

## **Trechus hauthi sp. n., a microphthalmic ground beetle from Mt. Choke, Ethiopia (Coleoptera: Carabidae: Trechini)**

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## RESEARCH ARTICLE

*Trechus hauthi* sp. n., a microphthalmic ground beetle from Mt. Choke, Ethiopia (Coleoptera: Carabidae: Trechini)JOACHIM SCHMIDT<sup>1</sup>, YESHITLA MERENE<sup>2</sup> & ARNAUD FAILLE<sup>3</sup>

## Abstract

*Trechus (Abyssinotus) hauthi* Schmidt & Faille, **sp. n.** is described from the Mt. Choke in northern Ethiopia. This new species is remarkable due to several unique character states with respect to the African fauna of *Trechus* Clairville: i) male basal protarsomeres female-like, not dilated or dentoid; ii) body fully depigmented; iii) compound eyes markedly reduced; iv) insertion point of the subapical seta of the elytral discal series laterally shifted towards the apex of the 4th stria. The new species is probably closely related, though externally not similar, to *T. abyssinicus* Quéinnec & Ollivier, 2021, which occurs on the same mountain.

**Key words:** *Abyssinotus*, new species, Afromontane forest, soil fauna.

## Zusammenfassung

*Trechus (Abyssinotus) hauthi* Schmidt & Faille, **sp. n.** wird vom Mt. Choke in Nord-Äthiopien beschrieben. Aufgrund mehrerer morphologischer Merkmale, die einmalig innerhalb der afrikanischen Fauna der Gattung *Trechus* Clairville sind, ist die neue Art besonders bemerkenswert: 1) basale Protarsomere des Männchen wie beim Weibchen ausgebildet, nicht verbreitert und gezähnt; 2) Körper gänzlich unpigmentiert, 3) Komplexaugen stark verkleinert; 4) Einlenkungsstelle der subapikalen Sinnesborste der dorsalen Borstenreihe auf den Flügeldecken nach laterad zur Spitze des vierten Streifens verschoben. Die neue Art ist wahrscheinlich nahe verwandt mit *T. abyssinicus* Quéinnec & Ollivier, 2021, der im selben Gebirge vorkommt, diesem in äußeren Merkmalen jedoch nicht ähnlich sieht.

## Introduction

The species-rich Holarctic ground beetle genus *Trechus* Clairville (s. l.) was found to be particularly diverse in the highlands of Ethiopia, and the volcano Mt. Choke in northern Ethiopia was identified as one of the diversity hotspots for this genus in the country (QUÉINNEC et al. 2021). In addition, Mt. Choke is particularly remarkable for the extremely high interspecific variation in the morphology of *Trechus* species occurring there. Giant species with body length up to 8.5 mm (e.g., *T. gizufu* Schmidt, 2023, *T. rex* Schmidt, 2023) occur alongside very small ones (e.g., *T. abyssinicus* [Quéinnec & Ollivier, 2021], with body length of 2.0–2.4 mm) (QUÉINNEC et al. 2021; SCHMIDT & MERENE 2024). Most species of the genus at Mt. Choke are characterized by various external features that are extremely rare in other areas, such as elytral pilosity, only one male protarsomere dilated, additional setae of the elytral umbilicate series present, and the second elytral discal seta absent (PAWŁOWSKI 2001, 2003; ORTUÑO & NOVOA 2011; QUÉINNEC et al. 2021). QUÉINNEC et al. (2021) found a remarkably high interspecific morphological variation in the mandibular dentition, previously unknown for *Trechus* (s. l.). It is all the more astonishing that all the species mentioned above belong to a single evolutionary lineage within *Tre-*

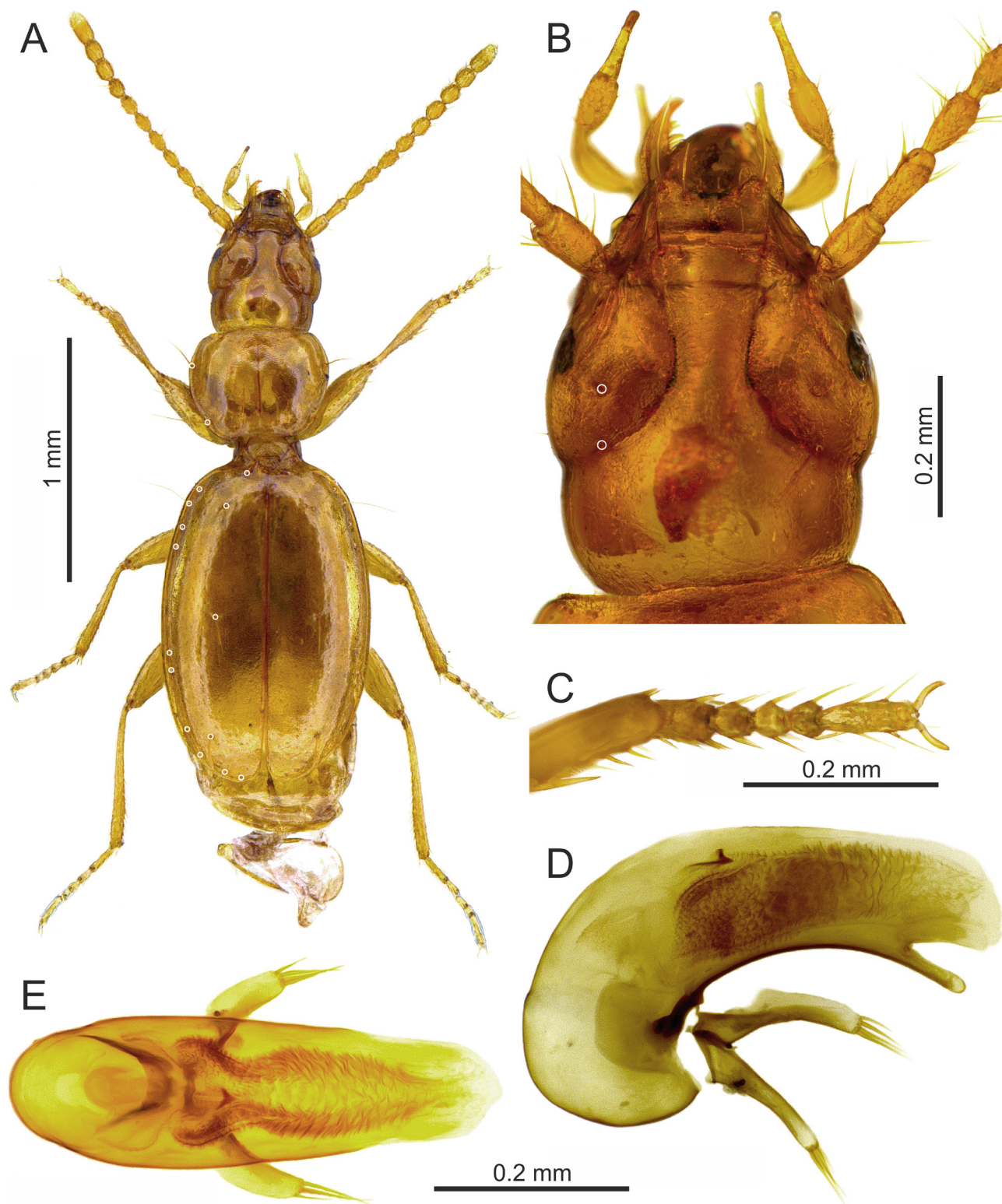
*chus* (s. l.), the subgenus *Abyssinotus* Quéinnec & Ollivier, which, according to current knowledge, is endemic to the highlands of northern Ethiopia (FAILLE et al. 2023).

In the present paper, we add a previously undescribed *Trechus (Abyssinotus)* species to the list of taxa endemic to Mt. Choke, which expands our knowledge of the variation of *Trechus* morphology, particularly due to its very small eyes, depigmented body, and female-like protarsomeres in the male.

## Material and methods

Specimens were examined using a Leica M205-C stereomicroscope. Photographs were taken using a Leica DFC450 digital camera with a motorized focussing drive, a Leica TL5000 Ergo light base, and diffused light with a Leica hood LED5000 HDI, subsequently processed with the Leica LAS application software and enhanced with CorelDRAW Graphics Suite X5. The specimens are deposited in the Natural History Museum of Addis Ababa University, Ethiopia (NHMAA), at the State Museum of Natural History Stuttgart, Germany (SMNS), in ARNAUD FAILLE's working collection (CAF, Stuttgart), and in JOACHIM SCHMIDT's working collection (CSCHM, later to be deposited in the Bavarian State Collection for Zoology, Munich).

Body size was measured from the tip of the mandibles in the opened position to the apex of the longer elytron. The lengths of the compound eye (CL) and tempora (TL) were measured



**Fig. 1.** *Trechus (Abyssinotus) hauti* Schmidt & Faille, **sp. n.**, paratype (male) from the northern slope of Mt. Choke. **A.** Habitus; the white circles point to the insertions of the setae on the pronotum and elytra. **B.** Head, dorsal aspect; the white circles point to the insertions of the supraorbital setae. **C.** Right protarsus, dorsal view. **D.** Aedeagus, left lateral view. **E.** Aedeagus, dorsal view.



across the longest distances in dorsal view. The widths of the head (HW), pronotum (PW) and elytra (EW) were measured at their widest points. The length of the pronotum (PL) was measured along the median line. The pronotal apical margin (PAW) was measured across the most protruding points of the rounded apical angles, the pronotal basal margin (PBW) across the tips of the markedly protruded basal angles at the level of the laterobasal setae. The length of the elytra (EL) was measured from the tip of the scutellar shield to the apex of the longer elytron. The length of the aedeagal median lobe (AL) was measured across the longest distance in lateral view.

## Results

### *Trechus (Abyssinotus) hauthi* Schmidt & Faille, **sp. n.** (Fig. 1)

#### Type material

**Holotype** ♂, with label data: Ethiopia, Amhara, N-slope Mt. Choke, N of Waber, alt. 3600 m, 11.V.2022, 10°44'30"N 37°46'57"E, leg. J. SCHMIDT & YESHITLA M. (CSCHM).

**Paratypes**: 53 exx (♂♂, ♀♀), with same data as holotype (CAF, CSCHM, NHMAA). 1 ♂: N-slope Mt. Choke, alt.

3800–3950 m, 10°43'16"N 37°51'15"E, 26.II.2019, leg. D. HAUTH, J. SCHMIDT, YESHITLA M. & YITBAREK W. (CSCHM). 1 ♂: N-slope Mt. Choke, alt. 3750–3850 m, 10°43'51"N 37°52'15"E, 9.V.2022, leg. J. SCHMIDT, YESHITLA M. (CSCHM). 1 ♂: NE-slope Mt. Choke, above Gumadur, alt. 3750–3850 m, 10°44'10"N 37°53'48"E, 5.V.2022, leg. J. SCHMIDT & YESHITLA M. (CSCHM). 1 ♀ (DNA voucher SMNS-L1806): W-slope Mt. Choke, 3370 m, 23.II.2019, 10°38'07"N 37°45'51"E, leg. D. HAUTH, J. SCHMIDT, YESHITLA M. & YITBAREK W. (SMNS).

#### Etymology

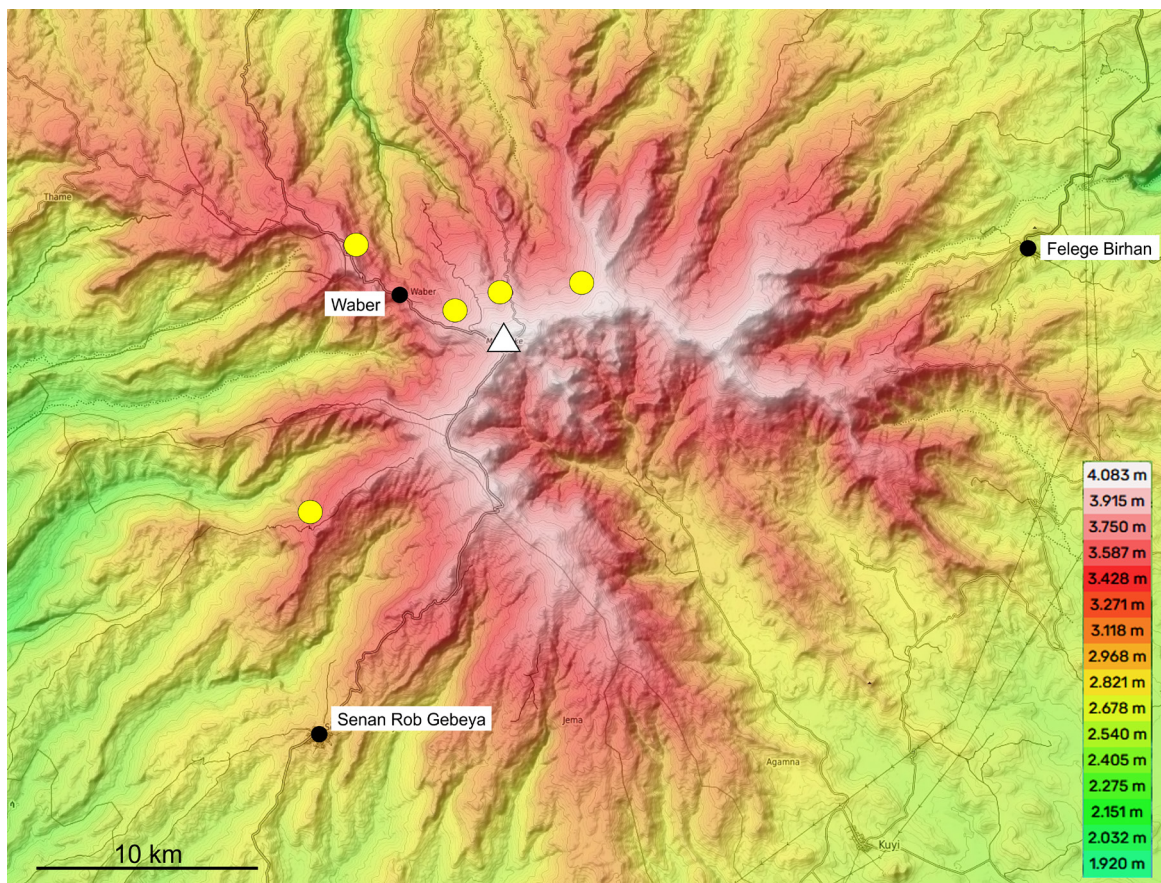
This interesting new species is dedicated to DAVID HAUTH (Marburg), who participated with very great engagement in the field work at Mt. Choke in 2019, when this species was found for the first time.

#### Description

Body length: 2.0–2.4 mm.

Proportions (n = 12): CL/TL = 1.82–2.67 ( $\bar{O}$  = 2.01); PW/HW = 1.23–1.26 ( $\bar{O}$  = 1.24); PW/PL = 1.24–1.34 ( $\bar{O}$  = 1.29); PW/PBW = 1.24–1.30 ( $\bar{O}$  = 1.27); PBW/PAW = 1.07–1.16 ( $\bar{O}$  = 1.11); EW/PW = 1.47–1.56 ( $\bar{O}$  = 1.52); EL/EW = 1.43–1.52 ( $\bar{O}$  = 1.47); EL/AL = 2.76–2.94 ( $\bar{O}$  = 2.83).

Colour: Entire body yellowish brown.



**Fig. 2.** Topographic map of Mt. Choke (highest point marked by a white triangle), showing sampling localities of *Trechus (Abyssinotus) hauthi* Schmidt & Faille, **sp. n.** (yellow circles). The base map was downloaded from <https://de-de.topographic-map.com/>.





**Fig. 3.** Sampling locality of *Trechus (Abyssinotus) hauthi* Schmidt & Faille, **sp. n.** on northern slope of Mt. Choke (May 2022). At this site, a single specimen was dug out of the humus and root material together with a large number of *T. abyssinicus*.

Microsculpture (magnification 80x): Sculpticells on dorsal surface of body large but finely engraved, almost isodiametric on head, slightly transverse on pronotum and scale-like on elytra.

Head: Moderately robust. Mandibles short, with right mandible tridentate (with apical tooth slightly larger than two basal teeth), without diastema, without recognizable separation of premolar and retinaculum (as in *T. abyssinicus*, see QUÉINNEC et al. [2021: Fig. 4H]). Labrum with apical margin moderately emarginated, with six setae near apical margin. Clypeus with two setae on each side. Compound eyes very small, about half as long as tempora, flat; widest portion of head situated about one eye length posterior to eyes (Fig. 1B). Tempora convex, clearly separated from the neck by an obtuse angle. Dorsal surface of head with supraorbital area and frons markedly convex and with supraorbital furrows deeply impressed, evenly curved. Two supraorbital setae and one suborbital seta on

each side. Tempora distinctly pubescent. Antennae short, with pedicel about as long as scape and with third antennomere about 3/4 of length of pedicellus.

Prothorax: Pronotum rather small, moderately transverse, sub-cordate, distinctly broadest before middle, with base slightly broader than apex; disc moderately convex. Anterior pronotal margin slightly concave, with anterior angles slightly protruded anteriorly, rounded; basal margin straight in middle, laterally evenly rounded towards the markedly protruded laterobasal angles, the latter situated at level of the end of the pronotal 4/5 (Fig. 1A); lateral margin markedly convex in front and slightly convex anterad of laterobasal angles; laterobasal angles marked by a very small obtuse tooth, but often indistinct. Marginal gutter narrow, smooth, slightly dilated between basolateral angle and laterobasal fovea. Median longitudinal impression finely incised, disappearing near apex and base; anterior transverse impression indistinct, smooth,



posterior transverse impression moderately deep, smooth, connected with the indistinct laterobasal foveae and the marginal gutter. Lateral and laterobasal setae present, with the former situated near the end of anterior pronotal third and the latter situated at the end of the pronotal 4/5. Pro- and mesepisternum glabrous and smooth.

**Pterothorax:** Elytra slender ovate, with disc moderately convex, in dorsal view broadest in middle, humerus evenly rounded, subapical sinuation indistinct, apex rounded. All striae on disc and sides of elytra (including the apical portion of the 8th stria) indistinct or absent; parascutellar stria absent; recurrent preapical stria short, moderately deep, with outer curvature directed towards the fifth stria. Parascutellar seta present; three discal setae present, with the anterior two located in the 3rd interval, adjoined to the 3rd stria (Fig. 1A): first seta located near the end of the anterior elytral 7<sup>th</sup>, second seta located about at elytral middle, third seta (= subapical seta) located about 1/7 of elytral

length from elytral apex, adjoined to the laterally shifted connection of the third with the fourth stria and therefore 'apical triangle' of Trechini markedly skewed (Fig. 1A); subapical seta of the recurrent stria isolated, removed from this stria by distance of the diameter of the pore. Number and position of the setae of the marginal umbilicate series normal for *Trechus* (s. l.). Metepisternum very short, glabrous, and smooth, with outer margin about as long as anterior margin.

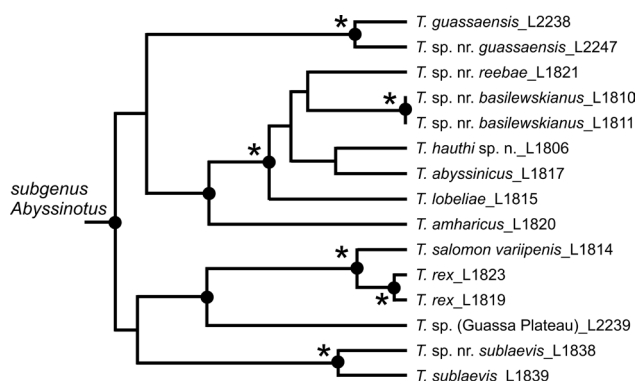
**Legs:** Moderately short and robust. Protibia dilated towards apex, nearly straight on external margin, with longitudinal groove on dorsal surface, without microsetae on anterior surface. Basal protarsomeres of male neither dilated nor dentoid, female-like (Fig. 1C).

**Male genitalia:** Aedeagal median lobe short and robust, rather weekly sclerotized, in lateral view markedly bent from basal bulb to base of apical lamella, the latter almost straight, long and slender, pipette-like, but with



**Fig. 4.** Type locality of *Trechus* (*Abyssinotus*) *hauthi* Schmidt & Faille, **sp. n.** on northern slope of Mt. Choke, north of the village of Waber (May 2022). More than 50 specimens were dug out and sifted from the humus and root material, mainly from *Kniphofia foliosa* Horst. No other *Trechus* species was found at this site.





**Fig. 5.** *Trechus* (*Abyssinotus*) subtree of the molecular phylogeny of Trechini beetles by FAILLE et al. (2023), modified (see that paper for details). Black circles and stars at branch nodes refer to posterior probabilities  $\geq 0.98$  and bootstrap values  $> 75$ , respectively.

the extreme apex shaped as a small membranous drop (Fig. 1D); in dorsal view broad, only slightly narrowed in apical half, shortly narrowed towards apex (Fig. 1E). Dorsal surface of median lobe sclerotized in basal half, sagittal aileron absent. Endophallus symmetrical in dorsal view, sac-like, densely covered by rows of sclerite scales, with a small V-shaped copulatory piece situated near base of endophallus in its quiescent position. Parameres almost symmetrical, short, each with four apical setae.

#### Differential diagnosis

*Trechus hauthi* sp. n. can be distinguished from all other Ethiopian *Trechus* (s. l.) species by the female-like male basal protarsomeres, which are neither dilated nor dentoid. Within the Trechina fauna occurring on Mt. Choke, *T. hauthi* sp. n. differs additionally in the depigmented body, markedly reduced size of the compound eye and the laterally shifted subapical seta of the elytral discal series. All other species known to occur on that mountain are characterized by a more or less markedly sclerotized integument and well-developed eyes, which are distinctly longer than half the length of the tempora. In addition, there is no other *Trechus* known to occur in Ethiopia which has the elytral subapical seta shifted laterally.

#### Distribution

Endemic to Mt. Choke in northern Ethiopia. The new species was found on the northern and western slopes of the volcano (Fig. 2).

#### Habitat preferences

All specimens of *T. hauthi* sp. n. were sifted from or dug out of humus layers under dense vegetation which, in

addition, was semi-shadowed by *Erica* trees (Figs. 3, 4). At most locations, it was found together with the mesophilic species *T. abyssinicus*, *T. amharicus* and *T. lobeliae* (Quéinnec & Ollivier, 2021). It was never found directly near water bodies. Based on the collecting circumstances, the new species can be considered a mesophilic and lucifugous representative of the Afromontane soil fauna.

## Discussion

Due to its particular external morphology with respect to other Ethiopian *Trechus* (s. l.), *T. hauthi* sp. n. seems rather isolated within that fauna. However, as shown by the molecular phylogeny of *Trechus* species presented by FAILLE et al. (2023), *T. hauthi* sp. n. (labelled as “*Trechus* sp.\_L1806”) is a member of a highly supported clade within the subgenus *Abyssinotus*, together with *T. abyssinicus*, *T. lobeliae*, and species closely related to *T. basilewskianus* Geginat, 2008 and *T. reebae* (Quéinnec & Ollivier, 2021) (Fig. 5). The molecular data are supported by the aedeagal morphology: in the external shape of the aedeagal median lobe, *T. hauthi* sp. n. is most similar to *T. abyssinicus* (Fig. 1D, E; QUÉINNEC et al. 2021, fig. 22B), and the drop-like weakly sclerotized median lobe apex might be a synapomorphy of the two species. In the tree of FAILLE et al. (2023), *T. abyssinicus* and *T. hauthi* sp. n. are shown as sister species, but with low support. QUÉINNEC et al. (2021) hypothesized that *T. afroalpinus* (Quéinnec & Ollivier) is closely related to *T. abyssinicus*, and erected the genus *Afrotrechus* Quéinnec & Ollivier for this group. *Afrotrechus* were synonymized with *Abyssinotus* based on molecular data (FAILLE et al. 2023). Interestingly, the sclerotization pattern of the endophallus in *T. afroalpinus* is very similar to that of *T. hauthi* sp. n.: In both species, a sclerite (probable copulatory piece) is developed dorsally near the base of the endophallus in its quiescent position (Fig. 1D, E; QUÉINNEC et al. 2021, fig. 21B). We interpret this pattern as derived and suggest a close relationship of these two species.


As noted above, *T. hauthi* sp. n. differs markedly from *T. abyssinicus* and *T. afroalpinus* in the size of the compound eyes, the shape of the male protarsomeres and the position of the elytral subapical seta. However, a development of the male tarsal morphology towards less dilatation is already visible in the two latter species, which are both characterized by the second tarsomere simple, neither dilated nor dentoid. In *T. abyssinicus*, dilatation of the first male tarsomere is markedly reduced and its apical tooth is comparatively small (see QUÉINNEC et al. 2021, fig. 22D). This could be a further indication that *T. hauthi* sp. n. is actually the sister taxon of *T. abyssinicus*. Anyway, the discovery of *T. hauthi* sp. n. provides remarkable

new insights into the morphological diversity of the Ethiopian *Trechus* fauna. The actual relationships of the species within the particular diverse subgenus *Abyssinotus*, however, still need to be clarified and, above all, require a larger sampling.


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