The call of Rhinella festae (Peracca, 1904) (Anura: Bufonidae) from Morona Santiago, Ecuador

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ABSTRACT
We describe for the first time the call of Rhinella festae (Peracca, 1904), recording it in captivity inside a plastic bag. The call is composed of 1 to 2 multi-pulsed notes (2–5 pulses), has an average duration of 0.72 s, and a dominant frequency of 1.40 kHz. This species is characterized by the absence of vocal slits and sacs, so the emission of this call would be considered unusual and uncommon. In addition to the purpose of improving the knowledge of species suggested as mutes, we have also compiled information from other anuran species that emit sounds with the absence of these anatomical structures.

Rhinella festae is a nocturnal species that is assigned to the Rhinella festae species group that inhabits the undergrowth of tropical and piedmont primary forests [1–3]. This species is distributed in middle and low elevations, up to 1700 m in the Cordillera de Kutuku and Cordillera del Cóndor in Ecuador and Peru [4,5].

One of the most conspicuous and important ethological features of anurans is their acoustic communication [6,7]. Anuran species have different types of calls, which express a wide variety of behaviours and are associated with a specific social context and function [8–11]. Anuran calls present specific characteristics for each species (i.e. spectral and temporal parameters), being used in the herpetology as an identification trait [6,12,13].

The call of Rhinella festae is a particularly unusual record because this species has no vocal slits and sacs [4], anatomical structures that are related to the sound production mechanism in anurans [7,14]. In this work, we present for the first time the call of Rhinella festae after remaining unknown more than 100 years later of its description as a new species.

Recordings were made on 26 November 2016 in the locality Rio Abanico (2° 13’ 25”S, 78° 14’ 45”W, datum WGS84, 1,570 m a.s.l.), at the province of Morona Santiago, Ecuador, at 18:00 h (16°C, 85% relative humidity). One male was unexpectedly recorded in captivity several hours after being collected while emitting calls from inside a plastic bag (ex situ) in a base camp. Calls were obtained using an Olympus WS-802 digital recorder about 1 m distance from the specimen. Calls were analyzed at a 44.1 kHz sampling rate and 16-bit resolution. The collected male was deposited at the División de Herpetología del Instituto Nacional de Biodiversidad, Quito, Ecuador (DHMECN 15830; SVL 34 mm). The recording was deposited at the Fonoteca Zoológica (www.fonozoocom) del Museo Nacional de Ciencias Naturales (CSIC), Madrid, Spain (FZ sound code 12,022).

For the analysis of the calls, we used Raven Pro version 1.4 [15]. In the settings, we applied a Hann window with 50% overlap and a DFT window width of 512 samples. Oscillogram and spectrogram images were obtained using R software version 3.6.3 [16], with the package Seewave version 2.1.5 [17] using a Hanning window type with 90% overlap, a fast Fourier transform (FFT) window width of 1024 samples, and a frequency limit of 4 kHz. Audio files in WAV format were imported with the tuneR package version 1.3.3 [18]. Definitions, terminology, and measurements in the description of the call follow Köhler et al. [11] and Sueur [19].

The call of Rhinella festae is composed of 1 to 2 multi-pulsed notes (2–5 pulses), with a mean dominant frequency of 1.40 kHz. The lowest dominant frequency values occur in the last pulses of the notes (Figure 1). We report the spectral and temporal parameters in Table 1. The analyzed calls were not assigned to a specific call type (see Toledo et al. 2015 [10]). They could tentatively be classified as advertisement calls, as these are most common in anurans [7,11]. Considering the low number of samples and the special condition of recording (i.e. calls emitted from inside a plastic bag), the calls of Rhinella festae analyzed in this report could not be considered like common of this species, because their calls in natural environments are not known.
The emissions of an individual in captivity may vary. Under this context, Batallas and Brito [20] described the advertisement call of Noblella lochites (Lynch, 1976) and mentioned that it is clearly different from calls recorded in captivity.

The call of *R. festae* is the first known and described call for the *Rhinella festae* species group. The unusual emission with the absence of vocal slits and sacs is not a characteristic and unique trait of *R. festae*, and it also occurs in other species of anurans (Table 2). One example to be noted is the case of Chiasmocleis antenori (Walker, 1973), in which Duellman [21] suggested that it must be a mute species due to the absence of these anatomical structures. However, the genus Chiasmocleis have been described the calls of this and several species that are characterized by the absence of vocal slits and sacs (Table 2).

*Rhinella festae* is an uncommon species in Ecuador, and the current state of its population is unknown [4,22]. Describing the call of this species will not only generate an identification trait, but it will allow with passive acoustic methods (knowing beforehand that it emits sounds and is not mute) to monitor and expand the knowledge of this species.

### Table 1. Descriptive statistics of call parameters of one individual of *Rhinella festae*.

| Parameters                              | Range (Mean ± SD) |
|-----------------------------------------|-------------------|
| Dominant frequency (kHz)                | 1.21–1.55 (1.40 ± 0.10) |
| Call duration (s)                       | 0.18–0.98 (0.72 ± 0.29) |
| Interval between calls (s)              | 1.87–29.45 (6.55 ± 7.95) |
| Call rate (calls/min)                   | 1.98–27.60 (14.29 ± 7.91) |
| Notes per call                          | 1–2 (1.75 ± 0.45) |
| Note duration (s)                       | 0.14–0.29 (0.22 ± 0.04) |
| Interval between notes (s)              | 12–26 (18.75 ± 3.37) |
| Note rate (notes/s)                     | 1.20–1.58 (1.47 ± 0.12) |
| Pulses per note                         | 2–5 (3.86 ± 0.79) |
| Pulse duration (s)                      | 0.011–0.058 (0.024 ± 0.01) |
| Interval between notes (s)              | 0.022–0.061 (0.041 ± 0.001) |
| Pulse rate (pulses/s)                   | 11.63–19.61 (14.91 ± 1.81) |

### Table 2. Studies that report call descriptions with absence of vocal slits or sacs in anurans.

| Species                          | Vocal slits | Vocal sac | Type          | Reference |
|----------------------------------|-------------|-----------|---------------|-----------|
| Chiasmocleis antenori           | Absent      | Absent    | Quantitative* | [23]      |
| Chiasmocleis carvalhoi          | Absent      | Absent    | Quantitative  | [24]      |
| Chiasmocleis mantiqueira        | Absent      | Absent    | Quantitative  | [25]      |
| Chiasmocleis parkeri            | Present     | Absent    | Quantitative  | [26]      |
| Craugastor aff.                 | Absent      | Absent    | Quantitative  | [27]      |
| Persimilis                      | Absent      | Absent    | Quantitative  | [28]      |
| Craugastor gabbi                | Absent      | Absent    | Quantitative  | [27]      |
| Craugastor galacticornatus      | Absent      | Absent    | Quantitative  | [28]      |
| Craugastor golmeri              | Absent      | Absent    | Quantitative  | [29]      |
| Craugastor noblesi              | Absent      | Absent    | Quantitative  | [30]      |
| Craugastor stejnegerianus       | Absent      | Absent    | Quantitative  | [31]      |
| Craugastor stejnegerianus       | Absent      | Absent    | Quantitative  | [27]      |
| Craugastor underwoodi           | Absent      | Absent    | Quantitative  | [27]      |
| Craugastor yucatanensis         | Absent      | Absent    | Quantitative  | [27]      |
| Gastrotheca cornuta             | Absent      | Absent    | Quantitative  | [33]      |
| Megaelosia goeldii              | Absent      | Absent    | Quantitative  | [34]      |
| Pristimantis dorado             | Absent      | Absent    | Quantitative  | [35]      |
| Pristimantis nelsonangolai      | Absent      | Absent    | Quantitative  | [36]      |
| Pristimantis paquishae          | Absent –    | Absent    | Quantitative  | [37]      |
| Pristimantis trachybaphus       | Absent      | Absent    | Qualitative   | [38]      |
| Rhinella festae                 | Absent      | Absent    | Quantitative  | [This study]|
| Stefania Evanisi                | Absent      | Absent    | Quantitative  | [33,39]   |
| Stefania rivieri                | Absent      | Absent    | Quantitative  | [33,39]   |
| Tripon spinosus                 | Absent –    | Absent    | Quantitative  | [40,41]   |

*Based on the analysis of the spectral and temporal parameters of calls. **Based on comments about onomatopoeia of sounds.
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Disclosure statement

No potential conflict of interest was reported by the author(s).

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