Begleitveröffentlichungen zu wissenschaftlichen Filmen

Film C 2392

Phrynohyas resinifictrix (Hylidae, Anura) - Calling behaviour

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Phrynohyas resinifictrix (Hylidae, Anura) - Calling behaviour

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Contents of the film
Call site (water-filled tree hole) and advertisement calls of the Amazonian treefrog *Phrynohyas resinifictrix* (Goeldi 1907). Sequences taken in the field at the "Panguana" study site (9°37'S, 74°56'W, 260 m; lowland Amazonia, Peru) during the onset of the rainy season.

Filminhalt
Phrynohyas resinifictrix (Hylidae, Anura) - Rufverhalten.
Rufstandort (wassergefüllte Baumhöhle) und Anzeigerufe der amazonischen Baumfroschart *Phrynohyas resinifictrix* (Goeldi 1907). Freilandaufnahmen, aufgezeichnet im Studiengebiet "Panguana" (9°37'S, 74° 56'W, 260 m; Amazonastiefland, Peru) zu Beginn der Regenzeit.

Contenido de la pelicula
Phrynohyas resinifictrix (Hylidae, Anura) - Comportamiento vocal.
Sitio de canto (hueco lleno de agua en un arbol) y cantos de cortejo de la rana arbórea amazonica *Phrynohyas resinifictrix* (Goeldi, 1907); filmado en el campo en la localidad "Panguana" (9°37'S, 74°56'W, 260 m; selva amazonica, Perú) en el comienzo de la estación de lluvias.

Mediographic data for film C 2392 of ÖWF
C 2392 *Phrynohyas resinifictrix* (Hylidae, Anura) - Calling behaviour.
16-mm-film, optical sound, colour, 3 minutes, original sound without commentary.
This film is for use in research and teaching at university level.
Institute: Institute of Zoology, University of Vienna, Austria.
Scientific author: W. Hödl.
Produced by the Austrian Federal Institute of Scientific Film, Vienna. Taken 1988, published 1990. Camera: E. Pavlousek; sound recording: A. V. Bossmayer.

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Introduction

Based on the examinations of preserved adult specimens most authors since MIRANDA-RIBEIRO (1926), including DUELLMAN (1956, 1971, 1977), considered *Phrynohyas resinifictrix* (Goeldi 1907) a synonym of the morphologically similar treefrog *Phrynohyas venulosa* (Laurenti 1768), widespread throughout the tropical lowlands of Middle and South America (DUELLMAN, 1971). Without further remarks LESCURE (1976) reported *Phrynohias* (sic) *resinifictrix* to produce a very different call ("un chant tres différent") from that of *P. venulosa*. ZIMMERMAN & HÖDL (1983) analysed the vocal behaviour and ecological characters of *P. resinifictrix* near Manaus, Brazil, and concluded that *P. resinifictrix* and *P. venulosa* are reproductively isolated species. In contrast to *P. venulosa*, which has been reported from open habitats like savannas, agricultural land, roadsides and towns, *P. resinifictrix* is only known from primary forest. There it calls (and breeds) in water-filled tree holes of large trees at heights above 10 m (LESCURE 1976, ZIMMERMAN & HÖDL 1983). GOELDI (1907) reports *Hyla* (=*Phrynohyas*) *resinifictrix* from the river Maracanâ (Pará, Brazil) to have a voice that is "surprisingly strong and sounds like *queng-queng* three or four times repeated". The local, evidently onomatopoetic name "cunnuarú" is formed by contraction of the Indian words "cunhâ" (= wife) and "arú"(= toad). The Tembé Indians report that this tree frog always calls for the female when the moon shines (GOELDI, 1907). On the Upper Amazonas and the river Itacoaí this frog[described as *P. venulosa* by LUTZ & KLOSS (1952) and LUTZ (1973)], which calls high up in the trees, is given the vernacular name "sapo canoeiro" ("boatman frog") "because (its) croaks imitate the tapping of the oars against the side of the canoes, which are used by the Indians to maintain the rhythm of the stroke when rowing" (LUTZ & KLOSS 1952). None of the authors has mentioned actually having observed calling individuals of *P. resinifictrix*. As these tree frogs vocalize in hollow trunks high up in the canopy during night hours, calls were assigned to individual males of *P. resinifictrix* only by indirect evidence [e.g. finding a male frog within or leaving the (nightly plugged and daily reopened) hole from where the sound originated (ZIMMERMAN & HÖDL 1983; McDIARMID, pers. comm.)].

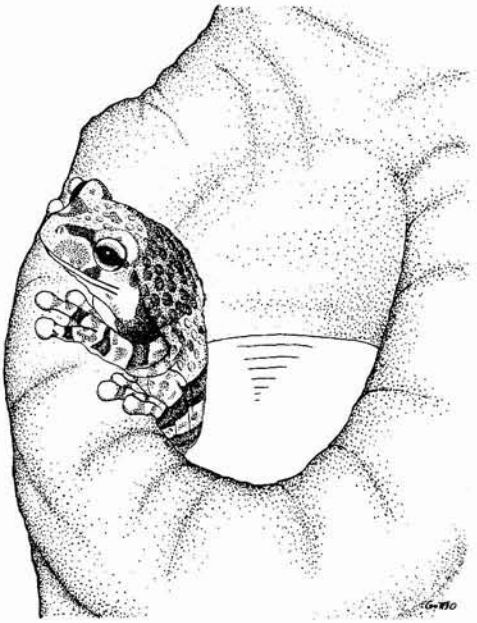

Fig. 1. Male *P. resinifictrix* at entrance to his call station (water-filled tree hole). Drawn by T. Guttmann after a photograph taken by the author at Panguana, Peru.

Methods

Calling activity of *P. resinifictrix* was recorded at the Amazonian study area "Panguana" (9°37'S, 74°56'W, 260 m; Lower Río Llullapichis, Peru) on 32 nights between 22 October and 29 November 1988. During the course of the study I approached the sites of calling males from the

main trail leading from the camp site via the "Estanque", a herpetologically well-studied primary forest pond (SCHLÜTER 1984, AICHINGER 1987), to the "Aguajal", a seasonally flooded palm (*Mauritia flexuosa*) swamp. By pressing an ear tightly against tree trunks I was able to locate the exact tree from which the frog was calling. Calling sites of male *P. resinifictrix* were located, marked, and revisited on each subsequent day during daytime (site 4) and nighttime (site 4, all other sites only when calling males were heard in the area). Inter-individual distance between nearest calling neighbours was 85 m in one case and exceeded 150 m in all other observations. Heights of located tree-hole entrances from where stationary frogs were heard calling measured 2.2 m, 5.2 m, approximately 9 m, and >10 m (n=4). The unexpected low calling site (2.2 m above ground level) was unusually exposed to view (call site 4, Fig. 1) and allowed filming of a vocalizing male. [Here, details on the calling behaviour of only the cinematographically documented individual (snout-vent-length 64 mm; Figs. 1, 2) are presented; observations on vocal activity and distribution of 9 other stationary calling males, data on occupied tree-hole sizes, water volume, and *P. resinifictrix*-tadpole ecology will be published elsewhere]. The calling behaviour of *P. resinifictrix* was filmed on 25 Oct. between 2200 and 2240 h with a sound-reduced 16 mm film camera (ARRI 16 SR). For illumination two battery-driven 12 V/ 100 W lamps were used. Prior to filming the frog was stimulated to call by playbacks of conspecific calls and call mimicks produced by the author. By gradually increasing the light intensity during stimulated vocal activity the stationary frog was adapted to the illumination necessary for filming.

Fig. 2. Calling male *P. resinifictrix* floating on water surface in tree hollow. Photo by M. Henzl [From HÖDL, 1990. By permission of Gustav Fischer Verlag. Stuttgart - New York]

Calls used for detailed analyses (Fig. 3) were recorded on 24 October 1988 between 2000 and 2015 h at an air temperature of 23.5 °C with a SONY Professional Walkman (WM D6C stereo cassette tape recorder); the microphone (AKG D 140 E) was placed at a distance of 1 m and faced the opening of the hollow occupied by the male. Sound intensity was measured at various frequencies and distances with a CEL-493 precision impulse integrating sound level meter (calibrated with a CEL-184 calibrator) and a CEL-296 third octave autoscan filter set. Calling activity was recorded continuously throughout one night (Oct. 27/28) with a UHER 4000 report monitor tape recorder operating at a speed of 2.4 cm/s and analysed with an EPSON PX-8 microcomputer-based event recorder (UNWIN & MARTIN 1987). Temporal and spectral analyses of the recorded calls were made with an integrated work station for digital signal processing (S_TOOLS) at the Kommission für Schallforschung (Austrian Acad. of Sciences).

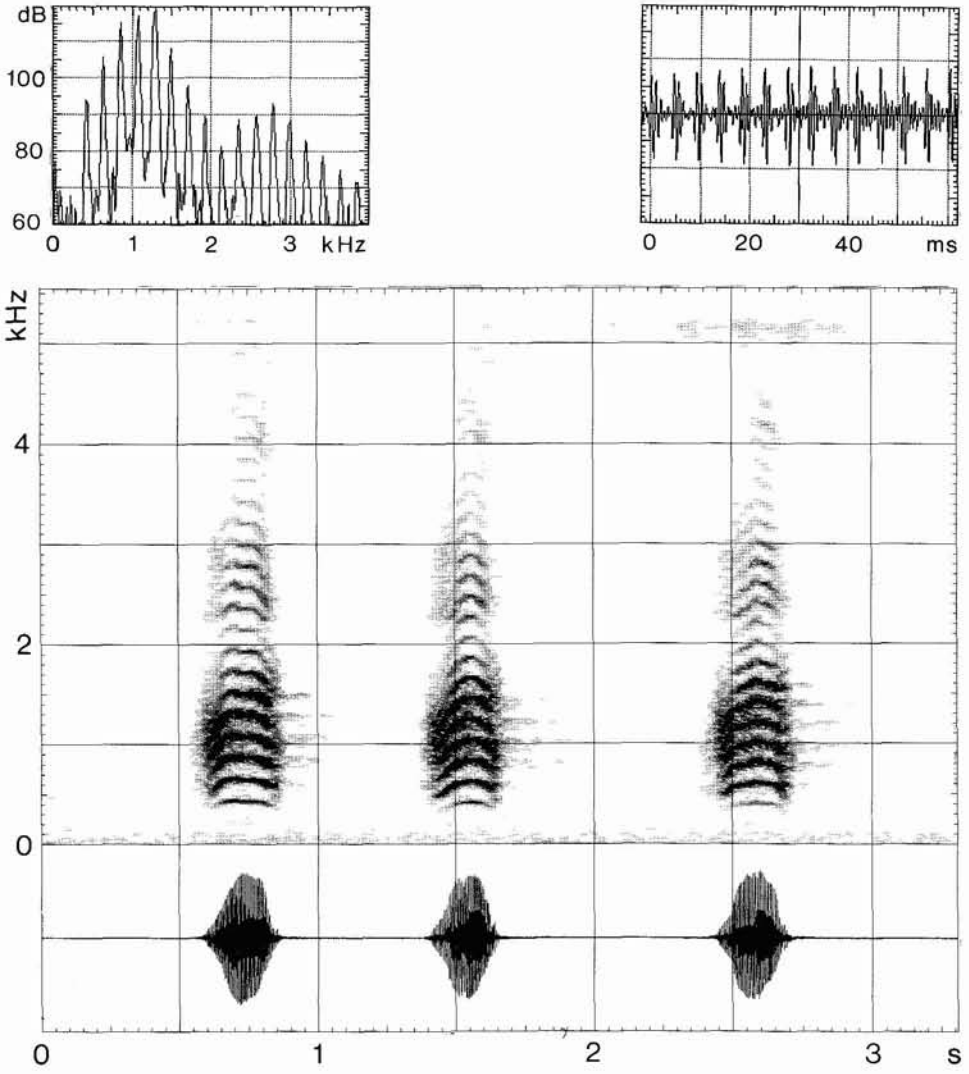

Fig. 3. Sonagram and oscillogram of a three-note advertisement call of *P. resinifictrix* (Panguana, Peru; 23.5 °C air temperature). Spectral section display (above left) and oscillogram (expanded time-base display) (above right) taken of the period between 30 ms before and 30 ms after peak intensity of first note.

Vocal activity of P. resinifictrix at Panguana (Peru)

The male *P. resinifictrix* at site 4 called during 21 of 32 observation nights. Calling occurred exlusively during rainless, primarily cloudless night hours. This observation corroborates the Indian legend that *P. resinifictrix* always calls when the moon shines (GOELDI 1907). The frog was found within the hollow only during periods of

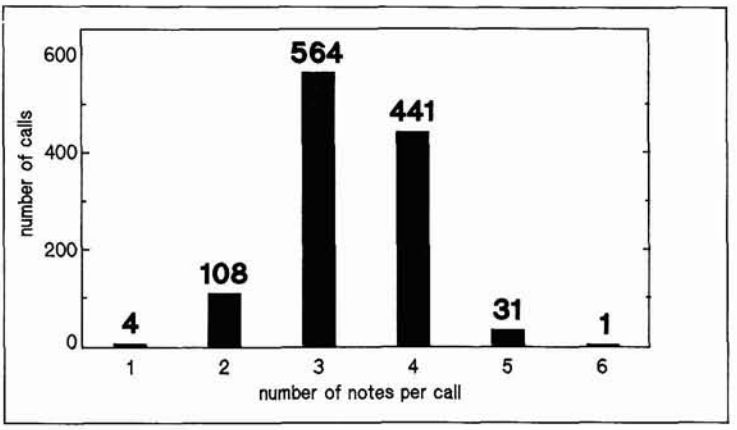

Fig. 4. Number of notes per advertisement call in *P. resinifictrix* from Panguana, Peru, (1149 calls analysed).

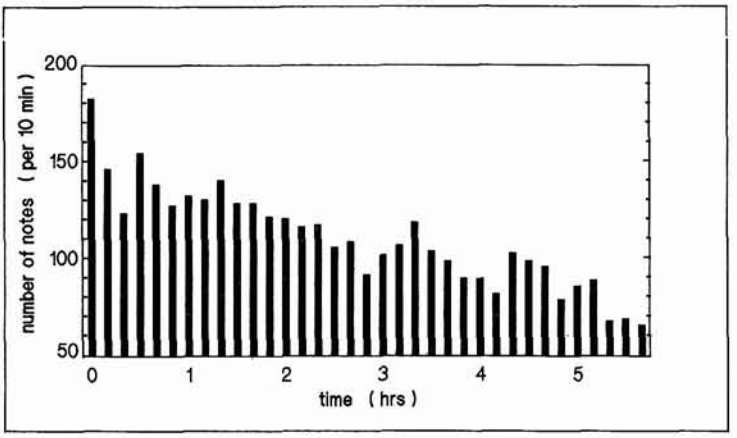

Fig. 5. Call rate of *P. resinifictrix* calling continuously for 5 h 50 min (1807 - 2357 h, 27 Oct. 1988) at Panguana, Peru, (1149 calls analysed).

calling. The frog's rapid descent from the canopy to its calling station could be observed on 25 Oct. at 1801 h and 27 Oct. at 1807 h. Immediately after arriving at the water-filled tree hollow the frog started to call (Fig. 2). After emitting the last call the male left the hollow (26 Oct. at 0138 h, 27 Oct. at 2357 h) and began a slow, deliberate return to the canopy.

A spectrogram of a characteristic call consisting of three notes is presented in Fig. 3. The notes are similar in spectral composition and show clear harmonic structures with sound energy distribution over a wide range of frequencies. The spectral section display taken at the maximum intensity of the first note of this call shows increased sound intensity at the fourth (867 Hz), fifth (1083 Hz) and sixth harmonic (1300 Hz), with the maximum intensity at 1300 Hz. The first harmonic, representing the pulse rate of 216.6 Hz (see extended time-base

display in Fig. 3) is more than 50 dB below the sound level pressure of the most intense frequencies and thus not visible within the spectrogram. The sound intensity 1 m from the tree-hole openening measured between 89 and 90 dB (re 20 μPa, peak time constant). Calls of *P. resinifictrix* recorded at site 4 on 27 Oct. 1988 were separated by intervals averaging 15.8 s (3.2 - 43.5 s, N = 100) and consisted of series of 1 to 6 (mean 3.3, N = 1149) notes (Fig. 4). Call rate (measured as number of notes per 10 min) varied throughout the night and was highest (182) at the onset and lowest (65) at the end of the nightly calling bouts (Fig. 5). Within a 5 h 50 min period (27 Oct., 1807 - 2357h) the male produced 3837 notes (1149 calls), i.e., 10.96 notes per minute. The mean duration of a note was 307 ms +/- 26.15 ms (249 - 366 ms, N = 100). The mean inter-note interval lasted 633 ms (471 - 809 ms, N = 78).

General considerations

The advertisement calls of male *P. resinifictrix* carry over long audible distances through utilization of the rain forest low-frequency sound window (optimal frequency range for signalling around 800 Hz); this acts as a strong selective force on long-range communication (WASER & BROWN 1984). Whereas low-frequency noise (200 Hz) mostly resulted from moving vegetation and dripping condensation, high frequency noise (2000 Hz) at Panguana was due to sounds produced by other frog species and insects. The sounds of monkeys and kinkajous (identified by local hunters) were the only biotic noises occasionally overlapping with the main energy range of *P. resinifictrix* at Panguana. During night hours, when background noise was high (at least above 40 dB) throughout the frequency range covered by the sound level meter (third octave bands between 0 - 20.000 Hz), *P. resinifictrix* could not be heard. Whereas rainfall (on 2, 22 and 23 November) apparently inhibited males of *P. resinifictrix* from producing advertisement calls, it greatly increased the acoustic activities of frogs breeding in forest ponds and streamside puddles (see also AICHINGER 1987).

The amplitude of a call decreases with increasing distance from the source. In addition to the inverse square law (amplitude reduction at a uniform rate of 6 dB per doubling of transmission distance), excess attenuation due to absorption, refraction, and reflection is known for rain forest environments (BROWN 1986). Frequency-dependent excess attenuation in *P. resinifictrix* calls was most likely responsible for the shift from 1300 Hz to around 800 Hz with increasing distance from the calling individual (HÖDL, unpublished data). Variations in spectral energy distribution in *P. resinifictrix* from the central Amazon Basin (ZIMMERMAN & HÖDL 1983) may be due to differences in recording distance. Temporal components of calls from the individual at Panguana (site 4) do not differ from those of *P. resinifictrix* from central Amazonia. Note duration, inter-note interval, notes per call, inter-call intervals, call rate and pulse rate of the advertisement calls from recordings of the male filmed at Panguana are well within the variational limits of the calls from ten individuals of the central Amazon Basin given by ZIMMERMAN & HÖDL (1983).

In addition to the advertisement call (type I call in ZIMMERMAN & HÖDL 1983), those authors described a second call type, which could not be heard under natural conditions at the Panguana study site. However, by using playbacks of conspecific advertisement calls I was able to easily induce these groan-like (territorial ?) vocalizations, which varied greatly in duration. Advertisement calls by the site-4 male were always given while floating on the water surface within the tree hollow; type 2 calls,

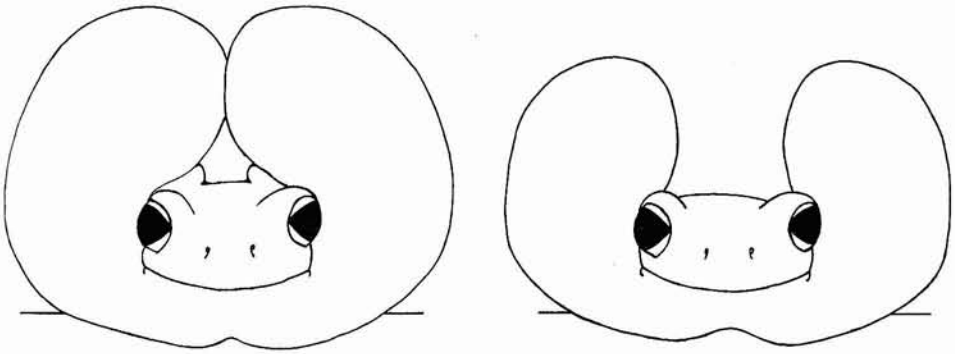

Fig. 6. Maximum vocal-sac inflation during advertisement-call production in *Phrynohyas coriacea* (left) and *P. resinifictrix* (right). Drawn after photographs taken by the author at Panguana, Peru.

however, were emitted in an upright position either at the inner side of the water-filled tree cavity, at the entrance of the tree hole, or from various sites in the canopy. Two other species of *Phrynohyas* are reported from Panguana. *P. venulosa* was observed in secondary forest of this lower río Lullapichis site by TOFT & DUELLMAN (1979). Calling males of *P. venulosa* are found in "explosive" breeding congregations at temporary pools at the onset of seasonal rains (ZIMMERMAN & HÖDL 1983). *P. coriacea* was observed calling exclusively during and after heavy rainfalls amidst large anuran breeding aggregations at the onset of the rainy season. Males of *P. coriacea*, characterized by highly inflatable vocal sacs (Fig. 6), called on ground level close to the water or in standing water bodies of the "Estanque" forest pond area (SCHLÜTER 1979, 1984; pers. obs.). Calling activities in *P. coriacea* and *P. venulosa* last for a few days a year. *P. resinifictrix* is reported to call for six months at Panguana [*P. resinifictrix* was erroneously classified as *P. coriacea* by AICHINGER (1987), AICHINGER pers. comm.] and throughout the year at the Reserva Ducke and the INPA-WWF reserves near Manaus, Brazil (ZIMMERMAN & HÖDL 1983).

Description of the film document

The first scene shows a male *P. resinifictrix* at the entrance of a water-filled tree hole. In the following scene, taken at an oblique angle from the side, the frog calls within the tree hole while floating on the water surface. Calls made up of four, six, four and three notes are given in succession. A scene taken from above shows the frog emitting a series of three notes. The last scenes show the frog perching at the edge of the tree-hole entrance prior to leaving the site.

Acknowledgements

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