Zootaxa 3184: 67–68 (2012)
www.mapress.com/zootaxa/

Correspondence

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

Description of the advertisement call of a species without vocal sac: *Craugastor gollmeri* (Amphibia: Craugastoridae).

ROBERTO IBÁÑEZ D.[1,2,3], CÉSAR A. JARAMILLO A.[1,2,4] & FRANK A. SOLÍS[2,3]

[1]*Smithsonian Tropical Research Institute, Apdo. 0843-03092, Balboa, Ancón, Panamá, Rep. de Panamá.*
E-mail: ibanezr@si.edu, jaramilc@si.edu
[2]*Círculo Herpetológico de Panamá, Apdo. 0824-00122, Panamá, Rep. de Panamá. E-mail: franksolisa@yahoo.es*
[3]*Departamento de Zoología, Universidad de Panamá, Panamá, Rep. de Panamá*
[4]*Departamento de Histología y Neuroanatomía Humana, Universidad de Panamá, Panamá, Rep. de Panamá*

The Central American frogs of the genus *Craugastor* consist of 113 species (Hedges *et al.* 2008; Frost 2011). *Craugastor gollmeri* (Peters) occurs in lowland to highland forests of central Panama, the Caribbean versant of western Panama and eastern Costa Rica, even extending into the Pacific versant in northwestern Costa Rica, within an altitudinal distribution range of 10–1520 m (Savage 2002). At some localities, *C. gollmeri* has been found to be an usual to common forest species, being primarily a diurnal species that inhabits leaf-litter on the forest floor (Ibáñez *et al.* 1995; Savage 2002). The snout-vent length (SVL) of adult frogs is 30–36.5 mm in males and 45–54 mm in females (Savage 1987). The males of *gollmeri* species group lack vocal slits and vocal sac (Savage 1987), and seem incapable of producing vocalizations (Savage 2002). Nonetheless, here we describe the vocalizations given by a male of *C. gollmeri* in captivity, considered to be advertisement calls (*sensu* Wells 1977). The role of advertisement calls in species recognition and reproductive isolation has been well established (Wells 2007), hence, the relevance of call characters in anuran phylogenetic and systematic studies (*e.g.*, Hoskin 2004).

A male of *C. gollmeri* was observed active on the dim forest floor at *ca.* 1700 h, near the headwaters of río Guabal (8.670888ºN 80.590406ºW, WGS84 datum, 704 m elevation), Coclé Province, Republic of Panama, on October 23, 1999. This male was transported to a laboratory in Panama City and kept isolated in a plastic bag, where he sporadically produced the same type of vocalization on several occasions during the evenings (1700–1900 h) of days preceding the recording date. In those days, CAJA saw him calling. On November 3, 1999, the male called for about 1 hr inside the bag, at an air temperature of 22°C. One of the calls was recorded by CAJA, using a Realistic directional microphone (Cat. no. 33–1062) and a SONY Cassette Recorder WM-D6C. The recording was digitized at a sampling frequency of 44.1 kHz and 16 bit resolution using the audio editing software Sound Forge 4.5, and analyzed with the software Avisoft-SASLab Pro 4.40. The digital audio file can be listened online at http://biogeodb.stri.si.edu/bioinformatics/dfm/metas/view/48405. We used the waveform display with a resolution of 0.7 ms to manually measure temporal variables of the call, the spectrogram display with a Hamming window, 512 points FFT size, 56 Hz bandwidth and 43 Hz resolution for frequency variables, and the power spectrum to determine frequency peaks. On the spectrogram display, we determined the maximum and minimum frequencies of each note to calculate its bandwidth. To determine frequency modulation, we used 128 points FFT size, 224 Hz bandwidth and 172 Hz resolution settings. The male was preserved as a voucher specimen and deposited in the Museo de Vertebrados de la Universidad de Panamá, MVUP 2325. This adult male measured 27.4 mm in SVL; therefore, sexual maturity of males is attained at a smaller size than previously reported (Savage 1987).

The advertisement call of *C. gollmeri* consists of a series of single, short, notes. On average, the male called very sporadically, emitting an advertisement call about every 30 min. This vocalization was rather a soft sound that could be heard 3-4 m away, consisting of 13 notes, given in a rapid succession (Fig. 1A). It sounded like a fast clatter of harsh and very short “ah” notes. The advertisement call had a duration of 1734.4 ms, and two main frequency peaks. The dominant frequency peaked at 1670 Hz, and the second frequency peak at 3100 Hz. The notes had a duration of 9.1±2.6 ms (mean±standard deviation, n=13 notes), and inter-note intervals of 135.1±35.5 ms (n=12 intervals). These notes were slightly downward frequency modulated (Fig. 1B). The lower frequency of the notes was 1265±46 Hz, their higher frequency is 3955±322 Hz, and their bandwidth was 2689±350 Hz (n=13 notes). The dominant frequency of the notes peaked at 1827±444 Hz, and the second peak at 3087±520 Hz (n=13 notes). The first note lacked a well-defined

Accepted by J. Padial: 13 Dec. 2011; published: 6 Feb. 2012

frequency peak; while in the last two notes, the second peak had a frequency equivalent to that of a third minor peak present in the previous notes. The bandwidth of the notes increased as they were emitted.

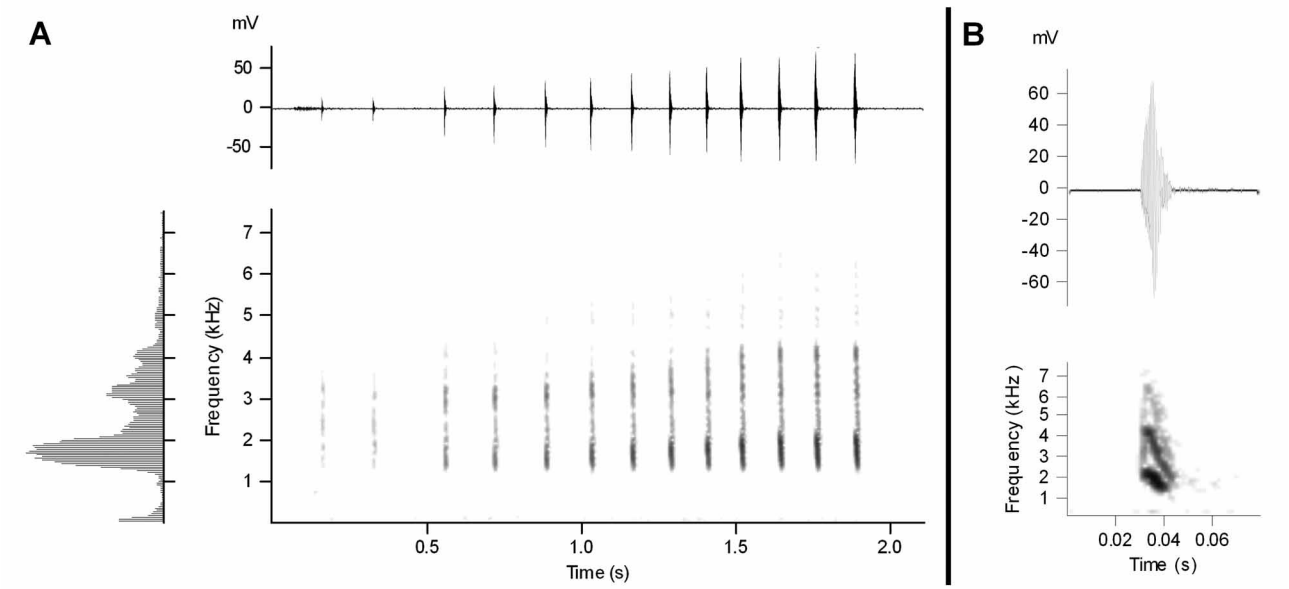

FIGURE 1. A. Waveform (upper), power spectrum (lower left) and spectrogram (lower right) of the advertisement call produced by the *Craugastor gollmeri* male (MVUP 2325). **B.** Waveform (upper) and spectrogram (lower) of the last note of the advertisement call.

Despite the lack of a vocal sac, we have shown that males of *C. gollmeri* are capable of producing vocalizations. It is known that the males of some other species of frogs, lacking this sound radiating organ, also produce calls (Wells 2007). Moreover, female frogs of a few species of the *fitzingeri* group are known to vocalize, *e.g.*, *C. crassidigitus* and *C. fitzingeri* females emit distress calls (Lynch & Myers 1983; Ibáñez *et al.*1999). The call of *C. gollmeri* is similar to the sporadic call of *C. fitzingeri* males which have a vocal sac (Lynch & Myers 1983). No further detailed comparisons or analyses can be made from just one recording. The difficulties for obtaining audio recordings from frogs that call sporadically could hinder the use of call characters in systematic studies; nonetheless, this does not diminishes their relevance in such studies. We suspect that males of other species in the *gollmeri* group also vocalize.

We thank B. Gratwicke, R. Márquez, J.M. Padial and A. Rodríguez for reviewing the manuscript. Fieldwork was conducted under ANAM permit No. 36–99.

References

Frost, D.R. (2011) *Amphibian Species of the World: an Online Reference*, Version 5.5, American Museum of Natural History, New York, USA. Available from: http://research.amnh.org/vz/herpetology/amphibia/ (December 7, 2011).

Hedges, S.B., Duellman, W.E. & Heinicke, M.P. (2008) New World direct-developing frogs (Anura: Terrarana): Molecular phylogeny, classification, biogeography, and conservation. *Zootaxa*, 1737, 1–182.

Hoskin, C.J. (2004) Australian microhylid frogs (*Cophixalus* and *Austrochaperina*): phylogeny, taxonomy, calls, distributions and breeding biology. *Australian Journal of Zoology*, 52, 237–269.

Ibáñez D., R., Jaramillo, C.A., Arrunátegui, M., Fuenmayor, Q. & Solís, F.A. (1995) Inventario biológico del Canal de Panamá. Estudio herpetológico. *Scientia (Panamá)*, Special Number 2, 111–159.

Ibáñez D., R., Rand, A.S. & Jaramillo A., C.A. (1999) *Los Anfibios del Monumento Natural Barro Colorado, Parque Nacional Soberanía y Areas Adyacentes*. Editorial Mizrachi & Pujol, Panamá, 187 pp.

Lynch, J.D. & Myers, C.W. (1983) Frogs of the *fitzingeri* group of *Eleutherodactylus* in eastern Panama and Chocoan South America (Leptodactylidae). *Bulletin of the American Museum of Natural History*, 175, 481–572.

Savage, J.M. (1987) Systematics and distribution of the Mexican and Central American rainfrogs of the *Eleutherodactylus gollmeri* group (Amphibia: Leptodactylidae). *Fieldiana Zoology*, 33, 1–57.

Savage, J.M. (2002) *The Amphibians and Reptiles of Costa Rica*. University of Chicago Press, Chicago, 934 pp.

Wells, K.D. (1977) The courtship of frogs. *In*: Taylor, D.H. & Guttman, S.I. (Eds), *The Reproductive Biology of Amphibians*. Plenum Press, New York, pp. 233–262.

Wells, K.D. (2007) *The Ecology and Behavior of Amphibians*. University of Chicago Press, Chicago, 1148 pp.