 1976, **syn. nov.**

Slender plant. Stem width in young stems (0.8–)1.4(–2) mm; internode length ca. 30 mm; node width (1.5–)2.5(–4.3) mm. Petiole (2.7–)5.5(–9) mm long. Leaves: l/b ratio 2.64; lamina lanceolate, (23–)34(–46) mm long and 8–20 mm wide; base acute; apex strongly acuminate. Inflorescence one per leaf axil, in some specimens longer than the subtending leaf when fully expanded; inflorescence peduncle 6–9(–12) mm long and less than 1.2 mm wide; more than 3 pairs of triads per inflorescence and up to 7. Triads peduncle (2–)4(–7.5) mm long and ca. 0.5–1 mm wide. Bracteoles triangular, subequal, central bracteole length 0.8–1.2 mm, lateral bracteoles length 0.7–1.1 mm. Floral buds length ca. (2–)3(–5) mm; flower length 4.5 mm; calyx length 0.5–1 mm. Fruit length ca. 6 mm. Distribution: In Venezuela: Widespread, Amazonas, Anzoátegui, Apure, Aragua, Bolívar, Falcón, Lara, Miranda, Monagas, Portuguesa, and Táchira states.

Specimens examined.—**Estado Apure:** Dtto. San Fernando, north bank of the Río Orinoco north of Isla Urbana and Isla Catarrosa, 13 May 1977, *Davidse & González 13145* (VEN). **Estado Aragua:** Las Moras, carretera hacia la Colonia Tovar, Dtto. Ricaurte, 12 Jan 1975, *Benítez de Rojas 1797* (MY, holotype of *S. eichlerianus*). **Estado Bolívar:** Cerro Baraguan and vecinity, 12 Jan 1956, *Wurdack & Monachino 41204* (RB, paratype of *S. eichlerianus*); Dtto. Piar, Gran Sabana, 52 Km N de Kama-merú, carretera El Dorado-Santa Elena, 4 Apr 1985, *Holst et al. 2210* (VEN). **Distrito Federal:** Caracas, s.d., *Bredenmayer 31075* (VEN). **Estado Falcón:** alrededores de Churuguara, 14 Aug 1982, *Lasser & Foldats 3020* (VEN**). Estado Lara:** selva nublada virgen, al sur de Agua Negra, al este de Cubiro, Dtto. Méndez, 5 Jul 1974, *Steyermark et al. 110113* (RB). **Miranda:** cerros inmediatos a Petare, carretera Santa Lucía, 28 Jul 1979, *Trujillo 4331* (VEN, isotype of *S. giovannae*). **Estado Táchira:** Los Mirtos, Páramo el Zumbador, Dtto. Jauregal del Estado Táchira, 30 Aug 1976, *Benítez de Rojas 2093* (VEN); Dtto. Junín, southern slopes of Cerro San Isidro, directly N of El Reposa, above Hacienda Bella Vista, quebrada Agua Caliente and tributaries, 13–14 Nov 1982, *Davidse & González 22199* (VEN).

ACKNOWLEDGMENTS

I greatly appreciate reviews of the manuscript by Betsy Jackes and an anonymous reviewer. Their comments improved the paper.

REFERENCES

Belbin, L. 1991. PATN pattern analysis package. Reference manual and users guide. CSIRO Division of Wildlife and Rangelands Research, Canberra, Australia.

Belbin, L. 1995. PATN analysis package. Users guide and technical references manual. CSIRO Division of Wildlife and Rangelands Research, Canberra, Australia.

Belbin, L. 2009a. PATN analysis package, version 3.12. Copyright 2001–2009. Blatant Fabrications, Pty Ltd. Australia.

Belbin, L. 2009b. PATN analysis package. Help topics. Blatant Fabrications, Pty Ltd. Australia.

Crisp, M.D. & P.H. Weston. 1993. 1993. Geographic and ontogenetic variation in morphology of Australian Waratahs (*Telopea*: Proteaceae). Syst. Biol. 42(1):49–76.

Dettke, G.A. & J.L. Waechter. 2012. *Struthanthus martianus*, a replacement name for the illegitimate *Struthanthus vulgaris* Mart. ex Eichler (Loranthaceae). Phytotaxa 57:6–9. doi:10.11646/phytotaxa.57.1.2

Gower, J.C. 1971. A general coefficient of similarity and some of its properties. Biometrics 27:857–871. doi:10.2307/2528823

Kazandjián, A. 2011. A morphometric analysis of *Struthanthus phillyreoides* and *S. dichotrianthus* (Loranthaceae) suggests these represent one single variable species. Bull. Torrey Bot. Club 138(1):1–15.

Kuijt, J. 2001. Loranthaceae. In: J. A. Steyermark, P. E. Berry, K. Yatskievyceh, & B. K. Holst, eds. Flora of the Venezuelan Guayana: Liliaceae-Myrsinaceae, Volume 6. Missouri Botanic Garden, St. Louis, Missouri, U.S.A. Pp. 37–59.

Kuijt, J. 2008. Loranthaceae. In: O. Hokche, P.E. Berry, & O. Huber, eds. Nuevo catálogo de la flora vascular de Venezuela. Pp. 444–448.

Kuijt, J. 2012. Reinstatement and expansion of the genus *Peristethium* (Loranthaceae). Ann. Missouri Bot. Gard. 98(4):542–577.

Kuijt, J. 2013. A brief taxonomic history of neotropical mistletoe genera, with a key to the genera. Blumea 58:263–266. doi:10.3767/000651913X676664

Kuijt, R. & B. Hansen. 2015. Santales, Balonopholares: Loranthaceae. In: K. Kubitzki, ed. Flowering plants. edicots. Volume XII. Pp. 73–121.

Martius, K.S. 1830. Systema vegetabilium: secundum classes, ordines, genera, species. Cum characteribus differentiis et synonymis. Flora 13(1):105.

Radford, A.E., W.C. Dickinson, J.R. Masey, & C.R. Bell. 1974. Vascular plant systematics. Harper & Row, Publishers, New York, New York, U.S.A.

Rizzini, C.T. 1975. Loranthaceae novae. Rev. Facultad Agron. Maracay 8(3):83–109.

Rizzini, C.T. 1976a. Loranthaceae. Bol. Soc. Venez. Ci. Nat. 22:328.

Rizzini, C.T. 1976b. Loranthaceae Austro Americanae Novae. Rodriguésia 41:7–35.

Rizzini, C.T. 1982. Loranthaceae. In F.Z. de Luces & J.A. Steyermark, eds. Flora de Venezuela 4(2):7–316.

Rizzini, C.T. 1985. New or less known Loranthaceae from Brazil and Venezuela. Ernstia 32:1–16.

Rohlf, F.J. 1998. tpsDig, digitize landmarks and outlines, version 2.0. Department of Ecology and Evolution, State University of New York at Stony Brook, New York, U.S.A. http://life.bio.sunysb.edu/ morph/morphmet/tpsdig2w32.exe. Accessed 17 Jul 2009.

Thiele, K. & P.Y. Ladiges. 1994. The *Banksia integriflora* L.f. species complex (Proteaceae). Australian Syst. Bot. 7:393–408. doi:10.1071/SB9940393

Thiers, B. 2016. Index Herbariorum: A global directory of public herbaria and associated staff. [continuously updated.] New York Botanical garden's Virtual Herbarium. http://sweetgum.nybg.org/science/ih/.