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Systematics of the poorly known treefrog *Leptopelis fizensis* (Anura: Arthroleptidae), with a description of its call

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Abstract

Leptopelis fizensis was described as a subspecies of *L. modestus* from specimens that were collected in 1956 in the region in and around Fizi, in present-day Democratic Republic of the Congo. We recently discovered *L. fizensis* in transitional and montane forest near the type locality and the southeastern Itombwe Plateau, respectively. A phylogenetic analysis (16S mitochondrial sequence data) of these samples and other *Leptopelis* species recovered *L. fizensis* as sister to *L. karissimbensis* with strong support, and rejected a close relationship between *L. fizensis* and both topotypic *L. modestus* from Cameroon and *L. mackayi* from Kenya. Herein, we provide a detailed description of the morphometrics, colour pattern, male advertisement call and natural history of this poorly known species. At least one literature record of *L. fizensis* from Tanzania has notable differences from our data, and requires further study to ascertain its taxonomic status.

Keywords

Amphibia; Central Africa; transitional forest; Itombwe Plateau

Introduction

In his opus on *Leptopelis* treefrogs of Zaïre (modern-day Democratic Republic of the Congo, DRC), Laurent (1973) described four new taxa, including the subspecies *L. modestus fizensis*. The latter description was based on specimens that had been collected in 1956 from the type locality at Mokanga (1170 m) and paratype locality at Fizi (ca. 1250 m). Three illustrations of the adult female holotype were provided, along with detailed measurements of the specimen and a description of its colour pattern. Selected measurements of several other paratype specimens were summarized in biometric analysis tables. Unfortunately, basic ecological information about the taxon was not provided, and the habitat was described only as lowland “forest strips” in the region around Fizi.

Schiøtz (1975) subsequently elevated the taxon to full species status, included a new locality from Gombe Stream National Park, Tanzania (ca. 775–1500 m elevation) in the species account, and justified his taxonomic action by stating that, “knowledge of the so-called *L. modestus* seems too imperfect to justify the erection of a new subspecies.” Fischer & Hinkel (1992) provided a description of *L. fizensis* in Rwanda, but the species account seems to be confounded because their information is not consistent with *L. fizensis* (e.g., distribution

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from Cameroon to DRC). Schiøtz (1999) continued to recognize *L. fiziensis* and clarified that the species is very similar to *L. modestus*, but can be distinguished from the latter taxon by the presence of a gray throat (versus blue in *L. modestus*). In the IUCN Red List Assessment for *L. fiziensis* (IUCN 2012) the assessors mentioned an additional locality in southwestern Tanzania (Senga, 1650 m) and unspecific localities in Burundi that required confirmation. Channing & Howell (2006) noted the distribution as “forests around Lake Tanganyika,” but illustrated only a single, unknown locality in western Tanzania on their distribution map (likely an error, K. Howell, pers. comm.). Behangana *et al.* (2009) listed *L. fiziensis* from one site in the Albertine Rift (AR), but no specific details were provided.

To ascertain the current status of *Leptopelis fiziensis*, two of us (EG and CK) visited the type localities of Mokanga and Fizi, DRC in January 2012. Because most of the area surrounding the type localities had been altered for agricultural use, we did not encounter any forest-endemic amphibian species. However, a nocturnal visual search of transitional, secondary forest at the edge of Kasanjala village southeast of Fizi (S04.37381, E28.93287, 1305 m) on 13 January 2012 led to the discovery of a population of *L. fiziensis* (Fig. 1). An additional single male specimen was collected from montane forest in the southeastern Itombwe Plateau during a nocturnal visual search of roadside vegetation south of Milembwe village (S03.88142, E28.85711, 1950 m) on 28 December 2010. Herein, we assess the systematics of the species, and describe its call.

Materials and Methods

Twelve specimens (UTEP 20455–66) of *Leptopelis fiziensis* were collected from Kasanjala (and one additional specimen from the Milembwe road locality, UTEP 20454), photographed in life, sampled for tissues (95% ethanol), fixed in 10% buffered formalin, and transferred to 70% ethanol for long-term storage in the herpetology collection at the University of Texas at El Paso (UTEP). Genomic DNA was isolated from alcohol-preserved muscle tissue samples of the above *L. fiziensis* specimens with the Qiagen DNeasy tissue kit (Qiagen Inc., Valencia, CA, USA). We used 25 µL PCR reactions with standard 16S primers (Palumbi *et al.* 1991) with an initial denaturation step of 95°C for 2 min, followed by denaturation at 95°C for 35 s, annealing at 50°C for 35 s, and extension at 72°C for 95 s with 4 s added to the extension per cycle for 32 cycles. Amplicons were visualized on a 1.5% agarose gel stained with SYBR Safe DNA gel stain (Invitrogen Corporation, Carlsbad, CA, USA), and target products were purified with AMPure magnetic bead solution (Agencourt Bioscience, Beverly, MA, USA). Sequencing reactions were purified with CleanSeq magnetic bead solution (Agencourt Bioscience) and sequenced with BigDye Terminator Cycle Sequencing Kits (Applied Biosystems, Foster City, CA, USA) with an ABI 3130xl automated sequencer at the DNA Core Facility at UTEP. Forward and reverse sequence contigs for each sample were assembled and edited using SeqMan (DNASTar, Madison, WI, USA) to ensure accuracy.

Phylogenetic analyses

Newly sequenced data for this study were deposited in GenBank, and included seven samples from Kasanjala (UTEP 20455, JX298067; UTEP 20457, JX298072; UTEP 20458, JX298070; UTEP 20459, JX298068; UTEP 20460, JX298071; UTEP 20462, JX298073; UTEP 20464, JX298069) and the single sample from the road near Milembwe (UTEP 20454, JX298074). For phylogenetic analyses, we also included previously published GenBank sequence data (16S mitochondrial data) for specimens of *Leptopelis karissimbensis* and *L. kivuensis* (HQ130759–61, HQ130763–65, HQ130767–78, HQ130782–85, HQ130787–88, Roelke *et al.* 2011), *L. mackayi* (AY940089, Köhler *et al.* 2006), *L. palmatus* (HQ130756, Roelke *et al.* 2011), and *L. modestus* from Nsoug, Cameroon (JQ715682–83, unpublished). The latter two samples (MCZ A-138022–23) are

from vouchered specimens at the Museum of Comparative Zoology, Harvard University, Cambridge, USA. Two outgroup taxa included *L. natalensis* (AF215449, Vences *et al.* 2003) and *L. millsoni* (HQ130757, Roelke *et al.* 2011).

An initial alignment was produced in MEGALIGN (DNA Star) with the ClustalW algorithm, and manual adjustments were made in MacClade 4.08 (Maddison & Maddison 2005). No ambiguously aligned regions were observed, and as a result, no data were excluded from phylogenetic analyses. Phylogenetic relationships among the samples were assessed with maximum parsimony (MP), maximum likelihood (ML), and Bayesian inference (BI) optimality criteria in the programs PAUP* 4.0b10 (Swofford 2002), RAxML (Stamatakis 2006), and MrBayes 3.1 (Ronquist & Huelsenbeck 2003), respectively. For MP analyses, the heuristic search algorithm was used with 100 random-addition replicates, accelerated character transformation and tree bisection reconnection branch swapping, zero-length branches collapsed to polytomies, and gaps treated as missing data; we used nonparametric bootstraps (1000 pseudoreplicates) to assess node support in resulting topologies from these parsimony searches (Felsenstein 1985). The Akaike information criterion (Posada & Buckley 2004) in jModelTest (Posada 2008) was used to find the model of evolution that best fit the data for subsequent BI analyses. RAxML analyses were executed with the GTRGAMMA model, and 100 replicate ML inferences were performed for each analysis. ML analyses were initiated with random starting trees and utilized the rapid hill-climbing algorithm (Stamatakis *et al.* 2007). Support for clades inferred by ML analyses was assessed with the rapid bootstrap algorithm with 1,000 replicates (Stamatakis *et al.* 2008). Phylogenetic trees were visualized with FigTree (<http://tree.bio.ed.ac.uk/software/figtree/>).

Bayesian analyses were conducted with default priors. Analyses were initiated with random starting trees and run for 20,000,000 generations; Markov chains were sampled every 1000 generations. Convergence was checked by importing the trace files (p files) from the MrBayes output to the computer program Tracer v1.3 (<http://tree.bio.ed.ac.uk/software/tracer/>), which plots the likelihood values against generation number. Once the graphical plot leveled off, convergence had been met; we conservatively discarded 25% of trees as “burn in.” Four separate analyses with two independent chains were executed to check for convergence of log-likelihoods in stationarity (Huelsenbeck & Ronquist 2001; Leaché & Reeder 2002). Comparisons of uncorrected p sequence mitochondrial divergence data were made with the complete deletion option in MEGA4 (Tamura *et al.* 2007).

Morphological analyses

Morphological characters were chosen from previous taxonomic assessments of *Leptopelis* (Köhler *et al.* 2006; Köhler 2009). All measurements were taken with digital calipers under a dissecting microscope and rounded to the nearest 0.1 mm. All body measurements were taken on the right side of the body. FP collected morphological data from these specimens, including snout–vent length (SVL); head width (HW)—measured at the widest point of the head; head length (HL)—measured at angle of the jaw, from the posterior edge of the mandible to the tip of the snout; interorbital distance (IO); eye diameter (ED); tympanum diameter (TD); eye–nostril distance (EN); nostril–nostril distance (NN); tibia length (TL); foot length (FL)—measured from the proximal edge of the inner metatarsal tubercle to the tip of the longest toe; hand length (HaL); horizontal length of the subocular mark taken at two different points (SbDL)—measured at its contact with the inferior edge of the upper jaw, and (SbDE)—measured at its contact with the eye. Meristic data included hand and foot webbing formulas, which were assessed by counting the number of phalanges (as recognizable by subarticular tubercles) free of webbing (Glaw & Vences 2007).

Acoustic analyses

Advertisement calls were recorded from seven adult male *Leptopelis fiziensis* at Kasanjala with a Zoom H4 Handy Recorder (B&H Photo, New York, NY, USA). Temperature was measured immediately after each recording to the nearest 1.0° C with a Fisher Scientific Traceable Digital Hygrometer/Thermometer (Fisher Scientific, Houston, TX, USA); temperatures were recorded approximately 1 m above ground where the majority of frogs were perched on vegetation and calling. The most clear and complete single advertisement call from each recording was analysed using Raven Pro 1.4 (Charif *et al.* 2010) and Canary 1.2 (Charif *et al.* 1995) software. We examined oscillograms (waveforms), audiospectrograms (sonograms), and results of the Fast Fourier Transformation (FFT; frequency spectrum) for spectral and temporal characters following the methodology and terminology of Diesmos *et al.* (2002) and Brown *et al.* (2002). Each call series was characterized by the following parameters: (1) call duration (seconds [s]); (2) number of pulses per call; (3) dominant frequency component (kHz); (4) low frequency component (kHz); (5) high frequency component (kHz); (6) mean intercall interval (s); and (7) intercall interval range (s). When detailed call data were available for individuals of proximate *Leptopelis* species in the Albertine Rift (i.e., Roelke *et al.* 2011), we compared them to call data for *L. fiziensis* with the student's *t* test.

Results

Phylogenetic analyses

The aligned and concatenated dataset totaled 629 base pairs, containing 36 autapomorphic and 50 parsimony-informative characters. The MP, ML, and BI analyses produced identical topologies for the relationships among the examined species of *Leptopelis* (Fig. 2). The GTR + I + G model of nucleotide substitution was selected by jModelTest for BI analyses. The MP analysis resulted in 10,059,600 equally parsimonious trees (length = 145, CI = 0.731, RI = 0.905); the ML analysis likelihood score was -1483.363634.

Our preferred tree (Fig. 2) recovered a moderately supported polytomy with the following branches: *L. palmatus* + *L. modestus*; *L. fiziensis* + *L. karissimbensis*; *L. kivuensis*; *L. mackayi*. A well-supported clade of *L. fiziensis* was strongly supported as the sister taxon to *L. karissimbensis*. Presumably topotypic samples of *L. modestus* from Cameroon (MCZ A-138022–23) were recovered as sister to *L. palmatus* with moderate support. Uncorrected *p* genetic divergences among the samples of *L. fiziensis* (Table 1) were very low (0.0–0.2%), and divergences between the latter species and its sister taxon *L. karissimbensis* were low (1.7–2.2%). Divergences between *L. fiziensis* and *L. modestus* were moderate (4.4–4.9%), and divergences between the latter taxon and *L. mackayi* were moderate (5.4–5.6%).

Morphological analyses

Results of our morphological analyses are shown in Table 2. Snout–vent length ranged from 29.7–34.8 mm in adult males, and our single adult female specimen was 45.9 mm long. Webbing formulas for our specimens were: 1(1.75), 2i(1.75), 2e(1.25–1.50), 3i(1.75–2.00), 3e(1.75), 4(1.00–1.25) (manus), and 1(1.00), 2i(1.00–1.25), 2e(0.25–0.50), 3i(1.75–2.00), 3e(0.50–0.75), 4i(2.00), 4e(1.75), 5(0.75–1.00) (pes); relative lengths of digits were III > IV > II > I (manus), and IV > V > III > II > I (pes).

Colour pattern variation among selected specimens of *Leptopelis fiziensis* is illustrated in Figure 3. Three main colour morphs were observed: (1) light brown or tan ground colour with brown to dark brown hourglass patterns (typical for *Leptopelis*) and bars on the dorsum of the body and limbs, often with a brown line from the posterior edge of the eyelids over the superior curvature of the tympanum to the insertion of the forelimb; (2) light brown

ground colour with faint indications of brown hourglass patterns and bars on the dorsum of the body and limbs, with fluorescent green flecks on the dorsum; and (3) beige ground colour with faint, light brown hourglass patterns and bars on the dorsum of the body and limbs, often with black tubercles on the dorsum. All individuals had a distinct, squarish subocular white spot, and white venters, except for males, which had throats with gray or brown pigmentation. All individuals had irises that were reddish brown superiorly, with a transition to grayish silver inferiorly. All individuals had areas of dark brown pigmentation on the posterior side of the knees and above the anus; these dark brown areas had a sharp white line on their superior border.

Acoustic analyses

Calls of *Leptopelis fiziensis* were recorded from seven males (Fig. 4, Table 3). The advertisement call is a series of two or three clacks/pulses sounding to the human ear as: “quack-quack.” Clack repetition rate is constant across the call. Mean call duration was 0.53 s, and intercall intervals were relatively short, ranging from 2.45–4.41 s. Calls consisted of two frequency components: a lower frequency component of 1.75–1.90 kHz and a high frequency component of 2.06–2.23 kHz. The dominant frequency component was 1.89–2.06 kHz.

Discussion

Our morphometric results and colour pattern description are mostly consistent with data provided by Laurent (1973) in the original species description, but the upper size limit of our male specimens (34.8 mm SVL, Table 1) is slightly larger (ca. 33 mm SVL; Laurent 1973: fig. 39). The three male specimens described by Schiøtz (1975, 1999) from Gombe Stream National Park, Tanzania are slightly larger (34–38 mm SVL), have “tiny light specks” on the dorsum, a greyish venter, reddish femur and golden iris. Channing & Howell (2006) provided a similar colour pattern description to that of Schiøtz (1975, 1999), but they noted females reach 38 mm and males only 35 mm. Given the relatively minor morphological differences between our DRC specimens and those from Gombe, Tanzania, we tentatively continue to recognize the latter population as *L. fiziensis*. However, additional morphological, molecular and acoustic data are required to confirm the identification of the Gombe population.

Our male advertisement call analyses identified several components that seem to be unique to *Leptopelis fiziensis*. The number of pulses (2–3) distinguishes *L. fiziensis* from other AR *Leptopelis*. Moreover, the mean high frequency (2.11 kHz) renders *L. fiziensis* one of the highest call frequencies of any *Leptopelis* examined from the AR (FP and EG unpubl. data; Roelke *et al.* 2011). This finding is consistent with the relatively small body size of male *L. fiziensis* and the supposition of an inverse relationship between call frequency and male body size (Duellman & Trueb 1994; Wells 2007).

In stark contrast to our findings, Channing & Howell (2006) described the call of *L. fiziensis* as “a deep unmelodic clack” that did not seem to be recorded or analyzed. The dominant frequency component ($P < 0.005$), number of pulses ($P = 0.032$) and call duration ($P < 0.005$) were significantly different between *L. fiziensis* and *L. kivuensis*. The dominant frequency component ($P < 0.005$) and number of pulses ($P < 0.005$) were significantly different between *L. fiziensis* and *L. karissimbensis* (Roelke *et al.* 2011, Table 3). Schiøtz (1967) described the call of *L. modestus* (Obudu Plateau, Nigeria) as “an indistinct unmelodious clack” and noted the maximum frequency intensity as 2 kHz. Amiet & Schiøtz (1974) and Schiøtz (1999) provided a similar figure and call description for *L. modestus* from Ongot, Cameroon, and added that the call is sometimes repeated twice. Although the 2 kHz datum is mostly consistent with *L. fiziensis*, the intercall interval illustrated by the latter

authors is much shorter (< 1 second) than our data for *L. fiziensis* (2.45–4.41 seconds). The range of call variables reported for *L. mackayi* in the original species description (Köhler *et al.* 2006) overlaps with *L. fiziensis* in some cases, but the number of pulses/note for the former species (6–12) is well outside the range for *L. fiziensis* (2–3).

Laurent (1973) remarked that he originally regarded *Leptopelis fiziensis* as a distinct species, but he decided to describe the new taxon as a subspecies of *L. modestus* after his biometric analyses suggested a close relationship to the latter species. Schiøtz (1999) explained that he regarded *L. fiziensis* as a full species because of the unsettled taxonomy of *L. modestus*, but that the two taxa were morphologically similar. Based on morphology, male advertisement call analyses and mitochondrial sequence data (16S gene), Köhler *et al.* (2006) recognized a population of *L. modestus* from forested areas of western Kenya as a new species, *L. mackayi*. Although the latter authors provided a morphological diagnosis of *L. mackayi* from *L. fiziensis*, no specific hypothesis about the relationship of their new species to other *Leptopelis* species was provided. Our phylogenetic analyses and sequence divergence data demonstrated that *L. fiziensis* is a distinct species from both *L. mackayi* and *L. modestus*.

Our Kasanjala specimens were found on shrubs and trees (ca. 1–3 meters above the ground) near a stream in transitional forest, which occurs in small natural swathes (i.e., “forest strips” *sensu* Laurent 1973) in the forest/savannah mosaic in the region around Fizi (Fig. 5). *Hyperolius langi* (Hyperoliidae) and an unidentified species of *Amietia* (Pyxicephalidae) were also present at the Kasanjala forest locality. The Milembwe road specimen (UTEP 20454) was calling from a leaf of a tree (ca. 1.5 m above ground) near a stream at the edge of montane forest. Schiøtz (1975, 1999) and IUCN (2012) noted the Gombe Stream males were collected on branches in dense low bush at the edge of a clearing in dry forest. IUCN (2012) described the record from southwestern Tanzania (i.e., Senga, 1650 m) as riverine forest within pristine miombo (*Brachystegia* spp.) woodland. Based on the record from IUCN (2012), Tim Davenport (pers. comm.) provided coordinates for the single *Leptopelis* specimen collected at Senga (S7.87408 E30.97461) in October 2005, and confirmed the habitat as woodland. Given the differences in habitat between the Senga specimen and our specimens from DRC, we suspect that the Senga record is not conspecific with *Leptopelis fiziensis*, and further study is needed to clarify its taxonomic status. Because of nearly complete destruction of lowland forests in western Burundi (EG, pers. obs.), unspecific records of *L. fiziensis* from the country (IUCN 2012) also require further study.

Our findings are consistent with Plumptre *et al.* (2003), who considered *Leptopelis fiziensis* to be one of only 37 AR endemic amphibian species. Additional work is necessary to improve knowledge of the distribution of *L. fiziensis* in eastern DRC, Burundi and Tanzania, but given the limited, currently known geographic distribution of the species and widespread deforestation in the region around Fizi and Itombwe (Greenbaum & Kusamba 2012), the current IUCN Red List status as data-deficient (IUCN 2012) should be reconsidered.

Our Milembwe road record includes *Leptopelis fiziensis* among the amphibian fauna of the Itombwe Plateau for the first time. Itombwe is renowned for harboring multiple endemic amphibian taxa, including monotypic genera (i.e., *Chrysobatrachus* and *Laurentophryne*) (Laurent 1964). Plumptre *et al.* (2007) ranked Itombwe highest among all studied sites in the AR for numbers of threatened species of amphibians, and tied for highest (with Virunga National Park) numbers of AR endemic amphibian species. With the recent description of the Itombwe endemic pipid frog *Xenopus itombwensis* Evans *et al.* 2008, Itombwe is now the most important site for amphibian conservation in the AR, and among the most important sites in continental Africa. Despite years of recognition as an important site for

conservation of AR endemic flora and fauna (Doumenge 1998), Itombwe did not become a natural reserve (Itombwe Natural Reserve, INR) until 2006, and threats from deforestation, cattle ranching, illegal mining and warfare continue to plague preliminary conservation efforts. These threats are likely to be exacerbated as a colonial-era mining road through the heart of the plateau is rehabilitated in 2012 (Greenbaum & Kusamba 2012). Efforts are underway to transition Itombwe from a reserve to a park (CK & A. Plumptre, pers. comm.), and biological exploration of the plateau should continue to bolster conservation efforts.

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Figure 1.

Map of the Itombwe Plateau and surrounding region showing the type locality for *Leptopelis fiziensis* at Mokanga (star), paratype locality at Fizi (open circle), literature record of Schiøtz (1975) from Gombe Stream National Park, Tanzania (open square), and recently discovered DRC populations at Kasanjala (closed circle) and the road south of Milembwe (closed square). A questionable record from Senga, Tanzania (see Discussion) is not included here.

Figure 2. Preferred maximum likelihood phylogeny generated with RAxML from the 16S mitochondrial dataset. Branch support values are Bayesian inference/maximum likelihood/maximum parsimony.

Figure 3.

Photographs of *Leptopelis fiziensis* in life. (A) UTEP 20459 (32.7 mm SVL), adult male from Kasanjala; (B) UTEP 20458 (33.6 mm SVL), adult male from Kasanjala; (C) UTEP 20462 (32.3 mm SVL), adult male from Kasanjala; (D) UTEP 20457 (34.3 mm SVL), adult female from Kasanjala; (E) UTEP 20454 (31.2 mm SVL), adult male from road south of Milembwe; (F) UTEP 20454 in ventral view.

Figure 4. Waveform diagram and spectrogram of calls of *Leptopelis fiziensis* (UTEP 20458) from Kasanjala, Democratic Republic of the Congo. See Table 3 for details of the calls.

Figure 5. Forest/savannah mosaic habitat near the village of Kasanjala where *Leptopelis fiziensis* was found. The frogs were found in transitional forest, which is visible in the background.

Uncorrected *p*-distances within and among selected individuals from the *Leptopelis* phylogeny. Data were calculated from a 16S mitochondrial sequence dataset.

Table 1

	1	2	3	4	5	6	7	8	9
1. <i>L. fizeiensis</i> UTEP 20464	—								
2. <i>L. fizeiensis</i> UTEP 20457	0.000	—							
3. <i>L. fizeiensis</i> UTEP 20454	0.000	0.002	—						
4. <i>L. karissimbensis</i> UTEP 20130	0.017	0.020	0.017	—					
5. <i>L. karissimbensis</i> UTEP 20126	0.020	0.022	0.020	0.002	—				
6. <i>L. modestus</i> MCZA-138022	0.047	0.044	0.047	0.047	0.044	—			
7. <i>L. modestus</i> MCZA-138023	0.049	0.046	0.049	0.049	0.047	0.002	—		
8. <i>L. kivuensis</i> UTEP 20153	0.047	0.044	0.047	0.040	0.042	0.051	0.054	—	
9. <i>L. kivuensis</i> UTEP 20138	0.056	0.054	0.056	0.044	0.047	0.061	0.063	0.017	—
10. <i>L. mackayi</i>	0.056	0.054	0.056	0.038	0.040	0.061	0.064	0.042	0.042

Morphometric data (in mm) for recently collected specimens of *Leptopelis fizeiensis* from Kasanjala and the road south of Milembwe, Democratic Republic of the Congo. For character abbreviations, see Materials and Methods. SD = standard deviation.

Table 2

	SVL	HW	HL	IO	ED	TD	EN	NN	TL	FL	HL1	SbDL	SbDE
Males (N = 12)	mean	31.7	12.7	12.3	7.1	3.7	2	2.8	3.6	17	15.1	1.5	1.3
	SD	±3.4	±1.4	±1.4	±0.7	±0.5	±0.4	±0.3	±0.3	±1.7	±1.7	±0.3	±0.4
	range	29.7–34.8	11.9–13.7	11.5–13.6	6.5–7.7	3.3–4.1	1.8–2.1	2.7–3.1	3.3–3.9	16.4–17.5	14.2–15.8	1.2–1.9	1.0–1.7
Female(N = 1)		34.9	13.6	13.1	7.4	4.1	2.3	2.8	3.5	16.7	15.1	1.6	1.3

Table 3

Call characteristics of recordings of seven male *Leptopelis fizeiensis* from Kasanjala, Democratic Republic of the Congo.

ID	Date	Time	Temperature (°C)	Mass (g)	Call Duration (s)	Number of Pulses/Call	Dominant frequency component (kHz)	Low frequency component (kHz)	High frequency component (kHz)	Mean interval (s)	Intercall interval range (s)
UTEP 20464	13-Jan 2012	19:25	21.1	2.1	0.52	2	2.06	1.90	2.23	3.19	2.45–4.39
UTEP 20463	13-Jan 2012	19:37	21.0	2.3	0.47	2–3	1.89	1.75	2.07	3.26	2.61–3.91
UTEP 20459	13-Jan 2012	19:46	20.9	2.4	0.59	2	1.89	1.75	2.06	3.53	2.75–4.32
UTEP 20462	13-Jan 2012	19:54	20.9	2.6	0.57	2	1.89	1.75	2.06	3.13	2.54–3.97
UTEP 20458	13-Jan 2012	20:08	20.9	3.1	0.55	2–3	1.89	1.75	2.06	3.19	2.70–3.44
UTEP 20461	13-Jan 2012	20:20	20.8	2.5	0.41	2	1.89	1.75	2.06	3.24	2.92–3.56
UTEP 20460	13-Jan 2012	20:30	20.8	3.0	0.63	2	2.06	1.89	2.23	3.63	3.61–4.41
Mean					0.53		1.93	1.81	2.11	3.31	