



A new species of *Trachylepis* (Squamata: Scincidae) from the Amhara Region, Ethiopia, and a key to the Ethiopian *Trachylepis*

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Abstract

Ethiopia is known for its highly endemic and rich herpetofaunal diversity shaped by its biogeographical patterns. Here, a new species of skink, *Trachylepis boehmei* **sp. nov.**, is described from the Ethiopian Highlands. It differs from its congeners in having smooth uncarinated dorsal scales, 26–29 scale rows around midbody, a slender body of small size, a relatively short tail, a low eye–snout distance and a unique colour pattern with 6–8 darkish brown dorsal stripes. Based on morphological characteristics, its biogeographical pattern and comparisons with other similar congeners this new species is closely related to *Trachylepis megalura*. A published new record of *Trachylepis wingati* for the Kafa region is re-examined and identified as *T. megalura*. An updated comprehensive key to the *Trachylepis* found in Ethiopia is provided. In the context of ongoing phylogenetic and taxonomic revisions of *Trachylepis* and its species complexes the presence of further cryptic taxa can be expected also for the Ethiopian biodiversity hotspots. Consequently, the need of further herpetological investigations in this region of ecological importance is stressed.

Key words: *Trachylepis boehmei* **sp. nov.**, scincid lizards, taxonomy, morphology, key, Ethiopian Highlands

Introduction

The Ethiopian Highlands are considered as an outstanding biogeographical region and biodiversity hotspot (Mittermeier *et al.*, 2011). High levels of species differentiation and phylogenetic disjunctions across this northern part of the Great Rift System have been reported for its endemic fauna and flora, including the herpetofaunal diversity (Freilich *et al.*, 2016; Mairal *et al.*, 2017; Manthey *et al.*, 2017). In the last years, numerous new reptile taxa have been described from Ethiopia, not only from well-known centres of species diversity, for instance the Bale mountains (Gower *et al.*, 2016; Koppetsch *et al.*, in prep), but also from the entire geographically diverse Ethiopian region (Wagner *et al.*, 2013; Šmíd *et al.*, 2015, 2019; Colston *et al.*, 2020). The presence of further cryptic taxa can be expected particularly for scincid lizards of the highly diverse and widely distributed genus *Trachylepis*. Presently, this genus comprises 87 species of both smaller and larger diurnal and mainly terrestrial skinks with well-developed limbs, long cylindrical tails and a characteristic large transparent disc in the fully movable lower eyelid (Largen & Spawls, 2010; Uetz *et al.*, 2020). The genus *Trachylepis* has been facing several nomenclatural changes: Its representatives formerly assigned to the lygosomine genus *Mabuya* Fitzinger, 1826 were placed in the Afro-Malagasy genus *Euprepis* Wagler, 1830 (Mausfeld *et al.*, 2002, 2004), but Bauer (2003) showed that in fact the oldest available generic designation is *Trachylepis* Fitzinger, 1843 for the African species. For Ethiopia, the following nine species of *Trachylepis* have been recorded: *Trachylepis brevicollis* (Wiegmann, 1837), *T. hildebrandtii* (Peters, 1874), *T. maculilabris* (Gray, 1845), *T. megalura* (Peters, 1878), *T. planifrons* (Peters, 1878), *T. quinquetaeniata* (Lichtenstein, 1823), *T. striata* (Peters, 1844), *T. varia* (Peters, 1867) and *T. wingati* (Werner, 1908) (Largen & Spawls, 2006, 2010; Sindaco *et al.*, 2012). Although synonymized with *T. varia* by Loveridge (1923) the status and distinctness of *T. isselii* (Peters, 1871) from the Horn of Africa is still uncertain (Largen & Spawls, 2010; Sindaco *et al.*, 2012; Weinell & Bauer, 2018).

Both morphological and phylogenetic studies of *Trachylepis* indicate that numerous taxa with a broad distribution range represent several so far undetected species or even species complexes (Sindaco *et al.*, 2012; Weinell & Bauer, 2018; Weinell *et al.*, 2019).

Apparently, this is also true for *Trachylepis megalura* (Peters, 1878), a secretive skink that can be found in moist grasslands at moderate to high elevations. It has a non-continuous and fragmentary distribution in sub-Saharan Africa (Largen & Spawls, 2010). This distribution pattern and less conspicuous appearance might suggest the existence of undetected taxa restricted to small mountainous areas. Marques *et al.* (2019) showed by investigating both the type material of *T. megalura* and the synonymized *T. massaiana* (= *Eumeces massaianus* Fischer, 1884) (de Witte 1933) that at least specimens from Angola and the Democratic Republic of the Congo represent the distinct taxon, *T. raymondlaurenti* Marques *et al.*, 2019.

Specimens from Ankober, Ethiopia, deposited in the collection of the ZFMK that have been assigned to *Trachylepis irregularis* (Lönnerberg, 1922) were investigated. *T. irregularis* is an Afrotropical species also showing a patchy distribution by inhabiting mountain peaks and massifs of Kenya and Uganda. Besides the large biogeographical distance, these specimens were also lacking the diagnostic characteristics of *T. irregularis*. In addition, a detailed morphological analysis of the museum material revealed their distinctness from all other *Trachylepis* occurring in the region and the presence of another cryptic taxon most closely related to *T. megalura*. In the following, these specimens are described as a new species.

Material and methods

Morphological analysis

A total of 41 ethanol-preserved specimens were examined and in the collection of the Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany (ZFMK) (see Appendix I. Material examined).

Scale counts were made using a stereo microscope and morphological measurements were taken with a Vernier caliper to the nearest 0.1 mm. For all specimens examined sex was determined and the following 25 characters or ratios reported: snout–vent length (SVL), from the snout tip to the vent; tail length (TL), from cloaca to tip of tail, measured only in specimens with complete, original tails; tail length/snout-vent length ratio (TL/SVL), measured only in specimens with complete, original tails; head length (HL), from tip of snout to anterior tympanum border; head height (HH), from the base of the maxilla to the top of head; head height/head length ratio (HH/HL); head width (HW), from the lateral edge of the left parietal to the lateral edge of the right, above the eyes; head width/head length ratio (HW/HL); eye–nostril distance (END), from the front of the eye to the nostril; eye–snout distance (ESD), from the front of the eye to the tip of the snout; eye–snout distance/head length ratio (ESD/HL); eye–ear distance (EED), from the posterior margin of eye to anterior margin of the ear; inter-nostril distance (IND), minimum distance between the nostrils; axilla–groin distance (AGD), from posterior of the insertion of the forelimb to anterior of the insertion of the hindlimb; number of scale rows at midbody (MSR); paravertebral scale rows (PSR), from the nuchal (excluded from count) to base of the tail within one longitudinal row; number of subdigital lamellae under fourth finger (LF4); number of subdigital lamellae under fourth toe (LT4); number of supraciliaries (SC); number of supralabials (SL); kind of contact between parietals (CP), separated (s), short contact ([c]), broad contact (c); contact between frontoparietals (CFP), separated (s), short contact ([c]), broad contact (c); contact between supranasals (CSN), separated (s), short contact ([c]), broad contact (c); contact between prefrontals (CPF), separated (s), short contact ([c]), broad contact (c); number of keels on dorsal scales (DK).

Characters for the morphological analyses were partially selected and modified based on previous taxonomic studies of *Trachylepis* (Weinell & Bauer, 2018; Marques *et al.*, 2019) (Table 1).

Colouration and patterns were carefully recorded for each individual.

Results

Systematics

Scincidae Gray, 1825

Trachylepis Fitzinger, 1843

Trachylepis boehmei, sp. nov.

Suggested common English name: Böhme's Grass Skink

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Material examined: Holotype: ZFMK 16795, adult female, Ankober (9°36'N, 39°44'E), elevation 2,450 m.a.sl., North Shewa, Amhara Region, Ethiopia (Fig. 2), collected by G. Nikolaus on 12 November 1975 (Fig. 1).

Paratypes: ZFMK 16785–86, 16788, 16791–92, 16794 and 16796: adult females, ZFMK 16787, 16789–90 and 16793: adult males, all with the same data as the holotype (Fig. 4B).

Diagnosis: *Trachylepis boehmei* sp. nov. can be distinguished from all other congeners by the following combination of characters: (1) slender body of small size, SVL up to 55.3 mm; (2) relatively short tail length, up to 69.6 mm (about 1.3 times SVL); (3) relatively short eye–snout distance, up to 0.3 times head length; (4) 26–29 scale rows around midbody; (5) smooth uncarinated dorsal scales; (6) unique colour pattern showing a striped throat (11–12 stripes), a lateral white stripe from eye to tail, dorsally a pale brownish colouration with 6–8 darkish brown stripes ranging from neck to the end of the tail, an unpatterned cremish white ventral colouration and a head with small brown spots dorsally.

Description of the holotype: A small skink with a total length of 103.1 mm (snout-vent length of 46.3 mm and a tail length of 56.8 mm) (Fig. 1). Cylindrical body and slender appearance; habitus and proportions of limbs and body comparable to *T. megalura*. Complete, non-regenerated tail relatively short, only 1.23 times SVL. Compact head (HL 9.8 mm; HW 6.2 mm) with blunt snout (ESD/HL 0.24) (Fig. 1D,E,F). Small, vertically oval ear opening. Transparent scale characteristic for *Trachylepis* skinks present in lower eyelid. Small nostrils, set posteriorly so that postnasal effectively borders the nostril. Rostral visible from above. Supranasals with contact. Wide frontonasal, in contact with loreal scale. Prefrontals in contact with each other, also bordering frontal, frontonasal, loreal, first and second supraocular and first supraciliary. Two loreals. Frontoparietals in contact with each other, also bordering frontal, third and fourth supraoculars, parietal and interparietal. Parietals only in slight contact. Frontal in contact with two supraoculars on each side. Frontoparietal plus interparietal length greater than frontal length. Interparietal with a visible parietal foramen. Five supraciliaries, seven supralabials. Both dorsal and ventral scales smooth without being even slightly keeled or carinated. 26 scales around midbody (MSR), 57 paravertebral scale rows (PSR). The limbs have five digits, order of finger size (first longest) is IV>III>II>V>I, relative length of toes IV>III>V>II>I. Smooth tarsal and palmar scalation. 13 subdigital lamellae under fourth finger, 16 subdigital lamellae under fourth toe.

Additional mensural and meristic measurements of the holotype are shown in Table 1.

Colour pattern in preservative: The female holotype shows a striped throat with twelve stripes (Fig. 1D). A lateral white stripe extends from the eye to the tail. Dorsally the holotype is coloured pale brownish with six darkish brown stripes ranging from the neck to the end of the tail (Fig. 1C). Posteriorly those stripes are discontinuous by flowing into each other. On the ventral side it shows an unpatterned cremish white colouration (Fig. 1A). On the dorsal side of the head small brown spots are present (Fig. 1F).

Variation: Variation in mensural and meristic characters for the adult type series is shown in Table 1. The paratypes of *Trachylepis boehmei* sp. nov. show eleven to twelve ventral stripes on the throat. Six to eight darkish brown stripes range from neck to the end of the tail. Head scalation is similar to holotype except for the contact of parietals and the contact of prefrontals, which vary in the paratypes from being separated to bordering each other (Fig. 4B).

Comparisons: *Trachylepis boehmei* sp. nov. can be easily distinguished from the other representatives of the genus *Trachylepis* occurring in Ethiopia (see the key to the Ethiopian *Trachylepis* provided below) by a variety of morphological characteristics. By having a smooth dorsal scalation it can be separated from all congeners showing a characteristic number of distinct keels (indicated in brackets) on their dorsal scales, *T. brevicollis* (2–3), *T. hildebrandtii* (3), *T. maculilabris* (5–8), *T. planifrons* (3, rarely 4–5), *T. quinquetaeniata* (3, rarely 4–5), *T. striata* (3, rarely up to 7), *T. varia* (3) and *T. wingati* (3). In addition, *Trachylepis boehmei* sp. nov. shows a comparable low number of midbody scale rows (26–29) and is easily distinguishable from *T. brevicollis* (30–35), *T. hildebrandtii* (32), *T. maculilabris* (30–38, rarely more than 34), *T. quinquetaeniata* (32–46, rarely more than 40), *T. striata* (32–42, rarely more than 36) and *T. wingati* (30–32). It differs from *T. megalura* by having a relatively short tail length, maximal 1.7 times the SVL (vs. generally more than twice the SVL), a relatively low eye–snout distance, up to 0.3 times the head length (vs. 0.4) and a shorter body size of around 46.8 mm SVL (vs. generally more than 55 mm SVL). Most specimens of *T. megalura* show at least 3 indistinct keels on their dorsal scales (vs. completely absent in the

TABLE 1. Mensural and meristic measurements of the type specimens of *Trachylepis boehmei* sp. nov. from Ankober, Ethiopia (linear measurements in mm). Absence (—) of characters are indicated in specimens with regenerated or incomplete tails. See Materials and Methods for explanation of the single character abbreviations.

| ZFMK nr. | 16785 | 16786 | 16787 | 16788 | 16789 | 16790 | 16791 | 16792 | 16793 | 16794 | 16795 | 16796 |
|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| | | | | | | | | | | | holotypus | |
| Sex | f | f | m | f | m | m | f | f | m | f | f | f |
| SVL | 57.2 | 63.3 | 51.2 | 53.1 | 53.3 | 41.3 | 48.6 | 33.4 | 41.6 | 55.3 | 46.3 | 48.2 |
| TL | — | 71.9 | 53.2 | — | — | 69.5 | 59.3 | — | 48.6 | — | 56.8 | — |
| TL/SVL | — | 1.14 | 1.04 | — | — | 1.68 | 1.22 | — | 1.17 | — | 1.23 | — |
| HL | 10.8 | 11.5 | 11.2 | 11.3 | 11.5 | 9.1 | 10.9 | 10.3 | 9.3 | 10.4 | 9.8 | 9.8 |
| HH | 5.4 | 5.4 | 5.3 | 4.6 | 5.7 | 3.7 | 4.9 | 5.2 | 4.8 | 5.2 | 4.9 | 4.8 |
| HH/HL | 0.50 | 0.47 | 0.47 | 0.41 | 0.50 | 0.41 | 0.45 | 0.50 | 0.52 | 0.50 | 0.50 | 0.49 |
| HW | 6.6 | 6.9 | 6.6 | 6.5 | 6.4 | 5.0 | 6.6 | 6.4 | 5.6 | 6.2 | 6.2 | 5.8 |
| HW/HL | 0.61 | 0.60 | 0.59 | 0.58 | 0.56 | 0.55 | 0.61 | 0.62 | 0.60 | 0.60 | 0.63 | 0.59 |
| END | 1.4 | 1.9 | 1.6 | 1.4 | 1.7 | 1.6 | 1.9 | 1.1 | 1.5 | 1.8 | 1.5 | 1.7 |
| ESD | 2.8 | 3.1 | 2.4 | 2.9 | 3.0 | 2.4 | 2.7 | 2.7 | 2.6 | 2.5 | 2.4 | 2.5 |
| ESD/HL | 0.26 | 0.27 | 0.21 | 0.26 | 0.26 | 0.26 | 0.25 | 0.26 | 0.28 | 0.24 | 0.24 | 0.26 |
| EED | 3.4 | 3.3 | 2.9 | 3.9 | 3.5 | 2.6 | 3.0 | 3.1 | 3.6 | 3.8 | 3.0 | 3.6 |
| IND | 1.6 | 1.5 | 1.2 | 1.2 | 2.3 | 1.6 | 1.5 | 1.7 | 1.9 | 1.7 | 1.2 | 1.5 |
| AGD | 32.9 | 35.2 | 27.7 | 28.3 | 29.1 | 21.1 | 29.0 | 33.7 | 22.5 | 31.5 | 27.3 | 27.7 |
| MSR | 27 | 28 | 26 | 26 | 27 | 26 | 27 | 28 | 26 | 29 | 26 | 27 |
| PSR | 58 | 56 | 53 | 54 | 56 | 53 | 55 | 58 | 55 | 53 | 57 | 55 |
| LF4 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 12 | 13 | 10 |
| LT4 | 14 | 15 | 15 | 14 | 13 | 15 | 15 | 13 | 14 | 16 | 16 | 14 |
| SC | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 5 | 5 | 5 |
| SL | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| CP | [c] | s | s | s | c | [c] | s | [c] | s | s | [c] | s |
| CFP | c | c | c | c | c | c | c | c | c | c | c | c |
| CSN | c | c | c | c | c | c | c | c | c | c | c | c |
| CPF | s | s | s | s | s | s | s | [c] | s | s | c | s |
| DK | smooth | smooth | smooth | smooth | smooth | smooth | smooth | smooth | smooth | smooth | smooth | smooth |

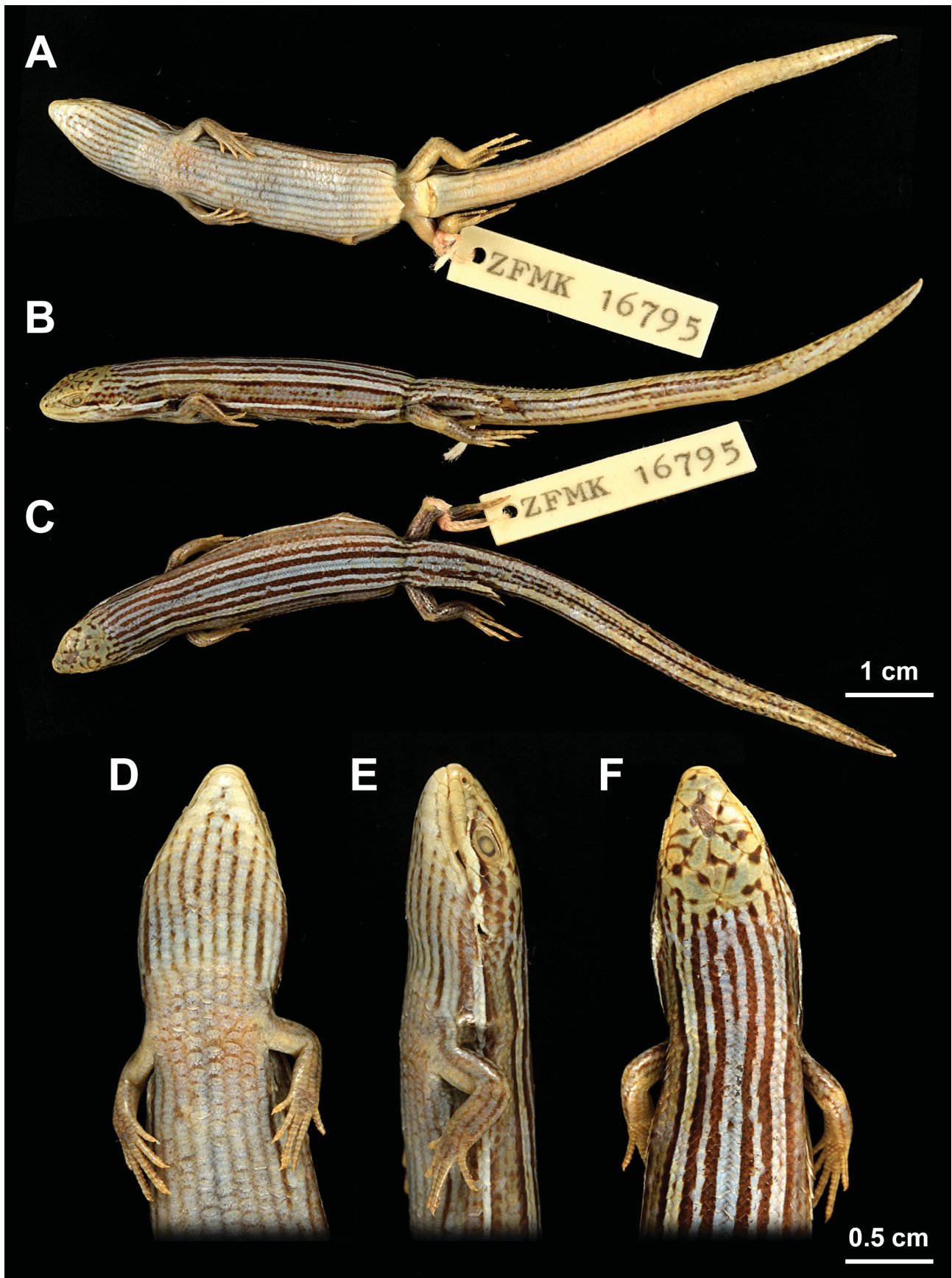


FIGURE 1. The preserved adult female holotype of *Trachylepis boehmei* sp. nov. (ZFMK 16795) from Ankober, Ethiopia, in ventral (A), lateral (B) and dorsal view (C). Head in in ventral (D), lateral (E) and dorsal view (F).

new species) (Marques *et al.*, 2019), but in some populations these can be also completely reduced (*T. Mazuch*, pers. commun.). Although, *Trachylepis boehmei* **sp. nov.** shows the closest morphological resemblance concerning its habitus and appearance to *T. megalura*, it is additionally distinguishable by its coloration and number of midbody scale rows. Both species have a prominent lateral white band running from below the eye along the entire body to the tail. However, *T. megalura* shows only 4 darkish brown, relatively indistinct fine dorsal stripes from the neck to the base of the tail, while the new species differs in having 6–8 darkish brown stripes dorsally ranging from the neck to the end of the tail by flowing into each other. While a maximum range of 22–28 scale rows at midbody has been reported for *T. megalura*, most individuals show 24–26 MSR, a lower number compared to *Trachylepis boehmei* **sp. nov.** having 26–29 MSR.

Despite the fact that the type series has been assigned to *T. irregularis* before, this biogeographically separated montane endemic from Kenya and Uganda can be easily distinguished from the new species by having 2–5 (regularly 3–4) distinct dorsal keels and a prominent vertebral whitish or golden double-stripe and two dorsolateral white stripes (see figure 2 in Koppetsch, in prep).

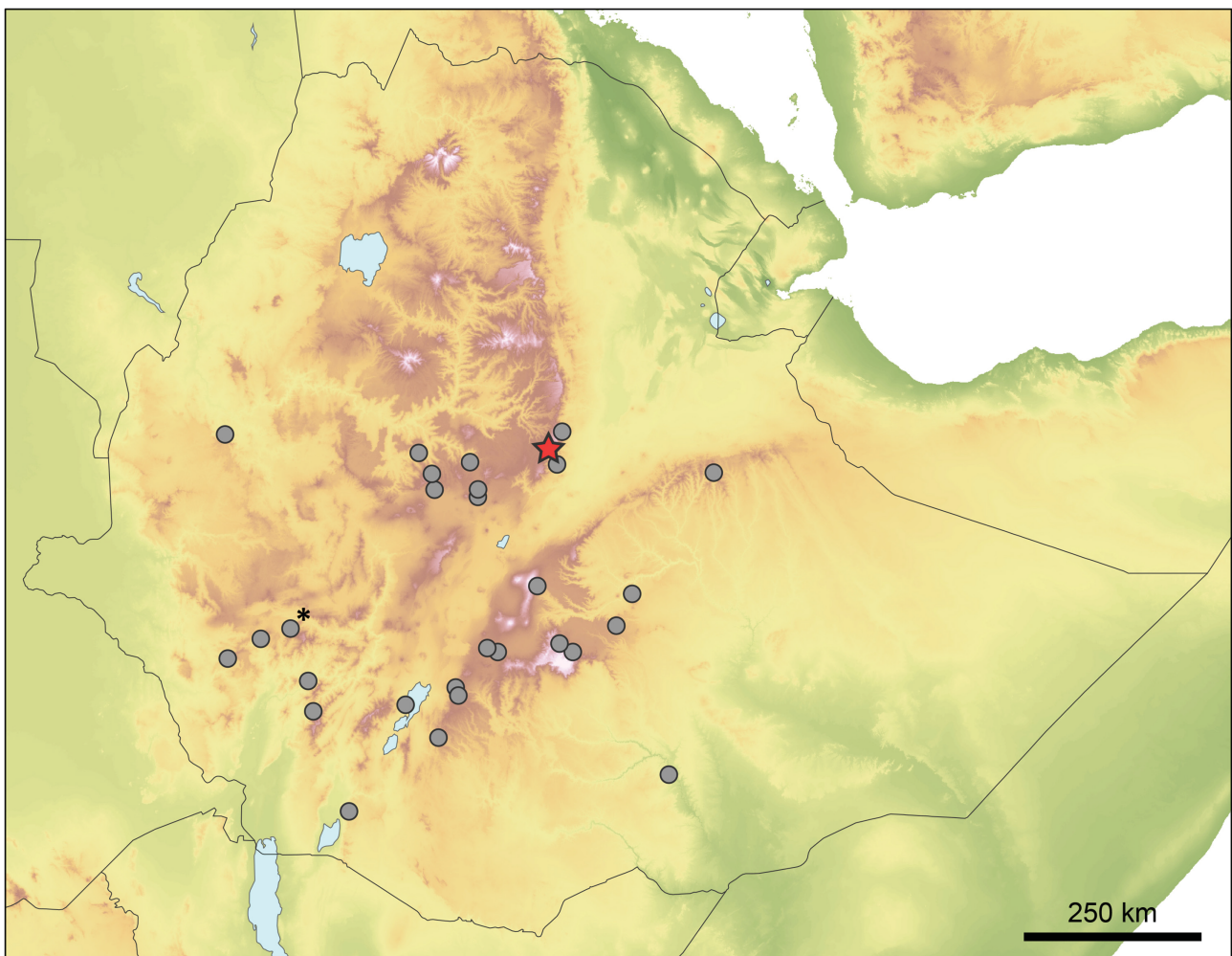


FIGURE 2. Map indicating the currently known distribution (red star) of *Trachylepis boehmei* **sp. nov.** in Ankober, Ethiopia. Grey dots show records of *T. megalura* based on distributional data after Marques *et al.*, 2019. The grey dot with a black asterisk indicates the record of the *T. megalura* specimen from Kafa Biosphere Reserve misidentified as *T. wingati* in Kirschey (2017).

Comparisons are based on species characteristics from Largen & Spawls (2010), Sindaco *et al.* (2012) and Marques *et al.* (2019). Differences between *Trachylepis boehmei* **sp. nov.** and congeners of similar habitus and size are shown in Table 2.

Etymology: The species is named after Wolfgang Böhme, German herpetologist at the Zoological Research Museum Alexander Koenig in Bonn, to honour his comprehensive and passionate research on African herpetofauna, the numerous contributions to its knowledge and his outstanding and ongoing strong promotion and supervision of the author.

TABLE 2. Mensural and meristic comparisons between *Trachylepis boehmei* sp. nov., *T. irregularis*, *T. megalura* (material examined + taken from Marques *et al.* (2019)) and *T. varia*. Linear measurements (in mm) and scale counts are given as mean values (Mean) ± standard deviation (SD) and sample size (N), minimum (Min) and maximum (Max) are shown. Absence (–) of characters is indicated. See Materials and Methods for explanation of the single character abbreviations.

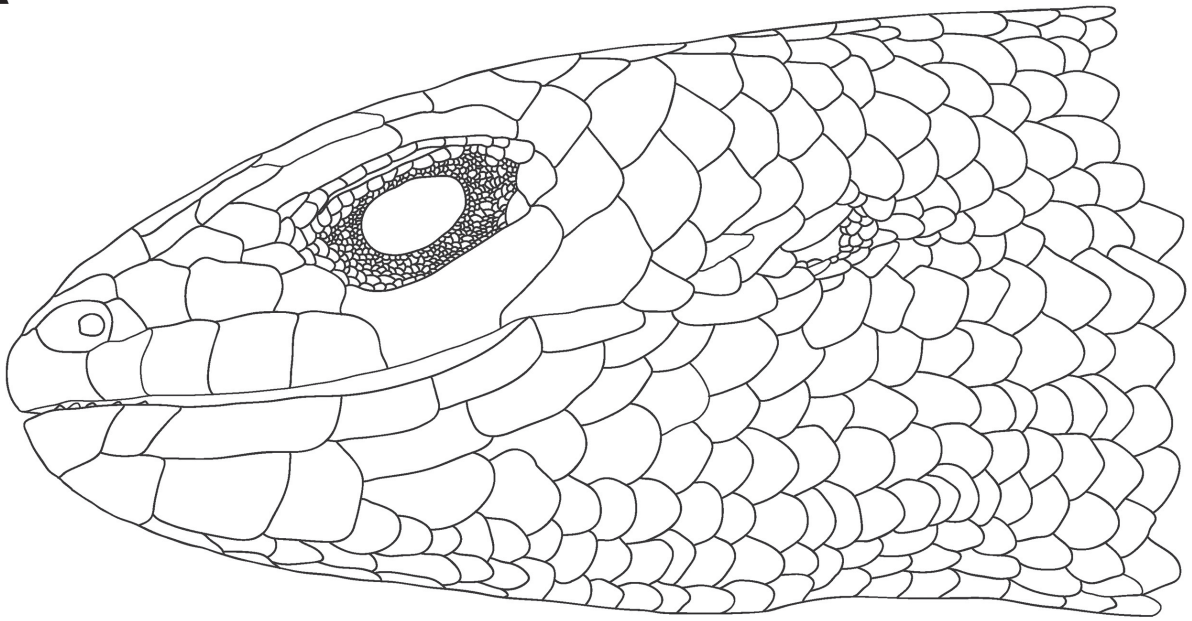
| Species | <i>Trachylepis boehmei</i> sp. nov. | | | <i>Trachylepis irregularis</i> | | | <i>Trachylepis megalura</i> | | | <i>Trachylepis megalura</i> | | | <i>Trachylepis varia</i> | | |
|----------|-------------------------------------|------|------|--|------|------|----------------------------------|------|-------|-----------------------------------|------|------|---|------|------|
| Locality | Ankober, Ethiopia | | | Aberdare, Mt. Elgon, Mt. Kenya, Kenya + Uganda | | | Kafa, Ethiopia + Kakamega, Kenya | | | from Marques <i>et al.</i> (2019) | | | Illubabor/Shoa, Ethiopia + Mt. Hanang, Tanzania | | |
| N | Mean ± SD | Min | Max | Mean ± SD | Min | Max | Mean ± SD | Min | Max | Mean ± SD | Min | Max | Mean ± SD | Min | Max |
| SVL | 46.8 ± 7.0 | 33.4 | 55.3 | 59.7 ± 5.9 | 52.8 | 68.8 | 62.3 ± 8.5 | 50.2 | 74.5 | 55.4 ± 17.0 | 22.0 | 83.5 | 50.4 ± 11.2 | 38.5 | 65.4 |
| TL | 58.6 ± 8.6 | 48.6 | 69.5 | 72.2 ± 16.1 | 48.4 | 82.5 | 107.1 ± 16.3 | 86.3 | 126.1 | 161.4 ± 44.2 | 214 | 341 | 60.5 ± 5.0 | 54.9 | 64.5 |
| TL/SVL | 1.3 ± 0.2 | 1.2 | 1.7 | 1.2 ± 0.3 | 0.8 | 1.6 | 1.8 ± 0.4 | 1.3 | 2.2 | 2.5 | 0.7 | 3.7 | 1.2 ± 0.3 | 1.0 | 1.6 |
| HL | 10.3 ± 0.8 | 9.1 | 11.5 | 12.6 ± 0.8 | 11.5 | 13.7 | 12.0 ± 0.9 | 10.5 | 13.2 | 9.6 ± 1.8 | 5.9 | 11.8 | 12.0 ± 2.1 | 9.6 | 14.4 |
| HH | 4.9 ± 0.5 | 3.7 | 5.7 | 5.9 ± 0.6 | 5.0 | 7.2 | 5.8 ± 0.5 | 5.3 | 6.7 | 4.9 ± 1.0 | 2.8 | 6.3 | 4.4 ± 0.7 | 3.5 | 5.2 |
| HH/HL | 0.5 ± 0.0 | 0.4 | 0.5 | 0.5 ± 0.0 | 0.4 | 0.5 | 0.5 ± 0.0 | 0.4 | 0.5 | – | – | – | 0.4 ± 0.0 | 0.4 | 0.4 |
| HW | 6.1 ± 0.5 | 5.0 | 6.6 | 7.7 ± 0.7 | 6.6 | 8.9 | 7.3 ± 0.7 | 6.5 | 8.6 | 6.5 ± 1.3 | 3.7 | 8.1 | 6.7 ± 1.4 | 5.0 | 8.2 |
| HW/HL | 0.6 ± 0.0 | 0.5 | 0.6 | 0.6 ± 0.0 | 0.5 | 0.7 | 0.6 ± 0.1 | 0.5 | 0.7 | 0.68 | 0.53 | 0.75 | 0.6 ± 0.0 | 0.5 | 0.6 |
| END | 1.6 ± 0.2 | 1.1 | 1.9 | 2.3 ± 0.4 | 1.6 | 2.7 | 2.7 ± 0.3 | 2.3 | 3.2 | 2.9 ± 0.6 | 1.7 | 4.0 | 3.0 ± 0.4 | 2.6 | 3.4 |
| ESD | 2.6 ± 0.2 | 2.4 | 3.0 | 4.5 ± 0.3 | 4.2 | 4.9 | 4.2 ± 0.4 | 3.5 | 4.7 | 4.3 ± 0.9 | 2.5 | 5.2 | 4.7 ± 0.7 | 3.6 | 5.1 |
| ESD/HL | 0.3 ± 0.0 | 0.2 | 0.3 | 0.4 ± 0.0 | 0.3 | 0.4 | 0.4 ± 0.0 | 0.3 | 0.4 | 0.45 | 0.35 | 0.52 | 0.4 ± 0.0 | 0.4 | 0.4 |
| EED | 3.3 ± 0.4 | 2.6 | 3.9 | 4.0 ± 0.3 | 3.6 | 4.4 | 3.6 ± 0.6 | 2.5 | 4.3 | – | – | – | 3.6 ± 0.8 | 2.6 | 4.5 |
| IND | 1.6 ± 0.3 | 1.2 | 2.3 | 1.9 ± 0.2 | 1.4 | 2.2 | 2.0 ± 0.3 | 1.5 | 2.4 | 1.8 ± 0.3 | 1.1 | 2.3 | 1.7 ± 0.1 | 1.5 | 1.8 |
| AGD | 27.8 ± 4.0 | 21.1 | 33.7 | 33.6 ± 5.7 | 26.3 | 42.8 | 34.9 ± 6.2 | 25.2 | 43.9 | – | – | – | 25.3 ± 4.3 | 20.9 | 31.2 |
| MSR | 26.9 ± 1.1 | 26 | 29 | 30.6 ± 0.5 | 30 | 31 | 25.7 ± 0.7 | 24 | 26 | – | 24 | 26 | 32.5 ± 0.6 | 32 | 33 |
| PSR | 55.1 ± 1.7 | 53 | 58 | 53.9 ± 2.2 | 51 | 58 | 54.1 ± 2.1 | 51 | 57 | – | 48 | 64 | 51.5 ± 2.5 | 49.0 | 55.0 |
| LF4 | 11.0 ± 1.0 | 10 | 13 | 13.4 ± 0.9 | 12 | 15 | 11.0 ± 0.7 | 10 | 12 | – | 10 | 14 | 15.5 ± 2.1 | 13.0 | 18.0 |
| LT4 | 14.4 ± 1.1 | 13 | 16 | 18.3 ± 1.7 | 16 | 20 | 15.0 ± 0.9 | 14 | 16 | – | 15 | 18 | 19.3 ± 1.0 | 18.0 | 20.0 |

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TABLE 2. (Continued)

| Species | <i>Trachylepis boehmei</i> sp. nov. | | <i>Trachylepis irregularis</i> | | <i>Trachylepis megalura</i> | | | <i>Trachylepis megalura</i> | | <i>Trachylepis varia</i> | | | | | |
|-------------|--|---|--------------------------------|---|-----------------------------|---|---|-----------------------------|---|--|---|--------------|---|-----|--|
| SC | 4.8 ± 0.4 | 4 | 5 | 4.0 ± 0.0 | 4 | 4 | 4.8 ± 0.4 | 4 | 5 | – | – | 5.0 ± 0.0 | 5.0 | 5.0 | |
| SL | 7.0 ± 0.0 | 7 | 7 | 7.0 ± 0.0 | 7 | 7 | 7.1 ± 0.3 | 7 | 8 | – | – | 7.0 ± 0.0 | 7.0 | 7.0 | |
| CP | [c] – s | | | c – s | | | s | | | – | | c – [c] | | | |
| CFP | c | | | c | | | c | | | – | | c | | | |
| CSN | c | | | c | | | c – [c] | | | c | | c | | | |
| CPF | [c] – s | | | [c] – s | | | [c] – s | | | usually [c] – s | | s | | | |
| DK | smooth | | | 3–4 (distinct) | | | 3 (indistinct) | | | 3 (indistinct) | | 3 (distinct) | | | |
| colouration | throat with 11–12 stripes; lateral white stripe from eye to tail; dorsally pale brownish with 6–8 darkish brown stripes from neck to the end of the tail; ventrally unpatterned cremish white; head with brown spots | | | throat with 12–14 indistinct stripes; 2 lateral white stripes (encompassing several lateral whitish spots) from eye to base of the tail; dorsally brownish with single darkish brown spots/bands and a dorsal whitish/golden double-line from neck to base of the tail; ventrally unpatterned | | | throat with 10–12 indistinct stripes; lateral white stripe from eye to tail; dorsally darkish golden-brown with 4 darkish brown (indistinct) stripes/bands from neck to base of the tail; ventrally cremish white | | | light orange-brown to grey-brown above, with a white lateral band/stripe | | | laterally 2 white bands side; dorsally beige brownish colouration with indistinct dark brown spot, ventrally cremish white; | | |

A



B

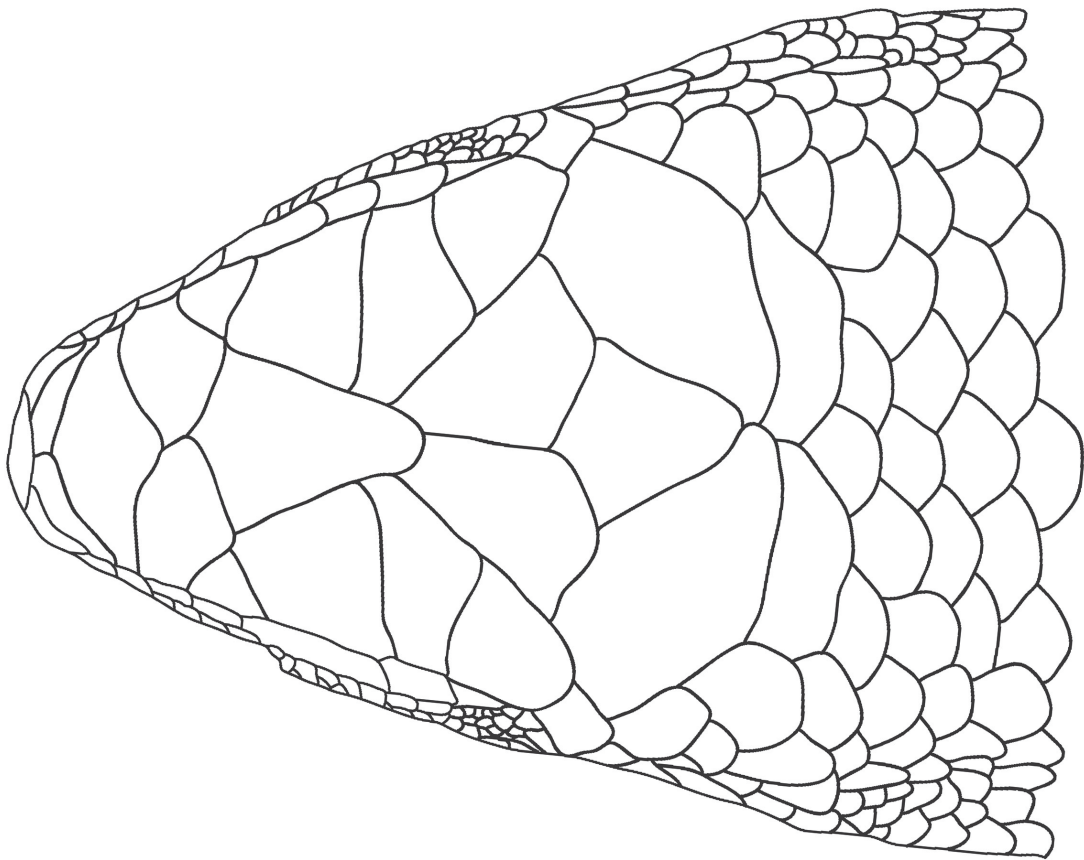


FIGURE 3. Head scalation of the holotype of *Trachylepis boehmei* **sp. nov.** (ZFMK 16795).



FIGURE 4. Fetus of *Trachylepis boehmei* **sp. nov.** (A) revealed by dissection of the female paratype (ZFMK 16796) (B).

Distribution, conservation and natural history: At present, *Trachylepis boehmei* **sp. nov.** is only known from its type locality, at elevations more than 2,400 m.a.sl. around Ankober in Ethiopia (Fig. 2). It is likely that this species also inhabits parts of the Ethiopian Highlands near the type locality in the eastern Amhara region, in particular other surrounding mountain ranges of higher altitude west of the Great Rift. While no observations of living specimens have been made so far, it is likely that also this newly described species of *Trachylepis* shows a diurnal activity pattern and lives predominantly on the ground or lower vegetation of mountainous moor- or moist grasslands at medium or higher elevation (Largen & Spawls, 2010), similar to other representatives of the *T. varia* group sensu Weinell *et al.* (2019), particularly to *T. megalura*. The currently known distribution range of *Trachylepis boehmei* **sp. nov.** is only restricted to a small area outside protected areas or a national park. Therefore, habitat destruction and fragmentation resulting from expansions of agricultural areas or logging activities might threaten this possibly endemic species and its ecological requirements. Nevertheless, its occurrence in the Wof-Washa Forest located between the Ankober, Tarmaber, and Basona Worana districts cannot be ruled out.

Six of the seven of the female paratypes, whose reproductive tracts have been dissected, contained three to four fetuses. Consequently, also *Trachylepis boehmei* **sp. nov.** is ovoviviparous, as the other species of the *T. varia* group (Weinell *et al.*, 2019). The fetuses revealed by dissection are at different levels of development, but in all of them the ground colour is cremish brown. Like the adults they show a lateral white stripe and six darkish brown stripes ranging from the neck to the end of the tail (Fig. 4A). Unlike *T. raymondlaurenti*, closely related to *T. megalura* and having neonates with prominent reddish-orange caudal colouration (Marques *et al.*, 2019), juveniles of *Trachylepis boehmei* **sp. nov.** seem to have no brightly coloured tails.

Discussion

Recent and ongoing comprehensive revisions of *Trachylepis* with phylogenetic analyses of taxonomic relationships within species complexes stress the presence of cryptic taxa and reveal the need of systematic studies (Weinell

& Bauer, 2018; Allen *et al.*, 2019; Weinell *et al.*, 2019). Since several new species have been described based on material from extensive field surveys in sub-Saharan Africa (Ceriaco *et al.*, 2016; Allen *et al.*, 2017; Marques *et al.*, 2019), also the existence of numerous undetected species hidden in museum collections can be expected. The newly described species *Trachylepis boehmei* **sp. nov.** is a suitable example of a distinct taxon discovered by detailed morphological and taxonomic investigations of old collection material. Although, quite similar in habitus and proportions, the new species shows several strong differences to *T. megalura* with which it might occur in sympatry with (Fig. 2). However, further research and analyses might show, that some of these records are in fact wrongly identified specimens and should be actually assigned to this new species. In contrast, the insufficient distinctness of *Trachylepis massaiana* is only based on a single morphological character: A tail length of less than two times the snout-vent length. Consequently, this led de Witte (1953) to his decision to consider it as a synonym of *T. megalura*. Recently, this was confirmed by a re-examination of the type material of *Eumeces massaianus* and shown, that the diagnostic feature of a proportionally shorter tail might be caused by the fact that its holotype is a subadult specimen (Marques *et al.*, 2019). Apart from the presence of various distinct morphological dissimilarities with *T. megalura* other than a relative shorter tail, the adulthood and sexual maturity of the types of *Trachylepis boehmei* **sp. nov.** is revealed by the numerous dissected paratypes carrying fetuses in their reproductive tracts.

The presence of a so far undetected and inconspicuous small skink species like *Trachylepis boehmei* **sp. nov.** or the recently described *Panaspis annettesabinae* Colston *et al.* (2020) with obviously restricted distribution ranges highlights the need of further extensive herpetological surveys to investigate the so far undetected cryptic lizard diversity in Ethiopia. Also, only insufficient knowledge exists concerning the distribution and biology of phenotypically similar taxa in species diverse but unexplored areas of Ethiopia. For example, Kirschey (2017) reported on the first record of *Trachylepis wingati* for the Kafa Biosphere Reserve in Ethiopia. However, a detailed morphological re-examination of the voucher specimen (ZFMK 103148) and comparison with a true *T. wingati* specimen (ZFMK 2950) from South Sudan revealed a lack of the diagnostic characters on which Werner (1907) had based his description (see Appendix I. Material examined). The specimen from Kafa shows only 26 midbody scale rows and no prominently tricarinated dorsal scalation, wherefore it should be assigned to *T. megalura*.

Nevertheless, biodiversity assessments are required and absolutely necessary to both examine species richness and to promote the imperative to protect and conserve regional areas of ecological importance (The Nature and Biodiversity Conservation Union (NABU), 2020). The possible endemism of *Trachylepis boehmei* **sp. nov.** to montane areas in the Ankober region is reflected by the high rate of species diversity of one of the richest biodiversity areas in the Ethiopia highlands (Lulekal *et al.*, 2014). Especially the Wof-Washa forest located in the Amhara region near Ankober is known for its high plant diversity, floristic composition and vegetal communities with more than 250 plant species from 71 families recorded (Teketay & Bekele, 1995; Fisaha *et al.*, 2013; Yirga *et al.*, 2019), including endemics such as *Aloe ankoberensis* M. G. Gilbert & Sebsebe 1997. Also numerous rare mammals (Teketay & Bekele, 1995; Goshme & Yihune, 2018), and even an endemic bird species such as the Ankober serin *Crithagra ankoberensis* (Ash, 1979) (Dessalegn *et al.*, 2018), can be found in one of the few remaining Afromontane forests of central Ethiopia. With respect to this outstanding biodiversity, species endemism and ecological value of the habitats found in the Ethiopian highlands this new possibly endemic skink stresses not only the need of preventing those areas from degradation and destruction but also the importance to investigate the cryptic and underestimated species richness of Ethiopia's herpetofauna more extensively in future.

Key to the *Trachylepis* of Ethiopia

(after Largen & Spawls (2006, 2010), Sindaco *et al.* (2012) and Marques *et al.* (2019); the validity of *T. isselii* follows Largen & Spawls (2006) and Sindaco *et al.* (2012); distributional data after Nistri & Vanni (2014), Ceriaco *et al.* (2016), Weinell & Bauer (2018) and Uetz *et al.* (2020).

- | | | |
|---|--|--|
| 1 | Dorsal scales prominently keeled or carinated. | 2 |
| - | Dorsal scales only indistinctly keeled or smooth | 10 |
| 2 | Frontoparietal shields fused; mid-body scale rows 30–34; dorsal scales with 3 keels; dark lateral band from eye to groin with a pale dorsolateral stripe above and pale lateral stripe beneath | <i>Trachylepis isselii</i> [Ethiopia, Eritrea] |
| - | Frontoparietal shields separated | 3 |
| 3 | Lower margin of the subocular clearly shorter (less than 50%) than its upper margin | 4 |
| - | Lower margin of the subocular clearly larger (more than 50%) than its upper margin | 5 |
| 4 | Auricular lobes conspicuously long and pointed; uniform pale brown above with a series of large dark blotches in a longitudinal row behind the ear; subocular scale usually excluded from the edge of the lip; dorsal scales with 3 distinct keels, 32 midbody | |

- scale rows *Trachylepis hildebrandtii* [Ethiopia, Somalia]
- No distinct auricular lobes, anterior margin of the ear with rounded scales; dark lateral band from eye to groin and broad dorsolateral pale stripes . . . *Trachylepis striata* complex [Ethiopia, Somalia, Sudan, Democratic Republic of the Congo, Uganda, Rwanda, Malawi, Tanzania, Kenya, Angola, Zambia, Zimbabwe, Namibia, Botswana, South Africa, Swaziland]
- 5 Dorsal scales with 5–8 keels; usually with distinct white, black-speckled labials; 30–38 midbody scale rows *Trachylepis maculilabris* complex [Ethiopia, Somalia, Sudan, Tanzania, Kenya, Uganda, Malawi, Zimbabwe, Mozambique, Angola, Zambia Central African Republic, Democratic Republic of the Congo Liberia, Ivory Coast, Ghana, Togo, Benin, Nigeria, Cameroon, Equatorial Guinea, Gabon]
- Dorsal scales with usually less than 5 keels 6
- 6 Small skink (SVL up to 60 mm); dark lateral band from eye to groin bordered by a pair of prominent pale dorsolateral and lateral stripes on each side *Trachylepis varia* complex [Ethiopia, Eritrea, Somalia, South Sudan, Sudan, Uganda, Kenya, Burundi, Malawi, Rwanda Tanzania, Democratic Republic of the Congo, Angola, NE Namibia, Botswana, South Africa, Swaziland, Zimbabwe, Mozambique, Zambia]
- Medium to large skink species; no, a single prominent or numerous indistinct pale dorsolateral stripes or bands. 7
- 7 Prominent sexual dimorphism (males with a series of large dark blotches in a longitudinal row behind the ear and a yellowish to orange stripe running laterally from supralabials to the neck; juveniles and females striped); midbody scale rows 32–46; dorsal scales with 3 (rarely 4 or 5) distinct keels *Trachylepis quinquetaeniata* [Ethiopia, Eritrea, Djibouti, Somalia, South Sudan, Sudan, Uganda, Kenya, Tanzania, Egypt, Mali, Niger, Nigeria, Senegal, Benin, Togo, Burkina Faso, Cameroon, Central African Republic, Chad, Democratic Republic of the Congo, Ivory Coast, Equatorial Guinea, Ghana, Guinea]
- No combination of characters described above present 8
- 8 A single very prominent whitish line with distinct dark margins extending from the eye laterally along the flanks to the groin; mid-body scale rows 30–32; dorsal scales with 3 distinct keels *Trachylepis wingati* [Ethiopia, South Sudan]
- No prominent whitish line on the flanks present 9
- 9 Prominent dark lateral band clearly separated from pale lower flanks; tarsal and palmar scales smooth or granular; midbody scale rows 26–32; dorsal scales with 3 (rarely 4–5) keels *Trachylepis planifrons* [Ethiopia, Somalia, Kenya, Tanzania, Uganda, Democratic Republic of the Congo, Zambia, Malawi]
- Lateral dark band (if present) not clearly defined; tarsal and palmar scales usually spinose or tuberculated; midbody scale rows 30–35; dorsal scales with 2–3 keels *Trachylepis brevicollis* complex [Ethiopia, Eritrea, Somalia, Djibouti, Sudan, Kenya, Uganda, Tanzania, Yemen, Saudi Arabia, Oman]
- 10 Strikingly long tail (generally more than twice the SVL); dorsal scales with three indistinct keels; 4 darkish brown, relatively indistinct fine dorsal stripes from the neck to the base of the tail; midbody scale rows 22–28 *Trachylepis megalura* [Ethiopia, Somalia, Sudan, Uganda, Kenya, Tanzania, Mozambique, Rwanda, Burundi, Democratic Republic of the Congo, Angola, Zambia]
- Short tail (maximal 1.7 times the SVL); dorsal scales smooth; 6–8 darkish brown stripes dorsally ranging from the neck to the end of the tail by flowing into each other; midbody scale rows 26–29 *Trachylepis boehmei* sp. nov. [Ethiopia]

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APPENDIX I. Material examined.

Trachylepis boehmei sp. nov.:

ETHIOPIA: Ankober (ZFMK 16785 – ZFMK 16796).

Trachylepis irregularis:

KENYA: Aberdare Mountains (ZFMK 41676 – 41678; ZFMK 68876); Mount Kenya: eastern side (ZFMK 44684); Mount Elgon (ZFMK 70821).

UGANDA: Mount Elgon (ZFMK 66629 – 66636).

Trachylepis megalura:

ETHIOPIA: Kafa: Bonga: Boka Forest Wetland (ZFMK 103136 – 103142, ZFMK 103148).

KENYA: Kakamega Forest (ZFMK 81997).

Trachylepis varia:

ETHIOPIA: Illubabor: Bedele (ZFMK 55503); Shoa: Addis Ababa (ZFMK 55542).

TANZANIA: Mount Hanang: Jorodom (ZFMK 74974 – ZFMK 74975).

Trachylepis wingati

SOUTH SUDAN: Bahr-el-Abiad: Abu Doleb (ZFMK 2950).