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The advertisement call and geographic distribution of *Odontophrynus lavillai* Cei, 1985 (Anura: Odontophrynidae)

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Currently, the genus *Odontophrynus* Reinhardt & Lütken comprises 11 species distributed in southern and eastern South America. Among them, *O. americanus* (Duméril & Bibron), *O. lavillai* Cei, *O. cordobae* Martino & Sinsch, and *O. maisuma* Rosset constitute a group of sibling diploid and tetraploid species, the *O. americanus* group (Rosset *et al*. 2006 and literature cited therein).

Interestingly, as in other anuran lineages (see Guignard *et al*. 2012), polyploidization might affect phenotypic features such as temporal and spectral characteristics of the advertisement call. In the genus *Odontophrynus* the pulse rate is lower in tetraploid than in diploid males (Bogart & Wasserman 1972; Martino & Sinsch 2002). In this regard, acoustic studies are useful for distinguishing these sibling species.

The advertisement calls of tetraploid *O. americanus* (Barrio & Pistol de Rubel 1972; Márquez *et al*. 1995; Salas & di Tada 1996; Martino & Sinsch 2002), *O. cordobae* (diploid species, Barrio 1964; Barrio & Pistol de Rubel 1972; Straneck *et al*. 1993, as *O. americanus*; Martino & Sinsch 2002; Grenat *et al*. 2013) and *O. maisuma* (diploid species, Borteiro *et al*. 2010) have been described, while the call of *O. lavillai* (diploid species) remains unknown. Barrio and Pistol de Rubel (1972) studied calls of diploid males of two Argentinean localities (Km 969, Catamarca; and Frías, Santiago del Estero), now assigned to *O. lavillai*, but they only published a spectrogram without data of the acoustic variables. Köhler (2000) described an advertisement call attributed to *O. lavillai*, but as we will discuss later, we believe that the voucher specimen was misidentified.

Here we present a description of the advertisement call of *O. lavillai*. This species was originally described from Sierra de Guasayán, Santiago del Estero (Cei 1985). Later, it was recorded from several localities of Argentina, Bolivia, Paraguay, and Brazil based on chromosome count, erythrocyte size, and morphological characters (see also new records in Figure 1B). *Odontophrynus lavillai* is associated to the Dry and Humid Chaco Ecoregions, and marginally to the Yungas Ecoregion (Rosset *et al*. 2006; 2009 and literature cited therein).

The specimens studied here come from three localities of Argentina and they are undoubtedly assigned to *O. lavillai* by the diploid number of chromosomes, the skin on dorsum heavily granular and glandular, and three transversal dark brown blotches on dorsum, lacking a light middorsal stripe (Figure 1A; Barrio & Pistol de Rubel 1972; Cei 1985; Rosset *et al*. 2009). Males were found calling within the water (semisubmerged) in temporary ponds after heavy rains. On 20 February 2002, calls of two males (FML 11159, plus an unvouchered male) were recorded at 1.5 km north of Gaona, Salta (25°15'33''S, 64°01'45''W). On 4 February 2004, calls of one male (MLP DB 2706) were recorded at 5 km south of Añatuya, Santiago del Estero (28°46'S, 64°47'W). Finally, on 11 March 2009, calls of two males (LGE 8599–8600) were recorded at El Sauzal, Chaco (24°34'59.5''S, 61°32'38.8''W). Calls were recorded with a Sony WM-D6C recorder and Sennheiser LR 66 microphone. Water and air temperatures (± 1°C) were measured near each recorded male with a digital thermometer. The snout-vent length (SVL) of each vouchered specimen was measured using a Vernier calliper (to the nearest 0.1 mm). Calls were digitized and analyzed with software Sound Forge 5.0 (Sony Creative Software Inc. 2007) and Syrinx 2.3s (Burt 2006), employing a sampling rate of 44.1 kHz and 16-bit precision. Dominant frequency was obtained with a FFT of 1024 points and a Hamming's sampling window. Series of 5–18 advertisement calls of better quality belonging to five specimens were analyzed. The following acoustic variables were measured: note (= call) duration (ND), internote duration (IND), notes/m (N/m), pulses/note (P/N), pulse duration (PD), interpulse duration (IPD), pulses/s (= pulse rate), and dominant frequency (DF), as defined by Heyer *et al*. (1990), and Littlejohn (2001).

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Comparisons with other species of the *O. americanus* group were based on Martino & Sinsch (2002) and Borteiro *et al*. (2010). We did not perform statistical tests because of the low number of studied males. Voucher specimens are deposited in the following herpetological collections: Instituto de Herpetología, Fundación Miguel Lillo (FML); personal collection of Diego Baldo, at Museo de La Plata, Argentina (MLP DB); and Laboratorio de Genética Evolutiva (LGE), Instituto de Biología Subtropical (CONICET-Universidad Nacional de Misiones), Posadas, Misiones, Argentina.

The advertisement call of *O. lavillai* consists of a multipulsed note, regularly repeated, without frequency modulation (Table 1, Figure 1C, D, E). The calls are similar among the three populations. However, we observed that the male from Añatuya emitted a shorter note with less pulses, and a pulse rate faster than the males from the other localities (with similar SVL and air temperature). Interestingly, we found calling males and an amplectant pair of *O. americanus* in temporary ponds near this latter male. Variation in the advertisement call of *O. cordobae* was reported when it was found in syntopic areas with *O. americanus* (Grenat *et al* 2013). Nonetheless, we do not know if this is the cause of the abovementioned differences in *O. lavillai*.

TABLE 1. Advertisement call characteristics of *Odontophrynus lavillai*. Values were calculated for each locality by pooling all measured calls from all specimens, and it are given as mean ±SD (range).

Localities	Calls/ males	Air temp./ time	SVL	ND (ms)	IND (ms)	Notes/m
1.5 km N Gaona	29/2	27°C/ 00:20	57.7 mm N=1	484.8±28.0 (430–525)	3466.5±2774.9 (978–9784)	16.6±9.0 (10.2–22.9)
5 km S Añatuya	15/1	24°C/ 22:45	55.5 mm N=1	301.5±38.8 (214–367)	8427.7±6720.8 (2194–21312)	8.0±1.3 (7.1–8.9)
El Sauzal	34/2	23°C/ 00:18	63.5 mm N=2	532.3±60.3 (443–700)	5604.6±8762.7 (1270–44722)	17.3±5.8 (12.1–26.5)
O. lavillai (all localities)	78/5	23–27°C/ 22:45–00:20	60.1 mm N=4	472.8±104.0 (301.5–583.0)	5656.9±2813.6 (1806.6–8427.7)	15.4±6.8 (8.0–22.9)

TABLE 1. (Continued)

Localities	Pulses/note	PD (ms)	IPD (ms)	Pulse rate	DF (Hz)
1.5 km N Gaona	56.6±3.3 (50–62)	5.9±1.0 (4.7–7.5)	2.8±1.0 (1.3–4.1)	116.7±1.1 (114.8–119.3)	654.0±60.4 (582–819)
5 km S Añatuya	40.0±5.8 (28–50)	5.5±0.3 (5.3–5.7)	2.2±0.2 (2.0–2.4)	132.5±5.5 (123.9–149.3)	790.2±105.8 (625–905)
El Sauzal	58.8±5.9 (50–75)	5.2±0.8 (4.3–6.6)	4.1±1.0 (2.3–5.3)	110.6±2.5 (105.8–113.8)	742.6±57.4 (690–862)
O. lavillai (all localities)	54.6±8.5 (40.0–62.5)	5.6±0.9 (4.5–7.0)	3.2±1.3 (1.8–5.0)	117.1±9.5 (107.2–132.5)	712.0±64.6 (637.1–790.2)

The dominant frequency of *O. lavillai* (637.1–790.2 Hz) is the lowest of the *O. americanus* group (1025–1075 Hz at 20°C in *O. americanus*, 990–1040 Hz at 20°C in *O. cordobae*, 1124–1211 Hz at 6°C in *O. maisuma*), which is likely related to the relatively larger SVL of the males (see data of the four species in Rosset 2008). The note duration of the call of *O. lavillai* (301.5–583.0 ms) is similar to that of *O. americanus* (524–558 ms), *O. cordobae* (421–475 ms), and *O. maisuma* (570–785 ms). The number of pulses/note in *O. lavillai* (40.0–62.5 pulses/note) is similar to that of *O. cordobae* (48–53 pulses/note) and *O. maisuma* (43–57 pulses/note) but is higher than in *O. americanus* (39–41 pulses/note). The pulse rate in *O. lavillai* (107.2–132.5 pulses/s) is similar to that *O. cordobae* (111–116 pulses/s) and is much faster than in *O. americanus* (73–77 pulses/s) and *O. maisuma* (71.1–77.2 pulses/s).

Finally, we wish to note that Köhler (2000) described the advertisement call of *O. lavillai* from Santa Cruz de la Sierra, Santa Cruz, Bolivia. This call was subsequently published by De la Riva *et al*. (2002, CD 2, track 51, six calls of one male, recorded by J. Köhler & S. Lötters) which in turn coincides with the record of J. Köhler deposited in the Fonoteca Zoológica (with the number 5573). Our analysis, in agreement with Köhler (2000), shows that this call consists of a multipulsed note with a duration of 361.5±30.3 ms (306–394 ms, N=6 calls of one male), 56.5±3.9 pulses/note (50–61 pulses/note, N=6), a pulse rate of 156.5±3.7 pulses/s (152.5–163.4 pulses/s, N=6), and a dominant frequency of about 1983±13.9 Hz (1961–2005 Hz, N=6). However, based on these results and comparing these vocalizations with those of *O. lavillai* (and other species), we conclude that the call described by Köhler (2000) and published by De la Riva *et al*.

(2002), does not belong to *O. lavillai*. We hypothesize that it might correspond to the advertisement call of a species of the genus *Ceratophrys*, mainly due to the fast pulse rate and high dominant frequency (see Lescano 2011 and literature cited therein for calls of Ceratophryidae). Examination of the voucher specimen is pending.

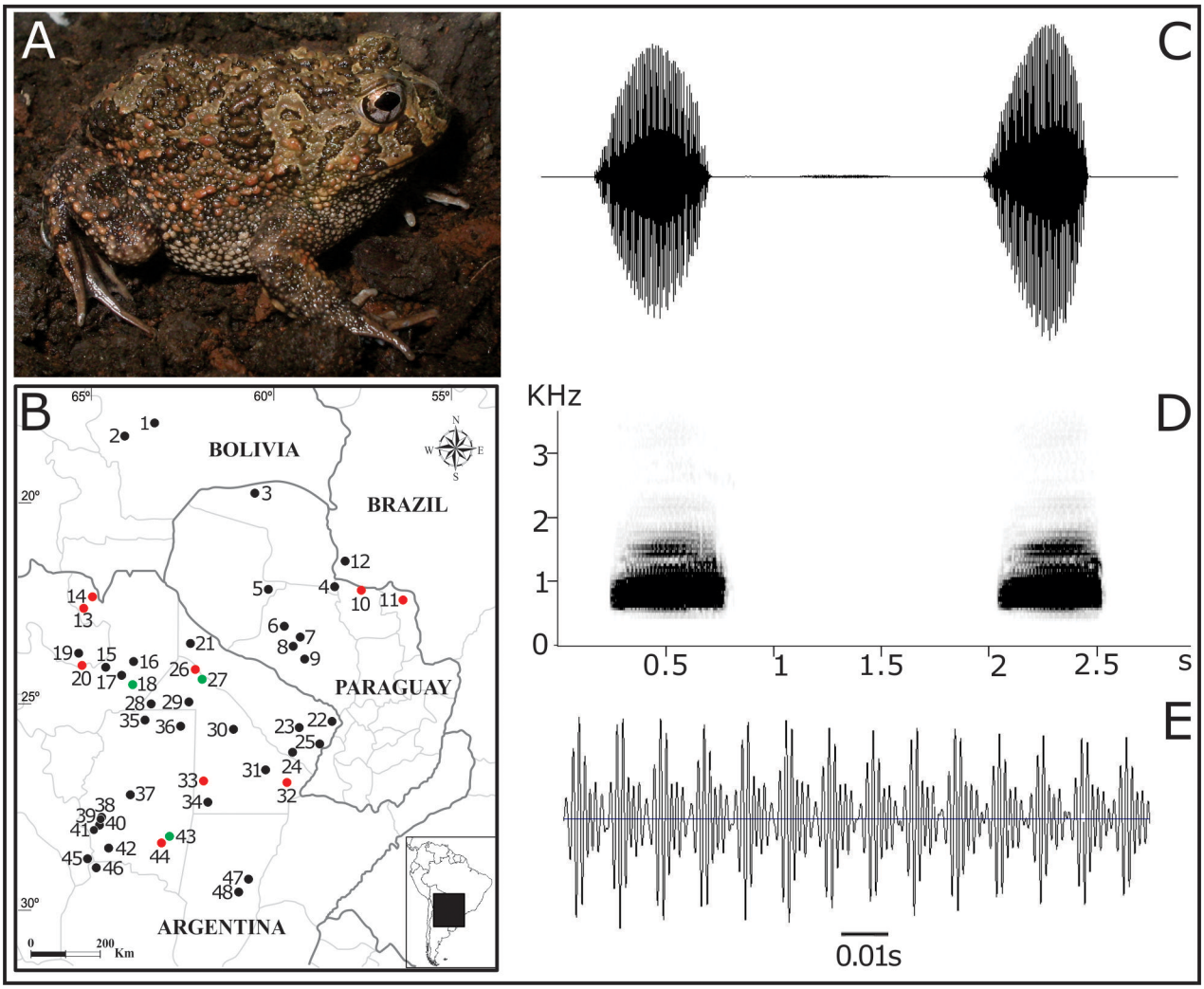

FIGURE 1. (A) Male of *Odontophrynus lavillai* from Añatuya, Santiago del Estero, Argentina (MLP DB 2706); (B) geographic distribution of this species (black dots after Rosset *et al*. 2009; red dots are new records; green dots are localities of recorded specimens; see Appendix 1); (C) oscillogram and (D) sonogram showing two calls (= notes); and (E) oscillogram showing 14 pulses of the call of a male (LGE 8599) from El Sauzal, Chaco, Argentina.

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APPENDIX 1. Localities of *Odontophrynus lavillai.*

BOLIVIA: 1) Santa Cruz de la Sierra, 2) Pampa Grande. PARAGUAY: 3) Parque Nacional Defensores del Chaco, 4) Puerto Casado, 5) Ea. Pozo Azul, 6) Ea. Juan de Salazar, 7) Ea. La Victoria, Km 234 Ruta Transchaco, 8) Km 347 Ruta Transchaco, 24 km NW Río Verde, 9) Rancho Carandá, 14 km W Km 323 Ruta Transchaco, 10) Río Apa, 11) Reserva Mbaracayú, puesto Morena. BRAZIL: 12) Fazenda Fronteira, Porto Murtinho. ARGENTINA: 13) Isla de Cañas, 14) Río Pescado, 15) Ruta Provincial 5, between Apolinario Saravia and Las Lajitas, 16) Estación Biológica Los Colorados, 17) Finca San Javier, 8 km S Joaquín V. Gonzalez, 18) 1.5 km N Gaona, 19) 7 km San Salvador de Jujuy, 20) 10 km N Los Lapachos, 21) Florencia (= La Florencia), 22) Ea. Don Teo, 23) Ruta Nacional 81, between Pirané and Palo Santo, 24) El Colorado, 25) Formosa, 26) El Sauzalito, 27) near Cementerio El Sauzal, 28) Taco Pozo, 29) Parque Provincial Loro Hablador, 30) Juan José Castelli, 31) Pampa Grande, 32) La Escondida, 33) General Pinedo, 34) 40 km SE Santa Silvina, 35) Monte Quemado, 36) El Caburé, 37) Bañado Los Figueroa, 38) Arroyo Casa del Tigre, 2 km Villa La Punta, 39) Villa La Punta, 40) Choya, 41) Frías, 42) Río Saladillo, 43) 5 km S Añatuya, 44) near Río Salado, 8 km SW Colonia Dora, 45) Ruta Nacional 157, Km 969, 46) Totoralejos, 47) Margarita, 48) Ea. La Cabaña, Vera y Pintado.