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Lectotype designation for *Hyla goughi* BOULENGER, 1911 (Anura: Hylidae: Hylinae) and its recognition as a valid species

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The Neotropical hylid genus *Dendropsophus* FITZINGER, 1843 has seen recent advances that significantly improved our understanding of species diversity, limits, evolutionary relationships, and taxonomy (e.g., FAIVOVICH et al. 2005, ORRICO et al. 2021, WHITCHER et al. 2025). However, while new species continue to be described (e.g., MOTTA et al. 2012, ORRICO et al. 2014, FERRÃO et al. 2020, AGUIRRE et al. 2025), detailed examination has revealed that the correct assignment of nomina to taxa is not always straightforward (e.g., ORRICO et al. 2013, JUNGFER 2017, MELO-SAMPAIO 2023, ARIAS-CÁRDENAS et al. 2024, MORAVEC et al. 2025, NAKAMURA et al. 2025).

Within the eight species groups currently recognized (WHITCHER et al. 2025), the *Dendropsophus minutus* group is one of the most widely distributed of the genus, with representatives inhabiting at least eight biomes along cis-Andean South America (ORRICO et al. 2021). Despite its extensive distribution, this group contains only seven recognized species (ORRICO et al. 2021, WHITCHER et al. 2025): *Dendropsophus amicum* (MIJARES-URRUTIA, 1998), *D. aperomeus* (DUELLMAN, 1982), *D. delarivai* (KÖHLER &

LÖTTTERS, 2001), *D. limai* (BOKERMANN, 1962); *D. minutus* (PETERS, 1872), *D. stingi* (KAPLAN, 1994), and *D. xapurien-sis* (MARTINS & CARDOSO, 1987). The external morphology of all the members of this species group is very similar and no synapomorphies are known for the group (ORRICO et al. 2021).

GEHARA et al. (2014) produced a phylogeographic study of *Dendropsophus minutus* and used as outgroups selected species of *Dendropsophus*. They identified multiple mitochondrial lineages within nominal *D. minutus*, some of which could be assigned to previously described species instead of *D. minutus* sensu stricto. One such case involved the clade containing the lineages numbered 1–6 (GL 1–6 hereafter), for which GEHARA et al. (2014) proposed resurrecting *Hyla goughi* BOULENGER, 1911 from the synonymy of *D. minutus* and applying this name to these lineages. This decision was taken because (1) recognizing GL 1–6 as *D. minutus* would render this species paraphyletic, (2) the type locality of *Hyla goughi* (Trinidad) was circumscribed within the GEHARA et al. (2014) sampling (GL 4), and (3) *Hyla goughi* was considered related to

D. minutus as suggested by COCHRAN & GOIN (1970) who examined a cotype (BM[NH] 1911.9.8.6 [1947.2.13.83]) and noticed that it was identical to their examined specimens of *Hyla minuta* from Colombia (collected in Villavicencio, Meta).

Notwithstanding, BARRIO-AMORÓS et al. (2019) disagreed with the suggestion of GEHARA et al. (2014) and considered *Hyla goughi* as a junior synonym of *Hyla microcephala* COPE, 1886, stating that (page 75): “CBA [Cesar Barrio-Amorós] examined the type of *Hyla goughi* (BMNH 1947.2.13.12) and it is considered to be conspecific with *Hyla microcephala* Cope, 1886. A cotype of *H. goughi*, BMNH 1947.2.13.83, is a subadult *Dendropsophus* aff. *minutus*” and again on page 169: “in a recent visit to the BMNH, CBA corroborated the holotype of *Hyla goughi* from Trinidad as *Dendropsophus microcephalus*”. That proposal was widely adopted (e.g., ORRICO et al. 2021, FROST 2025) and led ORRICO et al. (2021) to suggest that the only available name for GL 1–6 was *D. amicorum*. However, BARRIO-AMORÓS et al. (2019) considered that in Venezuela, at least two species of the *D. minutus* group would co-occur: *D. amicorum* (known from the holotype) and *D. cf. minutus* (GL 1–6, which they refer to as “at least four putative species”). At the time of the GEHARA et al. (2014) paper, *Dendropsophus amicorum* (MIJARES-URRUTIA, 1998) was not assigned to any species group (see FAIVOVICH et al. 2005) and this species was (and still is) known only from the holotype. Therefore, no topotypical material of *D. amicorum* was available to GEHARA et al. (2014) nor for subsequent studies (e.g., ORRICO et al. 2021, WHITCHER et al. 2025).

Nevertheless, contrary to the statement of BARRIO-AMORÓS et al. (2019), BOULENGER (1911) never established a holotype for *Hyla goughi*. In fact, he clearly stated that *Hyla goughi* “was fortunately represented by numerous specimens, [donated by LEWIS H. GOUGH from Trinidad] which have enabled me to observe the wide and rapid changes of colour which this species undergoes, and of which an idea can be gained from the annexed coloured plate made by Mr. J. Green at the Gardens under my direction.”, but did not select a particular specimen to represent the species and his description cites more than one specimen. These are therefore to be considered syntypes according to the International Code of Zoological Nomenclature (ICZN 1999).

The Data Portal of the Natural History Museum (NHM 2025) provides records of three hylid specimens collected by LEWIS H. GOUGH from Trinidad: BMNH 1925495 (formerly 1911.9.8.5), 1947.2.13.12 (formerly 1911.9.8.5), and 1947.2.13.83 (formerly 1911.9.8.6) (Fig. 1). The Data Portal also provides images of the latter two. It is clear that BMNH 1947.2.13.12 (formerly 1911.9.8.5) is a specimen of *Dendropsophus microcephalus*, as already noted in a label by MARINUS S. HOOGMOED dated 23 November 1977 that coincides with the statement of BARRIO-AMORÓS et al. (2019), and that 1947.2.13.83 (formerly 1911.9.8.6) is of a species similar to *D. minutus* as noted by COCHRAN & GOIN (1970).

As it is clear that there is no holotype for *Hyla goughi*, a question arises: Has a lectotype designation ever been

made? FROST (2025) states that “Condit, 1964, J. Ohio Herpetol. Soc., 4: 75, who noted a paralectotype (BMNH 1947.2.13.83) to be *Dendropsophus* aff. *minutus*”. While providing a list of type specimens assigned to the hylids in the British Museum at the time, CONDIT (1964) clearly states that: “Most of the authors who described the hylid types in the British Museum (Natural History) used a series of specimens for the original description. In most cases these were all labeled types; they are here considered as cotypes. When, in the future, these cotype series are studied in more detail, one of the specimens from each should be designated as a lectotype. If there was only one specimen used in the original description the author has labeled it as the type. Type as used in this paper is the same as holotype.”. CONDIT’s (1964) account on *Hyla goughi* reads:

“*Hyla goughi goughi* Boulenger, 1911

Proc. Zool. Soc., London, 1911, p. 1084, pl. 64.

COTYPES: 1911.9.8.5 (RR.1947.2.13.12), British West Indies: Trinidad, L.

H. GOUGH. 1911.9.8.6 (RR.1947.2.13.83), British West Indies: Trinidad,

L. H. GOUGH”

Therefore, it is clear that CONDIT (1964) cited the cotypes (= syntypes) but explicitly did not select a lectotype for *Hyla goughi* among the available specimens nor considered this name to be invalid or a junior synonym of any other name. In fact, CONDIT (1964) was literal in leaving the lectotype designation to future research (see respective section above).

BOULENGER (1911) did not detail how many specimens he examined or how many were “...brought back by [Lewis H. Gough] from Trinidad.”. It is likely that L. H. GOUGH brought living individuals and that E. G. BOULENGER was able to examine them while they were still alive because (a) BOULENGER’s (1911) title makes reference to “a new Tree-Frog from Trinidad, living in the Society’s Gardens”, (b) “BOULENGER’s knowledge of the exhibition of reptiles, amphibians and fishes and the conditions necessary to their well-being in captivity was unrivalled” (VEVERS 1946), and (c) BOULENGER (1911) explicitly states that specimens change colour quickly: “When startled the majority became of a bright lemon-yellow.”. Also, the beautiful image (here reproduced as Fig. 2) depicts seven individuals. Five are drawn in dorsal view and two in ventral view. However, it is possible that one given specimen could be the basis for more than one image. At least five of the figured frogs (four in dorsal view and one in ventral view) are clearly based on living, possibly calling, males given the overall yellow colour related to the dynamic sexual dichromatism typical of many hylid species in the reproductive phase (BELL & ZAMUDIO 2012, BELL et al. 2017; Fig. 3) and thus, the colour changes BOULENGER (1911) noted were seemingly differences in the intensity of the metachrosis rather than changes in colour pattern (as blotches, lines, and spots).

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Of the seven frogs illustrated in the plate provided by BOULENGER (1911), at least three in dorsal view are undoubtedly *Dendropsophus minutus*-like (with dark brown hourglass dorsal pattern and/or chevron marks over a

brown or pale brown dorsum, and with the unique snout resembling a Volkswagen Beetle hood). The two other images of specimens in dorsal view that visibly differ from *D. minutus*-like specimens are the completely white and

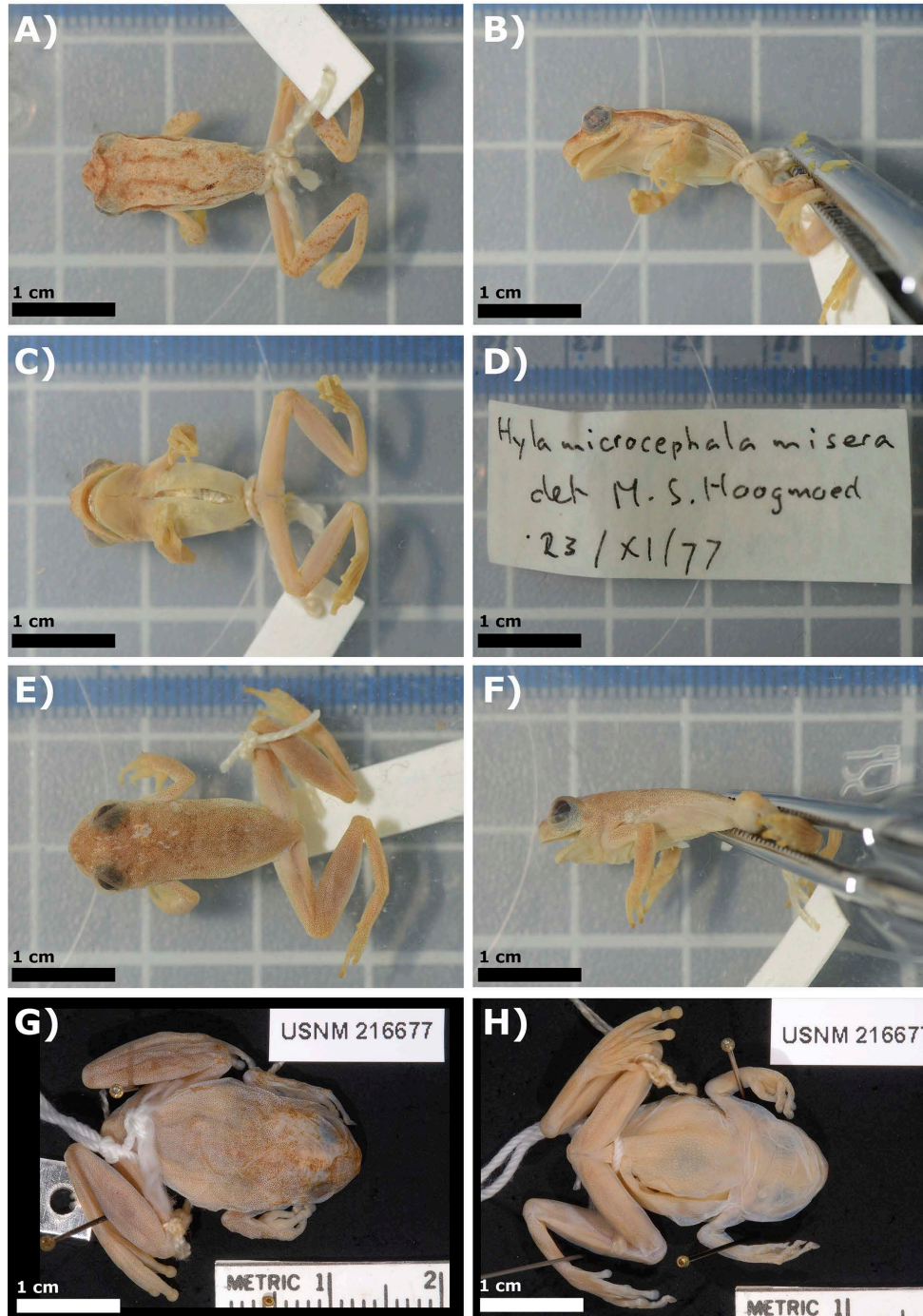


Figure 1. (A–C) Syntype (now paralectotype) of *Hyla goughi* BOULENGER, 1911, BMNH 1947.2.13.12 (formerly 1911.9.8.5), (A) dorsal view, (B) lateral view, (C) ventral view; (D) label for this specimen by MARINUS S. HOOGMOED; (E–F) syntype (now lectotype) of *Hyla goughi* BOULENGER, 1911, BMNH 1947.2.13.83 (formerly 1911.9.8.6), (E) dorsal view, (F) lateral view; (G–H) holotype of *Hyla amicorum* MIJARES-URRUTIA, 1998, USNM 216677, (G) dorsal view, (H) ventral view. Photographs of the types of *Hyla goughi* provided by Natural History Museum (2025), those of the type of *Hyla amicorum* provided by Smithsonian Institution (2025).

the half-black (or dark brown?), half-white images of specimens because they do not present neither the dorsal pattern nor the snout shape mentioned above. Although the half-black-half-white image could be a *D. minutus*-like specimen given the reddish pupil, the completely white one could correspond to *D. microcephalus* but lacks any characteristic that would provide a reasonable indication of its identity. Of the images depicting specimens in ventral view, one may be of a *D. minutus*-like specimen given the reddish pupil, a seemingly short and rounded snout, and a completely yellow venter; but this association is tentative at the best. The last one lacks any characteristic that would provide a reasonable indication of its identity. It is possible that the three images depicting white (or faded) specimens were produced based on preserved specimens given that bleaching is not unusual in preserved specimens exposed to direct sunlight, although BOULENGER (1911) passes the

impression that at least two live specimens were like this: “In one specimen I observed the head, fore limbs, and anterior part of the body to be dark brown, whilst the posterior part of the body and hind limbs were greyish white [as the image on the plate]. In another specimen the right half of the body was brown, the left half greyish white.”

It seems clear that all of the specimens used as models for the images in BOULENGER’s (1911) plate are the syntypes under Articles 72.4.1., 72.5.6., 73.1.4. of the Code (ICZN 1999). Nevertheless, only three extant specimens were found: BMNH 1925495 (formerly 1911.9.8.5), 1947.2.13.12 (formerly 1911.9.8.5), and 1947.2.13.83 (formerly 1911.9.8.6). Given that the type series comprises specimens from more than one species, a lectotype designation is in need. Henceforth, a second question arises: which specimen should be designated as lectotype? Both BMNH 1947.2.13.12 (formerly 1911.9.8.5), and 1947.2.13.83 (formerly 1911.9.8.6) are in excellent condition. Which one of these adheres best to the original description?

The description in BOULENGER (1911) is not specific enough to link it to a single specimen. However, he stated: (1) “Canthus rostralis feebly marked. Loreal region very slightly concave”; (2) “A brown or grey marking, often hourglass-shaped, edged with darker or lighter, extending from between the eyes to the anterior third of the back, followed by one or two transverse bars, is frequently present”; and (3) “the males issued a sharp creaky note”. A feebly marked canthus rostralis, hourglass spots on dorsum, and creaky notes are certainly characteristics more akin

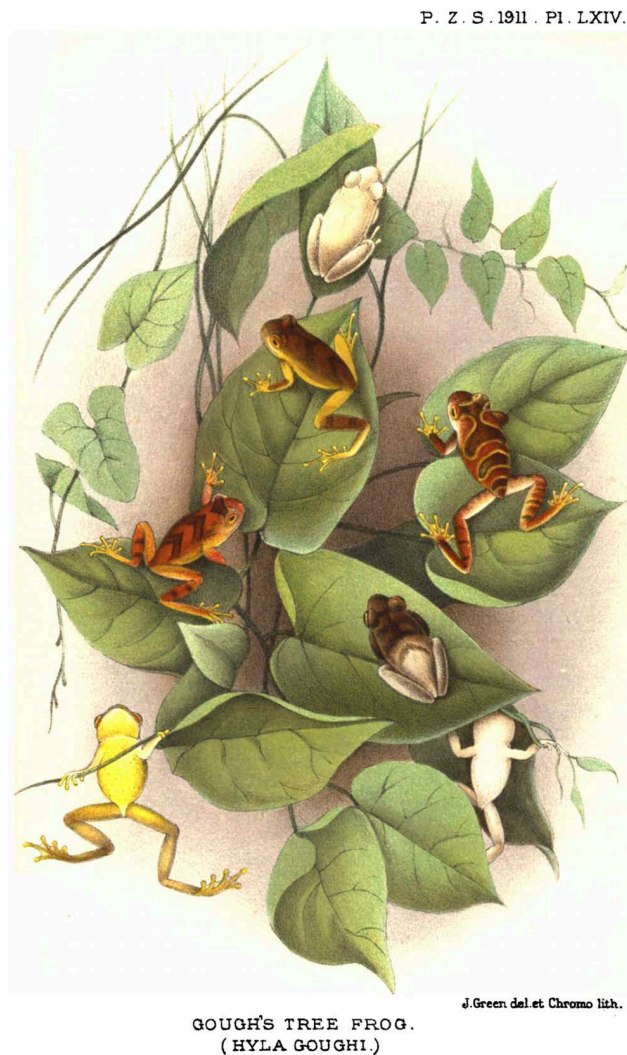


Figure 2. Reproduction of Mr. J. GREEN’s plate from BOULENGER (1911), depicting morphs of *Hyla goughi* (= *Dendropsophus goughi*).



Figure 3. A calling male of the *Dendropsophus minutus* group (possibly Gehara Lineage – GL 35) from Parque Ecológico de Gunma, municipality of Santa Bárbara do Pará, state of Pará, Brazil, not collected, displaying the yellow colour typical of the dynamic sexual dichromatism of reproductive males. Photograph by PEDRO PELOSO.

to those found in species of the *Dendropsophus minutus* group than those found in *D. microcephalus*, which has a marked canthus rostralis with a canthal stripe, lacks hour-glass spots on dorsum, and does not emit sharp squeaky notes (e.g., BOLÍVAR-G. et al. 2009, SAVAGE 2002). Nevertheless, BOULENGER (1911) also mentioned “In one specimen the marking took the shape of a cross-bar between the eyes and two parallel longitudinal bands extending along each side of the entire length of the back.” and that: “This species appears to be more nearly related to *Hyla strigilata* SPIX [now *Oloolygon strigilata* but by 1911, the association of the name to a biological entity was uncertain; see PIMENTA et al. 2007], from Brazil, and *Hyla misera* WERNER (Zool. Anz. 1903, p. 252), from Caracas, Venezuela, [= *D. microcephalus*]” making it evident that his description also highlights a few characters of at least one specimen of *D. microcephalus*. Besides the statements in the last two quoted sentences, *Hyla goughi* has been considered morphologically similar to *D. minutus* during the last fifty years (COCHRAN & GOIN 1970) until BARRIO-AMORÓS et al. (2019) placed *D. goughi* as a junior synonymy of *D. microcephalus*.

Finally, regarding the available syntypes of *Hyla goughi*, both BMNH 1947.2.13.12 (a specimen of *Dendropsophus microcephalus*, formerly 1911.9.8.5), and 1947.2.13.83 (a specimen of the *D. minutus* species group, formerly 1911.9.8.6) are in excellent condition and are good candidates to be selected as lectotype (there is no available image of BMNH 1925495). Therefore, considering that, overall, BOULENGER’S (1911) description of *H. goughi* largely refers to a *D. minutus*-like species, that there is at least one well-preserved *D. minutus*-like syntype, and that restoring an already available name rather than relegating it as a junior synonym of *D. microcephalus* and creating a new one for the lineages GL 1–6 of GEHARA et al. (2014) better contributes to a stable nomenclatural system, we here formally designate BMNH 1947.2.13.83 (formerly 1911.9.8.6) as the lectotype of *Hyla goughi* BOULENGER, 1911. To conform with the requirements of the amended International Code of Zoological Nomenclature, the nomenclatural act it constitutes has been registered in ZooBank (urn:lsid:zoobank.org:pub:53091223-65A5-40B6-9E22-957FoF636EoB) and is available from the following digital repositories: salamandra-journal.com, zenodo.org.

Morphological diagnoses among species assigned to the *Dendropsophus minutus* group are complicated by several factors, including high intraspecific variation in nominal taxa (e.g., see BARRIO-AMORÓS et al. 2019 for a discussion on *D. aff. minutus*; our *D. goughi*) and the lack of representative series of genotyped voucher specimens. Due to these challenges, providing definitive diagnoses lies beyond the scope of this work.

Reliable diagnoses are also hindered by the fact that *Dendropsophus amicornum* is known only from the holotype, which is poorly preserved. The original description is brief, and purported diagnostic traits (such as the absence of a dorsal pattern) are known to vary intraspecifically in the group (ORRICO et al. 2014). Consequently, the taxonomic status of *D. amicornum* remains unresolved.

The type locality of *Dendropsophus amicornum* is geographically close to two key sites: Atures, Amazonas, Venezuela (± 640 km away, where GL 6, now assigned to *D. goughi*, occurs; GEHARA et al. 2014), and Miraflores, Boyacá, Colombia, the type locality of *D. stingi* (GL 8), ± 635 km away. Genetic divergences (from a 16S mitochondrial gene fragment) among *D. goughi* lineages (GL 1–6) are of 3–5% (Table S3 of GEHARA et al. 2014) and although we are unable to rule out at the current state of knowledge that more than one species is contained in GL 1–6, these distances may simply correlate to geographic distances of conspecific lineages, rather than inter-specific divergence (FOUQUET et al. 2007). At the same time, genetic distances between *D. goughi* and *D. stingi* are 10–11%, and 8–11% relative to its remaining congeners of the *D. minutus* group (GEHARA et al. 2014). However, establishing a universal threshold for species delimitation is problematic (e.g., PADIAL et al. 2009, FOUQUET et al. 2014). Nevertheless, we consider it likely that *D. amicornum* is closely related or even conspecific with *D. goughi* or *D. stingi*; however, the lack of molecular data from topotypical specimens of *D. amicornum* or any other *D. minutus*-like specimen from nearby localities in the Andean Cordillera de Mérida and the western part of the Venezuelan Coastal Range, prevents us from testing this hypothesis.

Notably, so far, no evidence suggests that two distinct *Dendropsophus minutus* group species coexist along northern South America and the Caribbean, with one possible exception: ACOSTA-GALVIS (2017) reported *D. stingi* and *D. minutus* (his identification) from nearby localities (~ 10 km apart) in Casanare, Colombia. These populations are altitudinally segregated (*D. stingi* at 1000 m a.s.l., *D. minutus* at ~ 800 m a.s.l.), separated by a valley at 500 m a.s.l.

Given all these complexities, we remove *Dendropsophus goughi* (BOULENGER, 1911) from the synonymy of *Hyla microcephala* COPE, 1886 (where it has been placed by BARRIO-AMORÓS et al. 2019) and apply this name to the clade including lineages GL 1–6 as recovered by GEHARA et al. (2014). However, we cannot resolve the status of *D. amicornum*. Resolving this question, whether *D. amicornum* is a valid endemic of Cerro Socopó or a junior synonym of *D. goughi* or *D. stingi*, requires new topotypical material or museomic approaches as recently demonstrated in other cases (e.g., SCHERZ et al. 2020, KÖHLER et al. 2024, NAKAMURA et al. 2025, GRANT et al. 2025).

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