A. Angulo, air temperature 27 C; USNM 342986, recorded 6 January 1989 at 1830 h by R. B. Cocroft, air temperature 24.2 C, USNM Tape 206, cut 1; USNM 342985, recorded 30 December 1988 at 1845 h by R. B. Cocroft, air temperature 25 C, USNM Tape 203, cut 10

*Additional Specimens Examined*

*Adenomera andreae* type series: ZSM 145/1911/1-4 (four specimens)

*Adenomera hylaedactyla*: holotype ANSP 2240

*Other Tambopata Specimens Examined*

Forest Call I: USNM 268933–34, 268936, 247295, 247290, 242629; ROM 40110–17, 40321–26; MHNSM 18030, 18042

Forest Call II: USNM 268932, 268935, 268937–38, 247291–94, 247625–28

Forest Call III: USNM 343235

*Adenomera hylaedactyla*: USNM 342985–86, 345269 (Pakitza), 345270 (Pakitza); ROM 40102–04, 40107–08, 40327–28, 40330; MHNSM 18031, 18048

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# A NEW SPECIES OF *STEFANIA* (ANURA: HYLIDAE: HEMIPHRACTINAE) FROM THE SUMMIT OF CERRO AUTANA, ESTADO AMAZONAS, VENEZUELA

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ABSTRACT: We describe a new species of *Stefania* from the summit of Cerro Autana in Amazonas, Venezuela. It is the westernmost species hitherto known for the genus, being 200 km northwest of Cerro Huachamacari, the nearest known locality for any other *Stefania*. The new species is distinguished from other species of *Stefania* by the following combination of characters: fronto-parietal ridges present but reduced, foot webbing basal, discs on fingers and toes small, post-tympanic warts absent, and head as long as wide. Based on these traits, the species can be placed in the *Stefania evansi* group of Rivero.

*Key words:* Amphibia; Anura; Biogeography; Cerro Autana; Estado Amazonas; Hemiphractinae; Hylidae; New species; Venezuela

IN VENEZUELA, Hemiphractine frogs are represented by 4 genera (*Cryptobatrachus*, *Flectonotus*, *Gastrotheca*, and *Stefania*) and 21 species (1, 2, 6, and 12, respectively) (Barrio-Amorós, 1998; Frost, 2000; unpublished data for *Cryptobatrachus*). Among these, the genus *Stefania* has undergone many systematic changes. Since Rivero (1968) separated *Stefania* from *Cryptobatrachus*, the number of species has increased dramatically. The discovery of new species has coincided with the progressive exploration of the Guiana Shield, one of the most inaccessible and unknown areas in the world.

Boulenger's (1904) *Hyla evansi* was first considered to be a *Cryptobatrachus* by Ruthven (1922). Rivero (1961) described *H. marahuaquensis* and later he (Rivero, 1968) separated *C. evansi* from the Colombian species of *Cryptobatrachus* and erected the genus *Stefania* for *C. evansi*, tentatively placing *H. marahuaquensi*, as well as three new species (*S. ginesi*, *S. goini*, and *S. woodleyi*), in the new genus. Later, Rivero (1970) described an additional species (*S. scalae*) and assigned the six known species of *Stefania* to two well defined species groups, the *S. evansi* group (lowland to mid-elevation species with heads longer than wide: *S. evansi*, *S. marahuaquensis*, *S. scalae*, and *S. woodleyi*) and the *S. goini* group (high elevation inhabitants with heads wider than long: *S. ginesi* and *S. goini*).

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Duellman and Hoogmoed (1984) described two species (*S. riae* and *S. roraimae*) and synonymized *S. scalae* with *S. evansi*. The latest revision of Venezuelan *Stefania* (Señaris et al., 1996) contained descriptions of five additional new species (*S. oculosa*, *S. percristata*, *S. riveroi*, *S. satelles*, and *S. schuberti*), resurrected *S. scalae* from synonymy with *S. evansi*, and noted the probability of more undescribed taxa. The suggestion was proven to be true by the discovery of *S. tamacuarina* by Myers and Donnelly (1997). MacCulloch and Lathrop (2002) recently named three new species from Guyana.

During the first expedition to the summit of Cerro Autana, an isolated tepui 85 km south of Puerto Ayacucho in 1971, another unknown *Stefania* was collected by the team of the Venezuelan explorer Charles Brewer-Carías. We describe the species herein.

## Materials and Methods

Measurements were taken with a caliper (to 0.1 mm) and are expressed in millimeters (mm). Morphological terms and measurements are those of Duellman and Hoogmoed (1984) and Myers and Donnelly (1997). The webbing formula follows Myers and Duellman (1982). Measurements considered are: snout–vent length (SVL); tibia length (TL); femur length (FeL); foot length (FL); hand length (HL); head width (HW); head length (HeL); internarial distance (InD); upper eyelid width (UEW); interorbital distance (IOD); eye to posterior edge of nostril (EN); eye diameter (ED); tympanum diameter (TD); 3 finger disc width (FD); 4 toe disc width 4TD; depth of the head (DeH); distance between the anterior edge of the eye to the tip of snout (ETS); eye tympanum distance (ETD); 1 finger length (1FiL); 2 finger length (2FiL). Acronyms are AMNH (American Museum of Natural History, New York, USA), CVULA (Colección de Vertebrados, Universidad de los Andes, Mérida, Venezuela), EBRG (Museo de la Estación Biológica de Rancho Grande, Maracay, Venezuela), FMNH (Field Museum of Natural History, Chicago, USA), MBUCV (Museo de Biología de la Universidad Central de Venezuela, Caracas, Venezuela), MHNLS (Museo de Historia Natural La Salle, Caracas, Venezuela), OUM (Oxford University Museum, Oxford, UK). Cranial drawings are based on X-ray transparencies. Comparative data of other species were taken from Duellman and Hoogmoed (1984), MacCulloch and Lathrop (2002), Myers and Donnelly (1997), Rivero (1961, 1968, 1970), and Señaris et al. (1996).

## *Stefania breweri* sp. nov.

*Holotype.*—MBUCV 6574, an unsexed specimen from the summit of Cerro Autana (Wahari Kuaway), near the north ridge (4° 52′ N, 67° 27′ W), 1250 m elevation, Municipio Atures, Estado Amazonas, Venezuela; collected 12 February 1971, by Carlos J. Naranjo.

*Diagnosis*—A medium sized or possibly large *Stefania* (the only known specimen is 49.6 mm SVL); head as long as wide; frontoparietal ridges conspicuous; canthus rostralis distinct, angular, straight; tympanum somewhat less than 3/4 diameter of eye. First finger distinctly longer than second; discs on fingers and toes very small; toes webbed basally; hind limbs very long. Skin on dorsum smooth, with striking pattern of dorsolateral stripes and a discrete pale white interorbital bar; limbs with transverse brown bars on a pale ground color; venter pinkish, slightly transparent. *Stefania breweri* is a member of the *S. evansi* group (Rivero, 1970) and can be distinguished from other species of that group by the following combination of characters (those of *S. breweri* in parentheses). *Stefania scalae* has extensive toe webbing (basal), medium sized discs on fingers and toes (very small), no frontoparietal ridges (present). *Stefania evansi* has extensive webbing on the foot (basal), supernumerary tubercles on hands indistinct or absent (few but distinct). *Stefania riae* has knobs on the canthus rostralis (absent), no frontoparietal ridges (present), large oval discs on outer fingers (very small). *Stefania roraimae* has no frontoparietal ridges (present), enlarged discs on fingers (very small), supernumerary tubercles absent (present). *Stefania marahuaquensis* has posttympanic cuneiform warts on the tympanic area and anterior part of the dorsum (absent), enlarged discs on fingers and toes (very small). *Stefania percristata* has prominent frontoparietal ridges (present but reduced), five teeth on vomers (three-four), frontoparietal bones fused but with two small fontanelles (without fontanelles), nasal bones narrow, not

TABLE 1.—Measurements (in mm) of *Stefania breweri* and other Venezuelan *Stefania* of similar size. Data on the other species are taken from Señaris et al. (1996) and Myers and Donnelly (1997).

| Characters | *S. breweri* MBUCV 6574 | *S. tamacuarina* AMNH 131428 | *S. ginesi* FMNH 74041 | *S. oculosa* MHNLS 12961 | *S. satelles* MHNLS 10433 |
|---|---|---|---|---|---|
| SVL | 49.6 | 50 | 55 | 55.3 | 56.6 |
| TL | 32.5 | 30 | 33 | 33.1 | 29.5 |
| FeL | 29.1 | — | 29.5 | 33.8 | 32.2 |
| FL | 23.6 | 22.2 | 24.5 | 43.5 | 46.7 |
| HL | 14.3 | 15.9 | — | — | |
| HW | 18.5 | 20 | 23 | 22.6 | 21.2 |
| HeL | 18.5 | 19.7 | 20 | 20.9 | 20.8 |
| InD | 3.0 | 3.5 | — | — | |
| UEW | 5.0 | 5.0 | — | — | |
| IOD | 5.5 | 5.5 | — | 5.5 | 5.1 |
| EN | 4.8 | 6.0 | — | — | — |
| ED | 6.7 | 6.5 | — | 8.8 | 6.6 |
| TD | 3.2 | 3.5 | — | 4.0 | 4.6 |
| FD | 1.7 | 2.9 | — | — | |
| 4TD | 1.2 | 2.4 | — | — | |
| DeH | 8.7 | — | — | — | |
| ETS | 6.6 | — | — | 7.2 | 5.0 |
| ETD | 2.0 | — | — | — | |
| 1FiL | 10 | — | — | — | |
| 2FiL | 7.2 | — | — | — | |

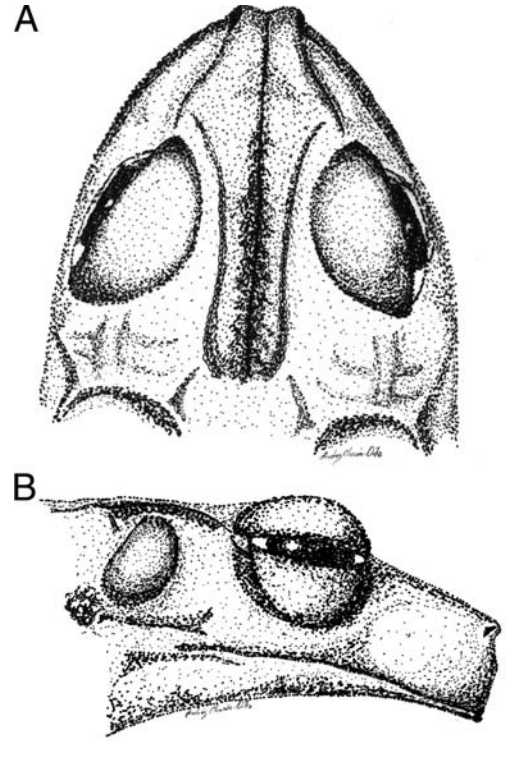


FIG. 1.—Dorsal (A) and lateral (B) view of the head of *Stefania breweri* sp. nov. (Holotype, MBUCV 6514). Scale = 10 mm.

in contact (broad, in contact). *Stefania tamacuarina* has knobs on the canthus rostralis (absent), enlarged discs on outer fingers and toes (small). *Stefania woodleyi* has granular to shagreened dorsal skin (smooth), frontoparietal ridges absent (present), supernumerary tubercles absent (small). *Stefania ackawaio* has shagreened dorsal skin (smooth), discs on hands and feet large (small), tubercles on upper eyelid (absent), dorsolateral stripes absent (present). *Stefania ayangannae* has supernumerary tubercles on hands and foot numerous, small, distinct (few), canthus rostralis curved (straight). Morphologically, *S. ayangannae* is the species that most closely resembles *S. breweri*. However, the known localities of these species are about 700 km apart, with all other species of *Stefania* occurring in between.

Six *Stefania* (*S. evansi*, *S. goini*, *S. marahuaquensis*, *S. riae*, *S. roraimae*, and *S. scalae*) are known to have a similar color pattern of dorsolateral pale stripes. *Stefania tamacuarina* also has a somewhat similar pattern, with dark brown blotches on a lighter ground dorsal color, but without dorsolateral stripes. However, we cannot base a diagnosis upon such a variable feature as color pattern, especially in *Stefania*. The other species of *Stefania* belong to the *goini* group, which is distinguishable from the new species by head proportions (wider than long; Table 1).

*Description.*—Head as wide as long, distinctly wider than adjacent part of body; depth of head slightly less than half length of head; snout subacuminate in dorsal view (Fig. 1A), truncate in profile (Fig. 1B), short, its length approximately equal to diameter of eye; canthus rostralis distinct, angular, straight, without knobs; loreal region strongly concave, sloping to lips; nostrils protuberant, directed laterally and slightly posterodorsally, immediately below canthus rostralis; distance between nostrils 55% of interorbital distance; internarial region concave; interorbital space distinctly concave because of frontoparietal ridges, which continue to back of skull; temporal region sloping, not concave; tympanum distinct, large, ovoid, diameter equal to half of horizontal diameter of eye, surrounded by an ossified annulus, separated from eye by

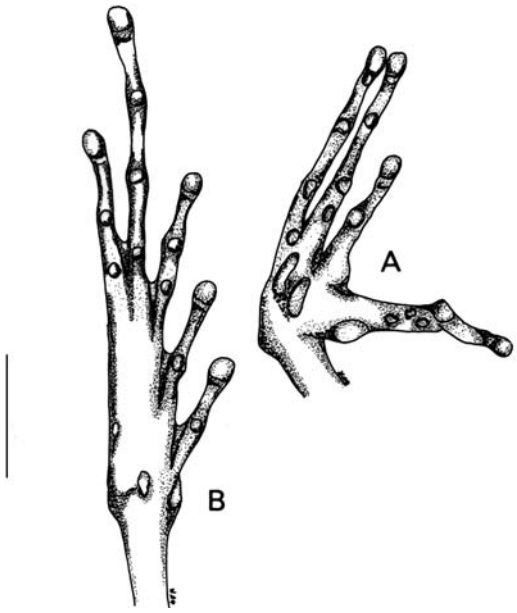


FIG. 2.—Ventral views of hand (A) and foot (B) of *Stefania breweri* sp. nov. (Holotype, MBUCV 6514). Scale = 5 mm.

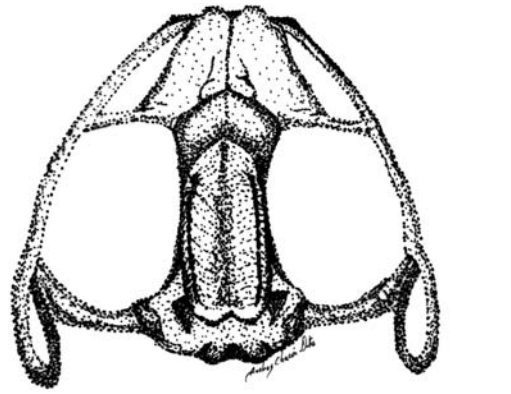

FIG. 3.—Dorsal view of the skull of *Stefania breweri* sp. nov. (Holotype, MBUCV 6514). Scale = 10 mm.

a distance of half diameter of eye; supratympanic fold narrow, distinct, angular, extending from posterior corner of eye to above insertion of forelimb, obscuring upper edge of tympanum; choanae moderate in size, oval; dentigerous processes of vomers short, each bearing three and four teeth on vomerine processes, transverse between choanae; pupil horizontal; palpebral membrane pale, without dark edge or reticulations.

Skin on dorsum and head, upper eyelids, temporal and loreal regions, throat, and limbs smooth; skin on chin, throat and chest smooth, belly and flanks finely granular; cloacal opening directed posteriorly at upper level of thighs.

Thenar tubercle large, distinct, elongate, ovoid (Fig. 2A); palmar tubercle distinct, bifid; subarticular tubercles large, distinct, round; supernumerary tubercles on palm few, small, round. Relative finger length II < I < IV < III; first finger distinctly longer than second (72% of length of finger I); third and fourth fingers fused at base; fingers unwebbed; discs on fingers small, slightly wider than penultimate phalange, smaller on first two fingers, largest on outer ones; width of larger discs equal to 10% of length of diameter of tympanum.

Inner metatarsal tubercle relatively large, elongate (Fig. 2B); outer metatarsal tubercle smaller, indistinct. Subarticular tubercles large, distinct, single, round. Supernumerary tubercles distinct, small, round, present mainly on proximal segments. Relative lengths of adpressed toes I < II < III < V < IV; third toe slightly shorter than fifth; toes webbed basally; webbing formula I 2 1/3—2½ II 2—3½ III 2½—3 1/3 IV 3½—2 V; toe discs ovoid, small, wider than penultimate phalange, smaller than fingers discs; heels of adpressed limbs overlap considerably.

Data on color in life is not available. In preservative, the dorsum is pale orange, with a discrete pale white interorbital bar, connected on the upper eyelids with fine white dorsolateral stripes. In dorsal view, the loreal region appears to be as white as the interorbital bar; the upper eyelids blackish; four round dark brown spots present between the dorsolateral stripes in the middle and posterior part of the dorsum; flanks whitish with a few dark brown bars contacting the exterior edge of the dorsolateral stripes; dorsal surfaces of the thighs with diffuse dark brown bars on a paler background; shank and feet conspicuously paler than body; suborbital brown and white bars present; tympanum distinctly paler than surrounding area; throat, chest and belly uniformly pinkish, and somewhat transparent.

*Cranial osteology.*—Based on X-ray transparencies of the holotype (Fig. 3), the skull is

well ossified; nasals broad, in medial contact throughout their length, protruding anteriorly beyond premaxillae; sphenethmoid in contact with nasals and frontoparietals; frontoparietals bearing lateral crests throughout their length; crista parotica fused totally with frontoparietals and exoccipital; zygomatic ramus of squamosal in contact with maxilla; otic ramus of squamosal in contact with crista parotica; quadratojugal in contact with maxilla.

*Habitat.*—The summit of Cerro Autana (Fig. 4A,B) is dominated by an open swampy landscape with submesothermic herbaceous vegetation characteristic of intermediate elevations from 500–1500 m and temperatures of 18–24 C in the Guiana Shield (Huber and Alarcon, 1988). The dominant plant taxa are *Brocchinia hechtioides* and *Kunhardtia rhodantha* (Steyermark, 1974). At the edges of the tepui, there are areas of exposed rock where several species of terrestrial orchids, plus *Navia pungens* and *Stegolepys pulchella* are dominant. On the northern part of the summit is a central dome that rises some 55 m above the grassland. Around this prominence, as well as along the crevices that channel water towards the northern and southern cliffs, is a humid environment supporting a dwarf forest of *Clusia* and many epiphytes. *Stefania breweri* was found within the tubular rolled leaves of a *Brocchinia* (Fig. 4B). Most species of *Stefania*, such as *S. evansi*, *S. goini*, *S. marahuaquensis*, *S. oculosa*, *S. percristata*, *S. scalae*, and *S. woodleyi*, are known to be rocky stream bank inhabitants (Duellman and Hoogmoed, 1984; Rivero, 1970; Señaris et al., 1996). *Stefania ginesi*, *S. satelles*, and *S. shuberti* are inhabitants of the high summits of tepuis from 1750–2600 m and have been found along creeks, but also under rocks, in bromeliads (*Brocchinia*), and on moss (Duellman and Hoogmoed, 1984; Gorzula and Señaris, 1998; Señaris et al., 1996). *Stefania riveroi* has been found on rocks at night (Señaris et al., 1996).

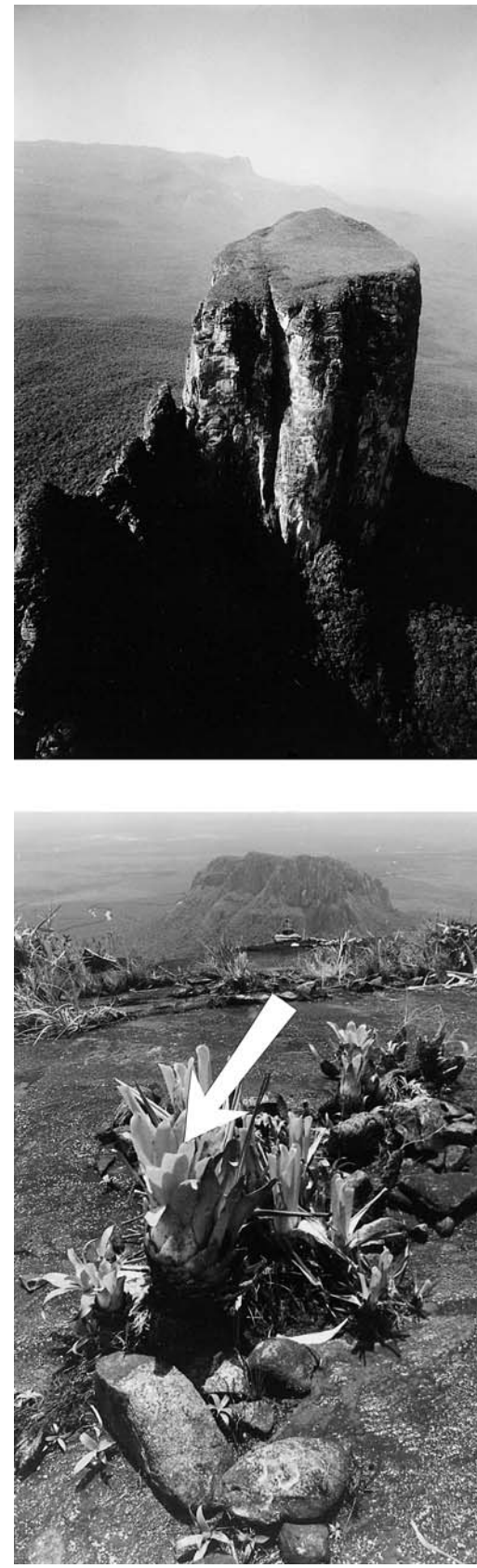

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FIG. 4.—(Upper) panoramic view of Cerro Autana. (Lower) summit of Cerro Autana, showing typical congregations of terrestrial bromeliads (*Brocchinia hechtioides*); white arrow indicates the place where *Stefania breweri* sp. nov. was found. Photos by Charles Brewer-Carías.

There is no literature about the ecology of *S. riae*, but Barrio-Amorós observed this species at Sarisariñama tepui in a sinkhole at 1000 m, with no flowing or standing water, only moist mossy walls and rocks with crevices and caves. *Stefania ayangannae*, *S. ackawaio*, and *S. coxi* were found away from water on branches of trees or woody shrubs, or on bromeliads, 1–5 m above the ground in a humid cloud forest at around 1500 m (MacCulloch and Lathrop, 2002). Because reproduction in *Stefania* is not dependent on free water, the presence of *S. breweri* on a tepui summit without constant water is not unusual. The only other frog species inhabiting the summit of Autana is *Leptodactylus lithonaetes*, which may use rain water for reproduction.

*Distribution.*—This species is known only from the type locality. The Cuao-Sipapo massif (Serranía de Paraque), of which Cerro Autana (Fig. 4A) seems to be a remnant, is nearby. *Stefania breweri* may occur on this massif as well.

*Etymology.*—The specific epithet is a patronym for Charles Brewer-Carías, to whom we are grateful for help and encouragement. Frank and Ramus (1995) proposed common names for *Stefania* species, without taking into account the peculiar distinctiveness of the genus, and named them simply "treefrogs," when only a few species are known to frequent trees. We suggest the English common name of "Brewer's carrying frog" for the new species and the common name of "carrying frogs" for all *Stefania* species. The proposed common name in Spanish is "Rana Stefania de Brewer," in accordance with names for other *Stefania* proposed by Barrio-Amorós (1998).

*Remarks.*—The holotype is somewhat dehydrated. The prominence of the frontoparietal ridges, the canthus rostralis, and concavities of the loreal and interorbital regions may be the result of dehydration. We decided not to dissect the only known specimen in order to avoid damage. Thus, the sex is unknown.

## Discussion

As previously noted, Rivero (1970) assigned the species of *Stefania* known at that time to two species groups (*S. evansi* and *S. goini* groups). Myers and Donnelly (1997) commented that Duellman and Hoogmoed (1984) did not explicitly assign their new species to either of Rivero's groups, but included the groups in their general discussions and summary. In their generic revision and description of five species, Señaris et al. (1996) placed their species in Rivero's groups. *Stefania tamacuarina* seems to be a member of the *S. evansi* group (Myers and Donnelly, 1997). *Stefania breweri* can be placed in the *S. evansi* group because of its head proportions and its mid-elevation habitat. Therefore, with the new taxa, Rivero's groups consist of the *S. evansi* group containing *S. ackawaio*, *S. ayangannae*, *S. breweri*, *S. evansi*, *S. marahuaquensis*, *S. percristata*, *S. riae*, *S. roraimae*, *S. scalae*, *S. tamacuarina*, and *S. woodleyi* (Fig. 5); and the *S. goini* group containing *S. coxi*, *S. ginesi*, *S. goini*, *S. oculosa*, *S. riveroi*, *S. satelles*, and *S. schuberti* (Fig. 6).

No species known from Venezuela are also known from other countries, with the exception of *S. scalae* in Guyana (MacCulloch and Lathrop, 2002). *Stefania evansi* has been listed continuously as present in Venezuela by La Marca (1992, 1997) and Barrio-Amorós (1998), perhaps due to the confusion with *S. scalae*. However, there are no known records of *S. evansi* from Venezuela, and it should be removed from any lists until its presence in Venezuela is confirmed. Although recent exploration has resulted in the discovery of *Stefania* in many mountains of southern Venezuela, still more exploration is needed. For example, *S. tamacuarina*, described from Pico Tamacuari (Serranía de Tapirapecó), Venezuela, probably also exists on the Brazilian side of the serranía. Likewise, *S. roraimae* is so far known only from the Guyanese side of the base of Roraima tepui, but it likely occurs in Venezuelan and Brazilian sides as well. With the recent and outstanding discovery of seven species of *Stefania*, mostly syntopic and inhabiting the same tepui in Guyana (MacCulloch and Lathrop, 2002), we can expect more cases of sympatry in Venezuela, where only two tepuis are known to be inhabited by more than one species: Cerro Jaua, where *S. oculosa* and *S. percristata* live in sympatry (Señaris et al., 1996), and Cerro Duida, where *S. marahuaquensis* and *S. goini* are syntopic (Señaris et al., 1996).

*Biogeography.*—Cerro Autana is located in the northwestern part of Estado Amazonas,

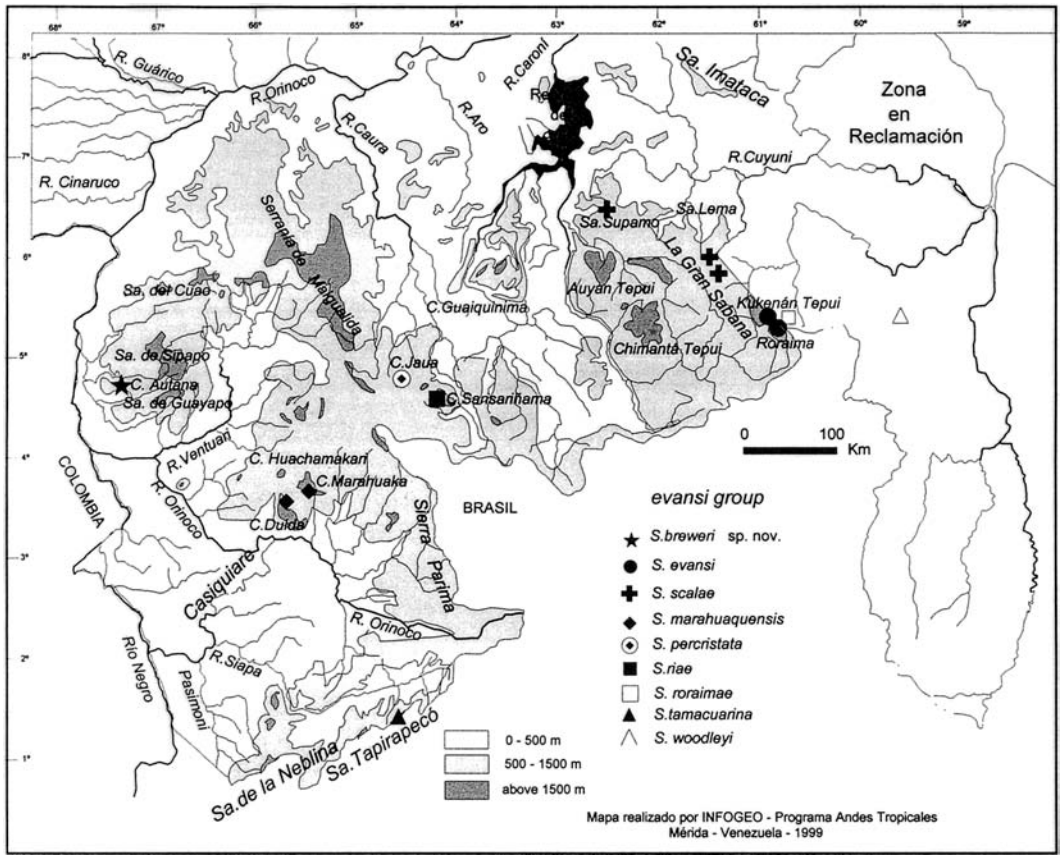


FIG. 5.—Geographic distribution of *Stefania evansi* group in Southern Venezuela. The star indicates the type locality (Cerro Autana) of *Stefania breweri* sp. nov.

Venezuela. It is the westernmost locality for the genus, 45 km east of the Río Orinoco, which marks the Venezuelan-Colombian border. West of the Orinoco, in Colombia, the landscape is a vast lowland plain covered with savannas and rainforest, with some uplands to the west (Serranía de Chiribiquete, maximum elevation slightly above 1000 m; and Serranía La Macarena, reaching 2500 m), each approximately 760 km from Autana. *Stefania* is not known from those serranías, and it is unlikely that it occurs there or in any of the lowlands in between. The closest locality from which a species of *Stefania* has been reported is Cerro Huachamacari (*S. goini*), 200 km to the southeast of Cerro Autana; the two highlands are separated by the lowland savannas of the Río Ventuari Valley. The discovery of *Stefania* on a northwestern tepui is surprising because of the great distance between Autana and the other known localities of the genus, and also because *Stefania* was not found on Yavi or Yutaje-Corocoro (Myers and Donnelly, 1996, 2001). Undoubtedly other species of *Stefania* are still to be discovered.

## RESUMEN

Describimos una nueva rana del género *Stefania* de la cumbre del Cerro Autana, estado Amazonas, Venezuela, siendo la especie más occidental hasta ahora conocida del género, a 200 km NW del Cerro Huachamacari, el punto más cercano de donde se conoce otra especie. La nueva especie se distingue del resto de especies del género por la combinación de los siguientes caracteres: crestas frontoparietales presentes pero reducidas, palmeadura pedial basal, discos en manos y pies pequeños, ausencia de tubérculos en la región post-timpanica, cabeza tan larga como

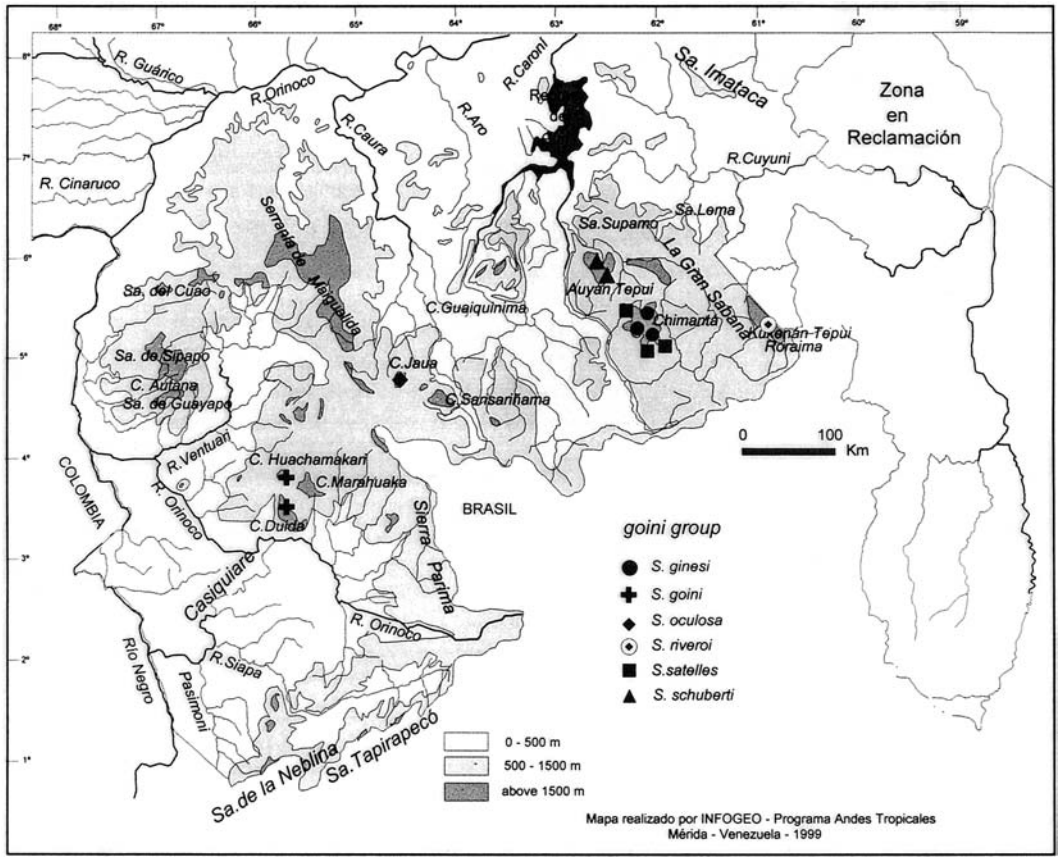


FIG. 6.—Geographic distribution of *Stefania goini* group in Southern Venezuela.

ancha. De acuerdo con estos caracteres, la especie es asignada al grupo *S. evansi* de Rivero.

*Acknowledgments.*—We are indebted to C. Brewer-Carías for the specimen and his encouragement; the Programa Andes Tropicales (PAT) for allowing Barrio-Amorós access to its facilities in Mérida; M. Molinillo (INFOGEO) for help preparing the maps; J. Brewer-Carías for arranging the transparency of *Stefania*; A. Orellana for his help in translating the text; A. Chacón for the drawings; A. Rodríguez-Acosta, R. Guerrero, W. E. Duellman, and M. Hoogmoed for their helpful and valuable comments on versions of the manuscript; and R. MacCulloch for sharing information and literature on the genus and its biogeography and natural history.

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## Appendix I

*Specimens Examined*

*Stefania riae*: Venezuela: estado Bolívar: Sima Mayor, Sarisariñama (EBRG 4533–42).

*Stefania scalae*: Venezuela: estado Bolívar: Salto El Danto, Sierra de Lema (CVULA 3183); km 112 (EBRG 980), km 117 (EBRG 3440), and km 125 of the road from El Dorado to Santa Elena de Uairén (MBUCV 6573), 860–1025 m, and another adult individual examined alive and photographed from Cerro Santa Rosa, Serranía del Supamo, 600 m.

*Stefania schuberti*: Venezuela: estado Bolívar: eastern side of the summit of the Auyán-tepui, 1750 m (EBRG 3000, 3001; MBUCV 3039).