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# THE ADVERTISEMENT CALLS OF THREE *ELEUTHERODACTYLUS* SPECIES (ANURA: LEPTODACTYLIDAE) IN A COLOMBIAN HIGHLAND COMMUNITY

por

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## Resumen

**Bernal, X. & F. Guzmán:** The Advertisement calls of three *Eleutherodactylus* species (Anura: Leptodactylidae) in a colombian highland community. Rev. Acad. Colomb. Cienc., 23 (Suplemento especial): 261-264, 1999. ISSN 0370-3908.

Se describen y comparan las llamadas de advertencia de tres especies de *Eleutherodactylus* de una comunidad de páramo en Colombia con base en un oscilograma y un sonograma característico de cada especie. Las llamadas de advertencia de estas especies difieren en características temporales y espectrales. La frecuencia dominante de la llamada de advertencia de las tres especies está correlacionada de forma inversa y significativa con el tamaño corporal. Los machos de las tres especies responden al playback de su propia llamada de advertencia con un silbido muy similar en todas las especies.

**Palabras clave:** Colombia, Comunidad, *Eleutherodactylus*, Llamada de advertencia, Variabilidad intragenérica.

## Abstract

The advertisement calls of three species of *Eleutherodactylus* from a Colombian highland community are described and compared based on a representative oscillograms and a sonogram for each species. The advertisement calls of these species differ in both temporal and spectral characteristics. The dominant frequency of the advertisement calls of the three species is inversely and significantly correlated with their body length. Males of the three species responded to the playback of their own advertisement call with a very similar whistle.

**Key words:** Colombia, community, *Eleutherodactylus*, advertisement call, intrageneric variability.

## Introduction

Because of their role as pre-zygotic species isolating mechanisms advertisement calls are important taxonomic determinants Schwartz (1987), Márquez *et al.* (1995). Although they are not expected to show clear homologies between species and could be obscured by convergences Duellman & Pyles (1983), they may offer taxonomic clues to confirm or clarify phylogenetic relationships.

*Eleutherodactylus* is a very diversified genus in northwestern South America where speciation is high Lynch (1999), Lynch & Duellman (1997). Due to the great number of species and the rate of their discovery, and in spite of the effort to understand the phylogenetic relationships between the species in this genus Lynch (1993), the phylogenetic relationship among many species such as those of páramos are unclear. This paper describes and compares the advertisement calls of three species of *Eleutherodactylus* of a highland frog community.

## Materials and methods

The study area is a small highland valley at an altitude of 3500 m (4° 42' 43" N, 73° 48' 25" W) in the Chingaza Natural Park in the eastern Andean chain of Colombia. In this area the vegetation is of the páramo type and dominated by grasses (*Calamagrostis effusa*), dwarf bamboo (*Swallenochloa tessellata*) and woolly plants (*Espeletia grandiflora*). The anuran community at the study site consists of one hylid (*Hyla labialis*), one dendrobatid (*Colostethus subpunctatus*) and three leptodactylids, all of the genus *Eleutherodactylus* (*E. bogotensis*, *E. elegans*, and *E. nericus*).

From January to June of 1998 we recorded the advertisement calls of 15 males of each species of *Eleutherodactylus* on a SONY tape recorder TMC-S68V.

Calls were analyzed using Canary 1.2 software (Charif *et al.* 1995) on a Power Macintosh computer at a sampling frequency of 44.1 kHz and 16 with bits of resolution. We analyzed five calls per individual and the variables measured were: dominant frequency (equivalent to the fundamental frequency for the three species), call duration, number of notes per call, number of pulses per note, pulse repetition rate (pulses per second) and note repetition rate (notes per second), as described by Cocroft & Ryan (1995). After recording we captured all focal males and measured their body length (SVL).

## Results

Calls of *Eleutherodactylus bogotensis*, *E. elegans* and *E. nericus* can be heard at night together with *Hyla labialis*. Nevertheless, *H. labialis* calls from ponds while the leptodactylids call from terrestrial sites. The males of the *Eleutherodactylus*-species usually call from elevated sites on a variety of plants. A summary of the numerical information from the sound analyses for the three species is shown in Table 1.

*Eleutherodactylus bogotensis* (Peters) was the medium-sized frog in the community (mean body length: 23.73 mm, s.d.: 1.43 mm). The advertisement call has between 5 and 39 unpulsed notes and the silent interval between the notes continuously increases within the call (Fig. 1). The silent interval between calls is very variable. The dominant frequency is 2.38 kHz (s.d.: 0.2 kHz) and we found a harmonic at 5.08 kHz.

*Eleutherodactylus elegans* (Peters) is the largest member of the genus in the area (mean body length: 38.96 mm, s.d.: 1.14 mm). The advertisement call has between 2 and 10 pulsed notes (Fig. 2). The number of pulses per note decreases in successive notes of the call, while the silent

Table 1. Summary of the numerical information from the sound analyses for the species of *Eleutherodactylus* of the community. Mean values and corresponding standard deviation (between parentheses) are presented.

	N (individuals analysed)	Dominant frequency (kHz)	Call duration (s)	Notes/call	Pulses/note	Calls/min.	Notes/s	Pulses/s
<i>E. bogotensis</i>	17	2.38 (0.1)	3.105 (1.33)	11.4 (4.00)	-	-	3.56 (0.43)	-
<i>E. elegans</i>	21	1.59 (0.1)	1.335 (0.73)	4.23 (1.72)	4.51 (2.04)	3.16 (2.9)	2.72 (0.47)	39.55 (14.9)
<i>E. nericus</i>	23	2.55 (0.2)	0.037* (0.02)	1	2.47 (1.19)	52.56* (24.9)	-	68.77 (23.3)

\* Uninote cally

interval between notes increases. The dominant frequency is 1.59 kHz (s.d.: 0.1 kHz) and we detected three harmonics, one between 2.6 and 3.3 kHz, another between 4.7 and 5.1 kHz and the last one with enough energy to be detected around 6.8 kHz. The calls are emitted at irregular intervals in series of up to 15 calls within 20 minutes or more, mainly at night, but occasionally during the day.

*Eleutherodactylus nervicus* Lynch, 1994 is the smallest member of the genus in the community (mean body length: 21.41 mm, s.d.: 2.05 mm). The advertisement call is composed of a single pulsed note (Fig. 3), emitted in series of 2 - 5 calls at regular intervals, or in series of more than 30 calls at irregular intervals. Sometimes the first calls of a series are not pulsed. The dominant frequency is 2.55 kHz (s.d.: 0.2 kHz) and in the sonograms we can detect two harmonics, at 4.7 kHz (range: 4.6-4.9 kHz), and 6.9 kHz (range: 6.8-7.1 kHz).

The dominant frequency of the advertisement call of the three species is inversely and significantly correlated with their body (snout to vent) length (Fig. 4). However, with the exception of *E. elegans*, we do not find a significant correlation between body length and dominant frequency within each species (Spearman correlation, *E. nervicus*  $\rho = -0.26$ ,  $p = 0.35$ ; *E. bogotensis*  $\rho = -0.33$ ,  $p = 0.18$ ; *E. elegans*  $\rho = -0.57$ ,  $p = 0.02$ ,  $N = 15$  in all cases).

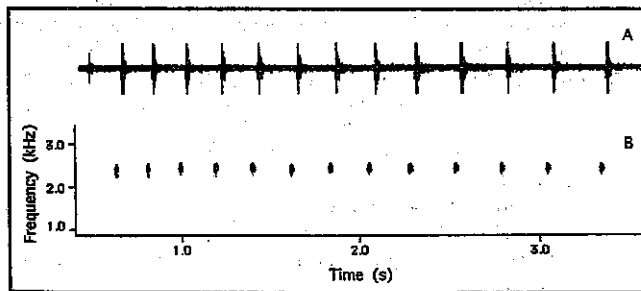


Figure 1. Representative oscillogram (A) and sonogram (B) of the advertisement call of *E. bogotensis*.

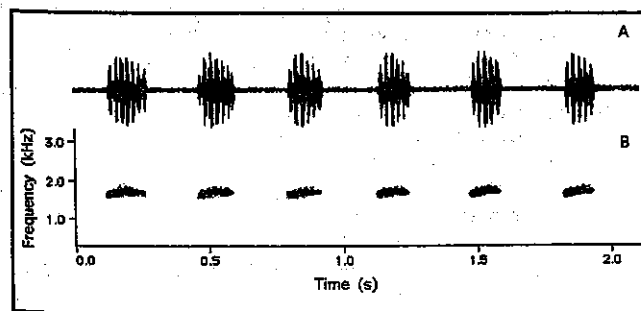


Figure 2. Representative oscillogram (A) and sonogram (B) of the advertisement call of *E. elegans*.

Males of all three *Eleutherodactylus* species responded to the playback of their own advertisement calls by uttering a whistle that was clearly different to the advertisement call (Fig. 5). All sounded like whistling and were similar in the three species. It probably functions as an aggression call.

## Discussion

The advertisement calls of *E. bogotensis*, *E. elegans* and *E. nervicus* differ in temporal and spectral characteristics. Being sympatric, this may be the result of selective pressure on the advertisement call, which is extremely important for communication and attraction between male and female in reproductive encounters, but at the same time should be an effective pre-zygotic isolating mechanism. A relationship between body length and dominant frequency of the advertisement call has been reported for many anuran species Sullivan (1982), Ryan

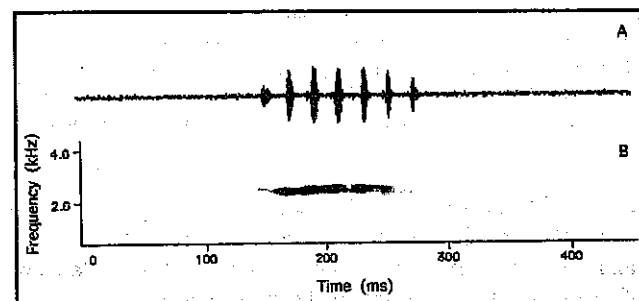


Figure 3. Representative oscillogram (A) and sonogram (B) of the advertisement call of *E. nervicus*.

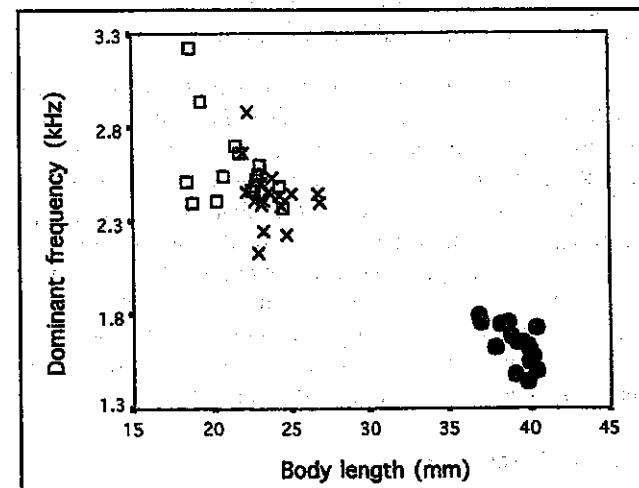


Figure 4. Relationship between body length and dominant frequency in three sympatric frog species.  $\square$ : *E. nervicus*,  $\times$ : *E. bogotensis*,  $*$ : *E. elegans* (Spearman correlation,  $\rho = -0.85$ ,  $p < 0.001$ ).

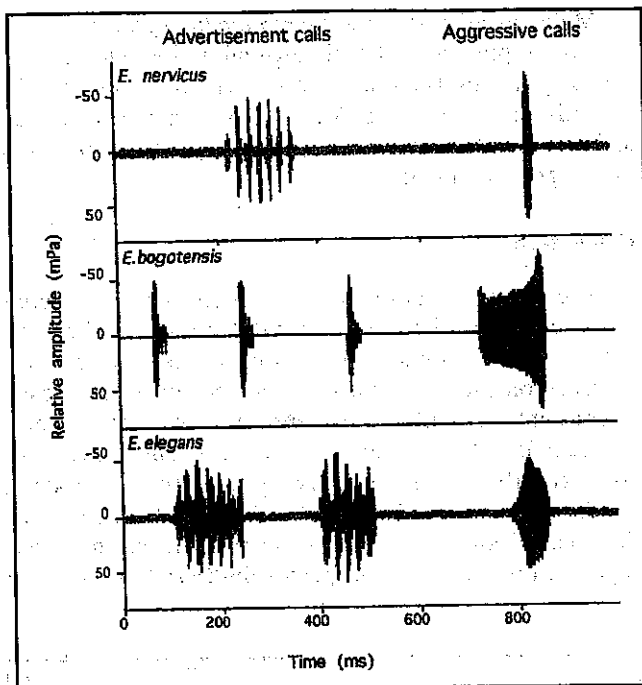


Figure 5. Comparison of the advertisement call with the aggressive calls for three syntopic *Eleutherodactylus* species. With exception of *E. nervicus* the advertisement call shows only the last notes.

*et al.* (1992), Zug (1993), Márquez (1995), Narins (1995). This relationship has been reported also in studies of large anuran communities Drewry & Rand (1983), Duellman & Pyles (1983). Spectral differences between species in the small community of the three *Eleutherodactylus* species in the páramo may support the existence of a selective pressure over call dominant frequency or body length. Nevertheless, alternative explanations like phylogenetic ones could be considered.

Aggressive calls have been reported for many species Fellers (1979), Wells (1980), Wells & Schwartz (1984). Demonstrations of interspecific aggression have been reported for some species (see revision by Gerhardt & Schwartz (1995). Signal similarity could be attributable to phylogenetic affinity or to convergence over evolutionary time. The similarity of the aggressive calls among the three sympatric *Eleutherodactylus* species may be due to their phylogenetic relationship. Information about more *Eleutherodactylus* species is needed to see whether similarity in aggressive calls is a shared derived character within this frog genus.

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