Redescription of calls of the Boettger's lizard, *Gallotia caesaris gomerae* (Boettger & Müller, 1914) from La Gomera, the Canary Islands, with the description of two different types of calls

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Some Reptiles are known to produce acoustic signals (Vitt & Caldwell, 2014). Among the modes of the three categories of devices of sound productions, involving massive air expulsion, rubbing or vibration of the integument and modulation of intermittent air movements through a modified glottis, lizards are capable of producing last ones, called vocalizations (Gans & Maderson, 1973). In the Canary Islands, genus *Gallotia* Boulenger, 1916, shares this feature. In 1910, about *Gallotia simonyi* (Steindachner, 1889), Philipp Lehrs gives the first description of the sound: *"eine deutlich quiekende Stimmäußerung erregter Tiere"* (a clear oinking voice animal expression) (Lehrs, 1910). In 1985, Wolfgang Böhme *et al.* review verbal descriptions of the genus and provides the first and last sonograms of several species in captivity (Böhme *et al.*, 1985). The recordings include *Gallotia galloti caesaris* (El Hierro) and *Gallotia galloti gomerae* (La Gomera), which are now grouped in the same species: *Gallotia caesaris* (Thorpe *et al.*, 1993; RICHARD & THORPE, 2001) and declined in two subspecies: *G. caesaris caesaris* (LEHRS, 1914), present on the island of El Hierro, and *G. caesaris gomerae* (BOETTGER & MÜLLER, 1914) on the island of La Gomera (BISCHOFF, 1998). For the first time, we describe the recorded calls of free-ranging animals of this last subspecies.

On the 18th of January 2017, during two hours, between 12:40 to 14:30 PM, at a same temperature around 25°C, we recorded the calls of a group of the Boettger's lizard at the Barranco del Agua, Las Hayas, La Gomera (28°07'22.7"N 17°17'21.9"W). We recorded the vocalisations with a recorder ZOOM H4n (44,1 kHz sampling rates and 16 bits), using the pre-recording function and the short gun microphone Sennheiser ME66 with the K6 powering module, protected with the basket windshield MZW 60-1 and wind muf. The microphone was positioned on the rock, placed at least 50 cm from the lizards. The temporal and spectral call parameters were normalized -3dB with the software Audacity® 2.2.2 (Audacity Team 2018) and analysed with the software Raven Pro 1.5 (Bioacoustics Research Program 2014) and Praat 6.0.30 (BOERSMA AND WEENINK, 2016). We measured the following parameters: call duration (ms), note number, note duration (ms), peak (or dominant) frequency (Hz), center frequency that divides the selection into

Table 1.
Acoustic parameters of the calls of *Gallotia caesaris gomerae* from the Barranco del Agua, Las Hayas, La Gomera Values are presented as mean ± standard deviation (range and number of measures).

N°call	Duration (s)	Fundamental frequency (Hz)	Peak frequency (Hz)	Min. frequency (Hz)	Max. frequency (Hz)
1	1.06	870.4±50.3 (282.8-2193.4 n=101)	1964.2±63.9 (1292-6287.7 n=107)	283	14887
2	0.54	516.6±18.7 (303.8-649.6 n=26)	1552.1±47.6 (1205.9-2239.5 n=50)	304	13230
3	0.94	1252.3±73.5 (472.8-2440.3 n=85)	1739.9±46.6 (516.8-2239.5 n=70)	473	14808
4	1.20	704.3±58.7 (259.8-2479.8 n=101)	1579.1±46.7 (516.8-2067.2 n=99)	260	14911
5	1.09	630.2±28.6 (187.1-1003.4 n=86)	1808.8±118.5 (602.9-9819.1 n=71)	187	14831
6	0.58	1131.6±97.4 (268.9-2187.8 n=56)	1941.6±147.6 (602.9-10249.8 n=59)	269	14917
7	0.69	1319.3±78.7 (585.2-2253.6 n=68)	1934.9±24.9 (1378.1-2411.7 n=69)	585	14872
8	0.55	1614.4±75.9 (612.6-2224 n=56)	2105.6±33.4 (1636.5-2584 n=56)	613	14863
9	0.49	591.3±19.2 (444.9-844.9 n=24)	882.9±84.9 (430.7-1292 n=12)	445	13721
10	0.42	612.1±6.8 (544.8-664.6 n=27)	925.1±76.7 (344.5-1722.7 n=27)	545	9669
All	7.56	964±50.3 (187.1-2479.8 n=630)	1767.5±27.4 (344.5-10249.8 n=620)	187	14917

two frequency intervals of equal energy, harmonics (Hz), maximum frequency (Hz) and minimum frequency (Hz). the definitions of the terms follow the review of Kölher *et al.* (Köhler *et al.*, 2017) and the Raven manual (Charif *et al.*, 2010). The frequency information was obtained through Fast Fourier Transformation (FFT) within a Hamming window, width, 1024 points, frequency step (bin width) of 43.1 Hz and time step (frame distance) of 0.00107 seconds. The fundamental frequencies and harmonics were measured in hertz with Praat; dominant frequencies in hertz by Raven, splitting selections borders by 10 ms steps.

A total of 10 calls of quality were recorded among a group of animals, compounded of adults and sub-adults. There were basking and moving on the rock, and in bushes, around the microphone. Animals were free-ranging, emited the calls spontaneously without being disturbed by sound recorders. Recorded calls could be divided into two categories (**Figure 1**): mixed, calls 1.1 to 1.8, and singles, calls 1.9 and 1.10. One of the first set (call 1.2) is truncated, nevertheless, we kept it because of provided spectral information. The average fundamental frequency varies from 516 to 1614 Hz (964±50.3, n=630), the dominant range from 882 to 2105 Hz (1767.5±27.4, n=620), the minimal one between 187 and 613 (396±48.6 Hz, n=10) and the maximum one between 9669 to 14917 Hz (14071±524, n=10) (**Table 1**).

Where *Gallotia* is known to squeal (Gans & Maderson, 1973) or to utter a squeak (Molina-Borja, 1985), in the detail, we distinguished three note structures and two types of calls.

Calls 1.1 to 1.8 are mixed, more than one note: with «wheeh», «grunt» and a modulated onset (call 1.4). «Wheew» is a modulated note; it's a whistle, from medium to high pitched, rather musical (Pieplow, 2017). They sounds like birds, like the Wood Duck, *Aix sponsa*. In this case,

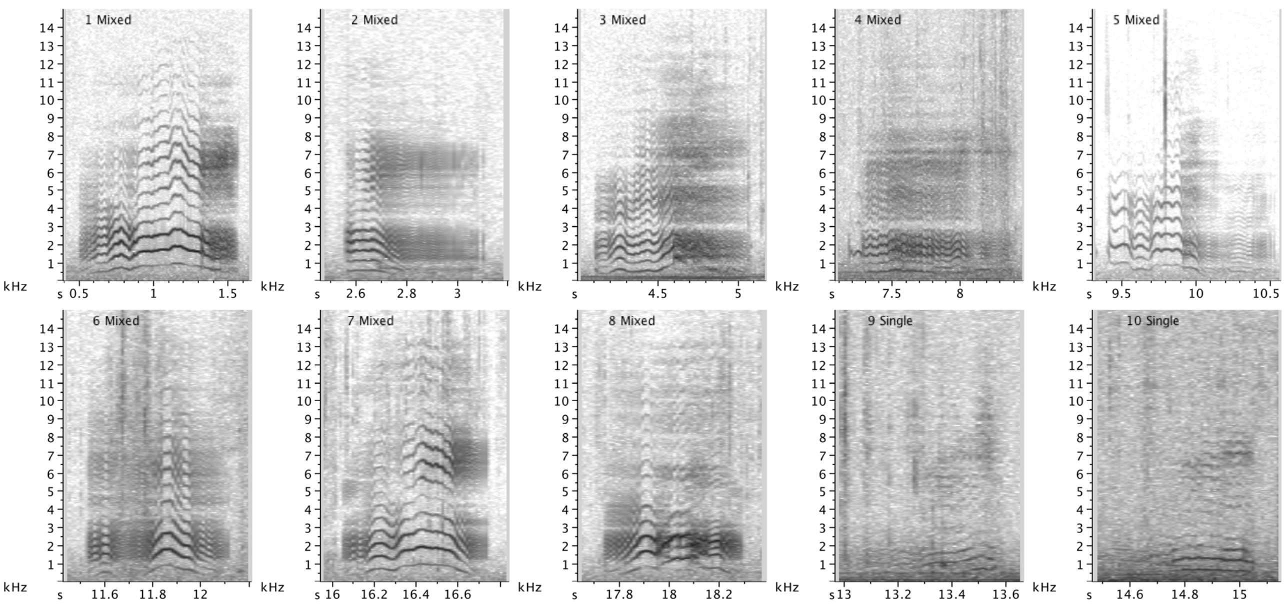

Figure 1.
Spectrograms of 10 calls of *Gallotia caesaris gomerae* (Boettger & Müller, 1914).

third harmonics are the loudest (2.9±0.1, n=57, Figure 2), yielding a nasal sound. The total number of harmonics is high (20.6±0.7, n=57). The «grunt» is a deep short sound characteristic of a hog, here a higher pitch sound, like a nasal squeaking.

The loudest harmonics are around the third (3.0±0.3, n=17). The number of harmonics is lower than the precedent note (17.4±0.4, n=17). The spread of energy is bi or trimodal (Figure 3).

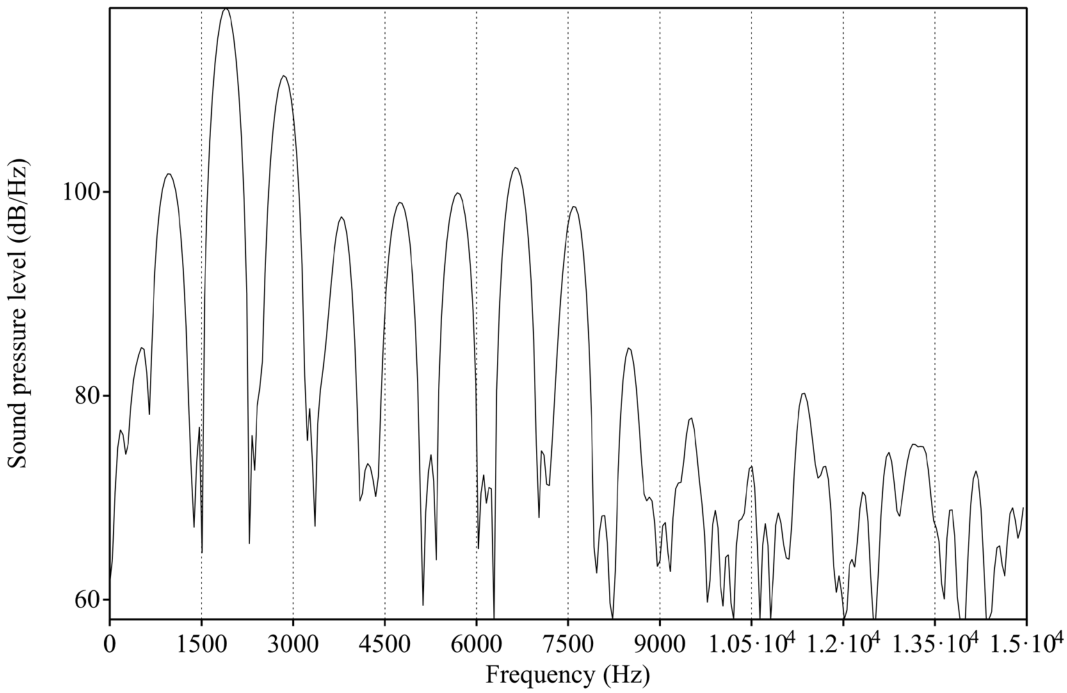

Figure 2.
Spectrum of call 1 at 4.25 seconds.

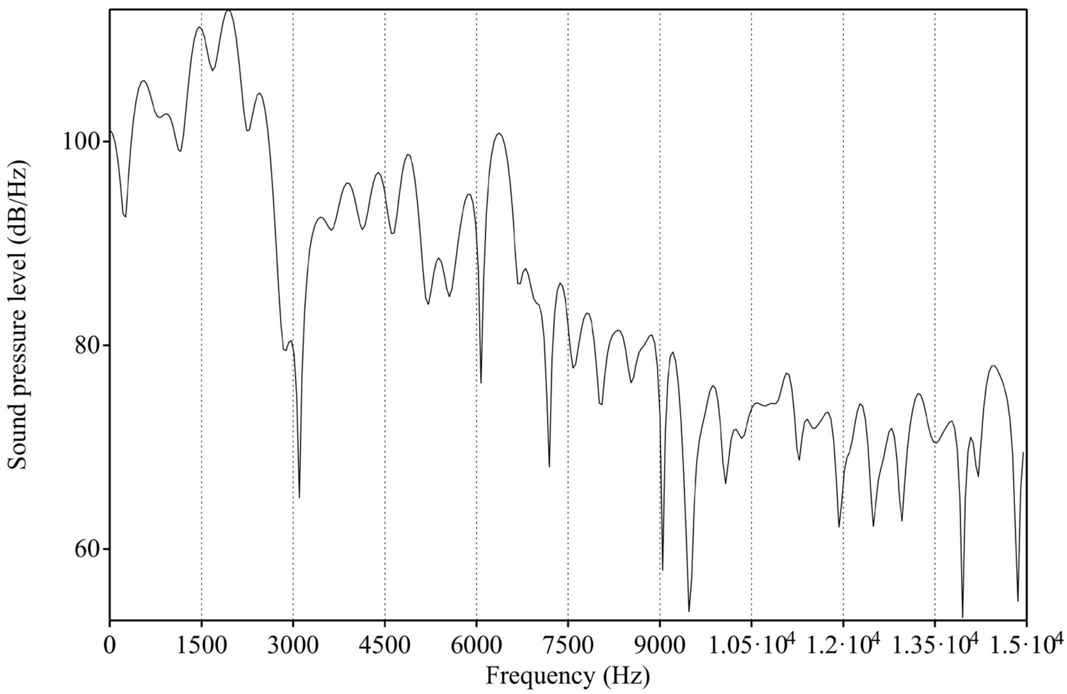

Figure 3.
Spectrum of call 4 at 7.7 seconds.

Lastly, there is a short modulated note, expressed in call 4 (**Figure 4**). It's a modulated onset, with only nine harmonics, and a high fundamental frequency around 1600 Hz. The calls 9 and 10 are single, compounded with one note where we find a bimodal distribution of energy (**Figure 5**). Furthermore, the compounded calls are longer than single ones (0.87±0.10 s n=7 versus 0.42±0.01 s n=2, **Figure 6**) and the center frequencies are clearly distinct (1938±53 Hz n=8 versus 517±86 n=2, **Figure 7**).

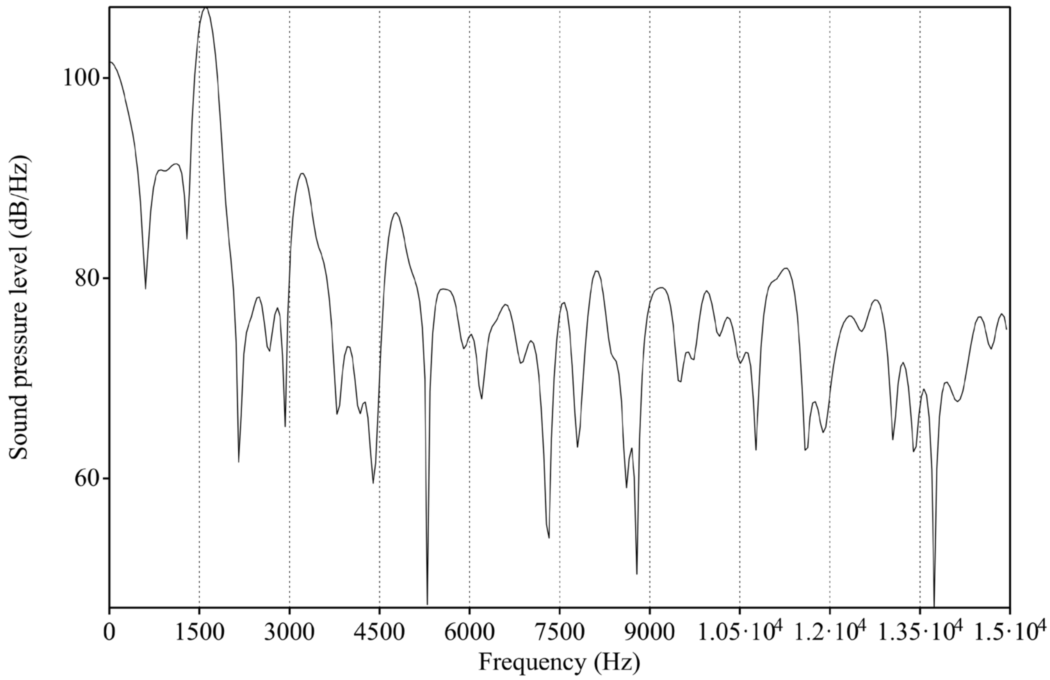

Figure 4.
Spectrum of call 4 at 7.25 seconds.

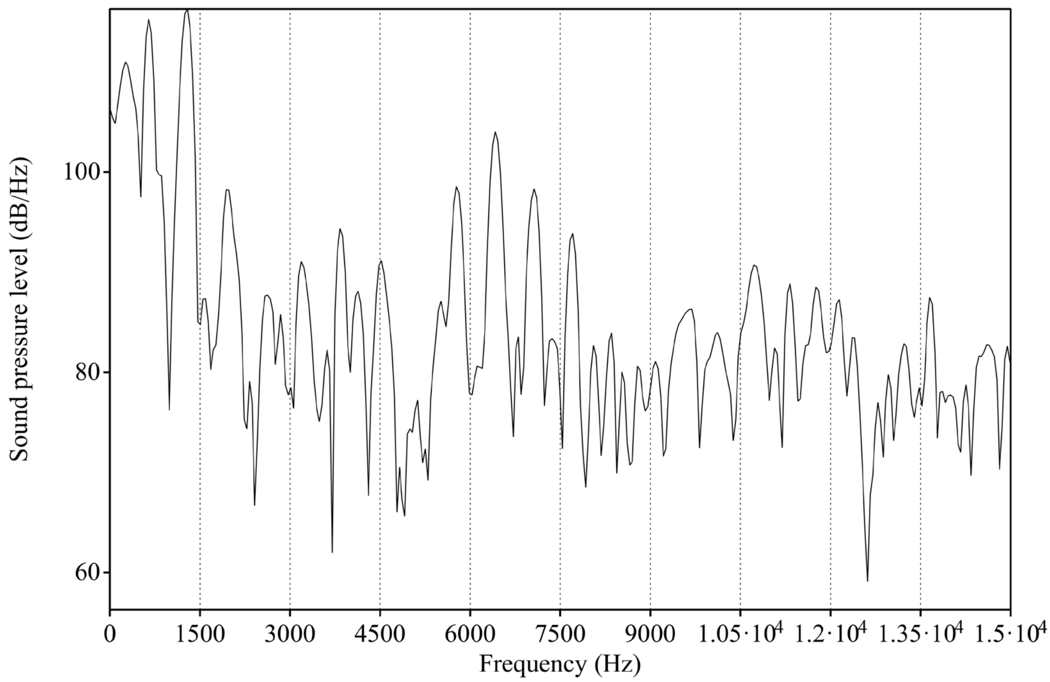

Figure 5.
Spectrum of call 10 at 14.9 seconds.

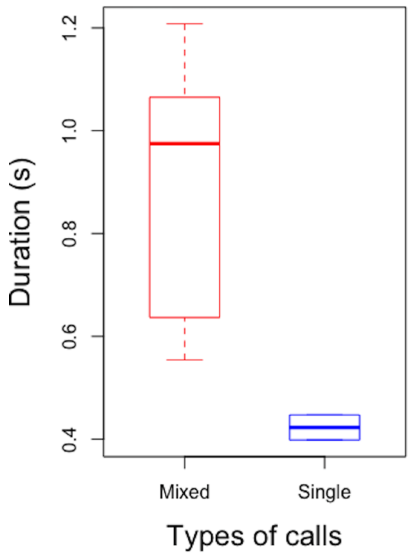

Figure 6.
Duration versus types of call.

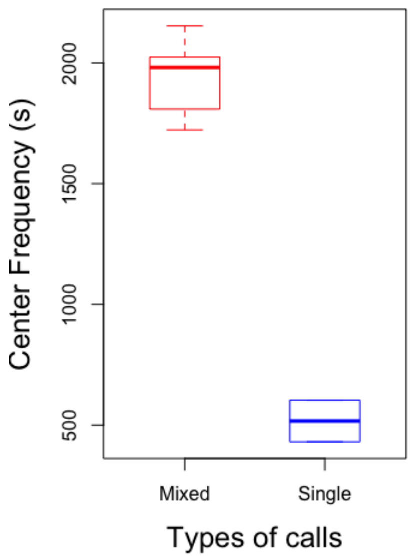

Figure 7.
Center Frequency versus types of call.

The spectrum structures present similarities with those of another Reptile of the Canary Islands: *Tarentola delalandii* (Duméril & Bibron, 1836) (Nettmann & Rykena, 1985). It would be relevant to record the calls from other species of *Gallotia* and compare their structure with that of *G. c. gomerae*; the whole set of data could be used to investigate the phylogeny (Cox *et al.*, 2010) of the calls. Moreover, we still need to investigate if the variation in the calling structure is related to the interindividual differences.

Addendum : calls in MP3 format

Call 1: https://observation.org/sound/9/88849.mp3

Call 2: https://observation.org/sound/0/88850.mp3

Call 3: https://observation.org/sound/1/88851.mp3

Call 4: https://observation.org/sound/2/88852.mp3

Call 5: https://observation.org/sound/3/88853.mp3

Call 6: https://observation.org/sound/4/88854.mp3

Call 7: https://observation.org/sound/5/88855.mp3

Call 8: https://observation.org/sound/6/88856.mp3

Call 9: https://observation.org/sound/7/88857.mp3

Call 10: https://observation.org/sound/8/88858.mp3

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