

Release call of *Corythomantis greeningi* Boulenger, 1896 (Anura: Hylidae)

Lucas Rafael Uchôa ^a, Etielle Barroso de Andrade ^{b*}

^a Programa de Pós-Graduação em Zoologia, Universidade Estadual de Santa Cruz, Ilhéus, 45662-900, Bahia, Brasil.

^b Instituto Federal de Educação, Ciência e Tecnologia do Piauí, Pedro II, 64255-000, Piauí, Brasil. *etlandrade@hotmail.com

Received: February 25, 2022 / Accepted: August 25, 2022 / Published online: September 30, 2022

Abstract

The release calls carry species-specific characteristics that can be used for the diagnosis of closely related species. Despite its importance, for the Lophyohylini tribe, this type of call is known only for two species. *Corythomantis greeningi* is a species widely distributed in xeric and sub-humid regions of northeastern Brazil. Herein, we describe for the first time the release call of *C. greeningi* recorded in the Pedro II municipality, state of Piauí, northeastern Brazil. The release call, emitted during handling in its axillary region, was structurally and quantitatively different from the advertisement call, presenting a lower number of pulses per note and a lower dominant frequency. This work represents an important contribution to the intra and interspecific communication mechanisms of the species.

Keywords: Lophyohylini; casque-headed tree frog; acoustic communication; Brazilian semiarid.

Canto de soltura de *Corythomantis greeningi* Boulenger, 1896 (Anura, Hylidae)

Resumo

O canto de soltura apresenta características espécie-específicas e pode ser utilizado para o diagnóstico de espécies intimamente relacionadas. Apesar de sua importância, para a tribo Lophyohylini, esse tipo de canto é conhecido apenas para duas espécies. *Corythomantis greeningi* é uma espécie amplamente distribuído nas regiões xéricas e subúmidas do nordeste brasileiro. Aqui, descrevemos pela primeira vez o canto de soltura de *C. greeningi* registrado no município de Pedro II, estado do Piauí, Nordeste do Brasil. O canto de soltura, emitido durante o manuseio na região axilar, foi estrutural e quantitativamente diferente do canto de anúncio, apresentando menor número de pulsos por nota e menor frequência dominante. Este trabalho representa uma importante contribuição para os mecanismos de comunicação intra e interespecíficos da espécie.

Palavras-chave: Lophyohylini; perereca-cabeça-de-capacete; comunicação acústica; semiárido brasileiro.

The release call represents one of several acoustic signals emitted by anurans as a form of intraspecific communication during the reproductive season (Toledo *et al.*, 2014; Köhler *et al.*, 2017). It is usually emitted by an individual (male or female) when it is amplexed or tentatively grabbed by a male, and suggest an unreceptive state of the individual (Toledo *et al.*, 2014; Köhler *et al.*, 2017). Like advertisement call, release call carries species-specific information and characteristics, which can be used for the diagnosis of closely related species, being therefore, a useful phylogenetic tool (e.g., Guerra, Baldo, Rosset, Borteiro, & Kolenc, 2011; Grenat & Martino, 2013).

The Lophyohylini tribe (Hylidae: Hylinae) is composed by 88 species (Frost, 2021), and in spite of this diversity, only two species were studied considering characteristics of the release calls (Gordo *et al.*, 2013; Forti, Foratto, Márquez, Pereira, & Toledo, 2018). Among the Lophyohylini, *Corythomantis greeningi* Boulenger, 1896 is a medium to large-sized hylid species (66.1-71.7 mm) widely distributed in xeric and sub-humid regions of northeastern Brazil (Figure 1), and Caatinga-Cerrado transition areas in the states of Minas Gerais,

Tocantins, and Goiás (Godinho, Moura, & Feio, 2013). Although part of the acoustic repertoire of this species is known (Jared, Antoniazzi, Katchburian, Toledo, & Freymüller, 1999; Jared & Antoniazzi, 2008; Juncá, Carneiro, & Rodrigues, 2008), the release call has never been described. Herein, we describe for the first time the release call of *C. greeningi*.

One individual of *C. greeningi* (Figure 2A) was recorded vocalizing in the Pedro II municipality (Figure 1; 4°25.704'S; 41° 27.081'W, datum WGS84, ca 600 m a.s.l.), state of Piauí, northeastern Brazil (collection permission: SISBio #61838-2/19). Release calls were recorded on 06 January 2019, at approximately 21:00 h. The calls were emitted during the handling of the male in the axillary region, simulating an amplexus. Handling was carefully performed by only one of the observers during the emission of the call. Voucher specimens was authorized with 5% lidocaine, fixed in 10% formalin and deposited at Biological Collection of the Instituto Federal de Educação, Ciência e Tecnologia do Piauí-IFPI *Campus* Pedro II (CBPII 074), state of Piauí,

Brazil, and the sound file is housed at the Fonoteca Neotropical Jaques Veilliard (acronym FNJV, #45548). The release call was recorded with a Tascam® DR-05 digital recorder coupled to a CSR HT-81 directional microphone, and sampled at 44.1 kHz and 16 bits resolution. The acoustic analysis was conducted in software Raven Pro 1.6.1 (Bioacoustics Research Program 2019). Raven settings were: window size = 512 samples; window type = Hann; 3dB filter bandwidth = 124 Hz; window overlap = 85% (locked); hop size = 76 sample; DFT size = 1024 samples (locked); grid spacing = 43.1Hz; brightness = 50%, contrast = 50%. The peaks of the dominant frequency were obtained through the “Peak Frequency (Hz)” function. The minimum and maximum frequencies (Hz) were considered as values with 5 and 95% of call energy obtained by “Frequency 5%” and “Frequency 95%” functions. The following acoustic parameters were analyzed: call duration, inter-call interval, note number per call, inter-note interval, note duration, note rate (note per second), maximum frequency, minimum frequency, and peak of the dominant frequency. Note and call terminologies follow Köhler *et al.* (2017) using a note-centered approach. Sound figure was produced using the packages Seewave 2.1.6 (Sueur, Aubin, & Simonis, 2008) and tuneR 1.3.3 (Ligges, Krey, Mersmann, & Schnackenberg, 2017), in software R 4.1.2 (R Core Team, 2021), with the following settings: window = Hanning; FFT size = 1024 samples; FFT overlap = 90%; color scale = 30 dB relative. A 36-dB noise reduction was applied to the release call using software Audacity 3.1.3 (Audacity Team, 2021).

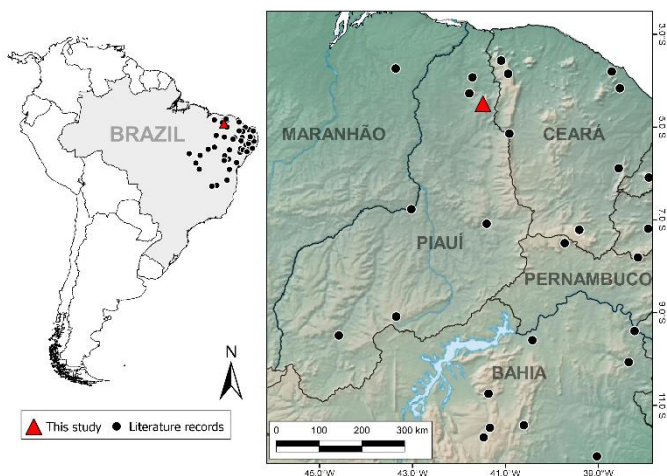


Figure 1. Geographic distribution of *Corythomantis greeningi* based on literature records (Borges-Nojosa & Cascon, 2005; Borges-Nojosa, Prado, Borges-Leite, Gurgel Filho, & Bacalini, 2010; Godinho *et al.*, 2013; Silva, Hoffmann, & Santana, 2014; Benício, Silva, & Fonseca, 2015; Santana *et al.*, 2015; Silva-Soares & Mônico, 2017; Marques, Haddad, & Garda, 2021) and record of municipality of Pedro II (red triangle), state of Piauí, Brazil.

The individual of *C. greeningi* emitted the release calls with its mouth closed along with vibrating pulses of the body wall. The release call is simple and composed of 3–13 (9 ± 3.43 ; 15 calls) multi-pulsed notes (Figure 2B-C) emitted at a rate of 9.2 calls per minute during 1:30 minutes. Peak of the dominant frequency ranging from 86.13 to 430.66 Hz (284.57 ± 66.64

Hz), not being possible to identify the harmonic bands, minimum frequency ranging from 0.00–172.27 Hz (121.45 ± 51.47 Hz) and maximum frequency ranging from 516.80–1464.26 Hz (958.61 ± 146.78 Hz). Call duration varied from 0.61–3.73 s (1.96 ± 0.86 s; 15 calls) with inter-call intervals from 0.48 to 12.21 s (3.75 ± 3.64 s; 14 intervals). Each call is composed by 3–10 pulses per note (6.5 ± 1.5 pulses/note; 136 notes; Figure 2C) with duration of 0.029–0.095 s (0.056 ± 0.011 s) and inter-notes intervals ranging from 0.086–0.457 s (0.174 ± 0.046 s; 135 intervals) emitted at a rate of 3.48–5.40 note per second (4.74 ± 0.55 note/s).

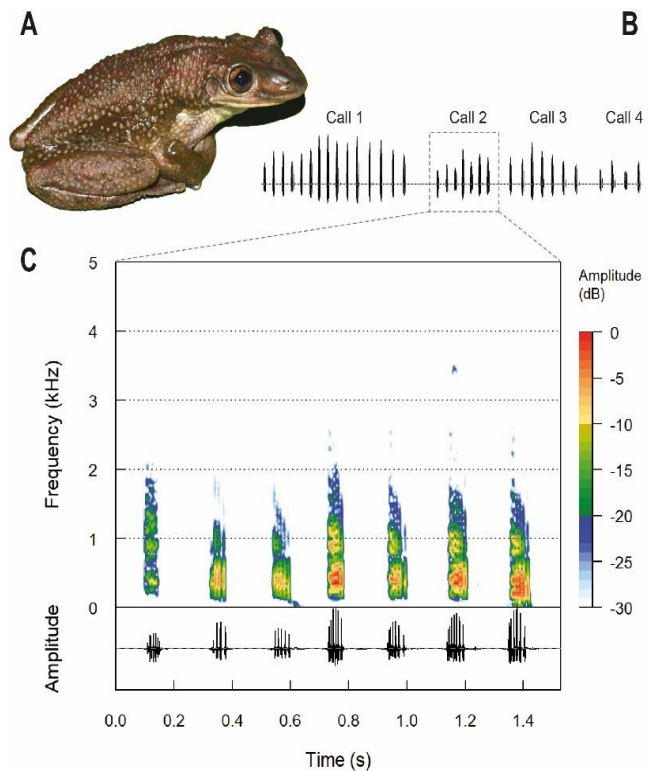


Figure 2. Release call of *Corythomantis greeningi*. A - Male of *Corythomantis greeningi* (CBPII 074; Snout-Vent Length = 71,74 mm) collected in the Pedro II municipality, state of Piauí, northeastern Brazil; B - Oscillogram section of four release calls of *C. greeningi*; C - Audiospectrogram (top) and corresponding oscillogram (bottom) of the call 2 of the previous figure detailing the seven notes.

Over the years, part of the acoustic repertoire of *C. greeningi* has been described for different populations. Jared *et al.* (1999) presented an audiogram of calls recorded in the Angicos municipality, state of Rio Grande do Norte, Brazil. Juncá, Carneiro, and Rodrigues (2008) described the advertisement call from state of Bahia, Brazil and compared it with that presented by Jared *et al.* (1999) interpreting it as a territorial call. However, Jared and Antoniazzi (2008) argued that this type of call was not specified since there was no descriptive or quantitative analysis of the call of individuals from Angicos. However, the call presented by Jared *et al.* (1999) and the advertisement call described by Juncá *et al.* (2008) are structurally similar. The advertisement call of *C. greeningi* consists of a multi-pulsed

note formed by two different types of notes with amplitude and frequency modulation at the end of the call (see figure 3 of Juncá *et al.*, 2008) and dominant frequency of 980 ± 210 kHz.

The release call was structurally and quantitatively different from the advertisement call. The main difference is observed in the type of the call, in which the release call is formed by several multi-pulsed notes emitted continuously without any modulation in the frequency. In addition, the number of pulses per note and dominant frequency of the release calls are lower, being this latter corresponding to 30% of the dominant frequency emitted during the advertisement call.

In contrast, the duration of the release call was seven times longer than the advertisement call. Structural differences between advertisement call and release call, specifically those related to the call duration, number of pulses, and dominant frequency, are common and well documented in different species (Köhler *et al.*, 2017; Mângia *et al.*, 2017, 2019; Pereira, Folly, Lacerda, & Rebouças, 2019). The release call of *C. greeningi* resemble more those of *Trachycephalus cunauaru* Gordo, Toledo, Suárez, Kawashita-Ribeiro, Ávila, Morais, & Nunes, 2013 than *Itapotihyla langsdorffii* (Duméril & Bibron, 1841), with as the first two species present a call composed by short-pulsed notes without harmonic structure (Gordo *et al.*, 2013), coinciding with the phylogenetic tree for Lophyohylinae proposed by Blotto *et al.* (2020).

Corythomantis greeningi is commonly observed calling in ponds hidden between rocks or close to rocky environments and the tadpoles are often found clasping on the rocky bed of lotic and lentic ponds (Jared & Antoniazzi, 2008; Juncá *et al.*, 2008). However, despite its wide distribution, little is known about the different aspects of its ecology and reproductive biology. Further studies are essential to understand all aspects of the reproduction of *C. greeningi* in xeric environments of northeastern Brazil, in particular the mechanisms of intra and interspecific communication of the species.

Acknowledgments

The authors are grateful to Instituto Federal de Educação, Ciência e Tecnologia do Piauí - IFPI for providing a grant through the Programa de Apoio à Pesquisa, Estruturação e Reestruturação Laboratorial - PROAGRUPAR-INFRA (edital nº 077 de 07/05/2018), Cornell Lab of Ornithology (Bioacoustics Research Program) for providing licenses of Raven Pro and to Instituto Chico Mendes de Conservação à Biodiversidade by licence (#61838-2/19). LRU thanks the Fundação de Amparo à Pesquisa e ao Desenvolvimento Científico e Tecnológico do Maranhão for the fellowship (#BM-01016/21).

References

- Audacity Team (2021). *Audacity®. Version 2.0.0. Audio editor and recorder*. <http://audacityteam.org/>. Accessed 25 Feb. 2021.
- Benício, R. A., Silva, G. R. & Fonseca, M. G. (2015). Anurans from a Caatinga area in state of Piauí, northeastern Brazil. *Boletim do Museu de Biologia Mello Leitão*, 37(2), 207-217.
- Bioacoustics Research Program (2019). *Raven Pro: Interactive Sound Analysis Software, version 1.5*. Ithaca, New York: The Cornell Lab of Ornithology. <http://www.birds.cornell.edu/raven>. Accessed 25 Feb. 2021.
- Boulenger, G.A. (1896) Descriptions of new batrachians in the British Museum. *Annals and Magazine of Natural History*, 6(17), 401–406.
- Borges-Nojosa, D.M. & Cascon, P. (2005). Herpetofauna da área Reserva da Serra das Almas, Ceará. Análise das variações da biodiversidade do bioma Caatinga, 1(1), 245-260.
- Borges-Nojosa, D.M.; Prado, F.M.V.; Borges-Leite, M.J.; Gurgel Filho, N.M. & Bacalini, P. (2010). Avaliação do impacto do manejo florestal sustentável na herpetofauna de duas áreas de caatinga nos municípios de Caucaia e Pacajus no Estado do Ceará. *Uso sustentável e conservação dos recursos florestais da caatinga*, 1(1), 315-330.
- Duméril, A.M.C. & Bibron, G. (1841). *Erpétologie Générale ou Histoire Naturelle Complète des Reptiles*. 8. Paris: Librairie Encyclopedique de Roret.
- Forti, L.R.; Foratto, R. M.; Márquez, R.; Pereira, V.R. & Toledo, L.F. (2018). Current knowledge on bioacoustics of the subfamily Lophyohylinae (Hylidae, Anura) and description of *Ocellated tree frog Itapotihyla langsdorffii* vocalizations. *PeerJ*, 6, 4813. doi: peerj.4813
- Godinho, L.B.; Moura, M.R. & Feio, R.N. (2013). New records and geographic distribution of *Corythomantis greeningi* Boulenger, 1896 (Amphibia: Hylidae). *Check List*, 9(1), 148-150. doi: 10.15560/9.1.148
- Gordo, M.; Toledo, L.F.; Suárez, P.; Kawashita-Ribeiro, R.A.; Ávila, R.W.; Morais, D.H. & Nunes, I. (2013). A new species of milk frog of the genus *Trachycephalus* *ischudi* (Anura, Hylidae) from the Amazonian rainforest. *Herpetologica*, 69(4), 466-479. doi: 10.1655/Herpetologica-D-11-00086
- Grenat, P.R. & Martino, A.L. (2013). The release call as a diagnostic character between cryptic related species *Odontophrynus cordobae* and *O. americanus* (Anura: Cycloramphidae). *Zootaxa*, 3635(5), 583-586. doi: 10.11646/zootaxa.3635.5.8
- Guerra, C.; Baldo, D.; Rosset, S.; Borteiro, C. & Kolenc, F. (2011). Advertisement and release calls in Neotropical toads of the *Rhinella granulosa* group and evidence of natural hybridization between *R. bergi* and *R. major* (Anura: Bufonidae). *Zootaxa*, 3092, 26-42. doi: 10.11646/zootaxa.3092.1.2
- Jared, C. & Antoniazzi, M.M. (2008). The casque-headed tree-frog *Corythomantis greeningi*: Clarifying some points on its biology. *Zootaxa*, 68, 67-68. doi: 10.11646/zootaxa.1792.1.5
- Jared, C.; Antoniazzi, M.M.; Katchburian, E.; Toledo, R.C. & Freymüller, E. (1999). Some aspects of the natural history of the casque-headed tree frog *Corythomantis greeningi* Boulenger (Hylidae). *Annales des Sciences Naturelles-Zoologie et Biologie Animale*, 20, 105-115. doi: 10.1016/s0003-4339(00)86975-0
- Juncá, F.A.; Carneiro, M.C.L. & Rodrigues, N.N. (2008). Is a dwarf population of *Corythomantis greeningi* Boulenger, 1896 (Anura, Hylidae) a new species? *Zootaxa*, 56, 48-56. doi: 10.11646/zootaxa.1686.1.4
- Köhler, J.; Jansen, M.; Rodríguez, A.; Kok, P.J.R.; Toledo, L.F.; Emrich, M.; Glaw, F.; Haddad, C.F.B.; Rödel, M.O. & Vences, M. (2017). The use of bioacoustics in anuran taxonomy: theory, terminology, methods and recommendations for best practice. *Zootaxa*, 4251(1), 1-124. doi: 10.11646/zootaxa.4251.1.1
- Ligges, U.; Krey, S.; Mersmann, O. & Schnackenberg, S. (2017). *TuneR: analysis of music and speech*. <https://CRAN.R-project.org/package=tuner/>. Accessed 25 Feb. 2021.
- Mângia, S.; Camurugi, F.; Pereira, E.A.; Carvalho, P.; Röhr, D.L.; Folly, H. & Santana, D.J. (2019). Release calls of four species of Phyllomedusidae (Amphibia, Anura). *Herpetozoa*, 32, 77-81. doi: 10.3897/herpetozoa.32.e35729
- Mângia, S.; Carvalho, P.; Pereira, E.A.; Cavalcanti, L.; Simões, C.R. & Santana, D. (2017). Release call of *Scinax eurydice* (Bokermann, 1968) (Anura, Hylidae) and advertisement call of northern populations. *Herpetology Notes*, 10, 237-243. doi: <https://www.biotaxa.org/hn/article/view/24694>
- Marques, R.; Haddad, C.F. & Garda, A.A. (2021). There and back again from monotypy: a new species of the casque-headed *Corythomantis* Boulenger 1896 (Anura, Hylidae) from the Espinhaço Mountain Range, Brazil. *Herpetologica*, 77(1), 56-71. doi: <http://dx.doi.org/10.1655/0018-0831-77.1.56>
- Pereira, E.A.; Folly, H.; Lacerda, J.V.A. & Rebouças, R. (2019). Release call of *Bokermannohyla ibitiopoca* Caramaschi & Feio, 1990 (Anura, Hylidae). *Zootaxa*, 4656, 193-195. doi: 10.11646/zootaxa.4656.1.13
- R Core Team (2021). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>. Accessed 25 Feb. 2021.
- Santana, D.J.; Mângia, S.; Silveira-Filho, R.R.D.; Silva Barros, L.C.D.; Andrade, I.; Napoli, M.F.; Juncá, F. & Garda, A.A. (2015). Anurans from the Middle Jaguaribe River Region, Ceará State, Northeastern

- Brazil. *Biota Neotropica*, 15(3): 1-8. doi: 10.1590/1676-06032015001715
- Silva, L.A.; Hoffmann, M.C. & Santana, D.J. (2014). New report of *Corythomantis greeningi* Boulenger, 1896 (Amphibia, Hylidae) in the Cerrado domain, state of Tocantins, Central Brazil. *Herpetology Notes*, 7(1), 717-720.
- Silva-Soares, T. & Mônico, A.T. (2017). Hind limb malformation in the tree frog *Corythomantis greeningi* (Anura: Hylidae). *Phyllomedusa. Journal of Herpetology*, 16(1), 117-120. doi: 10.11606/issn.2316-9079.v16i1p117-120
- Sueur, J.; Aubin, T. & Simonis, C. (2008). Seewave, a free modular tool for sound analysis and synthesis. *Bioacoustics*, 18(2), 213-226. doi: 10.1080/09524622.2008.9753600
- Toledo, L.F.; Martins, I.A.; Bruschi, D.P.; Passos, M.A.; Alexandre, C. & Haddad, C.F.B. (2014). The anuran calling repertoire in the light of social context. *Acta Ethologica*, 18, 87-99. doi: 10.1007/s10211-014-0194-4

License: Creative Commons CC BY NC 4.0

This article was published with open access for distribution under the terms of the Creative Commons Attribution License, which allows unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.