# Plant-borne vibration is related to the vocal repertoire of an Atlantic Forest marsupial frog: vocalization of *Fritziana tonimi* (Anura: Hemiphractidae)

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**Abstract.** Anurans communicate using different modes, such as acoustic, visual, and chemical signaling, which can be displayed independently or in a multimodal context. While knowledge of anuran acoustic communication has advanced substantially in recent decades, few reports have shown that amphibians communicate using seismic signals. Here we describe the vocal repertoire of the Neotropical marsupial frog, *Fritziana tonimi*, and report for the first-time a vocal response to a non-vocally induced plant-borne vibration in an anuran. Their advertisement call was emitted in a long call series. Calls had durations of 21–744 ms, were presented in 1–9 notes, had dominant frequencies of 2.24–3.10 kHz, and covered up to seven frequency bands. A single-pulse call resembling a short whistle was frequently emitted in response to a human touching a bromeliad leaf. We hypothesize that if *F. tonimi* could sense leaf movement produced by a conspecific, this call may be for reproduction or aggressive purposes. Further, this short call could have advantages over the more common long call series in that it could inform conspecifics of the presence of another male in the bromeliad while spending less energy and possibly lowering the risk of attracting predators. Future research could investigate whether other frogs communicate via seismic signals.

Key words. Amphibia, bioacoustics, seismic communication, taxonomy, Santa Teresa, Brazil.

## Introduction

Animal communication occurs using visual, chemical, tactile and acoustic channels, which can be displayed independently or in a multimodal context (e.g., Narins et al. 1997, 2007, Johansson & Jones 2007, Tyack 2019). Acoustic emission is conspicuous in the life cycle of invertebrates and vertebrates, and thus often studied. Classic taxa studied for acoustic communication are crickets, anurans, birds and some mammals, such as primates, bats and cetaceans (Gerhardt & Huber 2002, Obrist et al. 2010). Specifically in anurans, calling, apart from documented visual and chemical communication, is the most commonly observed form of communication, and most species have heritable and structurally simple calls (Bogert et al. 1960, Martin 1972, Gerhardt & Huber 2002, Narins et al. 2007, Wells 2007, Toledo et al. 2015, Köhler et al. 2017, Folly & Hepp 2019, Forti et al. 2019). In spite of that, specific repertoires can be complex, including multiple types of notes (Wells 1977, Wells & Greer 1981, Wells & Schwartz 1984, Loebmann et al. 2008, Costa & Toledo 2013), multiple combinations of notes (Haddad & Cardoso 1992, Narins et al. 2000, Christensen-Dalsgaard et al. 2002, Toledo et al. 2015, Zornosa-Torres & Toledo 2019), and multiple call types (Narins et al. 2000, Christensen-Dalsgaard et al. 2002, Loebmann et al. 2008, Toledo et al. 2015, Köhler et al. 2017).

Bogert (1960) divided anuran vocal repertoire into nine call types based on social context. Approximately half century later, Toledo et al. (2015) reviewed the historical

terminology applied to anuran call classification and proposed the use of 13 subcategories divided in three major categories: reproductive, aggressive, and defensive calls. Recently, Köhler et al. (2017) added feeding calls, referring to the sound produced by juveniles and tadpoles in the context of feeding. Such diversity is greater than previously conceived and challenges recent studies to describe all possible variations observed.

Knowledge of acoustic communication in anurans has advanced substantially in recent decades, but so far, few studies have shown that amphibians communicate via seismic signals (Gridi-Papp & Narins 2010). As an example, terrestrial frog signaling may include soil thumping in leptodactylid genera *Leptodactylus* and *Hydrolaetare* (Lewis & Narins 1985, Cardoso & Heyer 1995, Souza & Haddad 2003). Other species that call partially submerged in lentic waters, such as those of the genera *Bombina* (Bombinatoridae), *Physalaemus* and *Pseudopaludicola* (Leptodactylidae), may generate waves that are used by conspecifics for mate attraction or territorial spacing (Seidel et al. 2001, Forti & Encarnação 2012). In addition, Phyllomedusinae and Rhacophoridae treefrogs may produce plant-borne vibrations for territorial (Caldwell et al. 2010) and reproductive purposes (Narins et al. 1998). Finally, a recent study indicated that *Anomaloglossus beebei* (Aromobatidae) responds to leaf-induced vibrations on bromeliads leaves (Narins et al. 2018). Therefore, there are multiple ways in which seismic communication can be expressed in anurans, even though this major communication channel is often overlooked (Hill 2001, 2009, Narins et al. 2018).

The hemiphractid marsupial frogs of the genus *Fritziana* currently includes seven species (Frost 2023) distributed in the mountainous region across the central and southern Brazilian Atlantic Forest (Walker et al. 2018a). Out of these seven species, vocalization descriptions are lacking for *F. ulei* and *F. tonimi*. Here we describe the vocal repertoire of *Fritziana tonimi*, compare it to the other congeneric species, and report for the first-time a vocal response to a non-vocally induced plant-borne vibrations in anurans.

## Material and methods

Eight males of *Fritziana tonimi* (Fig. 1A) were recorded from August 2019 to January 2020 from three sites in the state of Espírito Santo, Atlantic Forest, southeastern Brazil: two males (Fonoteca Neotropical Jacques Vielliard, FNJV 44997–45005) from Parque Municipal São Lourenço, municipality of Santa Teresa (19°55'42" S, 40°36'28" W, 700 m a.s.l.); four males (FNJV 44993–96, 45010–12) from a population located in an open area on the top of a rocky inselberg, Pedra do Garrafão, municipality of Santa Maria de Jetibá (20°09'51" S, 40°56'00" W, 1160 m a.s.l.; Fig. 1B); and two males (FNJV 45006–09, 45013) from a population located in a forested area on the base of a rocky inselberg, Pedra do Garrafão, municipality of Santa Maria do Jetibá (20°10'01" S, 40°55'27" W, 1220 m a.s.l.; Fig. 1C). These expeditions were conducted in the rainy season and air temperature varied between 18 and 23°C.

Recordings were obtained using a Tascam DR-40 recorder (with internal microphone) at 44.1 kHz with a 16-bit resolution and analyzed using Raven pro 1.5 (Center for Conservation Bioacoustics 2014). Spectrograms were generated using the following set of parameters: window size of 256 samples, 81% overlap, hop size of 128 samples, Discrete Fourier Transform (DFT) of 256 samples, and Hann window type. Low frequencies up to 500 Hz (safely below the minimum frequency reached by *Fritziana tonimi*) were high-pass filtered to decrease background noise in the recording files. Minimum and maximum frequencies were calculated excluding the lower and higher portions of the call that concentrate 5% of energy each using Raven pro 1.5 measurement tools frequency 95% and frequency 5%, respectively. Bioacoustical terminology follows the call-centered approach of Köhler et al. (2017) and is in accordance with the homology criteria suggested by Sinsch & Jurasske (2006) and Folly et al. (2018). Different from these last authors but in accordance with Köhler et al. (2017), we used the term note instead of pulse-group, also following previous studies on *Fritziana* vocal traits (see Duellman & Gray 1983, Heyer et al. 1990, Weygoldt & Carvalho-e-Silva 1991, Franz & Melo 2015). What we considered to be call series, calls, notes and pulses are illustrated in Figure 2. Recordings were then compared to the literature available for other *Fritziana* species (Duellman & Gray 1983, Heyer et al. 1990, Weygoldt & Carvalho-e-Silva 1991, Sinsch & Jurasske 2006, Franz & Melo 2015, Folly et al. 2018).

In addition, 21 recordings were performed using an AudioMoth v.1.2.3 autonomous recorder (with internal microphone) at 48 kHz with a 16-bit sampling size. It was not possible to determine the number of males in these recordings. Recordings were not appropriate for analyses of most vocal parameters because calling males were distant from the recorder. Thus, these recordings were considered only to calculate call series duration, number of calls emitted per call series, and call emission rate. The autonomous recorders were installed in two distinct areas both with a high density and diversity of bromeliads: Estação Biológica de Santa Lúcia (19°58'18" S, 40°32'13" W, 770 m a.s.l.; FNJV 45014–45020) and an unprotected area adjacent to the Reserva Biológica Augusto Ruschi (19°51'54" S, 40°34'40" W, 925 m a.s.l.; FNJV 45021–45023), both located at municipality of Santa Teresa. Recordings took place on October and November 2019 and the air temperature varied between 17 and 21°C.

Vocal responses of *Fritziana tonimi* to plant-borne vibrations were induced in the field by touching occupied bromeliads with a hand (Supplementary Videos S1 and S2), touching unoccupied bromeliads in contact with an occupied one, touching the branches of the tree having an occupied epiphyte bromeliad, and in captivity by touching a mosquito net covering an occupied bromeliad (Supplementary Video S3). These video recordings were made using a Samsung J7 Prime2 cellphone and are deposited

at Museum of Zoology 'Adão José Cardoso' Audiovisual Collection, in the University of Campinas – UNICAMP (ZUEC-VID 792–794).

## Results

Males of *Fritziana tonimi* called alone or in a chorus from bromeliad axils (i.e., leaves that overlap at the base and form tanks to store rainwater). We classified these vocalizations as advertisement calls due to the following combination of characteristics: 1) emitted spontaneously (i.e., no playback or handling stimuli); 2) most common vocalization through different nights; and 3) similar call structure to other species of *Fritziana* (see Folly et al. 2018). The advertisement call was emitted in long call series (Table 1; Fig. 2A). Only one out of the 484 recorded calls were emitted in isolation (i.e., not in a call series). Call series had a duration of 0.2–31.4 s (mean ± SD: 17.8 ± 9.4; n = 22); there were 1–76 calls per call series (44.7 ± 24.5; n = 22); calls were emitted at a rate of 1.6–3.6 calls/s (2.5 ± 0.5; n = 21), and intervals between calls ranged between 121–2173 ms (225.8 ±

175.3; n = 418). Calls were emitted at lower rates at the beginning of the call series. Calls had durations of 21–744 ms (217.9 ± 101.7; n = 433), 1–9 notes per call (3.0 ± 1.4; n = 432), notes emitted at a rate of 4.0–31.4 notes/s (14.7 ± 4.1; n = 415), interval between notes of 5–448 ms (64.4 ± 46.9; n = 883), dominant frequency of 2.24–3.10 kHz (2.64 ± 0.21; n = 433), minimum frequency of 1.72–2.76 kHz (2.33 ± 0.24; n = 433), maximum frequency of 2.41–3.27 kHz (2.87 ± 0.21; n = 433), and up to seven frequency bands (for some calls the frequency bands were not visible). Calls usually had an ascendant power amplitude modulation. Notes had duration of 3–136 ms (26.8 ± 19.2; n = 1301), 1–12 pulses per note (2.9 ± 1.8; n = 1224), pulses emitted at rate of 47.6–333.3 pulses/s (117.6 ± 23.6; n = 967). Calls at the end of a call series usually had the last note with more pulses than those at the beginning of the call series (Figs 2A–C).

A single call series (Figs 2D–F) was considerably different from the others, which might have been motivated by a different phenomenon (see Köhler et al. 2017). Only three out of its 18 calls had notes well defined, whereas the other 15 had either a high pulse number emitted at a low and irregular rate (Fig. 2E) or fused notes, resembling one
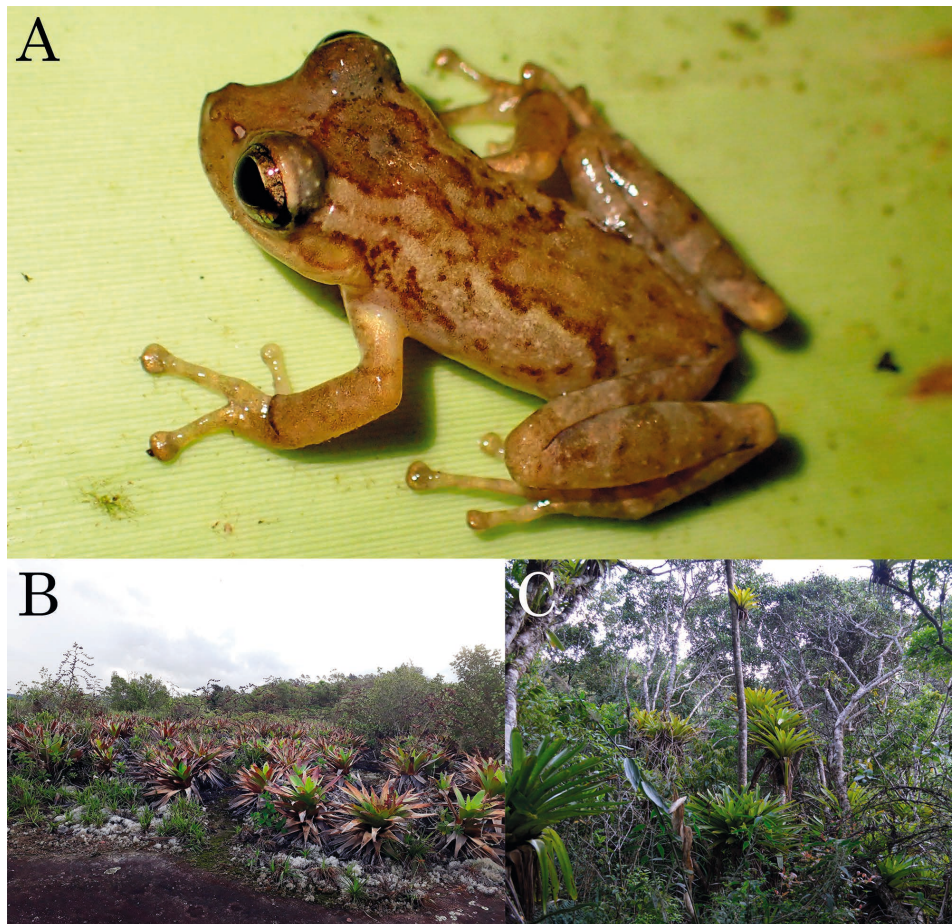


Figure 1. (A) A recorded male of *Fritziana tonimi* (FNJV 45011–12) from (B) an open area on the top of a rocky inselberg (20°09'51" S, 40°56'00" W, 1160 m a.s.l.). (C) A forested area of a second population of *F. tonimi* (20°10'01" S, 40°55'27" W, 1220 m a.s.l.). Both localities at Pedra do Garrafão, municipality of Santa Maria do Jetibá, state of Espírito Santo, southeastern Brazil.
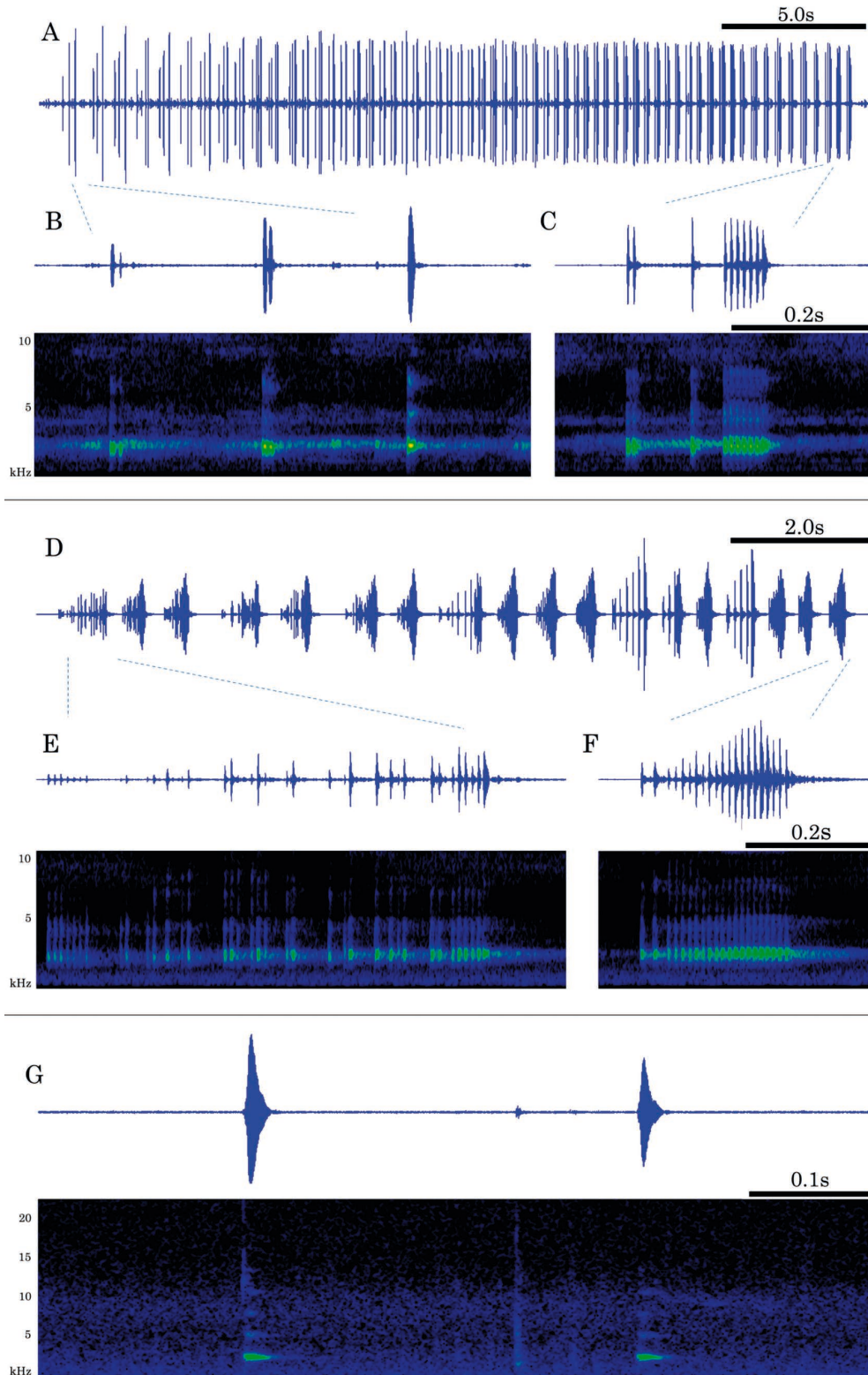
Figure 2. *Fritziana tonimi* vocal repertoire. Advertisement call: (A) oscillogram of a complete call series; (B) oscillogram and spectrogram of an initial and less pulsed call; and (C) oscillogram and spectrogram of a typical call. A second type of call: (D) oscillogram of a complete call series; (E) oscillogram and spectrogram of a longer and lower pulse rate call; and (F) oscillogram and spectrogram of a shorter and higher pulse rate call. (G) Oscillogram and spectrogram of two whistle-like pulses emitted right after a bromeliad was touched.

Table 1. Comparative acoustic traits of the advertisement call of *Fritziana* species with available acoustic data: (1) Duellman & Gray (1983); (2) Weygoldt & Carvalho-e-Silva (1991); (3) Sinsch & Juraske (2006); (4) Heyer et al. (1990); (5) Folly et al. (2018); (6) Franz & Melo (2015); (7) Present study. *Fritziana mitus* is referred to as *F.* aff. *fissilis* by Franz & Melo (2015). Values are presented as range (outside parenthesis) and average, standard deviation and sample number (inside parenthesis). * Values presented without unit of measurement in the original source and # frequency values given as fundamental frequency in the original source (see Folly et al. 2018). SVL values from Walker et al. (2018b).

| Species | *F. fissilis* | | *F. goeldii* | | | *F. ohausi* | | *F. izecksohni* | *F. mitus* | *F. tonimi* |
|---|---|---|---|---|---|---|---|---|---|---|
| SVL (mm) | (25.1–30.0; n=2) | | 19.5–30.2 (27.1±2.7; n=21) | | | 18.7–31.6 (26.8±3.1; n=43) | | 21.5–29.4 (25.9±2.8) | 16.2–23.7 (20.9±1.6; n=26) | 21.4–26.6 (23.7±1.7; n=14) |
| References | 1 | 1 | 2 | 3 | 3 | 1 | 4 | 5 | 6 | 7 |
| Call duration (ms) | – | – | – | (173±5) | (161±4) | – | 650–900 | 416–1737 (1035±214; n=50) | 470–730 (540±70) | 21–744 (217.9±101.7; n=433) |
| Call rate (call/s) | – | – | – | – | – | – | – | 0.5 (n=1) | – | 1.6–3.6 (2.5±0.5; n=21) |
| Note number per call | 2 | 4–5 (4.7) | – | 2 | 3 | 5–8 (6.5) | 5–6 | 3–11 (6.6±1.4; n=50) | 6–10 | 1–9 (3.0±1.4; n=432) |
| Note duration (ms) | 30–120 (75) | 170–200 (180) | – | (34±3) (43±3) | (46±3) (45±7) (42±6) | 50–70 (60) | 20–40 | 2–487 (55±55; n=331) | – | 3–136 (26.8±19.1; n=1301) |
| Note interval | – | – | 150–200 (190) | (96±7) | – | – | – | 20–262 (120±51; n=281) | – | 5–448 (64.4±46.9; n=883) |
| Note rate (pg/s) | 0.1 | 0.9 | – | – | – | 0.2 | 5–6 | 4.1–10.5 (6.5±1.1; n=50) | – | 4.0–31.4 (14.7±4.1; n=415) |
| Pulse number per note | – | – | – | 1–8 | 2–9 | – | 5–9 | 1–35 (4.6±3.7; n=331) | 1–4 | 1–12 (2.8±1.8; n=1224) |
| Pulse rate (pulse/s) | 40–44 (41.2)* | 100* | – | (126±5) (123±5) | (115±4) (118±2) (117±2) | 100* | – | 49.7–124.8 (90.2±10.7; n=308) | – | 47.6–333.3 (117.6±23.7; n=967) |
| Peak frequency (kHz) | 2.40*# | 3.15*# | 1.70–3.50# | (2.14±0.03) (2.40±0.04) | (2.19±0.01) (2.22±0.02) (2.39±0.05) | 2.40*# | 2.00–3.00 | 2.06–2.43 (2.25±0.10; n=50) | 3.00–3.37 (3.166±0.112) | 2.24–3.10 (2.64±0.21; n=433) |

note call (Fig. 2F). Due to the difficulty of properly quantifying notes in these calls, the following parameters were not evaluated for this call series: note per call, note duration, interval between notes, note rate per call, pulses per note, and pulse rate per note. Instead, the pulse number per call and pulse rate per call were calculated. This call series had duration of 11.2 s, 18 calls emitted at a rate of 1.6 call/s, interval between calls of 193–494 ms (271.1 ± 86.3; n = 17), call duration of 196–677 ms (361.9 ± 14.3; n = 18), 15–37 pulses/call (24.8 ± 6.3; n = 18), pulses emitted at a rate of 32.1–102.0 pulses/s (75.2 ± 22.7; n = 18), peak frequency of 2.76–2.93 kHz (2.92 ± 0.04; n = 18), minimum frequency of 2.41–2.58 kHz (2.55 ± 0.07; n =18), and maximum frequency of 3.10 kHz (n = 18). Calls had an ascendant power amplitude modulation.

A single-pulse call resembling a short whistle (Fig. 2G) was recorded in both natural and captive conditions. This call was emitted in three different contexts: (1) at the end of the first calls in a call series, which occurred in most of the recorded call series (22 out of 31 recorded call series); (2) sporadically isolated (not in a call series); and (3) in response to touching a bromeliad leaf (Supplementary Videos S1–S3). This call had a duration of 7–45 ms (19.4 ± 7.9; n = 54), dominant frequency of 2.4–3.10 kHz (2.62 ± 0.17; n = 54), minimum frequency of 2.07–2.76 kHz (2.40 ± 0.17; n = 54), maximum frequency of 2.58–8.27 kHz (3.18 ± 1.18; n = 54), and up to eight frequency bands. In five situations, it was emitted in short series with 2–3 calls (Fig. 2G) distancing 64.5–300.0 ms (164.7 ± 78.3; n = 9) from each other.

## Discussion

A robust comparison among species of *Fritziana* advertisement calls has been problematic to obtain largely due to

the lack of information on the number of analyzed samples (e.g., Heyer et al. 1990, Weygoldt & Carvalho-e-Silva 1991, Sinsch & Juraske 2006, Franz & Melo 2015) and/or to the low number of samples (e.g., Duellman & Gray 1983) presented in existing studies. This is particularly an issue because we cannot be sure that current information encompasses intraspecific variation. There are also issues related to nomenclature standardization and homology designation, which were partially resolved with Folly et al. (2018). However, by collating our current understanding of *Fritziana* advertisement calls, we hope that the present study helps resolve and identify some of these issues that may be addressed in future studies.

Vocal parameters of *Fritziana tonimi* advertisement calls overlap with the other species of *Fritziana* and may thus not be suited for diagnosis (Table 1). That is probably due to its long and heterogeneous call series. However, there some quantitative differences (mainly in temporal parameters) among vocalization of *Fritziana* species. *Fritziana tonimi* has shorter calls, with a lower note number per call, shorter intervals between notes, and notes emitted in a higher rate when compared to *F. izecksohni* (Folly et al. 2018). *Fritziana tonimi* has shorter calls with a lower number of notes per call, and a lower dominant frequency than *F. mitus* (referred to as *F.* aff. *fissilis* by Franz & Melo 2015). *Fritziana tonimi* has shorter calls and notes emitted at a higher rate than *F. ohausi* (Heyer et al. 1990). Compared to *F. fissilis*, *F. tonimi* does not usually have a first note longer than the others (first note longer than others in *F. fissilis*), has a shorter note duration, and has pulses emitted at a lower rate (Duellman & Gray 1983). Emission rates provided by Duellman & Gray (1983) for *F. fissilis*, *F. goeldii* and *F. ohausi* are outliers and were not considered in our comparisons (see Table 1). It is possible that Duellman & Gray (1983) considered note rate as the number of notes emitted per call series duration instead of the number of notes emitted per call duration, which may explain the lower values compared to other studies.

The vocal response of *Fritziana tonimi* to the bromeliad vibration was unexpected because most frog species interrupt calling upon a seismic disturbance, such as human approach (Bogert 1960, Ferreira et al. 2019, Narins 2019). Among anurans, seismic signals are related to different contexts. Some species are able to receive, interpret, and respond to abiotic seismic signals. For example, *Pelobates cultripes* and *Epidalea calamita* emerge from underground refugia after rainfall-induced vibrations in the soil (Marquez et al. 2016). Other species are able to produce seismic vibrations by toe twitching, vibrating the substratum to attract (e.g., *Rhinella marina*; Hagman & Shine 2008) or agitate prey and therefore making them easier to detect (e.g., *Anaxyrus fowleri* and *Breviceps mossambicus*; Sloggett & Zeilstra 2008). On the other hand, some species can both emit and perceive substrate-borne vibrations using them for intraspecific communication, such as *Leptodactylus albilabris* (Lewis & Narins 1985, Lewis et al. 2001) and possibly *L. syphax* (see Cardoso & Heyer

1995). *Agalychnis callidryas* is probably the most studied anuran regarding seismic communication. It uses plant-borne vibrations for agonistic interaction between adults (Caldwell et al. 2010), and its larvae hatch prematurely after seismically sensing potential predator vibration on the substratum (Warkentin et al. 2006, 2007, 2019). *Anomaloglossus beebei* is the only bromeligenous species known to communicate through plant-borne vibration, in which calling males generate vibrations on the bromeliad leaf that can both change call structure or the direction of movement on the substrate by conspecifics (Narins et al. 2018). Thus, adding to such rich forms of sensing, producing and responding to vibrations, our observation of a seismic-induced call by *F. tonimi* differs from all of those previously documented.

The anuran vocal repertoire has been divided into four major categories according to social context: reproductive, aggressive, defensive, and feeding contexts (Köhler et al. 2017). Defensive and feeding calls can be promptly discarded as possible explanations of *Fritziana tonimi* vocal responses to substrate vibration. Feeding calls are only emitted in the context of feeding. Defensive screams are subdivided into alarm, distress and warning calls (Toledo et al. 2015). Distress calls are the most common defensive vocalization among anurans (Toledo & Haddad 2009, Ferreira et al. 2019), but the short whistle-like pulse of *F. tonimi* definitely does not fit into this subcategory or resemble the acoustic structure of this category of call among other anurans (Forti et al. 2018). Furthermore, distress calls are emitted during the frog subjugation by a predator (Toledo et al. 2015, Ferreira et al. 2019). Alarm calls can also be discarded because the observed males remained in the same spot before the vocal emission. Alarm calls are emitted in two distinct situations (Toledo et al. 2015): with the frog moving away after being surprised by a potential predator or while being preyed upon, both eliciting a response from other conspecific anuran individuals (not observed). Finally, warning calls are emitted by frogs after the touch or during the approach of potential predator to warn sound-oriented predators about a risk the frog could confer (Toledo et al. 2015, Ferreira et al. 2019). Warning calls can also be discarded because *Fritziana* species are edible and do not offer risks to predators. Furthermore, the frequent emission of this whistle-like call by *F. tonimi* could instead attract predators.

Thus, we hypothesize that this whistle-like call emitted by *Fritziana tonimi* may relate to a reproductive or aggressive context. Among the different subcategories of these two classes of calls, advertisement, territorial or encounter calls are the most likely to match the function of the whistle. If *F. tonimi* could sense a leaf movement as soft as that produced by a conspecific (male or female) individual, then it could function to attract a female (similar to advertisement calls) or to repel a rival male (similar to territorial or encounter calls). In fact, some species present notes that can have this dual function. For example, in another Neotropical treefrog, *Dendropsophus minutus*, some notes serve both as an advertisement and aggressive signal (To-

LEDO et al. 2015). If true, this short call could have advantages over the more common, quite long (up to over 30 s) call series. First, it would inform both males and females about the presence of another male in that specific bromeliad. This could attract a female mate and repel a competitor male, possibly with low risk of attracting predators (e.g., TUTTLE et al. 1981, TUTTLE & RYAN 1981, 1982, IGAUNE et al. 2008). In fact, no more than one male was found in each bromeliad, a *sine qua non* condition for this hypothesis. Besides this, a short call uses much less energy than regular advertisement or territorial calls.

The emission of similar whistles was also reported for *Fritziana izecksohni* (FOLLY et al. 2018) and *F. goeldii* (WEYGOLDT & CARVALHO-E-SILVA 1991). *Fritziana izecksohni* emitted longer single pulses occasionally at the end of the calls resembling a whistle. *Fritziana goeldii* emitted call and call series (referred to as notes and calls respectively; see FOLLY et al. 2018) with a 'pip' sound. Also, *F. goeldii* males emitted a single short 'pip' in response to abrupt sounds, for example, when knocking the terrarium glass, or breaking a piece of wood close to the occupied bromeliad (WEYGOLDT & CARVALHO-E-SILVA 1991). These situations are similar to the ones that could elicit the vocal response of *F. tonimi*: knocking the terrarium glass as well as breaking a piece of wood clearly generates vibrations that could be sensed by these frogs.

These Atlantic Forest marsupial frogs are the first anurans known to respond vocally to non-vocally induced plant-borne vibrations. The present finding adds new insights to studies on social communication in bromeligenous frogs. Future experimentation should reveal the function of these calls, the extent to which *Fritziana tonimi* can perceive seismic cues, and determine whether these calls are used for intraspecific communication.

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## Supplementary data

The following data are available online:

Supplementary Video S1. Vocal responses of *Fritziana tonimi* to
plant-borne vibrations induced in the field by touching an oc-
cupied bromeliad (ZUEC-VID 792).

Supplementary Video S2. Vocal responses of *Fritziana tonimi* to
plant-borne vibrations induced in the field by touching an oc-
cupied bromeliad (ZUEC-VID 793).

Supplementary Video S3. Vocal responses of *Fritziana tonimi*
to plant-borne vibrations induced in captivity by touching the
mosquito net covering an occupied bromeliad (ZUEC-VID 794).