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First report on the advertisement call characteristics of the Beautiful Frog, *Phrynella pulchra* Boulenger, 1887, from Sumatra, Indonesia

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Phrynella pulchra, the only member of the microhyline genus *Phrynella*, is a frog of moderate size (maximum snout–vent length 45 mm; Manthey and Grossmann, 1997) that was originally collected in Malacca District, Malaysia (Boulenger, 1887; Günther, 1887). In Indonesia, this frog species occurs in the provinces of Aceh, North Sumatra, and Bengkulu (Akhsani et al., 2017). It inhabits forested areas at elevations ranging from 255–800 m (Inger and Iskandar, 2005; Kurniati, 2007). Individuals are most frequently observed on trees located approximately 5 m from stream banks (Kurniati, 2012).

Within the subfamily Microhylinae there are different types of advertisement calls. For example, *Metaphrynella pollicaris* produces non-pulsed notes (Matsui et al., 1996), whereas *M. sundana* produces notes with tonal pulses (Lardner and Lakim, 2002). Members of the genus *Kaloula* also exhibit a variety of advertisement call patterns and have been the subject of several studies (Chandramouli and Prasad, 2018; Gorin et al., 2024; Amram and Zainudin, 2026). Species such as, *K. indochinensis* and *K. kokacii* make single-note advertisement calls, while *K. baleata* and *K. pulchra* have varied pulses (Diesmos et al., 2002; Kanamadi et al., 2002; Malkmus et al., 2002; Luan et al., 2022). The advertisement call of *P. pulchra* has remained undescribed until now, leaving an important gap not only for our ecological understanding but also in terms of taxonomic research (Köhler et al., 2017).

The research was conducted for twelve days during the dry season (20 June–19 July 2011) in forested areas near seven villages (Lubuk Beringin, Lubuk Birah, Tiaro, Durian Rambun, Koto Rami, Birun, Tanjung Dalam) in Merangin Regency, Jambi Province, Sumatra, Indonesia. Visual Encounter Surveys were conducted on three nights per week in clear weather from 19:00–01:00 h using flashlights. A call was serendipitously recorded in the Lubuk Birah Village forest area (2.2476°S, 101.9404°E, elevation ca. 90 m) at a distance of approximately 1–2 m from the frog. Recordings were made with an A-Zoom H1N handy recorder and saved in WAV format at a 44.1 kHz sampling rate and 16-bit resolution. After 3:10 min of recording, the frog was captured in order to take measurements and photographs. Based on its external morphology (Boulenger, 1887; Günther, 1887; Akhsani et al., 2017), we identified the frog as a male *P. pulchra* with snout–vent length 34.8 mm. Air temperature near the calling male was 23°C.

A total of seven temporal properties of the call were obtained following Köhler et al. (2017) using Raven Pro v1.6 software (Centre for Conservation Bioacoustics, 2019). The measured temporal and acoustic properties were call duration (ms), inter-note interval (ms), call/note rate (notes per second), frequency modulation (Hz/ms), overall dominant frequency (Hz), and peak dominant frequency (Hz). Spectrograms were generated using the Hann window with 256 samples of the fast Fourier transformation and 87.5% overlap. Oscillogram and spectrogram images were created in RStudio v2022.12.0+353 with the *seewave* package v2.2.3 and *tuneR* package v1.4.7 (Ligges et al., 2018; Sueur et al., 2008; RStudio Team, 2020). Data are presented as mean ± SD (minimum–maximum).

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The advertisement call of the *P. pulchra* male consisted of a single note per call (n = 157), produced at a rate of 0.97 notes per second (Fig. 1A). Each note had a duration of 129.1 ± 6.9 (103.7–171), with inter-note intervals of 905.5 ± 270.2 (635.1–2451.6). The note structure was characterised by a rapid rise for approximately 2.7 ± 0.7 (2.2–9.8) from onset to peak amplitude, followed by a gradual decline for approximately 126.5 ± 7.1 (100.9–168.5) from peak amplitude to offset (Fig. 1A, B). Among the 157 notes, 26 had a frequency modulation of 1.5 ± 0.4 (1.1–2.7) with overall dominant frequency (DF) of 771.4 ± 177.5 (516.8–947.5). The note spectrum consists of three to five peak dominant frequency (Hz): DF1 at 500.3 ± 33.9 (430.7–516.8), DF2 at 952.9 ± 21.1 (947.5–1033.6), DF3 at 1460.6 ± 15.5 (1421.2–1507.3), DF4 at 1954.1 ± 40.1 (1894.9–1981.1 Hz), and DF5 at 2414.7 ± 15.9 (2411.7–2497.9 Hz).

The advertisement call of *P. pulchra* consists of regularly emitted notes. Each note exhibits a rapid rise from onset to peak amplitude, followed by a gradual decline to offset; this pattern represents a distinctive characteristic. This characteristic is unique and not present in *M. sundana* (Lardner and Lakim, 2002), *M. pollicaris* (Matsui et al., 1996), or *Kaloula* species (Luan et al., 2022). The unique note structure likely shaped by geographic variation, abiotic and biotic acoustic environments, and genetic drift (Jang et al., 2011; Velásquez et al., 2014; Lee et al., 2016). These factors influence the development of both the laryngeal apparatus and auditory systems (Simmons et al., 1992). Such adaptations may facilitate conspecific recognition and reduce the likelihood of interspecific hybridization (Chen et al., 2020). A comprehensive assessment is required to advance our understanding of call parameters and calling behaviour in *P. pulchra* and to clarify the mechanisms underlying the generation, maintenance, and evolution of acoustic signals (Srigyan et al., 2024).

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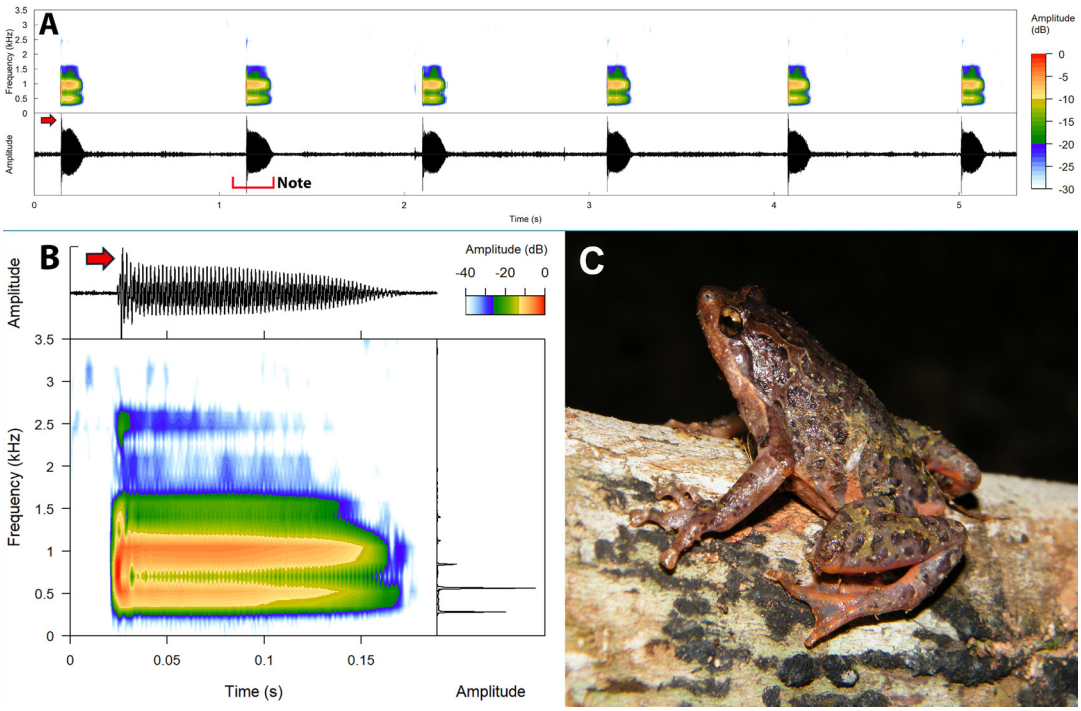

Figure 1. Acoustic repertoire of advertisement calls in a male *Phrynella pulchra* from Jambi Province, Sumatra, Indonesia. (A) Advertisement call of the male frog, with the spectrogram (Hz/s) displayed above and the oscillograms below (amplitude/s). The amplitude, or acoustic power is represented by colour intensity. (B) The structure of a note, with oscillograms presented above, spectrograms below, and frequency spectrum on the right. (C) A typical male *P. pulchra* from Indonesia. Photo by Mediyansyah.

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