

Elgon Francolin *Scleroptila elgonensis* should be treated as a species distinct from Moorland Francolin *S. psilolaema*

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Le Francolin d'Elgon *Scleroptila elgonensis* devrait être traité comme une espèce distincte du Francolin montagnard *S. psilolaema*. Le Francolin montagnard *Scleroptila psilolaema* est généralement considéré comme comprenant quatre sous-espèces sur les haut-plateaux de l'Éthiopie, du Kenya et de l'est de l'Ouganda. Ce traitement est basé sur les préférences d'habitat partagées (landes afro-alpines) et les caractéristiques du plumage supposées similaires des quatre taxons, bien qu'avant 1963 ils n'étaient pas traités comme conspécifiques. Afin de déterminer si cette approche est acceptable, nous avons examiné les données vocales et morphologiques, ainsi que certaines données génétiques. Les données vocales en particulier montrent des différences qualitatives, les vocalisations du Francolin d'Elgon ressemblant plus à celles du Francolin de Shelley *S. shelleyi* et du Francolin d'Archer *S. gutturalis* qu'à celles du Francolin montagnard. Nous concluons que les oiseaux éthiopiens ('Francolin montagnard' *S. psilolaema*) et ceux du Kenya et de l'Ouganda ('Francolin de l'Elgon' *S. elgonensis*) devraient être traités comme des espèces distinctes.

Summary. Moorland Francolin *Scleroptila psilolaema* is generally considered to comprise four subspecies in the highlands of Ethiopia, Kenya and eastern Uganda. This treatment is based on the shared habitat preferences (Afro-alpine moorland) and supposedly similar plumage characteristics of the four taxa, although prior to 1963 they were not treated as conspecific. To determine whether this approach is strongly supported, we examined vocal and morphological evidence, and reviewed the available genetic data. The vocal data in particular displayed qualitative differences, with vocalisations of Elgon Francolin being more similar to those of Shelley's Francolin *S. shelleyi* and Archer's (Orange River) Francolin *S. gutturalis* than those of Moorland Francolin. We conclude that Ethiopian birds ('Moorland Francolin' *S. psilolaema*) and Kenyan / Ugandan birds ('Elgon Francolin' *S. elgonensis*) should be treated as separate species.

S*cleroptila* francolins are secretive, cryptically coloured gamebirds found in grassland and scrubland across Africa, where they are often detected only by their strident advertisement calls. Moorland Francolin *S. psilolaema* occurs as a series of disjunct populations in the high mountains of Uganda, Kenya and Ethiopia (Crowe *et al.* 1986). Our recent field experience in both Ethiopia and Kenya, where we photographed and sound-recorded different populations, and the proposal by del Hoyo & Collar (2014) to split the species, caused us to question whether more than one species is involved. Here, we introduce new evidence concerning their vocalisations, reappraise the morphological evidence, and briefly review some genetic data to examine this question.

Morphology and the taxonomic history related to morphology

The high-altitude (Afro-alpine) francolins of Ethiopia, Kenya and eastern Uganda have been generally recognised as a single species, *Scleroptila psilolaema*, with either two or four subspecies

(White 1965, Crowe *et al.* 1986, McGowan 1994, Dickinson & Remsen 2013). *S. p. psilolaema* (G. R. Gray, 1867) and *S. p. ellenbecki* (Erlanger, 1905) occupy the central and south-eastern highlands of Ethiopia, respectively. Some 1,800 km further south, *S. p. elgonensis* (Ogilvie-Grant, 1891) and *S. p. theresae* (R. Meinertzhagen, 1937) occupy Mount Elgon on the eastern Uganda and western Kenya border, and the cluster of Mount Kenya, the Aberdares and Mau Narok, respectively. This paper recognises the 'red-winged group' of francolins in the genus *Scleroptila*, but retains *Francolinus* when dealing with historical information below. For ease of reference, the vernacular term Moorland Francolin will be used for the Ethiopian taxa, and Elgon Francolin for the Kenyan and Ugandan taxa.

Prior to the 1960s, Peters (1934) placed *psilolaema* (and *ellenbecki*) within Grey-winged Francolin *Francolinus africanus*, along with Orange River Francolin (now known as Archer's Francolin) *F. archeri*, and others, but placed *elgonensis* (*theresae* had not been described) into

Shelley's Francolin *F. shelleyi*. Mackworth-Praed & Grant (1952) did the same, maintaining *elgonensis* and *theresae* in *F. shelleyi*, and *psilolaema* and *ellenbecki* in *F. africanus*. These two treatments emphasise that the affinities of these subspecies were historically uncertain, with the result that they were attributed to other described species, but had not been considered as possible species in their own right, nor even as conspecifics. More recently, their treatment has evolved as follows.

Firstly, Hall (1963) examined specimens of all four subspecies in the British Museum (now Natural History Museum, Tring; NHMUK) collection, and considered them to represent a single species *Francolinus psilolaemus*. She was followed in this by White (1965). Snow (1978) also recognised just one species, but did not mention any of the subspecies, although he commented that southern populations, i.e. *elgonensis*, appeared to be more similar to Shelley's Francolin *S. shelleyi*. Crowe *et al.* (1986) in *Birds of Africa* recognised only two subspecies and a single species, treating *ellenbecki* as synonymous with the nominate and *theresae* within *elgonensis*. McGowan (1994) raised doubts as to the validity of *ellenbecki* and mentioned that *elgonensis* had been considered a separate species or as a race of *Francolinus shelleyi*. Madge & McGowan (2002) and Dickinson (2003) followed Crowe *et al.* (1986) in recognising a single species with two subspecies, i.e. nominate and *elgonensis*, with *theresae* as a synonym of the latter, but Dickinson (2003) did not mention *ellenbecki*, and a decade later Dickinson & Remsen (2013) did the same. Finally, del Hoyo & Collar (2014) recognised two monotypic species, *S. psilolaema* and *S. elgonensis*, based on the significant morphological differences between the two. Under *psilolaema*, they commented that *ellenbecki* was of doubtful validity and mentioned *theresae* as a synonym of *elgonensis*. Based on the lack of morphological differences, we have followed these authors in treating *psilolaema* and *ellenbecki* as synonymous ('Moorland Francolin'), and *theresae* as a synonym of *elgonensis* ('Elgon Francolin').

Vocalisations

Two sound-recordings of the advertisement calls of Moorland Francolin from Bale Mountains National Park in Ethiopia and one recording of Elgon Francolin from Mount Kenya in Kenya

were made using Sennheiser microphones and Sony PCM-M10 digital sound-recorders in .WAV format by CC and MSLM, respectively. The two recordings from the Bale Mountains were corroborated aurally using two recordings from the Sanetti Plateau, Ethiopia, available at www.xeno-canto.org (XC210009 and XC210010). The recording from Mount Kenya was corroborated aurally via the recording from Kenya on Stevenson *et al.* (2014). Having made the necessary comparisons to ensure the sonograms would be typical of both taxa, the authors' own recordings were transferred to computer, edited using Goldwave software (www.goldwave.com) and visualised with Raven Lite 1.0 software (Cornell Lab of Ornithology 2003), producing the sonograms shown in Figs. 1–2. These vocalisations were also compared aurally, including at artificially lowered sample rates to hear the structure more clearly.

This comparison shows that the advertisement calls of Moorland Francolin and Elgon Francolin differ in several characters. That of Moorland Francolin is a simple series of two-noted calls. The first element is longer (lasting *c.*0.40 seconds) and slightly wavering in quality, whereas the second is very short (*c.*0.08 seconds), although given at a similar pitch. These two-noted calls are uttered in rapid succession, with a gap of *c.*0.50 seconds between calls, giving them a jerky nature (Fig. 1).

The advertisement call of Elgon Francolin is a much more complex and rhythmic series of three-noted calls, which appears to simultaneously contain both clear, whistle-like sounds and more burry sounds. The first element is complex and comparatively long (*c.*0.30 seconds). This is followed by a quite long pause (*c.*0.20 seconds), then by short (*c.*0.05 second) and longer (*c.*0.15 second) notes given almost without a pause. These three-noted calls are uttered in rapid succession, but with a shorter gap of *c.*0.20 seconds between calls, giving them a more regular nature (Fig. 2).

Aurally and structurally, the call of Moorland Francolin is rather unique in the genus *Scleroptila*, whereas that of Elgon Francolin is similar to those of Shelley's Francolin and Orange River Francolin. The similarity to *S. shelleyi uluensis* was also noted by Jackson (1938) just prior to him collecting a specimen. Admittedly, the sonogram comparison is made between the calls of races *ellenbecki* and *theresae*. However there is good reason to

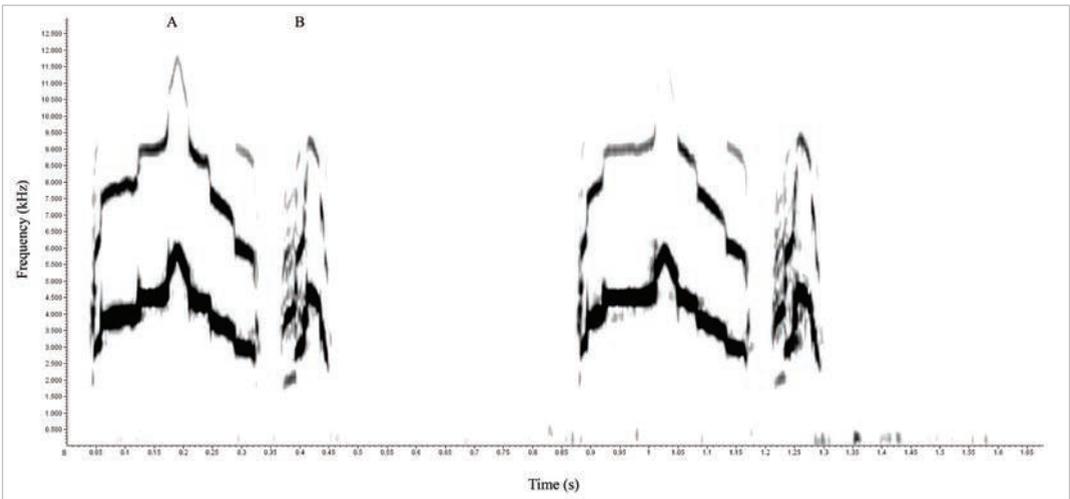


Figure 1. Sonogram of the advertisement call of Moorland Francolin *Scleroptila psilolaema*, recorded in Bale Mountains National Park, Ethiopia, April 2004 (Callan Cohen), showing two of the two-note calls that are repeated in a long series. Each call consists of a single more drawn-out note (A) followed by a very short note on a similar pitch (B).

Sonogramme du chant territorial du Francolin montagnard *Scleroptila psilolaema*, enregistré dans le Parc National des Montagnes du Balé, Éthiopie, avril 2004 (Callan Cohen), montrant deux des cris à deux notes qui sont répétés en longues séries. Chaque cri consiste en une note étirée (A) suivie par une note très courte d'une fréquence semblable (B).

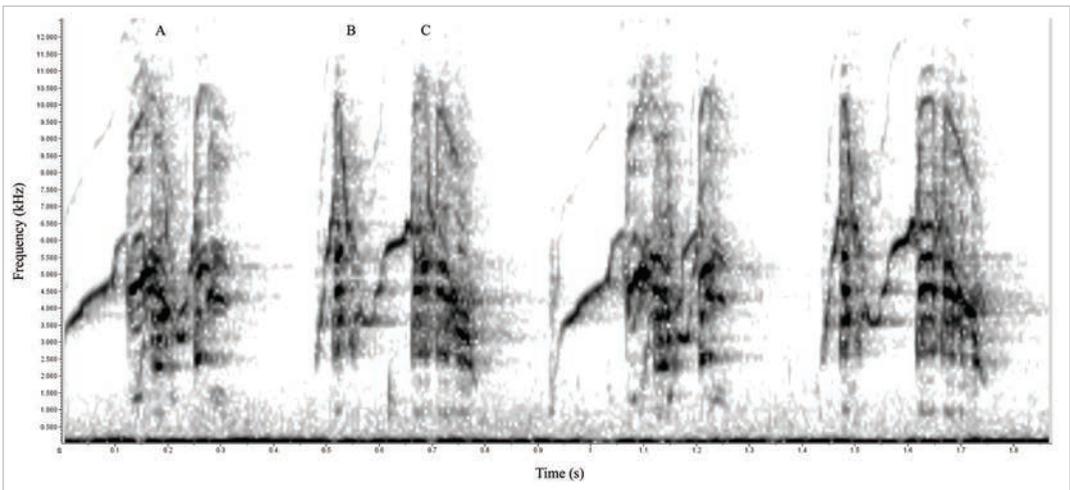


Figure 2. Sonogram of the advertisement call of Elgon Francolin *Scleroptila elgonensis*, recorded on Mount Kenya, Kenya, April 2016 (Michael Mills), showing two of the three-note calls given in a long series. The first note is quite complex and long (A), followed by a significant break before a very brief second note (B) and, immediately, a more complex third note (C). Note the more complex structure and 'even' nature of the calls.

Sonogramme du chant territorial du Francolin d'Elgon *Scleroptila elgonensis*, enregistré sur le mont Kenya, Kenya, avril 2016 (Michael Mills), montrant deux des cris à trois notes qui sont répétés en longues séries. La première note est assez complexe et longue (A), suivie d'une pause nette avant la deuxième note très brève (B) et, immédiatement, d'une troisième note plus complexe (C). Noter la structure plus complexe et assez similaire des cris.

consider the calls of *theresae* and *elgonensis* as being virtually identical, and therefore both are very different from *ellenbecki*. It is also very likely that

psilolaema, situated north of *ellenbecki*, will have the same vocalisation as *ellenbecki* and certainly not that of the Kenya / Uganda populations.

Table 1. Plumage differences between Moorland Francolin *Scleroptila psilolaema* of Ethiopia and Elgon Francolin *S. elgonensis* of Kenya and eastern Uganda, based on del Hoyo & Collar (2014)

Tableau 1. Différences de plumage entre le Francolin montagnard *Scleroptila psilolaema* d'Éthiopie et le Francolin d'Elgon *S. elgonensis* du Kenya et de l'est de l'Ouganda, basé sur del Hoyo & Collar (2014).

	Moorland Francolin	Elgon Francolin
Throat	finely spotted black	plain / unmarked
Throat bar	absent according to del Hoyo & Collar (2014), although narrow in some cases (see Figs. 4a–b)	conspicuous
Breast	buffy with vague black half spots	rufous with full black spots
Belly	creamy buff with chestnut crescents and chocolate brown Vs	chestnut intermixed with grey
Mantle	concolorous with rest of the upperparts	black-spotted rufous chestnut, contrasting with rest of upperparts
Wings	buff barring narrower	buff barring broader

Morphology

There are clear qualitative plumage differences between Moorland Francolin and Elgon Francolin, as summarised in Table 1 and corroborated by photographs of birds in the field (Figs. 3–5) and specimens at NHMUK (Figs. 6–7). The general ground colour of Elgon Francolin is much more rufous as opposed to the buff and grey tones of Moorland Francolin, especially obvious on the mantle that contrasts strongly with the grey upperparts, rather than being concolorous as in Moorland Francolin. *Scleroptila* plumages are very intricate and detailed, so speckling is not necessarily always a strong character for defining differences. However, the densely speckled throat of Moorland Francolin differs markedly from the plain throat of Elgon Francolin, and the breast markings are bolder and ‘simpler’ in Elgon vs. Moorland Francolin. Elgon Francolin may also be larger than Moorland Francolin (Hall 1963), although this has not been re-examined by either us or, seemingly, del Hoyo & Collar (2014).

Genetic evidence

The only relevant genetic data available appear in a Ph.D. study of the francolins to determine a classification system (Mandiwana-Neudani 2014). The phylogenetic work included the ‘red-winged group’ (genus *Scleroptila*) comprising six species, including Moorland Francolin, which was represented by three samples listed as being from *psilolaema*, *ellenbecki* and *theresae*.

However, the *psilolaema* specimen used (NHMUK 1880.1.1.1066) is mislabelled, based both on the morphological description as stated in the thesis and on its origin, again as stated

in the thesis, being Kenya (M. P. Adams *in litt.* 2017). The morphological description of the *S. p. psilolaema* specimen in the thesis mentions that the throat is unspotted white. This is completely at odds with the fact that both Ethiopian subspecies have speckled throats, and both Kenyan subspecies have clean whitish throats, as clearly shown in Figs. 6–7, thus strongly suggesting that the sample came from a specimen of *S. p. theresae* (it could not have come from Ethiopia).

The phylogenetic tree is shown as Fig. 8, and *psilolaema* should read *theresae* (see above). Despite the caveats that this study was restricted to just a single mitochondrial gene (cytochrome-*b*), had limited sampling and poor tree topology support bootstraps, the finding that *S. (p.) ellenbecki* is in a non-sister clade to *S. p. theresae* is a further indication of their distinctiveness

Discussion

The plumage differences between Moorland Francolin and Elgon Francolin have long been recognised, by Mackworth-Praed (1922), Friedmann (1930) and Hall (1963). Despite this, Hall (1963) decided to combine these previously separate species into a single one, a treatment that went unchallenged for the following 50 years, apparently because of the presumed habitat similarities (alpine areas). Del Hoyo & Collar (2014) were the first to re-examine these differences and, based on quantified differences in several traits (*cf.* Tobias *et al.* 2010), they recommended recognising two species. Our observations of plumage characters and previously unexamined vocalisations (see below) strongly support this treatment: i.e. Moorland Francolin *S. psilolaema*



Figures 3a–c. Elgon Francolin *Scleroptila elgonensis theresae*, Mount Kenya, Kenya, May 2007 (a) and May 2013 (b–c) (J. Bell [a] and S. Hatfield [b–c]). Features that differentiate it from Moorland Francolin *S. psilolaema*, visible here, include the unmarked throat bordered below by a black throat bar, bold black spots on the rufous breast and rufous mantle contrasting with the rest of the upperparts.

Francolin d'Elgon *Scleroptila elgonensis theresae*, mont Kenya, Kenya, mai 2007 (a) et mai 2013 (b–c) (J. Bell [a] et S. Hatfield [b–c]). Les caractères, visibles ici, qui le distinguent du Francolin montagnard *S. psilolaema*, comprennent la gorge unie bordée en dessous par une barre noire, les taches noires bien marquées sur la poitrine rousse et le manteau roux contrastant avec le reste des parties supérieures.

(endemic to Ethiopia) and Elgon Francolin *S. elgonensis* (in Kenya and eastern Uganda).

For the first time, we made direct comparisons of the advertisement calls of Moorland Francolin (represented by *ellenbecki*) and Elgon Francolin (represented by *theresae*). Vocalisations are useful indicators of relatedness (McCracken & Sheldon 1997). We found that advertisement calls of Elgon Francolin and Moorland Francolin not only differ significantly in structure, but that the calls of Elgon Francolin are rather similar to those of other members of the genus *Scleroptila*, whereas those of Moorland Francolin are rather unique. Thus, the vocal evidence also strongly supports the hypothesis that Moorland and Elgon Francolins are not a single species.



Table 2. Twenty-one species with allopatric highland / Afro-alpine distribution.
Tableau 2. Vingt-et-une espèces à distribution montagnarde / afro-alpine allopatrique.

Species occurring in Ethiopia and not Kenya	Species occurring in Kenya and not Ethiopia	Species occurring in both Kenya and Ethiopia
Blue-winged Goose <i>Cyanochen cyanoptera</i>	Jackson's Francolin <i>Pternistis jacksoni</i>	Malachite Sunbird <i>Nectarinia famosa</i>
Wattled Ibis <i>Bostrychia carunculata</i>	Olive Ibis <i>Bostrychia olivacea</i>	Tacazze Sunbird <i>Nectarinia tacazze</i>
Rouget's Rail <i>Rougetius rougetii</i>	Aberdare Cisticola <i>Cisticola aberdare</i>	Alpine Chat <i>Pinarochroa sordida</i>
Spot-breasted Plover <i>Vanellus melanocephalus</i>	Golden-winged Sunbird <i>Drepanorhynchus reichenowi</i>	
White-collared Pigeon <i>Columba albitorques</i>	Scarlet-tufted Sunbird <i>Nectarinia johnstoni</i>	
Golden-backed Woodpecker <i>Dendropicus abyssinicus</i>	Bronze Sunbird <i>Nectarinia kilimensis</i>	
Yellow-fronted Parrot <i>Poicephalus flavifrons</i>	Thick-billed Seed-eater <i>Crithagra burtoni</i>	
Black-winged Lovebird <i>Agapornis taranta</i>		
Thick-billed Raven <i>Corvus crassirostris</i>		
White-backed Black Tit <i>Melaniparus leuconotus</i>		
White-billed Starling <i>Onychognathus albirostris</i>		
Abyssinian Longclaw <i>Macronyx flavicollis</i>		
White-winged Cliff Chat <i>Thamnolaea semirufa</i>		
Black-headed Siskin <i>Serinus nigriceps</i>		



Figures 4a–b. Moorland Francolin *Scleroptila psilolaema ellenbecki*, Bale Mountains, Ethiopia, November 2013 (a) and November 2016 (b) (Nigel Redman). Visible features that differentiate it from Elgon Francolin *S. elgonensis* include the finely spotted throat, faintly spotted buffy breast, and mantle uniform with the rest of the upperparts, which are greyer. Francolin montagnard *Scleroptila psilolaema ellenbecki*, montagnes du Balé, Éthiopie, novembre 2013 (a) & novembre 2016 (b) (Nigel Redman). Les caractères visibles qui le distinguent du Francolin d'Elgon *S. elgonensis* comprennent la gorge finement tachetée, la poitrine chamois faiblement tachetée, et le manteau uniforme avec le reste des parties supérieures, qui sont plus grises.

An additional factor relates to avian biogeographic patterns across this region. Moreau (1966) believed these francolins were one species and that the species historically bridged the 500 km-gap between the mountains of Kenya and

Ethiopia. He suggested that the most reasonable explanation was that the birds inhabited altitudes with a lower limit of 1,500 m instead of the present 2,500 m in the glaciation era. However, the gap does not reach higher than 1,000 m



Figure 5. Moorland Francolin *Scleroptila psilolaema psilolaema*, 20 km north-east of Mukaturi, Ethiopia, September 2010 (Thomas Varto Nielsen)

Francolin montagnard *Scleroptila psilolaema psilolaema*, 20 km au nord-est de Mukaturi, Éthiopie, septembre 2010 (Thomas Varto Nielsen)

Figure 6. Ventral view of *S. p. psilolaema* specimen NHMUK 1880.1.1.1066, collected at Shoa, Ethiopia (Mark Adams, © Natural History Museum, London)

Vue ventrale du spécimen *S. p. psilolaema* NHMUK 1880.1.1.1066, collecté à Shoa, Éthiopie (Mark Adams, © Natural History Museum, London)

Figure 7. Ventral view of *S. p. theresae* specimen NHMUK 1965.M.2073, collected at Mount Kenya, Kenya (Mark Adams, © Natural History Museum, London)

Vue ventrale du spécimen *S. p. theresae* NHMUK 1965.M.2073, collecté au mont Kenya, Kenya (Mark Adams, © Natural History Museum, London)



across the whole of northern Kenya, and this landscape is much older than the rifting and lifting process leading to the shaping of the mountain areas (Spawls & Mathews 2012). As shown in Table 2, northern Kenya seems more likely to serve as a barrier, rather than a conduit, with 14 highland species occurring in Ethiopia and not Kenya. Similarly, seven such species occur in Kenya and not Ethiopia, including Jackson's Francolin *Pternistis jacksoni*, and only three species are common to both areas. However, the real significance of Table 2 is that none of the 14 species in Ethiopia and none of the seven

in Kenya possess a closest relative occurring on the opposite side of the northern Kenya barrier. Therefore Moreau's assumption that *S. (p.) psilolaema* and *S. (p.) elgonensis* must be each other's closest relative because they occupy similar moorland habitat is not unambiguously supported by the biogeographical, vocal or morphological evidence. Instead, it supports the hypothesis that they are two species that have evolved in different locations, and are not closest relatives. In the case of *elgonensis*, Shelley's Francolin, *S. shelleyi* seems a closer relative than *psilolaema*.

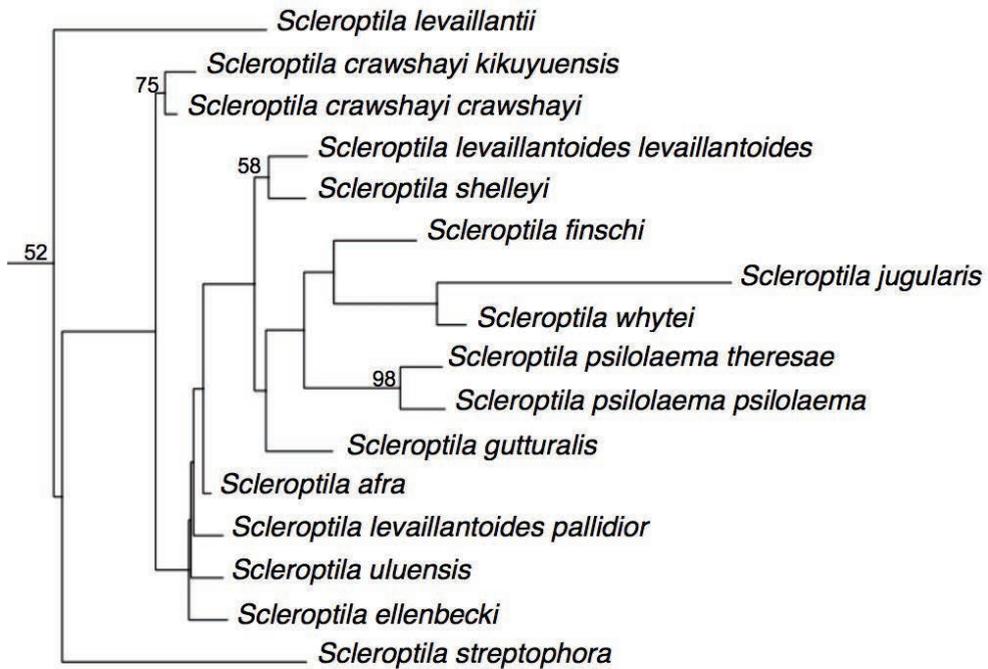


Figure 8. Maximum likelihood tree obtained from mitochondrial cytochrome-*b* characters. Numbers above branches represent bootstrap support values (from Mandiwana-Neudani 2014)

Cartographie de vraisemblance maximale obtenue par l'analyse des cytochromes-*b* mitochondriaux. Les chiffres au-dessus des branches représentent les valeurs de bootstrap (d'après Mandiwana-Neudani 2014)

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