ISSN: 2594-6153

Posição taxonômica de populações topotípicas das variedades de *Scinax x-signatus* para a Amazônia brasileira(Anura, Hylidae, Scinaxinae)

Guilherme R. F. Sichieri[1], Marcelo Gordo[2] e Ivan Nunes[1]

[1] Universidade Estadual Paulista (UNESP), Instituto de Biociências, Campus do Litoral Paulista, Laboratório de Herpetologia (LHERP). Praça Infante Dom Henrique, s/n, Parque Bitarú. 11330-900, São Vicente, SP, Brazil

[2] Universidade Federal do Amazonas, Instituto de Ciências Biológicas, Departamento de Biologia. 69077-000, Manaus, AM, Brazil

E-mail: guilherme_rey@hotmail.com

Resumo: *Scinax x-signatus* foi originalmente descrito por Spix (1824) da localidade "Provincia Bahiae". O holótipo da espécie foi perdido durante a Segunda Guerra Mundial e um neótipo não foi designado levando à sinonímia de *S. x-signatus* com *Hyla affinis* e *Hyla coerulea*, ambas do estado do Amazonas. Portanto, apresentamos aqui a variação fenotípica de caracteres morfológicos e morfométricos das populações dos estados da Bahia e Amazonas. Adicionalmente trazemos a variação acústica do estado da Bahia. Resultados bioacústicos da população baiana revelaram uma população coesa, com alto grau de sobreposição entre as variáveis. A morfometria e a morfologia de ambas as populações sugerem não se tratar da mesma espécie, mas possivelmente um complexo de espécies, principalmente no Amazonas. Nossos resultados combinados indicam que a população da Bahia é significativamente diferente da população do estado do Amazonas e um estudo mais abrangente com dados moleculares deve corroborar isto.

Palavras-chave: Amazonas; Bahia; bioacústica; clado *Scinax ruber*; taxonomia.

Taxonomic status of topotypic varieties of *Scinax x-signatus* species assigned by Spix (1824) for the Brazilian Amazon (Anura, Hylidae, Scinaxinae)

Abstract: *Scinax x-signatus* was originally described by Spix (1824) from "ProvinciaBahiae". The holotype was lost during World War II and a neotype was not designated, thus leading to the synonymy of *S. x-signatus* to *Hyla affinis* and *Hyla coerulea*, both from Amazonas. Herein we present the phenotypic variation of morphological and morphometric characters of populations from states of Bahia and Amazonas. Additionally we provide the bioacoustic variation from state of Bahia. Bioacoustic results show an acoustically cohesive population in Bahia, however morphometric and morphological results show that these populations may not represent the same species. Our combined results show that Bahia populations of *S. x-signatus* are significantly different from population of Amazonas and a more comprehensive study with molecular data should corroborate that.

Keywords: Amazonas, Bahia, bioacoustics, *Scinax ruber* clade, taxonomy.

Introduction

The genus *Scinax* comprises neotropical treefrogs and belongs to the family Hylidae which has species distributed from Mexico to Argentina, with great occurrence in tropical and

subtropical rainforests of southeastern Brazil [1,4]. This genus imposes a challenge due to its great diversity of species, intraspecific similarity and frequent descriptions of new species [7] and has been reorganized in the past decade by a couple of cladistic analysis [1,2,4].

Scinax x-signatus (Spix, 1824) belongs to the former *S. ruber* clade and is known to occur throughout South America, especially Colombia, Venezuela, Guyana, Suriname and Brazil [4]. Due to the lost of the holotype during World War II, currently two names remain junior synonym of *S. x-signatus*: *Hyla affinis* Spix, 1824 (Amazonas River, Brazil) and *Hyla coerulea* Spix, 1824 (municipality of Tefé, Amazonas state, Brazil) [5].

Objectives

In the present work we use morphology, color patterns and morphometry to provide the variation of the phenotypic characters of *S. x-signatus* populations from states of Bahia (topotypic locality) and Amazonas (topotypic junior synonyms locality) in order to compare these two populations. Additionally, we present the acoustic variation of *S. x-signatus* in its topotypic locality, state of Bahia, Brazil.

Materials and Methods

A total of 48 adult males from Bahia and 23 adult males from Amazonas were measured for morphometric analysis and 66 specimens from states of Bahia and Amazonas were studied for external morphology. We measured 17 morphometric characters, including snout-vent length, nine measurements of the head, tympanum, nostrils and eye and also seven of the limbs [7]. For the bioacoustics, a total of 36 recordings from ten municipalities from state of Bahia were analyzed. We used the Raven Pro 1.5 software to conduct all acoustic analysis and nine spectral and temporal variables were measured including call duration and interval, maximum, minimum and dominant frequency, duration, interval and rate of pulse emission [6]. A Principal Component Analysis (PCA) was performed to account for statistical significant variance in morphometric data.

Results

In dorsal view, 74% specimens presented rounded head or subovoid shape. In lateral view, 89% specimens presented protuse or rounded head. 41% specimens show no distinct spots at the inter orbital region of the head, while the remaining 59% presented transverse spots that forms a stripe connecting the eyes.

On the hidden portion of the thighs, only four specimens (9%) presented small white dots, 21 specimens (46%) presented yellow blotches on a grayish/brownish background, and 17 specimens (37%) presented no spots. On the dorsum, the most recurrent pattern is two spots below the eyes curved inwardly that reach the middle of the dorsum (43%), sometimes reaching the sacral region (40%). On the sacral region, 11 specimens (24%) presented two spots curved inwardly similar to those on the dorsum, although the majority of specimens (72%) had no distinct spots. On the dorsum, 15 specimens (75%) presented two spots beneath the eyes similar to those found in state of Amazonas and in six specimens (30%) a second pair of spots is present on the sacral region. On the interorbital region a transversal spot connecting the eyes is present in all specimens from Bahia, however some specimens from Amazonas presented no spots on this region. The spots on the hidden portion of the thighs are similar to those found in Amazonas, although the ones from Bahia are a little more whitish.

Males from Bahia have larger snout-vent length (SVL) than the Amazonian population (SVL from Bahia = 32.39 – 41.26 mm; SVL from Amazonia = 17.1 – 31 mm) and also have larger foot length (FL), head width (HW), head length (HL), hand length (HAL), forearm length (FAL), eye-nose distance (END), nostril-snout distance (NSD) and eye distance (ED). The PCA shows a complete segregation between these two populations (Figure 1).

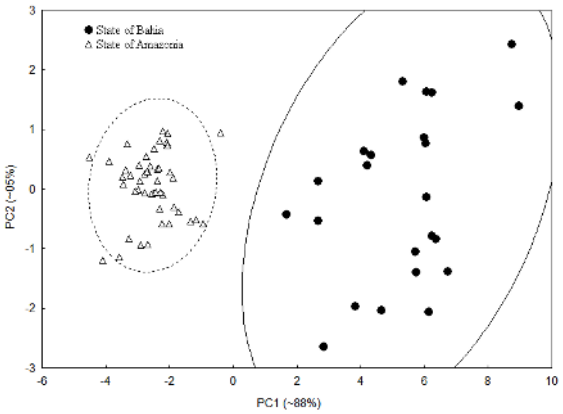


Figure 1.Projection of individual scores from the Principal Component Analysis (PCA) for the 17 morphometric variables. PC1 = Principal Component 1. PC2 = Principal Component 2.

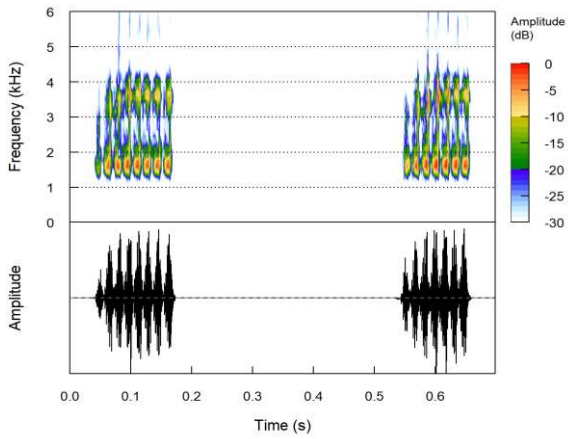


Figure 2. Advertisement call of *Scinax x-signatus* from Mata de São João, Bahia. Hot colors show more energy.

On the bioacoustics, the lower band of the call has dominant frequency around 1.034 up to 1.723 KHz and the upper band with dominant frequency around 3 up to 3.75 KHz. Advertisement calls show a large bandwidth, ranging from 0.141 – 6.785 KHz and dominant

ISSN: 2594-6153

frequency ranging from 1.034 – 3.79 KHz. Calls are short and range from 98 – 345 ms with 5 – 27 pulses per call emitted at a rate of 31.88 – 90.55 pulses/s. Pulse duration varies between 5.27 – 26.08 ms emitted in intervals between 1.21 – 18.44 ms. 25 recordings (69%) show an ascendant amplitude modulation reaching a plateau around the third or fourth pulse and sustaining it throughout the rest of the call. 22 recordings (61%) have two separated main frequency bands and in ten recordings (28%) from six different municipalities the males switch the dominant frequency between those two bands (Figure 2). Acoustic competition between conspecific and heterospecific males was found in some recordings.

Discussion

In general, specimens from state of Bahia showed less variation compared to the Amazonian population. Drawings made by Spix (1824) [8] show two pair of spots, one on the upper dorsum and the other on the sacral region, however this pattern was only found in eight specimens (17%) from Amazonas, thus leading us to conclude that this population might not represent the original *Hyla x-signata* (now *Scinax x-signatus*) described by the author in the early XIX century. Furthermore, this pattern is more recurrent in specimens from Bahia, which was expected, since this population theoretically is representative of *Hyla x-signata*. The general pattern of two pairs of longitudinal curved inwardly spots distinguishes *S. x-signatus* from species that have a dorsolateral white and/or dark brown longitudinal stripes (*Scinax auratus*, *S. cardosoi*, *S. cretatus*, *S. juncae*, *S. oreites*, *S. quinquefasciatus, S. squalirostris*, *S. staufferi*, *S. wandae*, *S. alter*, *S. crospedospilus*, *S. cuspidatus*, *S. imbegue*, *S. ruber*, and *S. tymbamirim*).

The great Snout-Vent length amplitude (SVL amplitude = 17.1 – 31 mm), together with the many color patterns found in Amazonas state represents evidence of several species under the name of *S. x-signatus.* Moreover, the segregation revealed by the PCA supports the hypothesis of two different species, currently under the same name.

There seems to be no geographic pattern in the advertisement calls analyzed. Most variables show overlap among municipalities. Only Santa Terezinha presented no variation of dominant frequency in all the 50 calls studied, with dominant frequency of 1.55 KHz and only in Conde the dominant frequency is always found on the upper frequency band. The greater number of pulses per call in Maracás may be explained by acoustic interaction with other

males, which also presents one male calling in silent intervals, what reduce acoustic interference among calling males.

Conclusions

Bioacoustics of the populations from state of Bahia showed a cohesive population, with overlap in almost every parameter. The morphometric segregation between populations from states of Bahia and Amazonas support the hypothesis of two different species under the same name. The great variation in morphology found in the Amazonian population, gives evidence of a complex of species being named as *Scinax x-signatus* or that are being misidentified in collections. We call attention to the urgency for the designation of a neotype, and the need for a more comprehensive work, including molecular data, in order to evaluate the total distribution range of *S. x-signatus*.

Acknowledgements: We thank to INPA, MNRJ/UFRJ and MZUSP for the loan of specimens and FNJV/UNICAMP, UEFS and UFBA for the recordings. To Fundação de Amparo a Pesquisa do Estado de São Paulo (FAPESP) for the Grant support (Proc. #18951-2).

References

1. Duellman, W.E., Marion, A.B. & Hedges, S.B. Phylogenetics, classification and biogeography of treefrogs (Amphibia: Anura: Arboranae). Zootaxa. 2016;4104(1):1-109.
2. Faivovich, J. A cladistic analysis of *Scinax* (Anura: Hylidae). Cladistics. 2012;18:367–393.
3. Faivovich, J., Haddad, C.F.B., Garcia, P.C.A., Frost, D.R., Campbell, J.A. & Wheeler, W.C. Systematic review of the frog family Hylidae with special reference to Hylinae: Phylogenetic analysis and taxonomic revision. Bull. Am. Mus. Nat. Hist. 2005;294:1–240.
4. Frost, D. R. Amphibian Species of the World: an Online Reference, version 6.0.American Museum of Natural History, New York. (accessed 10 November 2018) http://research.amnh.org/herpetology/amphibia/index.html.
5. Hoogmoed, M.S. & Gruber, U. Spix and Wagler type specimens of reptiles and amphibians in the Natural History Musea in Munich (Germany) and Leiden (the Netherlands). Spixiana. 1983;9:319–415.
6. Köhler, J., Jansen, M., Rodríguez, A., Kok, P.J.R., Toledo, L.F., Emmrich, M., Glaw, F., Haddad, C.F.B., Rodel, M.-O. & Vences, M. The use of bioacoustics in anuran taxonomy: Theory, terminology, methods and recommendations for best practice. Zootaxa 2017;4251:1–124. Wanger H, Bladt S, Zgainski EM. Plant drug analysis. Spring-Verlag Berlin. 1984:225-30.
7. Nunes, I., Kwet, A. & Pombal, J.P. Taxonomic revision of the *Scinax alter* species complex (Anura: Hylidae). Copeia. 2012;2012(3):554–569.
8. Spix, J.B. *Animalia nova sive Species novae Testudinum et Ranarumquas in itinere per Brasiliamannis MDCCCXVII-MDCCCXX jussu et auspiciis Maximiliani Josephi I. Bavariae Regis*. 1824