

## **Advertisement, aggressive, and possible seismic signals of the frog *Leptodactylus siphax* (Amphibia, Leptodactylidae)**

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**Advertisement calls from three geographically isolated populations of *Leptodactylus siphax* are remarkably similar. Aggressive calls of *L. siphax* sound to the human ear very different from the advertisement calls, although the basic structural components are similar. A male *L. siphax* responded with aggressive calls to a playback of his own advertisement call. The same male responded to playbacks of his aggressive calls with increased rate of aggressive calls and foot pounding behavior. The foot pounding produced audible clicks and, by its nature, seismic signals. This is the second known instance of *Leptodactylus* species producing seismic signals, each produced differently, however. It is not known whether *L. siphax* interprets the seismic signals. Seismic signalling in frogs may be much more common than currently believed.**

### INTRODUCTION

*Leptodactylus siphax* Bokermann, 1969 is restricted to rocky granitic outcroppings and is known from a few disjunct, widely separated, localities in Brazil (fig. 1). The first author recently recorded calls from three of these disjunct populations. We analyze the advertisement calls of the frogs from these three populations to determine whether there is any significant variation among them. At one locality, the first author was fortunate to observe and record *Leptodactylus siphax* aggressive calls and foot-pounding behavior. The foot-pounding may involve seismic communication, previously reported for the first time in frogs by LEWIS & NARINS (1985). We describe and comment on all of these calls and behaviors.



Fig. 1. — Known distribution of *Leptodactylus sypfax* in South America. Triangles: sites from which recordings are analysed in this paper (westernmost triangle: Barra do Bugres, Mato Grosso State; northernmost triangle: São Raimundo Nonato, Piauí State; southernmost triangle: Alpinópolis, Minas Gerais State). Square: site from previously published recording by W. C. A. BOKERMANN (Chapada dos Guimarães, Mato Grosso State). Dots: other known localities (note that southernmost dot, the locality of Serra do Espinhaço, Minas Gerais State, was incorrectly placed in northeastern Brazil in HEYER, 1979, fig. 21).

## METHODS AND MATERIALS

Recordings were made using a Uher Report 4000 reel-to-reel tape recorder. The recording information is:

(1) Tape ASN/AJC (Arquivo Sonoro Neotropical/Adão J. CARDOSO) 13, cut 6, Brazil, Minas Gerais State, Alpinópolis, Fazenda Salto; no voucher specimen; recorded by A. J. CARDOSO; 11 October 1981; 21.00 hours; 22°C air temperature. Ten advertisement calls are analyzed from this individual.

(2) Tape ASN/AJC 84, cut 2, Brazil, Mato Grosso State, Barra do Bugres, Reserva Biológica Serra das Araras; no voucher specimen; recorded by A. J. CARDOSO; 19 November 1988; 20.30 hours; 26°C air temperature. Sixteen advertisement calls are analyzed from this individual.

(3) Tape ASN/AJC 101, cut 2, Brazil, Piauí State, São Raimundo Nonato, Parna, Serra da Capivara, localidade Caldeirão; voucher specimen ZUEC 8829 (Universidade Estadual de Campinas); recorded by A. J. CARDOSO; 4 March 1990; 20.00 hours; 27.5°C air temperature. Ten advertisement calls, 9 aggressive calls, and 1 foot pounding are analyzed from this individual.

The recordings were analyzed with "Canary" software from the Cornell Laboratory of Ornithology on a Macintosh IIfx computer. The sampling rate used to convert the analogue signals to digital format was 22,254.5 Hz with 8-bit precision. Filter bandwidths of 353 Hz and frame lengths of 256 points were used for both audiospectrogram and spectrogram analyses.

Call terminology follows that defined in HEYER et al. (1990).

## RESULTS

## ALPINÓPOLIS DATA

Three individuals were calling at the recording site. The calling males were separated from each other by a distance greater than 100 m, far from water, in an area characterized by large rocks, among which crevices were abundant. The individual recorded was calling near one of these crevices, into which it fled after being approached to within about 10 m. Only the advertisement call was recorded; no playback was presented to the frog.

The advertisement call (fig. 2 A), is given at an average rate of 0.8 per second. Call duration ranges from 59 to 64 ms. The call is frequency modulated with a rapid rise time; the broadcast frequency range sweeps from 390 to 2110 Hz with maximum broadcast intensity between 1310 and 1330 Hz. The call is strongly partially pulsed, typically with 3 almost completely defined pulses. Harmonics are present (not particularly visible on fig. 2 A, but spectrogram analyses of calls [not shown] indicate their presence).

