

Frogs too look for better interior designs

Ramya Badrinath and K. V. Gururaja

Acoustic signalling is a primary mode of communication in several groups of animals like insects, birds, frogs and whales, which is a cooperative channel. It enables quick transfer of information between the sender and the receiver without any visible contact. Acoustic signalling is one of the factors in optimizing natural selection and the vocal repertoire plays a significant role in signalling intentions and resource qualities to potential partners¹.

It is well known that humans advertise about their wealth and status especially when it has to be communicated to their potential life partners². This is associated with the evolutionary significance of mate choice as females prefer to have social security of their progeny³. But neither is this unique to humans nor are they the first to do so. A recent publication has demonstrated that frogs, which have evolved on this planet about 360 million years ago (humans came to existence merely 0.2 million years ago on earth), do such advertisement campaign⁴. It is shown that frogs showcase their apartments (burrows) and its quality to their potential life-partners.

Frogs and toads (anurans) are acoustically well equipped and the sounds from their own vocalization play an integral and crucial role in their existence⁵. They vocalize by passing air through the larynx in the throat and produce a variety of sounds depending on the situation. Vocalization in frogs is species-specific, with each species having a unique calling pattern. There are at least five different types of frog calls. The most predominant vocalizations are advertisement calls, wherein male individuals call potential partners for breeding and in some cases female individuals respond with a reciprocal call. The other types of calls are territorial calls (to mark the boundary of an individual), distress calls (made during an attack by a predator), warning calls (to warn on being disturbed) and release calls (calling for release from the grip of another male). The advertisement calls can either be individual or in chorus depending upon the species⁶.

Cui *et al.*⁴ have shown that the males of Emei music frogs (*Babina dauchina*) advertise their resources like nests, bur-

rows, territories and feeding by vocalization. The females of Emei music frogs evaluate their potential male vocalizations showing their preference between 'burrow-inside and burrow-outside' calls. The males have a characteristic vocalization to advertise their resources like burrows, that they build along the edges of the ponds for mating and it is quite a challenge for the males to acoustically advertise their resources than exhibiting their overt sexual characters to females. To facilitate their hypothesis, Cui *et al.*⁴ incorporated acoustic properties on *Metaphrynella sundana* (Peters, 1867), *Eupsophus calcaratus* (Gunther, 1881), *E. emiliopugini* (Formas, 1989) and *E. roseus* (Domeril, Bibron, 1841) in their study. The experiments were carried out comparing the calls of these frogs from inside and outside of their nests. The burrow structures were measured and acoustic parameters of the burrows were determined. The female preference between 'in and out' calls was determined using phonotaxis (movement towards or away from the source of sound) experiments.

Cui *et al.*⁴ recorded the inside and outside burrow calls of male frogs using a directorial microphone connected to a digital recorder which was placed about 1 m from the subject. At 5 calls per male, about 150 inside calls produced inside burrows from 30 males and 100 outside calls in free conditions from 20 males were recorded. The properties of the burrows, namely mouth area, depth and body mass and snout vent length of frogs were determined after recording the inside calls. The peak sound pressure levels of in and out calls were measured using a sound-level meter.

Three stimulus pairs (in-out calls of different males, in-out calls of the same male and out call paired with random signals) were antiphonally broadcast to the females. The female responses were tracked with a closed circuit camera. The responses were marked positive if the females approached the speakers within 10 cm and a 'no response' was scored against females not responding within 30 min.

Four acoustic properties – note duration, inter-note interval, fundamental

frequency and centre frequency were recorded. Inside calls differed from the outside calls varying in energy distribution, note durations and sound pressure level. This is attributed to the properties of the burrow such as entrance area and depth, and also the calling effort of the frog. Females chose inside calls to outside calls.

Animals other than humans were not known so far to acoustically advertise their resources to potential mates through vocalizations. However, the study by Cui *et al.*⁴ showed that the male Emei music frog facilitates mate selection by vocally advertising reproductive sites such as burrows, nests, hides, holes, etc., which are likely to aid strongly and directly to females. Females, for secured and safe mating, pay close attention to the male-constructed reproductive sites. In some acoustics studies that are underway in the Western Ghats⁷ (K. V. Gururaja, pers. obs.), it has been found that large-sized canopy frogs (*Raorchestes ponmudi* and *R. graminiurupes*) call at very low frequency (~1.5–2 kHz), whereas small-sized shrub/herb-dwelling species (*R. tuberochumerus* and *R. bombayensis*) call at high frequency (~3–4 kHz). One can relate body size to frequency^{8,9} and it would be an interesting question to look at why canopy frogs call at low frequency compared to shrub-dwelling frogs? What is the ecological and evolutionary significance in such niche partitioning? Few species of night frogs (species of the genus *Nyctibatrachus*) were found covering their spawn with mud and exhibiting courtship behaviour (Figure 1). Such behaviours by endemic frogs of the Western Ghats seek more research on behavioural ecology on amphibians of India, which have not been explored in detail¹⁰.

In summary, these results uncover an interesting function of advertisement calls and furnish a model to explore the role of mate selection, pre-mating reproductive isolation and speciation, where the focus is mainly on resource quality and its quantification. Thus, anuran acoustic signalling is subjected to strong pressures of mating behaviour, where there is a significant vocal competence among

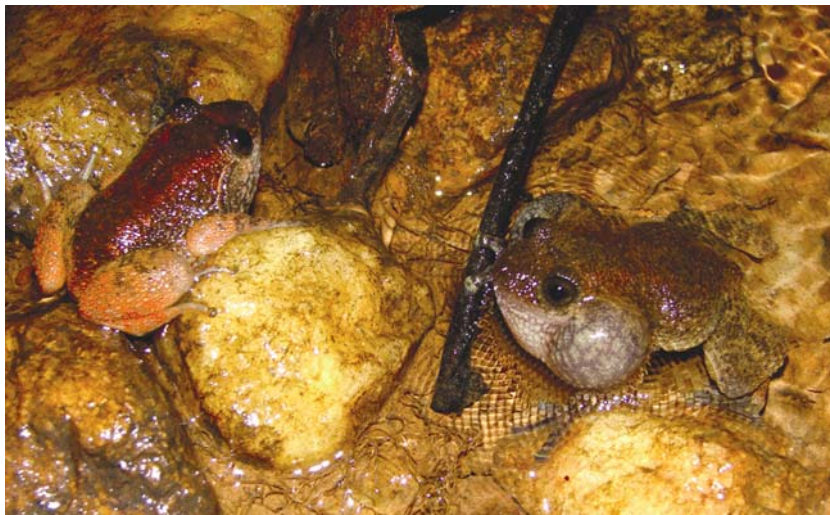


Figure 1. Male (on the right, giving advertisement calls) and female (on left, listening to him) of *Nyctibatrachus jog* (Jog Night Frog).

male frogs. Such studies are needed in India as it is home to 304 species of frogs and toads, and we hardly know about the acoustic properties of about one-sixth of them¹⁰. This study also leads us to explore other types of calls and interesting facts about them.

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Ramya Badrinath* is in Gubbi Labs, # 2-182, 2nd Cross, Extension, Gubbi 572 216, India; K. V. Gururaja is in the Centre for Infrastructure, Sustainable Transport and Urban Planning, Indian Institute of Science, Bangalore 560 012, India.

*e-mail: ramya@gubbilabs.in