HERPETOTROPICOS Vol. 5(1):49-54
www.herpetotropicos.com

Original article / *Artículo original*
ISSN 1690-7930 (Printed) ISSN 1856-9285 (Online)
Printed in Venezuela.

A FROG SURVIVOR (AMPHIBIA: ANURA: AROMOBATIDAE: *MANNOPHRYNE*) OF THE TRADITIONAL COFFEE BELT IN THE VENEZUELAN ANDES

ENRIQUE LA MARCA[1,2]

[1] *Laboratorio de Biogeografía, Escuela de Geografía, Facultad de Ciencias Forestales y Ambientales, Universidad de Los Andes, Mérida, Venezuela.*

ABSTRACT: A new collared frog of the genus *Mannophryne* is described from the Andes of Lara State, in western Venezuela. The new taxon is readily distinguished from its congeners by its small size (x SVL male 19.5 mm, females 23.5 mm), the presence of two conspicuous short pale bands from posterior border of eye to the level of shoulder, a reduced foot web (I2.0–1.0II1.0–1.0III1.5–1.0IV1.0–1.0V), and a wide collar with not well defined pale spots. The new species is most similar to the geographically closest relatives *M.yustizi* and *M. larandina. Mannophryne yustizi* is a larger and less webbed frog, with smaller tympana, and well-defined larger pale spots on collar. *Mannophryne larandina* is a larger frog with more distinct para-cloacal pale bands, and well-defined larger pale spots on collar. The new species is defined, diagnosed, and described for the first time. Ecological notes are provided on this true survivor of the increasingly deforested semi-deciduous mountain environments of the Venezuelan Sierra de Portuguesa, the northernmost mountain range of the Andes. The new species is proposed to the conservation category of Endangered (EN), due to its very high risk of extinction in the wild.

Keywords: Frog, Taxonomy, Ecology, Conservation, Semi-deciduous forests, Venezuela.

RESUMEN: E. La Marca. "Una rana (Amphibia: Anura: Aromobatidae: *Mannophryne*) sobreviviente del cinturón tradicional del café en los Andes de Venezuela". Una nueva rana con collar del género *Mannophryne* es descrita de los Andes del estado Lara, en el occidente de Venezuela. El nuevo taxón se distingue rápidamente de sus congéneres por su pequeño tamaño (x SVL macho 19.5 mm, hembras 23.5 mm), la presencia de dos bandas claras conspicuas cortas desde la parte posterior del ojo hasta el nivel del hombro, una membrana pedal reducida (I2.0–1.0II1.0–1.0III1.5–1.0IV1.0–1.0V) y un collar ancho con puntos claros no bien definidos. La nueva especie es más similar a sus parientes geográficamente más cercanos, *M. yustizi* y *M. larandina. Mannophryne yustizi* es de mayor tamaño, menor palmeadura, tímpanos más pequeños, y puntos claros mayores y mejor definidos sobre el collar. *Mannophryne larandina* es de mayor tamaño, tiene bandas para-cloacales más notorias, y puntos claros mayores y mejor definidos sobre el collar. La nueva especie es definida, diagnosticada y descrita por vez primera, y se provee notas ecológicas de este verdadero sobreviviente de los ambientes montañosos deforestados en la venezolana Sierra de Portuguesa, la cadena montañosa más septentrional de los Andes. Se propone la nueva especie para la categoría de Amenazada (EN, por sus siglas en Inglés), debido a su alta probabilidad de extinción en la naturaleza.

Palabras clave: Rana, Taxonomía, Ecología, Conservación,Bosques semi-caducifolios,Venezuela.

INTRODUCTION

Collared frogs of the genus *Mannophryne* constitute, perhaps, the single most conspicuous amphibian element of the semi-deciduous forests along the foothills to middle altitude environments in the Cordillera de Mérida. Five out of 15 species assigned to this genus (Manzanilla *et al*. 2009) are currently known from these Venezuelan Andes. The genus is starting to stand out as an speciose taxon, and the urge to describe new taxa is boosted by the fast and massive destruction that is taking place in the "coffee belt" environments where these frogs live.

The object of the present paper is to describe a small collared frog, readily distinguished by its conspicuous short pale dorsolateral bands, inhabiting a threatened belt of semi-deciduous forests in southern Lara state, on the lowland versant ("vertiente llanera") of the Venezuelan Sierra de Portuguesa, the northernmost portion of the Andes mountain range in South America.

MATERIAL AND METHODS

Terminology and methods for adult specimens follow La Marca *et al*. (2004). Measurements (in mm) were taken with a digital caliper Helios® (with a precision of 0.01 mm). Measurements taken for post-metamorphic specimens were snout-to-vent length (SVL); head length, from tip of snout to posterior corner of mouth (HL); head width, maximum straight distance between angle of jaws (HW); eye-to-naris distance, from anterior corner of eye to center of naris (EN); internarinal distance, maximum straight length between centers of nares(IN); eye length, from anterior to posterior corner of eye (EYE); horizontal length of tympanum, distance between anterior and posterior level of tympanum (T); hand length, from proximal edge of palmar tubercle to tip of finger III (HAND); tibia length, from outer edge of flexed knee to heel (TL); foot length, from proximal edge of outer metatarsal tubercle to tip of toe IV (FOOT); interorbital distance,

[2] Send correspondence to / *Enviar correspondencia a*:
enrique.lamarca@gmail.com

Received / *Recibido* 12 APR 2009
Accepted / *Aceptado* 04 JUL 2009

between borders of upper eyelids (IOD); upper eyelid width, between border of eye and base of eyelid (UEW); distance from anterior border of eye to tip of snout (ETS); distance from anterior border of tympanum to posterior border of eye (TE); length of shank from tibio-tarsal joint (knee) to heel (TARSUS); length of dermal fold on tarsus (TARSAL FOLD).

Type specimens are deposited at ULABG, the Collection of Amphibians and Reptiles of the Laboratorio de Biogeografía, Universidad de Los Andes, in Mérida, Venezuela.

DESCRIPTION OF SPECIES

Mannophryne speeri sp. nov.
(Figs. 1, 2, 3)

Holotype
ULABG 5393, an adult female with deeply convoluted oviducts and eggs about 1.1 mm in diameter, coming from: Approx. 1 Km NNE from Laguneta, 960 m.asl, 65.9 km on the road from the crossroads Guanare- Suruguapo heading to Villanueva, Sierra de Portuguesa, Municipio Morán, Estado Lara, Venezuela. Collected on 12 February 2004 by Enrique La Marca, Diego Cadenas and Francisco Nava.

Paratypes (16)
Juveniles and newly metamorphosed specimens of unknown sex ULABG 5377-5389; adult male ULABG 5390; adult females ULABG 5391-5392; all topotypes, bearing the same data as the holotype.

Etymology
The specific name is dedicated to Mr. Jason W. Speer, who generously contributed to research leading to the description of this new amphibian species. The patronym is constructed as a noun in the (single, masculine) genitive case.

Definition
A small species of *Mannophryne* (SVL single adult male 19.5 mm, females 23.0-24.1 mm); characterized by (1) skin of dorsum smooth with small inconspicuous tubercles on lower back; (2) tympanum without an evident supratympanic fold, about 1/2 the horizontal length of eye; (3) tip of snout acutely rounded in dorsal view, rounded to almost truncate in lateral views; (4) canthus rostralis not well defined, almost straight; (5) first finger equal to second; (6) disk on third finger about 1.6 times wider than adjacent phalanx; (7) fingers with thick lateral fringes; thickened edge along outer edge of fourth finger, from base of pad to close to outer metacarpal tubercle; (8) cloacal fold short; (9) tarsal fold strong, not ending in tubercle but having a little distal enlargement; (10) foot-web formula: I2.0–1.0II1.0–1.0III1.5–1.0IV1.0–1.0V; (11) toes with very narrow lateral folding flaps; (12) short pale dorsolateral bands present; (13) disc on fourth toe wider than preceding phalanx; (14) oblique inguinal band from groin to near upper arm insertion; (15) collar wide, with ill-defined pale blotches; (16) ventrolateral band absent; (17) marks on venter, absent; (18) third finger in males, not enlarged; (19) short teeth, not fang-like; (20) lingual papillae absent; (21) pad absent on distal portion of forearm in males; (22) testes cream.

Diagnosis
Mannophryne speeri sp. nov. is readily distinguished from most other species in the genus by having a pair of pale dorsolateral bands, character shared only (La Marca 1994) with *M. herminae* (Boettger, 1893); *M. neblina* (Test, 1956); *M. oblitterata* (Rivero, 1984); and *M. yustizi* (La Marca, 1989). The new species is distinguished from *M. herminae* by having a less spotted collar and a larger tympanum (much spotted collar, and tympanum about 2/5 length of eye in the later), and being more webbed between toes I and II, and IV and V (I1.5-1.0II, IV1.0-1.5V in *M. herminae*). *Mannophryne neblina* is a larger frog (x SVL males 25.1 mmm, females 26.9 mm) with immaculate pale upper lips (unique among *Mannophryne* frogs). *Mannophryne obbliterata* is a much larger frog (x SVLmales 33.4 mmm, females 36.1 mm) with a very extensive foot web. *Mannophryne yustizi* is less webbed (I1.0–0.5II1.0–1.0III1.0–1.0IV0-5–1.0V), has a smaller tympanum, and well-defined large (>0.5 mm) spots on collar. The later species, and *M. larandina* (Yústiz, 1991), are the geographically closest relatives to the new species. *Mannophryne speeri* sp. nov. differentiates from *M. larandina* (characters of the later given within parentheses) mainly by having more distinct para-cloacal pale bands (not very distinct), collar with ill-defined small pale spots, <0.4 mm (well-defined large pale spots, >0.5 mm), and thick lateral fringes on fingers (narrow folds).

Description of Holotype
Head as wide as long. Interorbital area slightly curved; interorbital distance about 3/2 greater than upper eyelid width. Canthus rostralis not well defined, almost straight. Nares slightly elevated, directed laterally and slightly backwards; nares closer to tip of snout than to eye (3/4 of the distance between tip of snout to eye). Loreal region almost vertical, slightly concave, descending abruptly to lips. Snout sub-ovoid in dorsal view; tip of snout acutely rounded in dorsal view, almost truncate in lateral view. Horizontal length of eye about 1.5 times eye-to-nostril distance. Internarial distance about 1.6 times eye-to-nostril distance. Tympanum little less than half the eye diameter, separated from eye about 1/2 its horizontal length; supratympanic fold not evident; tympanic ring inconspicuous, with anterior ridge slightly elevated. Two to three coalescent tubercles near corner of mouth.Tongue broadly oval, wider about mid-length and very slightly notched on its posterior end; slightly longer than wide; posterior 1/3 not adherent to floor of mouth. Lingual papillae absent. Choanae rounded,not concealed by palatal shelf of maxillary arch. Maxilla and premaxilla toothed; teeth very short and not fang-like.

Dorsum smooth on anterior part, bearing small inconspicuous tubercles on lower back. Cloacal fold short. Flanks shagreened, with some low and flat tubercles. Throat, chest and venter, smooth. Upper arm and forearm shagreened. No small inconspicuous tubercle on distal end of ventral surfaces of forearm. Inner metacarpal tubercle (thenar) oval, about 1.5 times longer than wide. Outer metatarsal tubercle (palmar) rounded in outline, about three to four times the size of thenar. No supernumerary tubercles. Subarticular tubercles moderate-sized, flattened, rounded to oval. Largest on first finger. Small pads on fingers. Pads wider than long, largest pad on third

finger, about 1/2 size of tympanum and about 1.6 times wider than adjacent phalanx. Fingers free, bearing thick lateral fringes, although not much conspicuous, along last phalanx of digits. Thickened edge along outer edge of fourth finger, from base of pad to close to outer metacarpal tubercle. First finger equal to second (Fig. 1). Third finger in males not enlarged. Disks on fingers oval in shape, with two squarish, well-defined dorsal scutes.

Some inconspicuous flat tubercles on shanks; absent on rest of posterior extremities. Length of tibia about 47% snout-to-vent distance. Tarsal fold strong, short (45% of tarsal length), not ending in tubercle, having a little distal enlargement; inner metatarsal tubercle elongated. Outer metatarsal tubercle almost rounded, small (about 2/3 the size of inner metatarsal tubercle). Subarticular tubercles oval, flattened. Toes moderately webbed; foot web formula: I2.0–1.0II1.0–1.0III1.5–1.0IV1.0–1.0V. Toes with very narrow lateral folding flaps, more conspicuous toward base of toes. Disc on fourth toe wider than preceding phalanx. Largest toe disk on second toe (Fig. 1), ¼ wider than adjacent phalanx. Heels barely overlap when thighs are held at right angles to body axis.

Measurements of holotype (in mm)

SVL 23.4, TL 11.1, HW 8.1, HL 8.0, T 1.5, EYE 3.2, EN 2.1, IN 3.3, HAND 6.6, FOOT 10.3, IOD 2.9, UEW 2.2, ETS 8.5, TE 0.9, TARSUS 6.2, TARSAL FOLD 2.8.

Coloration of holotype in ethanol 70% (after fixation with formaldehyde 14%)

Dorsum dark brown, bearing two short narrow pale bands from upper eyelid to shoulder (at level of arm insertion) (Fig. 2). Some small non-pigmented areas, near the urostyle.

Loreal region dark brown, same as dorsum of head, not forming a band, delimited in its inferior part by a clear area covering mandibles from tip of snout to upper arm insertion; the later pale area is dusted with dark brown markings. Tympanum covered in its upper half part by a dark area coming from dorsum and upper part of flanks, from which it is not differentiated, and an inferior part pale colored continued with pattern of mandibles.

Flanks dark brown, with an oblique pale band extending from groin to close to level of upper arm insertion. Lower part of flank with some pale ill-defined blotches on a dusky background.

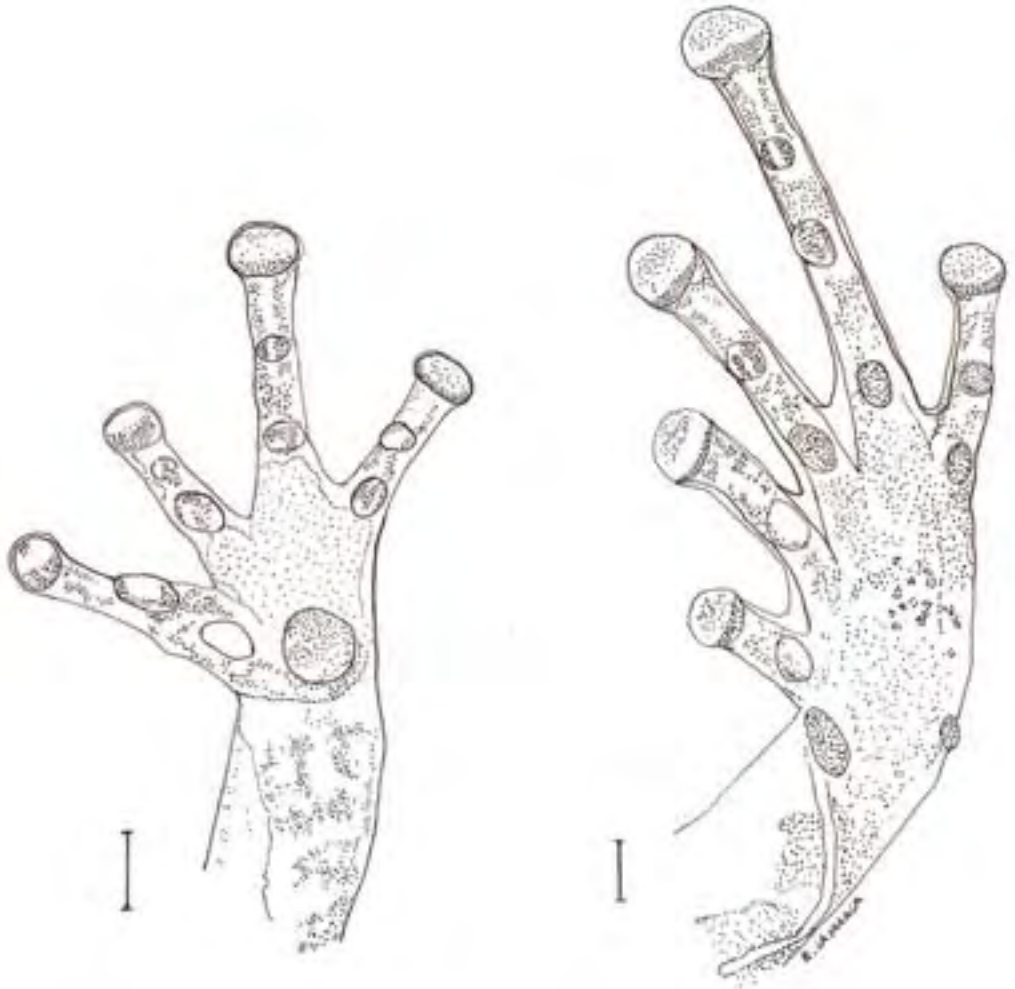

FIG. 1. Left hand and foot of *Mannophryne speeri* sp. nov. (holotype ULABG 5393). Scale= 1 mm.
Mano y pata izquierdas de Mannophryne speeri *sp. nov. (holotype ULABG 5393). Escala= 1 mm.*

Thighs bearing alternating bands, dark-brown ones followed by dusted pale-cream ones. Para-cloacal bands short and wide, extending from level of urostyle to mid-length of thighs. Shanks and tarsi with a dusty cream background with dark brown markings suggesting bands. Arm dusky, with an anterior dark band, and a dark band on wrist. Fingers and toes, dorsally, with bands not well defined. Pale brown to cream scutes, the later bordered by dark brown pigmentation.

Palms and soles heavily pigmented with dark brown; metacarpal and metatarsal tubercles dark gray. Throat with half anterior part heavily dusted with dark brown stippling, central part almost immaculate cream. Collar wide, with heavy dark stippling, concentrating in some parts as to suggest dark spots. Some pale areas never get to constitute pale spots, giving the impression of a marbled band. Ventral aspects of belly, thighs and shanks almost immaculate cream, having scattered inconspicuous stippling that do not form a pattern.

Variation

The holotype (ULABG 5393) is an adult female bearing eggs, about 1.1 mm in diameter. Adult female ULABG 5392 bears eggs about 1.7 mm; the only other adult female (ULABG 5391) appears to have recently spawned. Adult females have yellow throats and a wide collar (Fig. 3), and the eggs have a dark brown layer covering a yellowish-cream content. The single adult male (ULABG 5390) has cream testes about 1.5 mm in diameter, vocal slits, ventral surfaces darkened by heavy dark stippling, and lacks a collar.

The short dorsal pale bands are very distinctive in the holotype, and also conspicuous in the remaining adult females, although ULABG 5391 have them narrower, and ULABG 5392 somewhat wider. Most of the juveniles conspicuously bear the short bands, albeit some specimens (e.g. ULABG 5380) tend to have them not so much evident. Pale dorsal bands are not evident in adult male ULABG 5390 (which is almost completely darkened on dorsum) nor in juveniles/newly metamorphosed ULABG 5353-5355, 5377 and 5388.

FIG. 2. Adult female of *Mannophryne speeri* sp. nov. (holotipo ULABG 5393) in life. Photo by P. Soriano.
Hembra adulta de Mannophryne speeri *sp. nov. (holotipo ULABG 5393) en vida. Foto por P. Soriano.*

The majority of the type-series individuals are juveniles or newly metamorphosed specimens of undetermined sex, with a SVL ranging from 11.1 to 14.3 mm (n: 17, mean: 13.0 mm), except for ULABG 5353, a juvenile female of 17.1 mm SVL having undeveloped ovaries. Since most of the individuals of the new species are juveniles, not enough samples are available to document statistical variation in measurements of adult specimens. Nonetheless, it is evident that females are larger than the single adult male. Table 1 shows variation on measurements of adult specimens in the type series.

Ecological notes

The ecology of *Mannophryne speeri* sp. nov. is largely unknown, paralleling the poorly known forested humid environments in southern Lara state, south of the Boconó Fault system, the later purportedly associated with the rising of the Sierra de Portuguesa mountain range (Smith *et al*. 1991). Those forests are the spongy reservoirs that empty their waters into the mighty Orinoco River through tributaries of the Portuguesa River. The population of the new species was found in a cascading mountain stream tributary of the Morador River in the Portuguesa River basin. It comprised at least 50 specimens, about 25 of which were seen, and 17 were captured between 12:35 and 13:05 h. Some specimens avoided capture hiding in crevices of schist and slate rocks within the stream, or diving into the muddy bottom.

The local Life Zone (following Holdridge´s system, fide MARNR and Gob. Lara 2002) has been characterized as "bosque muy húmedo Premontano" (Premontane very humid forest). This kind of forest is equivalent to the "selva semicaducifolia montana" (semideciduous mountain forest) of La Marca and Soriano (2004), a plant formation that experiences water shortage during a few months of the year, during the dry season that usually spans from December to March. Some trees loose their leaves as a strategy to cope with the water stress. At the time of collecting, in February, the place was covered by a great amount of decaying leaves that covered the stream banks. According to MARNR and Gob. Lara (2002), the rainy season in the area occurs from April to November.

The Andean semi-deciduous forest usually occurs between 800 and 1700 m elevation and, albeit highly interrupted in present days, in the past it had a more continuous distribution along the foothills of both external versants of the Andean Cordillera de Mérida. The type locality of *Mannophryne speeri* lies within the altitudinal range of this type of forest, to which the new species seems to be restricted. In the region, at about 1300 m elevation, the seasonal forest is replaced by a humid montane forest like that found in the geographically close Yacambú National Park, near Sanare, where another member of the genus, *M. yustizi*, inhabits.

The climate has been classified (MARNR and Gob. Lara 2002) as sub-humid to humid; although mean temperatures and precipitation are not known with precision in the region, this kind of forest has been characterized (La Marca and Soriano 2004) as having annual mean temperatures between 16 and 23 ºC, and annual mean precipitation between 1200 and 1900 mm. While collecting at the type locality, we recorded the air temperature at 1 m above the edge of the stream as 33.0 ºC, while that of the water at 10 cm depth as 23.3 ºC, at 13:05 h.

FIG. 4. Ventral view of holotype of *Mannophryne speeri* sp. nov. (ULABG 5393).

Vista ventral del holotipo de Mannophryne speeri *sp. nov. (ULABG 5393).*

Table 1. Measurements (in mm) of adult *Mannophryne speeri* sp. nov. given as an absolute value, or as a mean followed by range of variation within parentheses. M= male (ULABG 5390), F= Females (ULABG 5391-5393). Abbreviations as explained in materials and methods.

Tabla 1. *Medidas (en mm) para adultos de* Mannophryne speeri *sp. nov. dadas como un valor absoluto, o como una media seguida por el rango de variación entre paréntesis. M= Macho (ULABG 5390), F= hembras (ULABG 5391-5393). Abreviaturas como se explica en la sección de materiales y métodos.*

Sex	N	SVL	TL	HW	HL	T	EYE	EN	IN	HAND	FOOT
M	1	19.5	10.1	7.1	7.8	1.3	2.6	1.7	2.5	4.5	9.7
F	3	23.5 (23.0-24.1)	11.1 (10.7-11.6)	8.5 (8.1-9.2)	8.1 (7.5-8.7)	1.6 (1.5-1.7)	3.1 (2.8-3.2)	2.0 (1.9-2.1)	2.8 (1.9-3.3)	6.4 (6.2-6.6)	10.6 (10.3-11.0)

Trees at the collecting site were between 5 and 15 m high, with interrupted canopy. Although the colourful yellow-flowering Araguaney (*Tabebuia chrysantha*) and the purple-flowering Apamate (*Tabebuia pentaphylla*) are good tree representives of the Life Zone at this region (MARNR and Gob. Lara 2002), we only found the also splendid orange-flowering Bucare (*Erythrina* sp.).

We did not hear any amphibian calls, nor we see *Mannophryne* tadpoles. Nonetheless, reproductive activity was recorded for a syntopic *Rhinella* toad of the *margaritifera* complex, of which we collected a chain of eggs (ULABG 5395), eight tadpoles (ULABG 5394) and a juvenile (ULABG 5396). A *Chironius* snake (ULABG 5397) was found in the same region, at an altitude of 1375 m. No other herp species are documented from the vicinities of the type locality. A Pseudotelphusidae crab was also in the same stream; Vargas-Galarce and La Marca ("2006" 2007) considered another freshwater crab of this family as a potential natural predator of *M. trujillensis*.

Conservation

Most of the original semi-deciduous forests in the Andes have been destroyed or highly modified for agricultural purposes, mainly for coffee plantations. Coffee started to replace the original forest cover since the middle of the XIX century. Municipio Morán, where the type locality lies, is not the exception to this rule, being the largest coffee producer in Lara State (MARNR and Gob. Lara 2002).

Forest destruction is held responsible for the huge loss of biodiversity in the region. Without doubt, actual situation leaves the semi-deciduous forest, like the one inhabited by the new species, as patchy remnants where the last populations strive to survive. The situation is worsened by the fact that there are not intact examples of this kind of forest in the Venezuelan Andes, and that it is poorly represented in the national system of protected areas. Taking the later into account, and knowing that many *Mannophryne* have populations with high site fidelity, I propose this frog to be considered as an endangered frog. Although we did not find more populations of the new species in the streams along the road from Suruguapo to Villavicencio, I believe its presence may be documented from nearby forests of Lara and Portuguesa states in the future, if monitoring studies are undertaken. Two other *Mannophryne* species live in Lara state, and both inhabit national parks: *M. yustizi* lives within the Yacambú national park, while *M. larandina* is a dweller of the Dinira National Park. *Mannophryne speeri* sp. nov inhabits an unprotected area.

I consider the species to be facing a very high risk of extinction in the wild and, accordingly, suggest the new species be proposed to the category of Endangered (EN), based on the following criteria: area of occupancy estimated to be less than 500 km^2, albeit so far known from a single location, and an estimated projected continuing decline in the extent of occurrence of the species, and a continuing decline in the extend and quality of habitat [category EN B2ab(i,iii)].

ACKNOWLEDGMENTS

I express my sincere thanks to Jason W. Speer, of Quality Float Works, Inc., Illinois, and to Kevin C. Zippel, of Amphibian Ark, both in USA, for their support to the research leading to the study and description of the new species.

My gratitude to my disciples, biologists Diego Cadenas and Francisco Nava, for participating in the collection of the type series, as well as to the local elementary school teachers Maria Isabel Ramos and Nellys Soto, that shortly accompanied us in the area.

Four-wheel vehicles were generously provided to field studies through the courtesy of the Geography Institute of the Venezuelan University of Los Andes at Mérida, Venezuela. This work benefited from financial and/or logistic support provided to the author by the National Geographic Society (grant No. 6176-98, "Herpetofaunal diversity in the lower Andes of Western Venezuela"), by PROVITA (through Fondo IEA, Projects "Andean Dendrobatoid frogs" and "Amphibians and Reptiles of Pueblos del Sur: Inventory of Species and Conservation"), as well as by the BIOGEOS Foundation to the study of biological diversity, Mérida, Venezuela.

REFERENCES

La Marca, E. 1994. Taxonomy of the frogs of the genus *Mannophryne* (Amphibia: Anura: Dendrobatidae). Publicaciones de la Asociación Amigos de Doñana 4:1-75.

La Marca, E. and P. Soriano.2004. Reptiles de Los Andes de Venezuela. Fundación Polar, Conservación Internacional, CODEPRE-ULA, Fundacite Mérida, BIOGEOS. Mérida, Venezuela.173 pp.

Manzanilla, J., E. La Marca and M. García-París. 2009. Phylogenetic patterns of diversification in a clade of neotropical frogs (Anura: Aromobatidae: *Mannophryne*). Biological Journal of the Linnaean Society 97:135-199.

MARNR (Ministerio del Ambiente y de los Recursos Naturales Naturales Renovables) and Gobernación del Estado Lara. [2002]. Atlas del Estado Lara. Servicio Autónomo de Geografía y Cartografía Nacional. Caracas, Venezuela. 87 pp.

Smith, R.F., N. Briceño, A. Chavez P. and G. Monroe. 1991. Aspectos descriptivos de la fisiografía de la Sierra de Portuguesa. 22 unnumbered pages *In* R.F. Smith, A. Rivero M., F. Ortega and J.A. Catalá. Ecología del estado Lara. Biollania. Edición Especial Nº 1. Monografías Científicas del Museo de Ciencias Naturales de la UNELLEZ Guanare, Estado Portuguesa, Venezuela, Nro. 1.

Vargas Galarce, J.Y. and E. La Marca. "2006" 2007. A new species of collared frog (amphibia: Anura: Dendrobatidae: *Mannophryne*) from the Andes of Trujillo State, Venezuela. Herpetotropicos 3(1):51-57.