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# ON DISTRESS CALLS OF MALE *Hemidactylus brookii parvimaculatus* DERANIYAGALA, 1953 (REPTILIA: GEKKONIDAE) FROM SRI LANKA

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## Abstract

Two types of distress calls were recorded from three male *Hemidactylus brookiii parvimaculatus*. One type consisted of clicks and one of a single squeak. Twelve calls were analysed. Distress calls comprising a squeak had an average length of 0.070 sec while those comprising clicks averaged 0.329 sec. The difference in length of the two types of calls was significant ($P<0.05$). Average maximum sound intensity of all calls was 76.9 dB and was reached between 3045 Hz and 7473 Hz ($\bar{x}$ = 4451 Hz). Maximum frequency varied from 7194 Hz to 16238 Hz having an average of 13393 Hz and the average minimum frequency was 1230 Hz. All squeak distress calls showed harmonics, whereas no harmonics occurred in calls with clicks.

***Key words*: *Hemidactylus brookii parvimaculatus*,** bioacoustics, distress call, Sri Lanka.

## Introduction

A number of gecko species are known to emit calls in potentially dangerous situations. These may either be threat calls of a gecko calling prior to physical contact and to intimidate a conspecific or a potential predator. These calls may be rather long in duration. After contact, usually after a gecko has been bitten, it may react with a comparatively short distress call which is certainly the call most often described in geckos (e.g. Barts, 2002, 2006; Brown, 1985; Frankenberg, 1973, 1975, 1978; Grammentz, 2005b,c,d, 2007; Grammentz & Barts, 2004; Kreuzer & Grossmann, 2003; Marcellini, 1974; Morgue, 1913; Nettmann & Rykena, 1985; Scerbak, 1981; Werner *et al.*, 1978). According to Frankenberg (1975) distress calls have an antipredatory function. Information from a number of species of the genus *Hemidactylus* is available on sound production during different situations, including *H. frenatus* (Frenkel, 2006; Marcellini, 1974, 1977; McCann, 1940), *H. turcicus* (Frankenberg, 1982), *H. mabouia* (Grammentz, 2003; Regalado, 2003), *H. platycephalus* (Grammentz, 2005a) and *H. angulatus* (Grammentz, 2005d). The first anatomical studies on the voice apparatus of the genus were carried out one century ago by Steck (1908) on *H. garnotii*. Probably the first mention of the voice of

*Hemidactylus brookii* and at the same time its distress call was made by Lang (in Schmidt, 1919). He reported that the geckos on being captured emitted a weak sound. Despite the wide distribution of *H. brookii* no bioacoustic analysis of this type of call has been carried out on this species since. The aim of the present work is to fill this gap by an analysis of the sound properties and structure of this part of the species bioacoustic behaviour.

## Material and Methods

Four adult male *H. b. parvimaculatus* were caught at Aluthgama (alt. 2 m; 06°27' N, 79°59' E), Sri Lanka, in November 2007 for sound recordings of distress calls. Altogether, 12 distress calls were recorded from three specimens. The snout – vent length of these geckos were 4.8 cm (male 1), 4.9 cm (male 2) and 5.4 cm (male 3). All calls were emitted in identical situations while handling the gecko, simulating the attack of a predator.

The recording equipment is the same as described by Gramentz (2005a,c). The sound card used was Creative Soundblaster Audigy 2 ZS Platinum Pro with a sample rate of 44100 Hz, 16 bit. Various software was used for sound analysis such as Adobe Audition 1.5, Avisoft-SASLab, Creative WaveStudio and Raven1.2. The areas in the 3D figures below about 300 Hz result from working noises of the recorder.

Air temperatures at which the calls were recorded ranged from 27.6 – 27.9 °C. Distance between geckos and microphone during recording distress calls was 5 – 10 cm. The sound of the geckos was recorded either during the night of capture or the following morning. The geckos were released the following night at precisely the same locations they had been first seen prior to capture. Terminology used is the same as in Gramentz (2003 & 2008).

## Results

Of four male *H. b. parvimaculatus* caught for sound analysis three (75%) produced distress calls. The ultimate intention of the call is probably to be released from the supposed predator's grip. There is some marked variation in the distress calls of *H. b. parvimaculatus*. However, beside the differences in call types produced in a distress situation, each call type has a rather uniform and identifiable structure. Calls could be separated into two groups according to their structure such as those formed by a highly condensed number of amplitudes with a squeak-like sound (n = 9) and those containing a number of clicks with a discernable time gap between them (n = 3).

The clicks of the call depicted (Pl. 5: Fig. 1) had time gaps of 0.062, 0.033 and 0.020 sec. The duration of four clicks measured a mere 0.003 sec. In another call with three clicks the gaps between them were 0.130 and 0.073 sec, while the clicks varied in length between 0.003 and 0.007 sec. The five clicks of the call (Pl. 5: Fig. 2 & 3) showed time gaps of 0.152, 0.129, 0.120 and 0.183 sec. The first click appeared 0.055 sec after the beginning of the call. The clicks also had also a short length between 0.004 and 0.006 sec.

According to the frequency of recorded distress calls, those with a squeak occur more frequently representing 75% of the calls and the remaining 25% of calls were those with clicks.

All calls were rather short in duration, always less than one second and usually less than one quarter second in length. Distress calls without clicks had an average length of only 0.070 sec (SD = 0.03, range: 0.029 – 0.116 sec, n = 9), while those with clicks were considerably longer with an average of 0.329 sec (SD = 0.28, range: 0.121 – 0.642 sec, n = 3). From these data it can also be seen that the longest distress call was one with clicks and a length of 0.642 sec and the shortest was 0.029 sec long with a squeak. There is a statistically significant ($P<0.05$) difference between the mean length of those calls with a squeak and with clicks ($t = 2.57$, *t*- test).

All distress calls had an average maximum sound intensity of 76.9 dB. Maximum sound intensity lasted only between 0.002 and 0.004 sec its position was always located in a strong harmonic. Maximum sound intensity was reached between 3045 Hz and 7473 Hz ($\bar{x}$ = 4451 Hz, SD = 1242, n = 12). Maximum frequency varied from 7194 Hz to 16238 Hz having an average of 13393 Hz (SD = 2861, n = 12). Average minimum frequency was 1230 Hz (SD = 610, range: 277 – 2122 Hz, n = 12).

All distress calls with a squeak showed harmonics over most part of the call. No harmonics could be identified in the short clicks.

Some of the distress calls show very peculiar harmonics (Pl. 5: Fig. 4 & 5). In particular, one call each of male 2 and male 3 showed peculiar bending or up- and down-curved harmonics. By way of comparison, in other calls (Pl. 5: Fig. 6 & 7)

harmonics were more or less linear, but kept the rather large frequency interval between harmonics. However, in two distress calls (Pl. 5: Fig. 3 & 10), one with a squeak together with clicks and one without clicks, harmonics were rather linear, more numerous and showed very short intervals between harmonics in comparison to all other distress calls.

The call of Pl. 5: fig. 7 was interesting as it contained altogether nine harmonics of three different intensities with 3 harmonics to each category, classifiable as strong, medium and weak. Harmonics of Pl. 5: fig. 7 analysed from bottom to top: the lowest harmonic is of medium strength at about 1568 Hz, followed by three strong harmonics at 3137 Hz, 4797 Hz and 6181 Hz. Another two medium strong harmonics followed at 7658 Hz and 9226 Hz and on top three weak harmonics at 10518 Hz, 12271 Hz and 13747 Hz. The average frequency interval between these harmonics was rather homogeneous being 1522 Hz (SD = 147.8). Average maximum sound intensity (dB) of weak, medium and strong harmonics was 46.3 dB (SD = 2.3, n = 3), 59.3 dB (SD = 3.4, n = 3) and 79.3 dB (SD = 4.4, n = 3) respectively. Interestingly, the frequency of the lowest harmonic is virtually identical to the average frequency interval between the harmonics.

The maximum frequency in all recorded distress calls varied between 7194 Hz and 16238 Hz with an average of 13393 Hz (SD = 2861, n = 12) and the average minimum call frequency was 1230 Hz (SD = 610, range: 277 – 2122 Hz, n = 12).

## Discussion

In comparison to the distress calls of other gecko species described in the literature the calls of *H. brookii parvimaculatus* are also short, but some variations in length and structure exist between species. Very short distress calls have been recorded in *Haemodracon riebecki* with an average length of only 0.069 sec (range: 0.046-0.080 sec, Gramentz, 2005b) and also *Stenodactylus stenurus* with an average of 0.034 sec (range: 0.033-0.036 sec, Gramentz, 2004). However, in *S. stenurus* three types of distress calls were found and the longest had an average length of 0.129 sec (range: 0.111-0.143 sec). In *Thecadactylus rapicauda* an average distress call length of 0.235 sec was found (range: 0.091-0.360 sec, Gramentz, 2007). In terms of call lengths the distress calls of the closely related *Hemidactylus angulatus* were also shorter than one second (with few known exceptions distress calls of gecko species studied to date frequently have lengths of $^{1}/_{10}$ to $^{3}/_{10}$ of a second), but they are considerably longer ($\bar{x}$ = 0.454 sec, range: 0.224 – 0.955 sec, Gramentz, 2005d) than those of *H. b. parvimaculatus*. Furthermore no distress call with clicks could be recorded for *H. angulatus*. Clicks have been found only in the advertisement call for *H. angulatus* (Gramentz, 2005d). However, beside some marked differences in distress calls between the related taxa *H. b. parvimaculatus* and *H. angulatus*, there are also similarities in the calls of both. While in all distress calls of *H. b. parvimaculatus* harmonics were present, in *H. angulatus* this was also the case in 7 of 12 (58%) calls (Gramentz, 2005d).

Beside differences in sound intensity and maximum frequency the type of distress call of *H. b. parvimaculatus* shown in Pl. 5: fig. 8, 9 & 10 can be similar to that of *T. rapicauda* (Gramentz, 2007), but some calls are different in the respect that amplitudes show different strength over the call length (Pl. 6: Fig. 11). When comparing the structure of the distress calls of *H. angulatus* with that of *H. b. parvimaculatus* there are obvious differences, which can be seen in oscillograms. While in *H. angulatus* a distress call was formed by 2 to 8 pulses ($\bar{x}$ = 5.8) (Gramentz, 2005d), no pulse structure was evident in the calls of *H. b. parvimaculatus*. A pulse structure is also present in the distress call of *H. platycephalus* (Gramentz 2005a). Possibly, there are also differences in the frequency range between both species. In male *H. angulatus* frequencies between around 100 Hz and 12500 Hz were recorded which is less in terms of minimum frequency as well as maximum frequency than the present findings of *H. b. parvimaculatus*. Wever (1978) studied the ear structure of one specimen of *H. brookii*, however no hearing properties were given. In the related species *H. angulatus* he found that the ear showed excellent sensitivity over the range of 200-1000 Hz. As it was simulated here, a distress call is most likely not only produced when a gecko is being bitten by a conspecific but also during an attack of a potential predator forming a part of the species anti predator behaviour. Presuming that - as in other gecko species distress calls also have an intraspecific meaning - the sensitivity range should be expected to be slightly higher in *H. b. parvimaculatus*. Furthermore it is very probable that *H. b. parvimaculatus* is using acoustic communication in other situations than in the present case and is capable of producing some other types of calls.

Frankenberg (1982) tentatively described different calls in *H. turcicus* such as escape call, defence call, release call and threat call produced in distress situations. The two different call types with their high variation found in *H. b. parvimaculatus* and summarised here as distress calls may, too, have different functions similar to *H. turcicus*. Further studies on the behaviour of the geckos and their associated call types should be carried out which may possibly lead to our better differentiation of the calls of *H. b. parvimaculatus*.

## Acknowledgement

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# PLATE 05

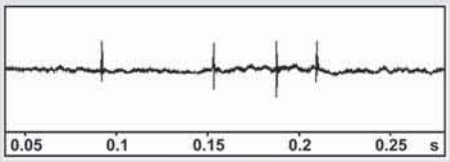



**Fig. 01:** Distress call oscillogram of a male *Hemidactylus brookii parvimaculatus* with four clicks and a length of 0.121 sec.

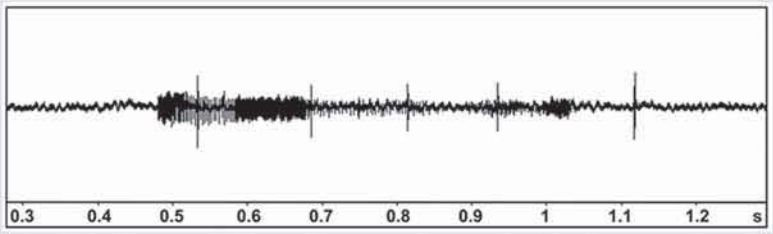



**Fig. 02:** Distress call oscillogram of a male *Hemidactylus brookii parvimaculatus* with a length of 0.642 sec.

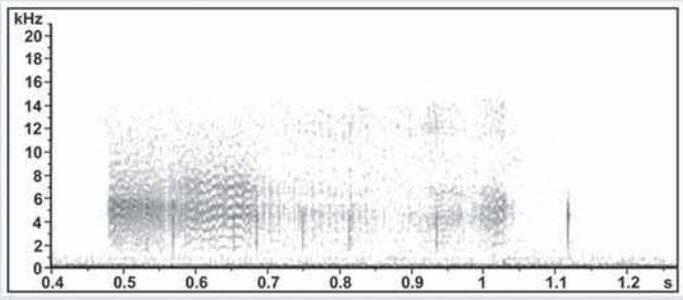



**Fig. 03:** Audiospectrogram of the same distress call as in fig. 2.

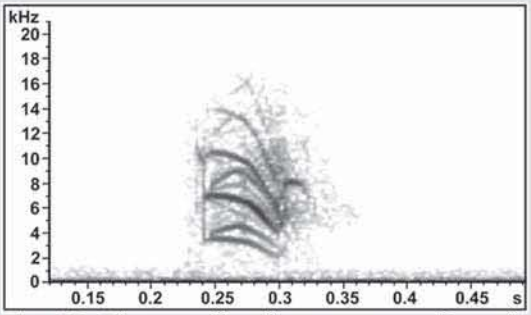



**Fig. 04:** Distress call audiospectrogram of a male *Hemidactylus brookii parvimaculatus* with a length of 0.089 sec.

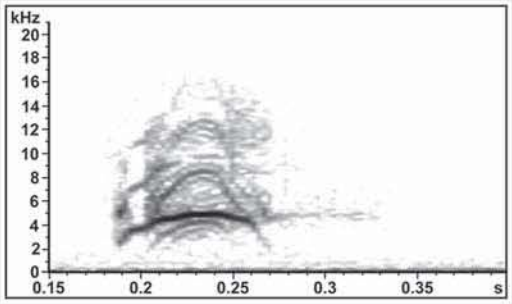



**Fig. 05:** Distress call audiospectrogram of a male *Hemidactylus brookii parvimaculatus* with a length of 0.084 sec.

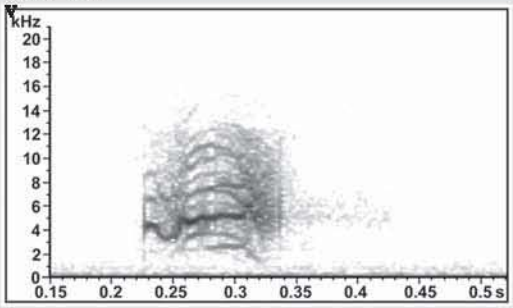



**Fig. 06:** Distress call audiospectrogram of a male *Hemidactylus brookii parvimaculatus* with a length of 0.116 sec.

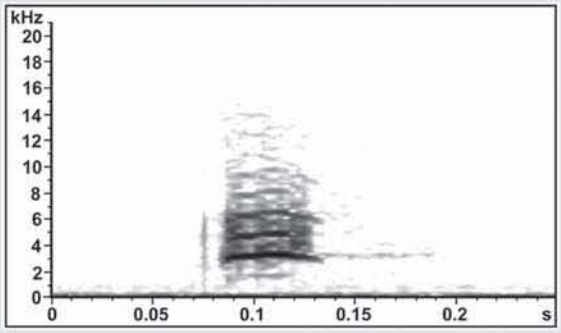



**Fig. 07:** Distress call audiospectrogram of a male *Hemidactylus brookii parvimaculatus* with a length of 0.047 sec.

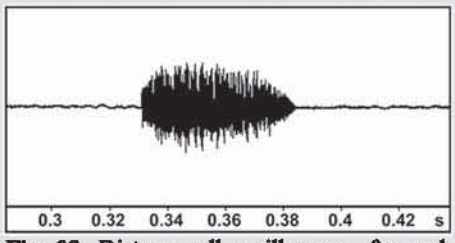



**Fig. 08:** Distress call oscillogram of a male *Hemidactylus brookii parvimaculatus* with a length of 0.054 sec.

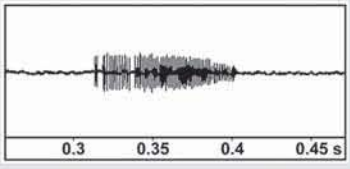



**Fig. 09:** Distress call oscillogram of a male *Hemidactylus brookii parvimaculatus* with a length of 0.091 sec.

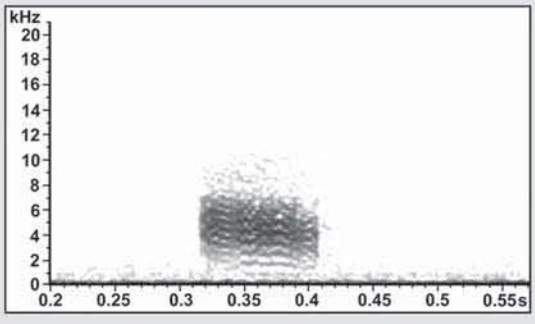



**Fig. 10:** Audiospectrogram of the same distress call as in fig. 9.

# PLATE 06

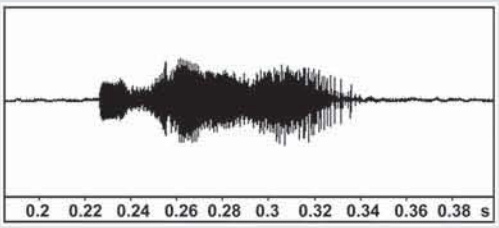
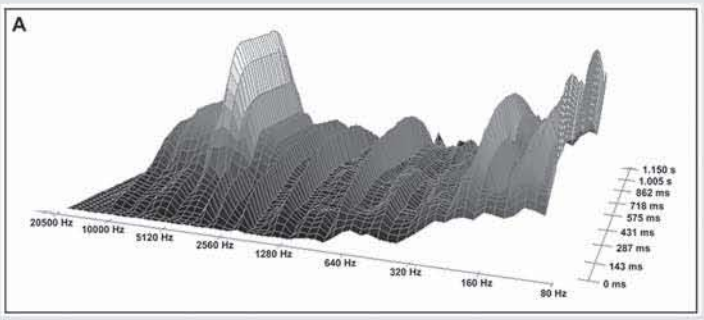



**Fig. 11:** Distress call oscillogram of a male *Hemidactylus brookii parvimaculatus* with a length of 0.116 sec.



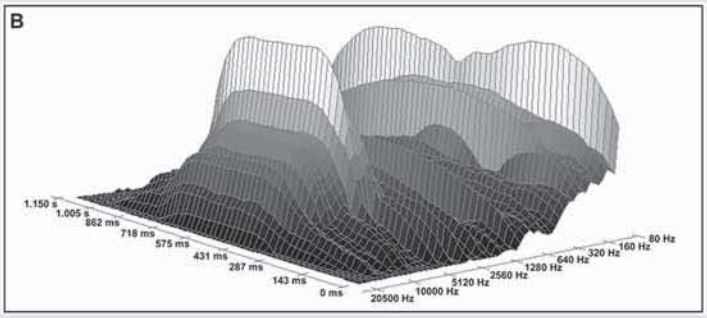
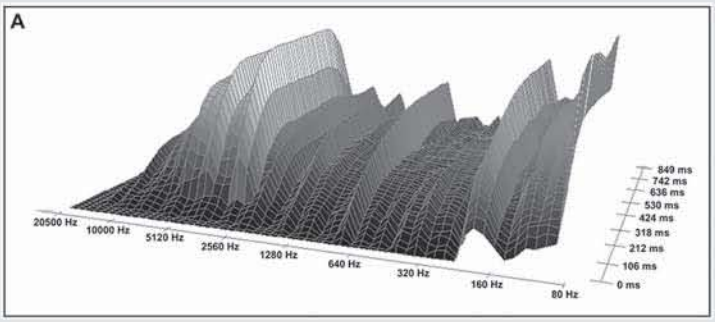




**Fig. 12:** Three-dimensional image of the same distress call as in fig. 5. A and B showing the call from two different angles.



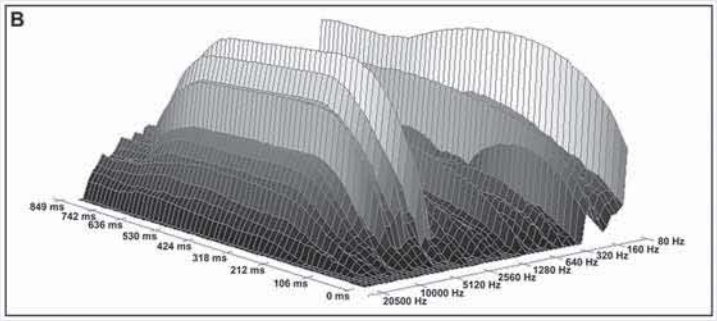




**Fig. 13:** Three-dimensional image of the same distress call as in fig. 7. A and B showing the call from two different angles.