

Short Notes

The advertisement calls of two New Guinean species of *Litoria* (Amphibia, Anura, Hylidae)

Ignacio De la Riva, Jaime Bosch, Rafael Márquez

Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales, CSIC, José Gutiérrez Abascal 2, 28006 Madrid, Spain

The study of variation of vocalizations across large distributional areas can provide information about potential topics of interest for taxonomic research. The anuran fauna of New Guinea includes a considerable array of species, many of which remain relatively unstudied (Zweifel and Taylor, 1982). The most diverse group of frogs of the island is the hylid genus *Litoria*, which contains at least 54 New Guinean species (Allison, 1996). Whereas some of the species of *Litoria* are common and relatively well known, others are virtually unknown except for their original descriptions. This is especially true regarding the Indonesian part of the island, Irian Jaya, where herpetological research has been scarce. In this paper we contribute to the knowledge of the anuran fauna of New Guinea by providing a quantitative description of the calls of two species of *Litoria* from Irian Jaya. One of them, *Litoria infrafenata* (Günther), is well known and widespread, and the other, *L. sanguinolenta* (Van Kampen) is mostly known hitherto only from its original description, made almost 100 years ago.

Recordings were obtained by the first author in August 1992. Air temperature was taken with a dry bulb thermometer. Recording equipment consisted of a Sanyo M1120 cassette tape recorder. We present a representative audiospectrogram and oscillogram (waveform) for a selected 2.5 s recording segment for each species. A longer recording (10-90 seconds) was analyzed, when available, to generate numerical information on the spectral and temporal characteristics of the sounds.

Recordings were processed with Sound Tools hardware and software (Digidesign, Palo Alto, USA), a digital signal analysis system based on an Apple Macintosh. The sounds were digitized and edited at a sampling frequency of 44.1 KHz and 16 bit resolution. Recordings were deposited in the animal sound collection of the Fonoteca Zoológica (Museo Nacional de Ciencias Naturales, CSIC), Madrid. Signalyze software (Infosignal,

Lausanne, Switzerland) was used to obtain numerical information and to generate audiospectrograms and waveforms. Frequency information was obtained through fast Fourier transform (FFT) (width, 1024 points). The terminology used for the description of the advertisement calls follows Heyer et al. (1990).

Nine different call characteristics were considered: call duration (ms), number of notes per call, note duration (ms), number of pulses per note, fundamental frequency (Hz), dominant frequency (Hz), dominant frequency band width (Hz), notes per minute (within calls), and calls per minute. The resolution for temporal variables was 2 ms, and for spectral variables 10 Hz.

Additionally, three recordings of *L. infrafrenata* from commercial recordings of other authors were analyzed for comparison: two recordings obtained by Stewart (1998) in the Daintree National Park (Queensland, Australia, ca. 16°21'S/145°17'E) and in Julatten (a location very close to the Park, at 16°37'S/145°20'E), and a third recording obtained by Trenerry et al. (1995) in the vicinity of Townsville (Queensland, Australia, 19°16'S/146°47'E). These recordings were processed and analyzed as described above.

Litoria infrafrenata (Günther, 1867). This species is widespread in the Australasian region, occurring in Cape York Peninsula and Queensland (Australia), New Guinea, New Ireland, and Bismarck Archipelago, and it has been introduced into Java (Frost, 2002).

Recordings of *L. infrafrenata* were obtained on 26 August 1992 at Waganu, on the left bank of the Sirets (or Baliem) River, southern Irian Jaya (Indonesia) (unfortunately, the coordinates of this locality could not be found). The dominant vegetation around this locality is lowland tropical rainforest, although it was substantially disturbed around the village. Males were calling perched on banana trees at night (1-2 m above ground). Air temperature at the time of recording was 23°C.

Menzies (1976) describes the call of *L. infrafrenata* as "... a loud barking, not unlike that of a dog. The barks, which are actually double notes, follow at a rate of 2 per second". To the best of our knowledge, the physical description of the call of *L. infrafrenata* has not been published formally.

The calls from the single individual recorded at Waganu had about 100 ms duration and were composed of two notes with similar spectral structure, the second note being somewhat shorter (fig. 1A, table 1). The dominant frequency is distributed in a broad band about 1900 Hz wide, with a prominent peak around 2000 Hz. Calls were emitted at a rate of about 90 calls per minute.

The acoustic characteristics of fifteen calls from two individuals recorded in Townsville (Trenerry et al., 1995) were very similar to the individual recorded in Waganu: calls were emitted at a rate of 78 calls per minute, of 113 ms duration, constituted by two notes of 43 and 39 ms duration respectively, and with a dominant frequency of 1788 Hz. Ten calls from two individuals from Daintree NP (Stewart, 1998) were slightly longer (142 ms on average), but equally constituted by two notes of 45 ms duration, with a dominant frequency of 1856 Hz and were emitted at a rate of 76 calls per minute. On the other hand, 10 calls from one individual from Julatten (Stewart, 1998) presented similar acoustic characteristics (calls of 83 ms duration with two notes of 39 ms length and with a dominant frequency of 1709 Hz) but were arranged distinctively in trains of calls. These trains of calls, observed from several individuals, were composed of an increasing number of two-note calls (from 2 to 9), and therefore were of increasing duration (from 112 to 2392 ms). In addition, within a train of calls, the two-note calls were emitted at increasing intensities.

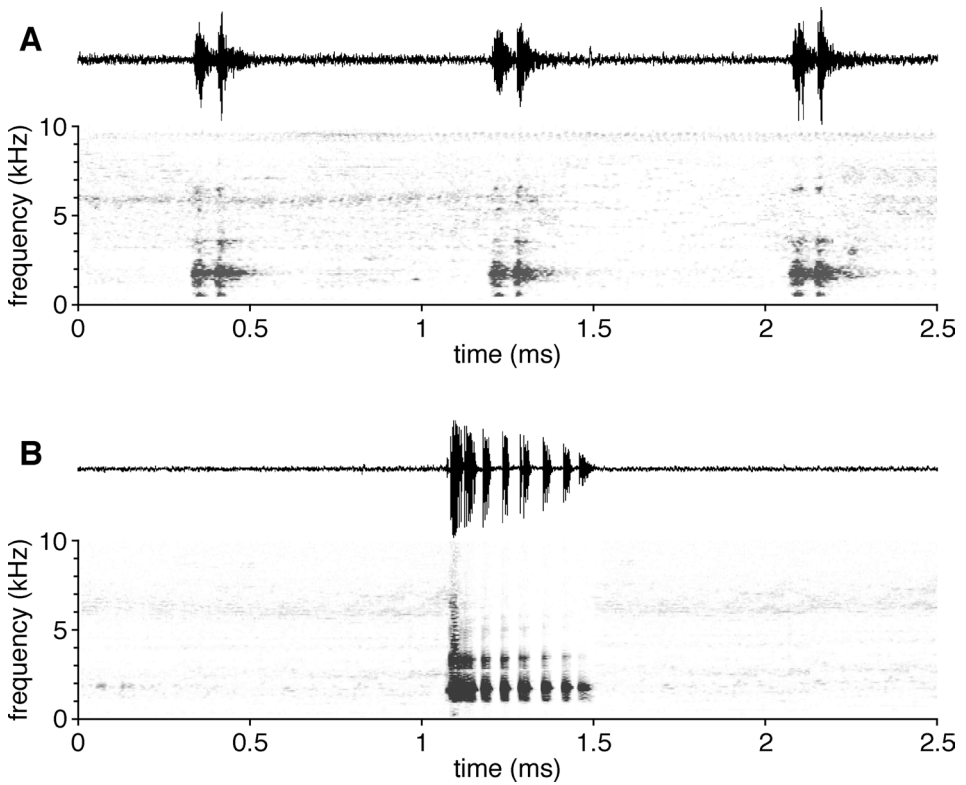


Figure 1. Waveform and audiospectrogram of the advertisement calls of (A) *Litoria infrafrenata* and (B) *Litoria sanguinolenta* from recordings obtained at Waganu, Irian Jaya, Indonesia (air temperature, 23°C).

It has been suggested that, because of the wide distribution of this species and the fact that it has populations in several islands and other populations that are isolated by large mountain ranges, *L. infrafrenata* might be a complex of species or populations in incipient process of speciation, a hypothesis supported by allozyme data (Dessauer et al., 1977; Sumida et al., 1998). Tyler and Davis (1978) recognized two subspecies of *L. infrafrenata*, which are now considered synonyms (see Frost, 2002). Unfortunately, no temperature data are available for the Australian recordings. However, even in spite of this lack of information, the evidenced similarity between the recordings from Waganu and those from the Australian localities indicates that, on the basis of the advertisement calls, no remarkable differences exist between the populations of *L. infrafrenata* from New Guinea and Australia. Thus, no potential areas of interest for taxonomic research are revealed by bioacoustics. Nevertheless, the differences found between the recordings from Daintree National Park and Julatten populations, suggest that some variation exists in the call of *L. infrafrenata*. Because these two localities are geographically close to each other (about 40 km) and the differences are related to the arrangement of calls in trains and not to

Table 1. Summary of numerical parameters of vocalizations of two species of *Litoria* from Waganu (Irian Jaya, New Guinea). Mean values followed by standard deviations (in parentheses) and ranges. Air temperature, 23°C.

	<i>L. infrafrenata</i>		<i>L. sanguinolenta</i>	
Sample size (number of calls)	27		17	
Call duration (ms)	101 (7) 90-115		404 (42) 314-471	
Number of notes per call	2 (0) 2-2		7 (1) 6-8	
Note duration (ms)	first note	second note	first note	other notes
	41 (5) 33-52	29 (6) 19-41	55 (17) 37-84	25 (5) 17-31
Number of pulses per note	-		first note	other notes
			11 (3) 8-16	4 (1) 3-5
Fundamental frequency (Hz)	608 (30) 525-666		1925 (70) 1787-2029	
Dominant frequency (Hz)	1919 (114) 1555-2201		1925 (70) 1787-2029	
Dominant frequency band width (Hz)	1865 (231) 1600-2264		1672 (139) 1494-1920	
Note repetition rate (within calls; number of notes/m)	839 (66) 699-971		653 (61) 839-1053	
Call repetition rate (number of calls/m)	93 (16) 57-116		17 (6) 10-25	

the temporal or spectral characteristics of the typical single call, we suggest that some environmental, extrinsic factors (e.g., social context, presence of other species which might compete for the acoustic niche) or intrinsic state (e.g., hormonal levels) may account for the variation observed.

Litoria sanguinolenta (Van Kampen, 1909). To the best of our knowledge, this species remains almost unknown since its description from Sabang, Lorentz River, southern Irian Jaya. Boulenger (1912) considered it a synonym of *L. infrafrenata*, a criterion not followed by Van Kampen (1923), who reported the last specimens known to date (Tyler, 1968). Thus, besides providing the call description, the data presented herein mean the formal rediscovery of *L. sanguinolenta* almost a century after its description and the first additional information on the species. A color plate of the specimen recorded was published by De la Riva (1992). Conditions, date, and location of recordings are the same that those of *L. infrafrenata* explained above.

A male was calling from a forest gap near the village. It was around 1.5 m above the ground, on vegetation covering a broken log. The specimen was perching on a leaf with the head downwards while calling. Another male, not observed, was calling in the background.

The calls from the two individuals recorded were of about 400 ms duration and were composed of 6-8 short, pulsed notes emitted in rapid succession and decreasing in amplitude (fig. 1B, table 1). The first note was considerably longer (55 versus 25 ms in average) and had a higher number of pulses (11 versus 4 in average) than the others. The dominant frequency was distributed in a broad band of about 1670 Hz width with a peak around 1900 Hz. Calls were emitted at a rate of about 17 calls per minute.

Tyler and Davis (1978) placed *L. infrafrenata* and *L. sanguinolenta* as the two only species in the *L. infrafrenata* species group, although further arrangements of the genus have not necessarily maintained this scheme. The anuran advertisement calls are often too distinct between closely related species as to ascertain a phylogenetic relationship based only on bioacoustical parameters; contrarily, species not related may present remarkably similar calls (De la Riva et al., 1994). Thus, our data on the advertisement calls of the two species of *Litoria* considered herein do not allow us to make any statement about the placement of *L. sanguinolenta* in the *L. infrafrenata* group. A broader study on the advertisement calls of frogs of the genus *Litoria* might cast more light on this topic.

Acknowledgements. The first author is grateful to his field companions who patiently awaited every day until he obtained the necessary recordings and photographs of every frog encountered. Our field guide, Herman Sihotang was invaluable to reach the goals of the expedition. We are grateful to Jean-Mark Hero, James Menzies, and Michael Tyler for helping with the bibliographic search. Murray Littlejohn and an anonymous referee made valuable criticisms on the manuscript. Partial funding for the analyses was provided by projects 07M/0083/02 (PI: R. Márquez) Comunidad Autónoma de Madrid, and project BMC 2000-1139 (PI: R. Márquez), Ministerio de Ciencia y Tecnología of Spain, and publication costs were funded by project REM 2001-1046 (PI: Ignacio De la Riva), Ministerio de Ciencia y Tecnología of Spain.

References

- Allison, A. (1996): Zoogeography of amphibians and reptiles of New Guinea and the Pacific region. In: The Origin and Evolution of the Pacific Island Biotas, New Guinea to Eastern Polynesia: Patterns and Processes, p. 407-436. Keast, A., Miller, S.E., Eds, Amsterdam, SPB Academic Publishing.
- Boulenger, G.A. (1912): On some tree-frogs allied to *Hyla caerulea* with remarks on noteworthy secondary sexual characters in the family Hylidae. Zool. Jb. Suppl. **15**: 211-218.
- De la Riva, I. (1992): *Litoria sanguinolenta*. Bol. Asoc. Herp. Esp. **3** (back cover plate).
- De la Riva, I., Márquez, R., Bosch, J. (1994): Advertisement calls of Bolivian species of *Scinax* (Amphibia, Anura, Hylidae). Bijdr. Dierk. **64**: 75-85.
- Dessauer, H.C., Gartside, D.F., Zweifel, R.G. (1977): Protein electrophoresis and the systematics of some New Guinea hylid frogs (genus *Litoria*). Syst. Zool. **26**: 426-436.
- Frost, D.R. (2002): Amphibian species of the world. V2.21 Database, American Museum of Natural History, <http://research.amnh.org/cgi-bin/herpetology/amphibia>
- Heyer, W.R., Rand, A.S., Cruz, C.A., Peixoto, O.L., Nelson, C.E. (1990): Frogs of Boracéia. Arq. Zool., S. Paulo **31**: 231-410.
- Menzies, J.I. (1976): Handbook of common New Guinea frogs. Wau Ecology Institute, Handbook 1, Wau, Papua New Guinea.
- Stewart, D. (1998): Australian Frog Calls, Tropical North-east (Audio CD). Nature Sound Mullumbimby NSW, Australia.

- Sumida, M., Allison, A., Nishioka, M. (1998): Genetic relationships and phylogeny of Papua New Guinean Hyliid frogs elucidated by allozyme analysis. *Japan. J. Herpetol.* **17**: 164-174.
- Trenerry, M., Dennis, A., Werren, G. (1995). Frog calls of north-east Queensland. Audio Cassette produced by J.M. Hero. Townsville, Queensland, Australia.
- Tyler, M.J. (1968): Papuan hylid frogs of the genus *Hyla*. *Zool. Verhand.* **96**: 1-203.
- Tyler, M.J., Davis, M. (1978): Species groups within the Australopapuan hylid frog genus *Litoria* Tschudi. *Austr. J. Zool., Suppl. Ser.* **63**: 1-47.
- Van Kampen, P.N. (1923): *Amphibia of the Indo-Australian Archipelago*. Leiden.
- Zweifel, R.G., Taylor, M.J. (1982): Amphibia of New Guinea. In: *Biogeography and Ecology of New Guinea*, p. 759-801. Gressitt, J.L., Ed., *Monographiae Biologicae* Vol. 42, The Hague, Junk Publishers.

Received: January 8, 2003. Accepted: April 30, 2003.

Diet of the large water snake *Hydrodynastes gigas* (Colubridae) from northeast Argentina

María Soledad López, Alejandro R. Giraudo

National Institute of Limnology, CONICET, José Maciá 1933, (3016) Santo Tomé, Santa Fe, Argentina

Hydrodynastes gigas (Dumeril, Bibron and Dumeril, 1854), is one of the largest snakes of South America reaching a maximum total length of 3 m (Bernarde and Moura-Leite, 1999). It is a semiaquatic species (Strüssmann and Sazima, 1990, 1993; Cadle and Greene, 1993; Giraudo, 2001) that inhabits several types of wetland in subtropical and tropical regions in Peru, central and south-eastern Brazil, eastern of Bolivia, Paraguay to northern and east Argentina (Abalos and Mischis, 1975; Cei, 1993; Williams and Scrocchi, 1994; Moura-Leite et al., 1996; Bernarde and Moura-Leite, 1999; Giraudo, 2001).

The diet of *H. gigas* had been mentioned by few authors, and most of the data are imprecise, lacking quantitative and qualitative analyses (Serié, 1919; Amaral, 1977; Cei, 1993; Strüssmann and Sazima, 1993; Williams and Scrocchi, 1994; Achaval and Olmos, 1997). These authors showed that it is a general predator eating fishes, frogs, mammals, birds and carrion. *H. gigas* is one of the most frequently found snakes in the lowland of Paraná and Paraguay basin (Strüssmann and Sazima, 1993; López, 2000). Here we report the diet of *H. gigas* based on stomach contents and regurgitated items from several wild specimens from this region.

We examined 40 specimens of *Hydrodynastes gigas* (see appendix 1) from field sampling and museum collections. Most of the field observations are from north-eastern Argentina (in the provinces of Formosa, Chaco, Corrientes and Santa Fe), with some from Paraguay (in the department of Ñeembucú). This region is a lowland area (50 m average altitude) with alluvial flood plains of the Paraná and Paraguay rivers. The vegetation is formed