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Distress call of *Hypsiboas leucocheilus* (Caramaschi and Niemeyer, 2003) (Anura, Hylidae)

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Abstract. The distress call is characterized by loud, explosive calls emitted in response to disturbance or potential predators. Herein we describe the distress call of a female of *Hypsiboas leucocheilus* from Aripuanã, north of Mato Grosso state, Brazil. The call is emitted with the mouth open and consists of a single, not pulsed, harmonic note. This call is similar to other distress calls known for Brazilian hylids.

Keywords. amphibian communication, vocalization, distress call, Mato Grosso state, Brazilian Amazon.

Introduction

Animal communication was defined by Slater (1983) as the influence that one animal exercise over another. In anurans, vocalization is the most conspicuous behavior characterizing them as mainly acoustic animals (Haddad, 1995). Acoustic and/or larval characters along with adult morphology have been used successfully to resolve taxonomic problems in anurans (see Cruz, 1990; Haddad et al., 2003). For this reason, larval, ecological, and ethological data are as important as a traditional adult morphology analysis (Brooks and Mclennan, 1991).

In the behavioral repertoire of anurans, calls are used in different contexts and the same species may present different acoustic signals (Wells, 1977). The distress call is characterized by loud, explosive calls emitted in response to disturbance or potential predators (Duellman and Trueb, 1994). The possible functions are to warn conspecifics of predator presence (Duellman and Trueb, 1994) and/or, more likely, to frighten (or surprise) auditively oriented predators, or even, to attract a secondary predator capable of interfering in the predatory process (Hödl and Gollmann, 1986). Distress calls can be emitted with open or closed mouth (see Duellman and Trueb, 1994 for examples).

Hypsiboas leucocheilus (Caramaschi and Niemeyer, 2003) is a large species (57.7–67.9mm SVL in males, 71.9–81.2mm SVL in females), belonging to the *Hypsiboas albopunctatus* (Spix, 1824) species group, known only from primary forests along small streams, near tributaries of the Aripuanã, Juruena and Teles Pires rivers, in north-western Mato Grosso state, Brazil (Pansonato et al., 2011).

Materials and Methods

We collected a female of *Hypsiboas leucocheilus* on 7 March 2008, between 21:00 h and 23:00 h, in the marginal vegetation of a rivulet in a primary ombrophilous forest, in “fazenda Maracatiá”, Aripuanã municipality (10°09’34” S, 59°28’4.50” W), Mato Grosso state, Brazil. Calls were recorded with a Panasonic RQ-L11 recorder and digitalized with sampling rate of 16.000 Hz and 16 bits resolution. The calls were analyzed with AVISOFT-SASLab Light for Windows, version 3.74. Audiospectrograms were produced according to the following parameters: FFT = 256; Frame = 100; Overlap = 75; and flap top filter. The oscillogram and power spectrum were produced in SoundRuler Version 0.9.4.1. Terminology follows Duellman and Trueb (1994). Call parameters and oscillogram shape follow Tárano

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Table 1. Described distress calls of Hylidae (VC = variation coeficient).

Taxa	SVL (mm)	Note duration (sec)	Dominant Frequency (kHz)	VC Note duration	VC Dominant Frequency (kHz)	Reference
Aplastodiscus albosignatus (female)	47.9	1.11 ± 0.63	6.43 ± 0.69	931.88	931.88	Toledo and Haddad, 2009
Aplastodiscus arildae (male)	-	-	4.67 ± 3.09	-	151.13	Orrico et al., 2006
Aplastodiscus arildae (male)	39.19	0.40 ± 0.09	5.59 ± 2.43	444.44	230.04	Toledo and Haddad, 2009
Aplastodiscus cochranae (male)	43.5	1.52 ± 0.37	6.19 ± 0.39	410.81	1.587.18	Toledo and Haddad, 2009
Aplastodiscus leucopygius (male)	41.09	0.44 ± 0.17	6.00 ± 0.68	258.82	882.35	Toledo and Haddad, 2009
Aplastodiscus perviridis (female)	43	0.76 ±0.55	7.02 ± 1.80	138.18	390.00	Toledo and Haddad, 2009
Aplastodiscus perviridis (male)	37.74	0.70 ± 0.23	4.22 ± 1.06	304.35	398.11	Toledo and Haddad, 2009
Bokermannohyla circumdata (female)	66.5	0.94 ± 0.32	3.97 ± 1.22	293.75	325.41	Toledo and Haddad, 2009
Bokermannohyla hylax(male)	58.2	1.17 ± 0.30	3.17 ± 0.99	390.00	320.20	Toledo and Haddad, 2009
Bokermannohyla izecksonni (male)	45	0.79 ± 0.26	3.75 ± 1.61	303.85	232.92	Toledo and Haddad, 2009
Bokermannohyla luctuosa (male)	49	1.01 ± 0.22	3.35 ± 0.31	459.09	1.080.65	Toledo and Haddad, 2009
Dendropsophus minutus	25.3	0.18	5.59	*	*	Toledo and Haddad, 2009
Dendropsophus werneri	17	0.037 ± 0.021	5.77 ± 0.45	176.19	1.282.22	Lingnau et al., 2004
Hypsiboas albomarginatus (female)	53.5	0.14 ± 0.10	1.74 ± 0.34	140.00	511.76	Figueiredo-de-Andrade et al., 2010
Hypsiboas albomarginatus (male)	47.6	0.39 ± 0.17	3.54 ± 2.05	229.41	172.68	Toledo and Haddad, 2009
Hypsiboas bischofii (female)	37.14	0.29 ± 0.06	5.13 ± 2.33	483.33	220.17	Toledo and Haddad, 2009
Hypsiboas boans (male)	100	0.62 ± 0.14	0.3 – 3.0	442.86	*	Hödl and Gollmann, 1986
Hypsiboas boans (male)	88	0.76 ± 0.21	0.4 – 2.5	361.90	*	Hödl and Gollmann, 1986
Hypsiboas boans (male)	126	0.64 ± 0.04	0.5 – 4.0	1.600.00	*	Hödl and Gollmann, 1986
Hypsiboas caingua (male)	32.5	0.43 ± 0.67	7.41 ± 7.49	64.18	98.93	Toledo and Haddad, 2009
Hypsiboas caipora (male)	-	0.062 – 0.640	-	*	*	Antunes et al., 2008
Hypsiboas exastis	-	0.51 ± 0.21	-	242.86	*	Loebmann et al., 2008
Hypsiboas faber (female)	83.3	1.83 ± 0.98	4.20 ± 0.52	186.73	807.69	Toledo and Haddad, 2009
Hypsiboas faber (juv)	38	0.85	-	*	*	Sazima, 1975
Hypsiboas faber (juv)	41	0.64 ± 0.36	4.37 ± 2.15	177.78	203.26	Toledo and Haddad, 2009
Hypsiboas faber (male)	-	0.50	-	*	*	Martins and Haddad, 1988
Hypsiboas faber (male)	-	1.00	-	*	*	Martins and Haddad, 1988
Hypsiboas faber (male)	92.6	0.70 ± 0.02	3.15 ± 0.72	3.500.00	437.50	Toledo and Haddad, 2009
Hypsiboas faber	100	0.7 ± 0.2	0.55 ± 0.05	350	1100	Forti and Bertoluci, 2012
Hypsiboas lanciformis (juv)	52	0.38 ± 0.02	-	1.900.00	*	Hödl and Gollmann, 1986
Hypsiboas lanciformis (juv)	46	0.51 ± 0.078	-	653.85	*	Hödl and Gollmann, 1986
Hypsiboas lanciformis (male)	73	1.09 ± 0.38	-	605.56	*	Hödl and Gollmann, 1986
Hypsiboas lanciformis (male)	68	0.57 ± 0.18	-	316.67	*	Hödl and Gollmann, 1986
Hypsiboas latistriatus(female)	46.47	0.57 ± 0.33	5.47 ± 1.25	172.73	437.60	Toledo and Haddad, 2009
Hypsiboas leucocheilus (female)	69.98	0.20 ± 0.03	1.31 ± 0.51	666.67	256.86	**Present work**
Hypsiboas lundii (female)	73	0.62 ± 0.16	4.38 ± 1.55	387.50	282.58	Toledo and Haddad, 2009
Hypsiboas lundii (juv)	43.9	0.69 ± 0.11	1.98 ± 1.71	627.27	115.79	Toledo and Haddad, 2009
Hypsiboas lundii (male)	59	1.09 ± 0.35	0.89 ± 0.10	311.43	890.00	Toledo and Haddad, 2009
Hypsiboas pardalis(male)	60.2	0.35 ± 0.16	1.14 ± 0.72	218.75	158.33	Toledo and Haddad, 2009
Hypsiboas raniceps (female)	73.05	0.37 ± 0.05	1.04 ± 0.72	740.00	144.44	Toledo and Haddad, 2009
Hypsiboas raniceps (male)	43	0.19 ± 0.02	-	950.00	*	Hödl and Gollmann, 1986
Hypsiboas raniceps (male)	67.7	0.33	0.95	*	*	Toledo and Haddad, 2009
Pseudis cardosoi	48	0.40 ± 0.02	4.48 ± 0.89	2.000.00	503.37	Toledo and Haddad, 2009
Pseudis platensis	45	0.40 ± 0.06	3.78 ± 0.60	666.67	630.00	Toledo and Haddad, 2009

(2001) and Orrico et al. (2006). Voucher specimens are deposited in Coleção Herpetológica Museu de Zoologia João Moojen, Universidade Federal de Viçosa, Viçosa (MZUFV), Minas Gerais, Brazil.

We, additionally, tested the influence of body size (SVL) on the dominant frequency, and call duration for all available hylid distress calls (Table 1), using a linear regression (Toledo and Haddad, 2009). We performed the linear regression in Stata 11.1 for Mac.

Results

When captured and handled, the female (MZUFV 8484; Fig. 1) produced a strong, explosive call that we understood as a distress call. During manipulation, it emitted the 11 calls recorded and described below.

Figure 1. Adult female of *Hypsiboas leucocheilus* (MZUFV 8484) (SVL 69.98 mm).

The call is composed of a single, harmonic, not pulsed note (Fig. 2 A-B) with duration of 0.20±0.03 s [0.14 – 0.26 s] (average ± standard deviation [amplitude]). In the oscillogram, the call is bell-shaped, slightly descending. Dominant frequency (taken in the point of maximum energy of the oscillogram) was 1994±170 kHz (amplitude=1718 – 2229) in the second harmonic.

Discussion

The distress call of *H. leucocheilus* was emitted with the mouth open as noted for other distress calls described for anurans (Toledo et al., 2005), and especially for the genus *Hypsiboas* Wagler, 1830 (Martins and Haddad, 1988).

It also presented a stable and descending shape, different of the distress calls described by Lingnau et al. (2004) and Orrico et al. (2006) for *Dendropsophus werneri* (Cochran, 1952) and *Aplastodiscus arildae* (Cruz and Peixoto, 1987 “1985”), respectively. Those calls do not present a rigid form, and are altered in function of stimuli given.

Hödl and Gollman (1986) present data for *H. raniceps*, a species closely related to *H. leucocheilus*. Our results show differences in all parameters analyzed by Hödl and Gollman (1986), with marked differences in call duration and fundamental frequency (f_0) of *H. leucocheilus* (Table 1); however, all species present a stereotyped shape of the distress call.

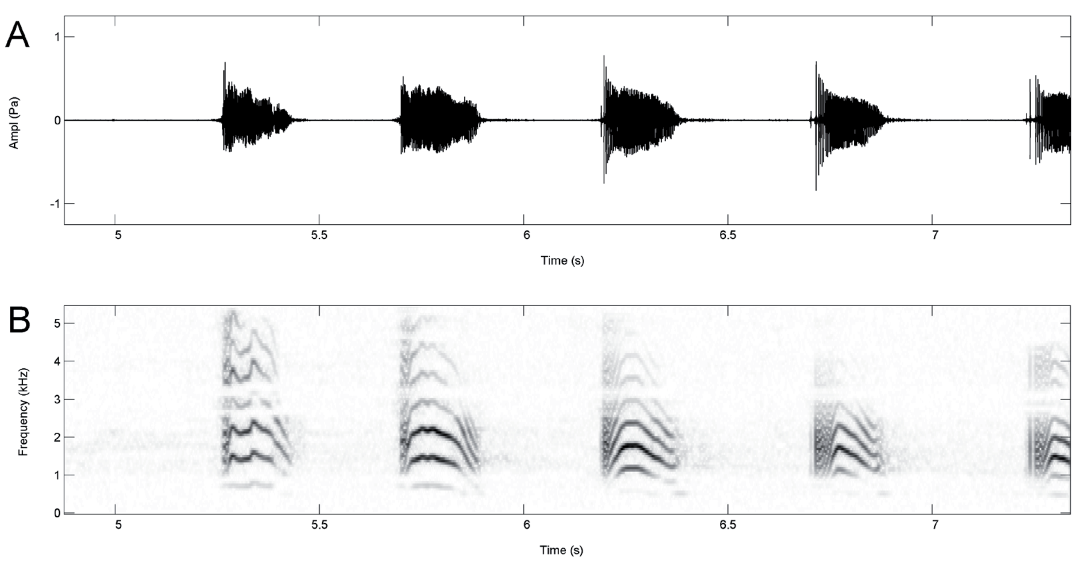

Figure 2. *Hypsiboas leucocheilus*: distress call (A) oscillogram and (B) audiospectrogram (air temperature = 25ºC).

The differences found can be due to sexual differences since the calls analyzed by Hödl and Gollman (1986) are from males and juveniles. Literature on distress calls refers largely to males or unsexed juvenile individuals (Sazima, 1975; Hödl and Goldmann, 1986); however, female calls of any kind are rare. Since distress calls are though to be "designed" as anti-predator strategies, they are useful to all individuals and it will be no surprise if more and more female distress calls are described in the future.

The analyzed female of *H. leucocheilus* did not present any type of associate behavior along with the distress call emission, such as death feigning or biting for example, as mentioned by Duellman and Trueb (1994). Of the described distress calls, none has shown to be similar in numerical data to the one of *H. leucocheilus* and, as observed by Hödl and Gollman (1986), although very variable, distress calls of different species are different.

Toledo and Haddad (2009) suggest that anuran size is directly related to successful acoustic defensive strategies, since small species do not use this behavior, but larger ones do. The same authors also show that in anurans, the snout-vent-length (SVL) is positively correlated to the duration of the distress call (DC) and negatively related to dominant frequency (DF). In our linear regression we found the same result as Toledo and

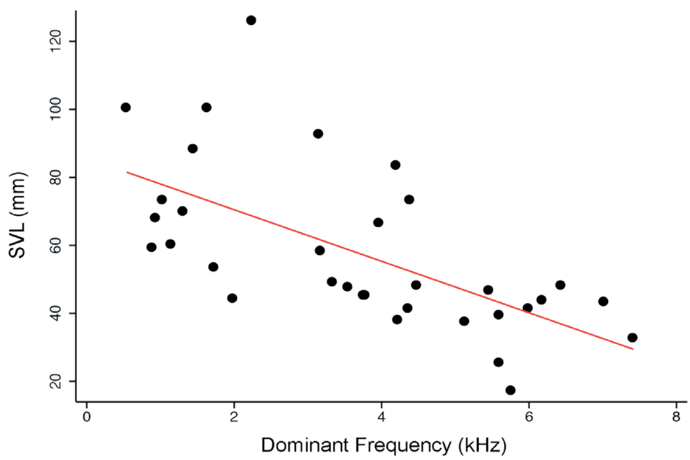

Figure 3. Linear regression ($r^2 = 0.3946$; P = 0.0001) between snout-vent-length (SVL) and dominant frequency (kHz) in 33 hylid frogs.

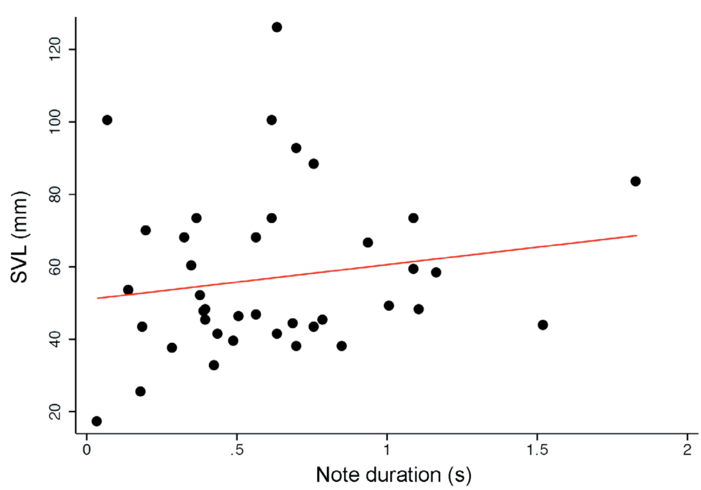

Figure 4. Linear regression ($r^2 = 0.0273$; P = 0.3144) between snout-vent-length (SVL) and duration of distress calls (s) in 39 hylid frogs.

Haddad (2009) for dominant frequency (r^2 = 0.3946; P = 0.0001; N = 33) (Figure 3). However, we did not find a relation for call duration (r^2 = 0.0273; P = 0.3144; N = 39) (Figure 4).

To produce these results, we used the same database as Toledo and Haddad (2009), and Hödl and Gollmann (1986) for Hylidae, with the inclusion of data from a second species of *Dendropsophus* (*D. werneri*) described by Lingnau et al. (2004), plus *Hypsiboas albomarginatus* (Figueire-de-Andrade et al., 2010), and *H. faber* (Forti and Bertoluci, 2012), not included in their work. Since the single inclusion of a small species data in the regression database caused such significant change, this call could be understood as an outlier and our results should be interpreted with caution. Nevertheless, it elicits the need to look for distress calls in smaller species to better understand the evolution of distress calls as an acoustic defensive strategy.

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References

Brooks, D. R., Mclennan, D. A. (1991): Phylogeny, ecology, and behavior: a research program in comparative biology. Chicago and London, The University of Chicago Press.

Caramaschi, U., Niemeyer, H. (2003): New species of the *Hyla albopunctata* group
from central Brazil (Amphibia, Anura, Hylidae). Boletim do Museu Nacional Nova Série **504**: 1-8.

Cruz, C.A.G. (1990): Sobre as relações intergenéricas de Phyllomedusinae da Floresta Atlântica (Amphibia, Anura, Hylidae). Revista Brasileira de Biologia **50**: 709-726.

Duelmann, W.E., Trueb, L. (1994): Biology of amphibians. Baltimore and London, Johns Hopkins University Press.

Figueiredo-de-Andrade, C.A., Santana, D.J., Carvalho-e-Silva, S.P (2010): Distress call of a female *Hypsiboas albomarginatus* (Anura, Hylidae). Herpetology Notes **3**: 37-39.

Forti, L.R., Bertoluci, J. (2012): Distress call of *Hypsiboas faber* (Anura: Hylidae) during a *Liophis miliaris* (Serpentes: Colubridae) attack. Herpetology Notes **5**: 187-188.

Haddad, C.F.B. (1995): Comunicação em anuros. Anais de Etologia **13**: 116-132.

Haddad, C.F.B., Garcia, P.C.A., Pombal Jr, J.P. (2003): Redescrição de *Hylodes perplicatus* (Miranda-Ribeiro, 1926) (Amphibia, Anura, Leptodactylidae). Arquivos do Museu Nacional **61**: 245-254.

Hödl, W., Gollmann, G. (1986): Distress calls in neotropical frogs. Amphibia-Reptilia **7**: 11-21.

Lima, A.P., Magnusson, W.E., Menin, M., Erdtmann, L.K., Rodrigues, D.J., Keller, C., Hödl, W. (2006) Guide to the frogs of Reserva Adolpho Ducke – Central Amazonia. Attama. Manaus.

Lingnau, R., Guimarães, L.D., Bastos, R.P. (2004): Vocalizações de *Hyla werneri* (Anura, Hylidae) no sul do Brasil. Phyllomedusa **3**: 115-120.

Martins, M., Haddad, C.F.B. (1988): Vocalizations and reproductive behavior in the smith frog, *Hyla faber* Wied (Amphibia: Hylidae). Amphibia-Reptilia **9**: 49-60.

Orrico, V.G.D., Carvalho-e-Silva, A.M.P.T., Carvalho-E-Silva, S.P. (2006): Redescription of advertisement call of *Aplastodiscus arildae* and description of the call *Aplastodiscus weygoldti* with general notes about the genus in Southeastern Brazil (Anura, Hylidae). Revista Brasileira de Zoologia **23**: 994-1001.

Pansonato, A., Ávila, R.W., Kawashita-Ribeiro, R.A., Morais, D.H. (2011): Advertisement call and new distribution records of *Hypsiboas leucocheilus* (Anura: Hylidae). Salamandra **47**: 55-58.

Kiesecker, J.M. (2003): Invasive species as a global problem. Toward understanding the worldwide decline of amphibians. In: Amphibian Conservation, p. 113-126. Semlitsch, R.D., Ed., Washington, Smithsonian.

Slater, P.J.B. (1983): The study of communication. In: Animal Behaviour, 2 Communication, p. 9-42. Halliday, T.R., Slater, P.J.B., Eds., New York, W.H. Freeman and Company.

Tárano, Z. (2001): Variation in male advertisement calls in the neotropical frog *Physalaemus enesefae*. Copeia **4**: 1064-1072.

Toledo, L.F., Tozetti, A., Zina, J. (2005): *Leptodactylus labyrinthicus* (Pepper Frog): defensive repertoire. Herpetological Bulletin **90**: 29-31.

Toledo, L.F., Haddad, C.F.B. (2009): Defensive vocalizations of neotropical anurans. South American Journal of Herpetology **4**: 25-42.

Wells, K.D. (1977) The Social Behavior of Anuran Amphibians. Animal Behavior **25**: 666-693.

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