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## New Species and Subspecies of the *Trechus (Microtrechus) nebulosus*-group from the Southern Appalachians (Coleoptera: Carabidae: Trechinae)

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### Abstract

Ten new species and two new subspecies of the *Trechus (Microtrechus) nebulosus*-group BARR, 1962 are described from the southern Appalachians in North Carolina and Tennessee (USA): *T. wayahbaldensis* sp.n. (Wayah Bald), *T. clingmanensis* sp.n. (Clingmans Dome), *T. ramseyensis* sp.n. (Ramsey Cascade, Great Smoky Mountains), *T. thomasbarri* sp.n. (Haoe Lead), *T. snowbirdensis* sp.n. (Joanna Bald), *T. pseudonovaculosus* sp.n. (Clingmans Dome), *T. tobiasi* sp.n. (Tusquitee Bald), *T. haoeleadensis* sp.n. (Haoe Lead), *T. stefanschoedli* sp.n. (Thunderhead Mountain), *T. luculentus joannabaldensis* ssp.n. (Joanna Bald), *T. luculentus cheoahbaldensis* ssp.n. (Cheoah Bald), *T. cheoahensis* sp.n. (Cheoah Bald).

One former subspecies of *T. luculentus* BARR, 1962 is raised to species status: *T. unicoi* BARR, 1979 stat.n. The status of the insufficiently known *T. stupkai* BARR, 1979 (syn. of *T. verus* BARR, 1962?) is discussed. The aedeagi of all but two cave-dwelling species are figured.

Key words: Carabidae, Trechinae, Trechini, *Trechus*, *Microtrechus*, Nearctic region, USA, North Carolina, Tennessee, Appalachians, taxonomy, new species, new subspecies.

### Zusammenfassung

Zehn neue Arten und zwei neue Unterarten der *Trechus (Microtrechus) nebulosus*-Gruppe BARR, 1962 werden aus den südlichen Appalachen in North Carolina und Tennessee (USA) beschrieben: *T. wayahbaldensis* sp.n. (Wayah Bald), *T. clingmanensis* sp.n. (Clingmans Dome), *T. ramseyensis* sp.n. (Ramsey Cascade, Great Smoky Mountains), *T. thomasbarri* sp.n. (Haoe Lead), *T. snowbirdensis* sp.n. (Joanna Bald), *T. pseudonovaculosus* sp.n. (Clingmans Dome), *T. tobiasi* sp.n. (Tusquitee Bald), *T. haoeleadensis* sp.n. (Haoe Lead), *T. stefanschoedli* sp.n. (Thunderhead Mountain), *T. luculentus joannabaldensis* ssp.n. (Joanna Bald), *T. luculentus cheoahbaldensis* ssp.n. (Cheoah Bald), *T. cheoahensis* sp.n. (Cheoah Bald).

Eine Unterart des *T. luculentus* BARR, 1962 wird zur Art erhoben: *T. unicoi* BARR, 1979 stat.n. Der Status des ungenügend bekannten *T. stupkai* BARR, 1979 (syn. von *T. verus* BARR, 1962?) wird diskutiert. Von allen (bis auf zwei Höhlen bewohnende) Arten werden die Aedeagi abgebildet.

### Introduction

The southern Appalachians are inhabited by a unique diversity of species of the genus *Trechus* CLAIRVILLE, 1806. Around 60 species and subspecies are known from this

comparatively small area! They are all wingless and restricted to cool and moist habitats in the forest zone. Therefore most of them are endemics of a single mountain peak or a mountain range above 1000 m or a cave system. The composition of this fauna has been revised in several papers by BARR (1962, 1979, 1985) and DONABAUER (2005). Nevertheless there are still several species and subspecies awaiting description.

The author conducted intensive collections for 28 days in May/June 2004 in more than 30 locations. The preferred collection technique was sifting humid and wet leaf litter and needle duff from the forest floor. This resulted in finding thousands of specimens of *Trechus* representing most of the described species and several new ones. The main purpose of this second paper is to summarize the results of these collections with respect to the *T. nebulosus*-group (as established by BARR (1962, 1979)) of the subgenus *Microtrechus* JEANNEL, 1927.

#### Abbreviations

CO	- County	NC	- North Carolina
GSM	- Great Smoky Mountains	TN	- Tennessee
MD	- Martin Donabauer	USA	- United States of America

#### Acknowledgements

Thanks to my wife Barbara for her patience and support in the Appalachians. Furthermore I am grateful to Mag. Birgit Milachowski, Dr. Alexander Dostal, Dr. Herbert Zettel, and Dr. Peter Cate for reviewing this paper.

#### Method

Full taxonomic descriptions are provided for new species. Descriptive statistics for measurements and proportions are provided in tables at the end of the paper. The body length is measured from labrum to the apex of the elytra. For described species please refer to the original descriptions. A key is not provided, because there are not sufficient significant characteristics beside the aedeagus. For determination please use the aedeagus and the habitus figures. All specimens, including holotypes and paratypes, are stored in the author's collection.

#### *Trechus (Microtrechus) nebulosus*-group BARR, 1979

##### Diagnosis within *Microtrechus*:

- Body comparatively large or very large (usually 3.5–5.0 mm, exceptionally small females > 3.0 mm), always significantly larger than the representatives of the *T. (Microtrechus) vandykei*-group and moderately larger than the syntopic representatives of the *T. (Microtrechus) uncifer*-group.
- Elytra convex and broadly ovate.
- Male aedeagus large, robust, with variable aedeagal apex varying from simple and slightly up-turned to hooked or reflexed. Internal sack armed with dense, but normal sized scales or without scales. No species has a combination of large scales AND a hooked apex as in the *T. (Microtrechus) uncifer*-group. The internal sack contains furthermore highly diagnostic copulatory pieces.

All species belonging to this group are immediately separable from other *Microtrechus* by the large, broad and convex body shape. It should be remarked that female specimens of the *nebulosus*-group are extremely similar to the species related to *T. (s.str.) schwarzi* BARR,

1962, which is the result of convergent adaptation to the same microhabitat. Both groups seem to be strictly allopatric.

With respect to the form of the aedeagus the *uncifer*-group is especially similar to *T. verus* BARR, 1962 and *T. wayahbaldensis* sp.n. (*nebulosus*-group), but these two species do not have large scales in the internal sack. Furthermore they fill up important distributional gaps in the *uncifer*-group. Therefore it remains uncertain that these two groups are monophyletic.

**Catalogue (in alphabetical order):**

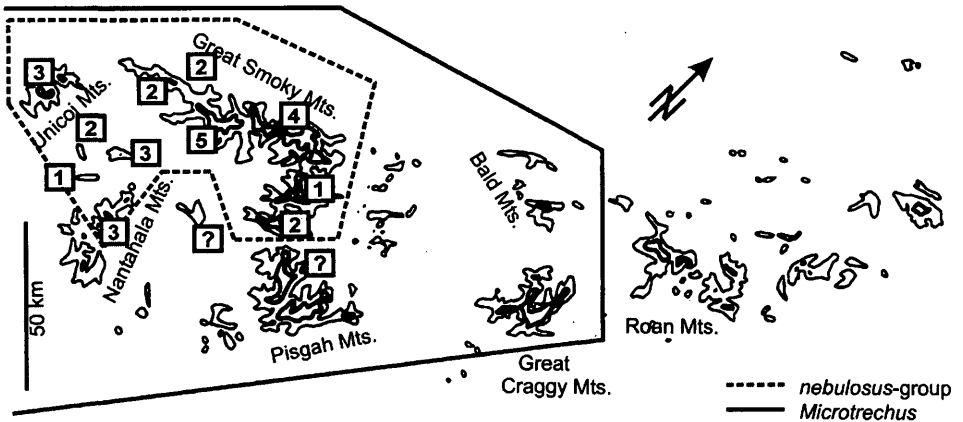
<i>T. (M.) balsamensis</i> BARR, 1962	Plott Balsam Mountains
<i>T. (M.) cheoahensis</i> sp.n.	Cheoah Bald
<i>T. (M.) clingmanensis</i> sp.n.	GSM Central: Clingmans Dome
<i>T. (M.) haoeleadensis</i> sp.n.	Unicoi Mountains: Haoe Lead
<i>T. (M.) luculentus cheoahbaldensis</i> ssp.n.	Cheoah Bald
<i>T. (M.) luculentus joannabaldensis</i> ssp.n.	Snowbird Mountains
<i>T. (M.) luculentus luculentus</i> BARR, 1962	GSM Central
<i>T. (M.) luculentus wayahensis</i> BARR, 1979	Wayah Bald
<i>T. (M.) nantahalae</i> BARR, 1979	Nantahala Mtns.: Copper Ridge Bald
<i>T. (M.) nebulosus</i> BARR, 1962	GSM Central
<i>T. (M.) novaculosus</i> BARR, 1962	GSM Central
<i>T. (M.) pseudonovaculosus</i> sp.n.	GSM Central: Clingmans Dome
<i>T. (M.) ramseyensis</i> sp.n.	GSM East: Ramsay Cascade
<i>T. (M.) rosenbergi</i> BARR, 1962	Plott Balsam Mountains
<i>T. (M.) snowbirdensis</i> sp.n.	Snowbird Mountains: Joanna Bald
<i>T. (M.) stefanschoedli</i> sp.n.	GSM West: Thunderhead Mountain
<i>T. (M.) stupkai</i> BARR, 1979 (?= <i>verus</i> )	GSM East
<i>T. (M.) tennesseeensis tauricus</i> BARR, 1962	GSM: Bull Cave
<i>T. (M.) tennesseeensis tennesseeensis</i> BARR, 1962	Berry Cave, Roane Co., TN
<i>T. (M.) thomasbarri</i> sp.n.	Unicoi Mountains: Haoe Lead
<i>T. (M.) tobiasi</i> sp.n.	Tusquitee Bald
<i>T. (M.) tuckaleechee</i> BARR, 1962	GSM: Tuckaleechee Caverns
<i>T. (M.) unicoi</i> BARR, 1962 stat.n.	Unicoi Mountains West
<i>T. (M.) valentinei</i> BARR, 1979	GSM Central: Mount Kephart
<i>T. (M.) verus</i> BARR, 1962	GSM East
<i>T. (M.) wayahbaldensis</i> sp.n.	Nantahala Mountains: Wayah Bald

**Habitats:** All species are extremely hygrophilous. Most species are restricted to cool habitats at the highest elevations of the southern Appalachians. It must be pointed out that some members of this group occur at comparatively much lower elevations than the representatives of the two other groups of *Microtrechus* (e.g. *T. tennesseeensis*, *T. luculentus* ssp. in cave entries or by following cold river streams). Therefore some of the populations seem to be less isolated than the species of the *T. uncifer*-group.

The species are extremely specialized and prefer three different types of habitats:

1. Sink holes, cave entries and caves in the carstic foothill section north of the southern Appalachians: *T. tennesseensis* ssp., *T. tuckaleechee*.
2. Beside springs and small rivers in the upper and middle forest zone: e.g. *T. luculentus* ssp., *T. nantahalae*.
3. Under wet moss carpets on rocks and cliffs and under deep layers of needle duff in spruce-fir forest on the highest mountain peaks: *T. novaculosus*, *T. nebulosus*, *T. rosenbergi* etc.

**Distribution:** The members of the *nebulosus*-group are spread continuously over a well-defined, rather small part of the distribution area of *Microtrechus* (see distribution map). An interesting fact is that on Clingmans Dome in the GSM five species coexist but only 70 km away in the Pisgah ridge not a single species exists, although there is no significant distributional barrier in-between the two areas. In the northeastern part of the southern Appalachians this group is replaced by species of *Trechus* s.str. In the southeastern southern Appalachians the group is totally or partly replaced by species close to *T. aduncus* (*T. uncifer*-group, compare distribution map provided by DONABAUER 2005). The highest diversity of taxa can be found in the GSM.



Map of distribution: Southern Appalachians in NC and TN. Thin contour level: 1200 m; thick contour level: 1500 m. Numbers in boxes represent the number of species in this area.

### Annotated checklist and descriptions

**The *verus*-subgroup:** The following subgroup is characterized by small eyes, body pale, and slender aedeagus with hooked apex and rather small and simple copulatory pieces. All species show adaptations to a hidden way of life deeper in the soil. Distributed in the GSM and on Wayah Bald.

#### 1. *Trechus (Microtrechus) verus* BARR, 1962 (Fig. 1, 4, 7)

**MATERIAL:** 33 ex.: USA, TN/NC, Swain/Haywood CO, GSM, Cataloochee Balsam (Summit), 27.V.2004, leg. MD (coll. MD).

**TYPE LOCALITY:** Mt. Sterling (GSM).

**DIAGNOSIS:** Rather small-sized species within the *nebulosus*-group (BL = 3.5-3.8 mm) characterized by pale reddish colouration, small eyes, and hooked aedeagus with internal sack armed with two small, simple copulatory pieces; parameres normal. Therefore the aedeagus would fit much better in the relationship of *T. aduncus* (*T. uncifer*-group), although the internal sack is not armed with scales.

**DISCUSSION:** BARR (1962) originally placed *T. verus* in the *uncifer*-group, but later he transferred it to the *nebulosus*-group, solely based on the fact that the internal sack is not covered by large scales (BARR, 1979). I therefore start with this very aberrant species as a 'link' to my previous paper. A phylogenetic analysis of relationships is outside the scope of this paper, but it can be assumed that the *nebulosus*-group as defined here is not monophyletic and that the species closely related to *T. aduncus* are derived from a part of the *nebulosus*-group.

**DISTRIBUTION:** Endemic in the easternmost GSM: Ramsey Cascades, Cataloochee Balsam and Mt. Sterling.

**HABITATS:** The specimens were sifted from deep layers of wet leaf litter between rocks and in muddy seeps. Not rare.

### **2. *Trechus (Microtrechus) stupkai* BARR, 1979 (?= *verus* BARR, 1962) (Fig. 2, 5, 8)**

**MATERIAL:** 6 ex.: USA, TN, Servier CO, GSM, Ramsey Cascade, 6.VI.2004, leg. MD (coll. MD).

**TYPE LOCALITY:** Ramsey Prong (GSM).

**DISTRIBUTION:** Known only from the type locality.

**HABITATS:** The specimens were sifted from wet leaf litter at the base of a wet, vertical cliff directly beside the famous Ramsey Cascade together with *T. ramseyensis* sp.n. and two other *Microtrechus* of the *vandykei*-group.

**DISCUSSION:** The specimens collected at Ramsey Cascade (type locality of *T. stupkai*) fit the original description, but do not show relevant differences neither in the aedeagus nor in the shape of the pronotum to the population of the Cataloochee Balsam (*T. verus* according to BARR, 1979). The type locality of *T. verus* is Mt. Sterling, very close to Cataloochee Balsam and in the same ridge. After discussion with the author, a final decision is postponed after the comparison of the types and the analysis of larger series of specimens from several locations in the GSM.

### **3. *Trechus (Microtrechus) wayahbaldensis* sp.n. (Fig. 3, 6, 9, 10)**

**TYPE MATERIAL:** Holotype ♂ and 4 paratypes (2 ♂♂, 2 ♀♀): USA, NC, Macon CO, Wayah Bald, 17.V.2004, leg. MD (coll. MD).

**DIAGNOSIS:** Distinguished from other species of the *nebulosus*-group by rather pale colouration, small eyes and small, obtuse and not prominent basal angles of pronotum. Furthermore characterized by unique form of aedeagus: internal sack without larger scales, armed with two thin, straight and elongated copulatory pieces of equal length; one copulatory piece strongly up-turned at the very end; apex of aedeagus strongly reflexed in lateral view and almost symmetric in dorsal view (similar to *T. verus* and the *T. uncifer*-group); parameres normal (slender and styliiform).

*T. wayahbaldensis* sp.n. is extremely similar to *T. verus*, but can be distinguished by the form of the copulatory pieces and the different form of the aedeagal apex. The distribution

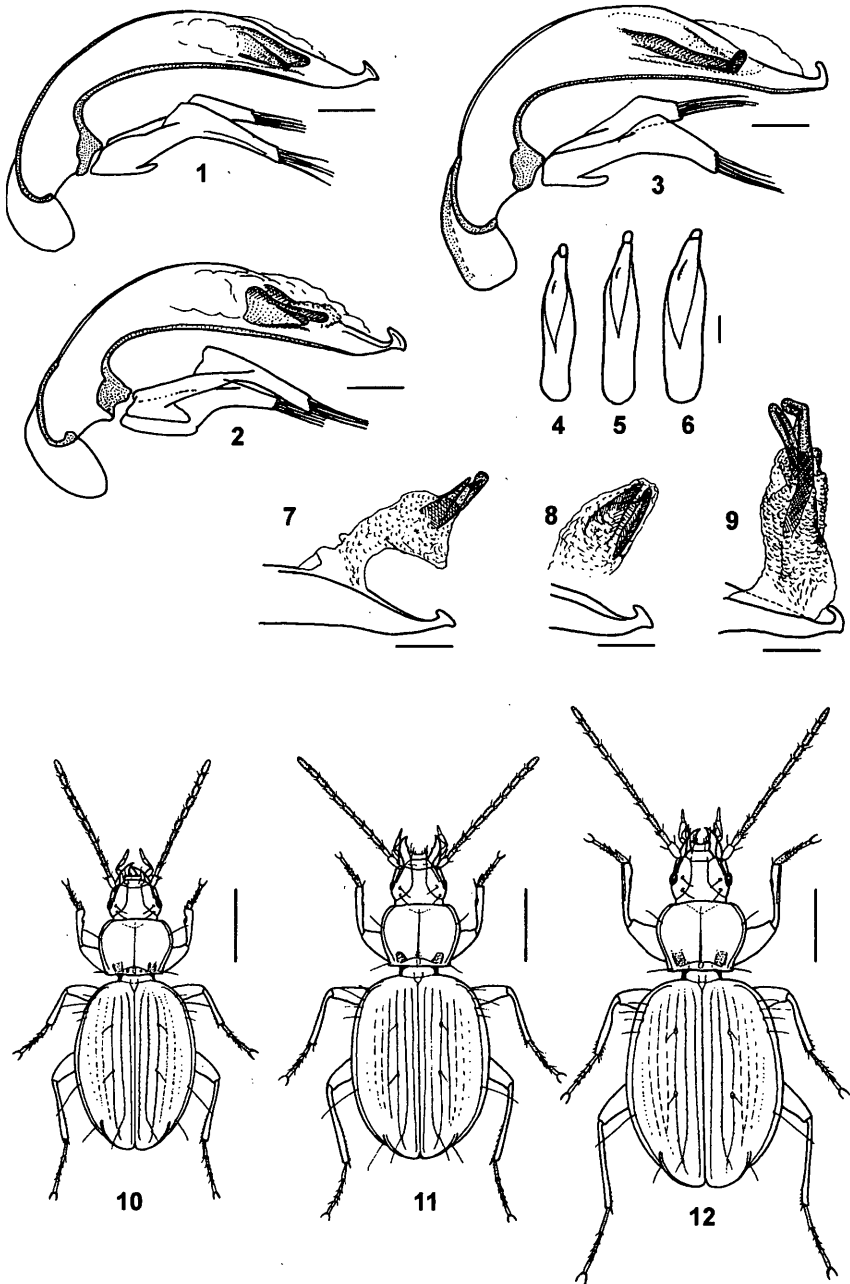


Fig. 1-9: Aedeagus in lateral (1-3) and dorsal (4-6) view, aedeagal apex with ejected internal sack and copulatory pieces (7-9), scale = 0.1 mm: 1+4+7) *T. verus* (Cataloochee Balsam); 2+5+8) *T. stupkai*=? *T. verus* (Ramsey Cascade); 3+6+9) *T. wayahbaldensis* sp.n. (Wayah Bald).

Fig. 10-12: Habitus, scale = 1 mm: 10) *T. wayahbaldensis* sp.n (Wayah Bald); 11) *T. clingmanensis* sp.n. (Clingmans Dome); 12) *T. ramseyensis* sp.n. (Ramsey Cascade).

areas of both species are significantly distinct, with many other species of the group in-between.

**DESCRIPTION:** Habitus as in fig. 10; length 3.5-4.0 mm, males significantly larger than female. Body moderately elongated and moderately convex, elytra elongate oval. Body entirely reddish piceous, paler on head, along suture and along border of elytra; elytra shiny with slight bluish lustre; legs entirely pale, contrasting with body; first segments of antenna pale, segment 3 or 4 and all following slightly darker.

Head with strong microsculpture. Elytra and pronotum shinier and with less developed microsculpture (examined with 40 x). Antenna slender, of normal length. Eyes slightly reduced in size, rather small but not flat, length of temples slightly shorter than eye diameter.

Pronotum comparatively slender, moderately rounded laterally, slightly convex on disc, maximal width before middle, not strongly constricted and almost not sinuate before small basal angles, anterior and posterior margins nearly straight; front angles rounded and not prominent; basal angles rectangular or slightly obtuse angled and small; basal foveae present and strongly impressed; median line distinct, almost extended to margins.

Elytra elongate ovate, moderately convex, shoulders completely rounded and not prominent; inner striae (1-3) strongly impressed and slightly irregularly punctuate, posterior and lateral (4-6) increasingly shallow, but still clearly visible; outermost striae indistinct.

**AEDEAGUS** (Fig. 3, 6, 9): Similar to that of *T. verus* (different copulatory pieces) and some species of the *uncifer*-group: shape atypical for this species group because of strongly hooked apex and elongate and slender shape. Internal sack is not armed with large scales and therefore *T. wayahbaldensis* belongs to the *nebulosus*-group and not to the *uncifer*-group. Internal sack (Fig. 9) armed with two slender, straight and elongate, medium-sized copulatory pieces, one strongly up-turned apically, the second simple. Aedeagal apex elongate and straight in lateral view, with distinct, strongly reflexed and broad hook, more or less symmetric in dorsal view.

**DISTRIBUTION:** Wayah Bald, very likely strictly endemic on this peak, because already replaced on the neighbouring peak, Burningtown Bald, by the similar, but not closely related *T. nantahalae*.

**HABITATS:** Very rare, taken together with a much larger number of *T. luculentus wayahensis* and many *T. barberi* in wet places.

#### **4. *Trechus (Microtrechus) tuckaleechee* BARR, 1962**

No material studied. My collecting activities were restricted to the higher mountains of the southern Appalachians and I could not find this species outside caves. For further information on this cave-dwelling species please refer to BARR (1962).

**DISTRIBUTION/HABITATS:** In the Tuckaleechee Caverns, a large stream cave at low elevations in the GSM in the Dry Valley.

**The *valentinei*-subgroup:** The following species group is certainly monophyletic and already characterized by the remarkable form of the aedeagus with apex strongly asymmetrically twisted to the right side in dorsal view and with parameres non-styliform, but cut off strongly asymmetrically (unique within the whole genus!). Furthermore characterized by pale colour and reduced eyes. All three (or four) species described here are strictly endemic in the GSM and were already known to BARR (1979), who treated them as a single species (*T. valentinei*).

On account of significant differences in the aedeagus, especially the form of the aedeagal apex and the copulatory pieces, I do not follow this opinion.

**5. *Trechus (Microtrechus) valentinei* BARR, 1979 (Fig. 13, 16, 19)**

**MATERIAL:** 81 ex.: USA, TN/NC, Sevier/Swain CO, GSM, Newfound Gap - Mt. Kephart, 9.VI.2004, leg. MD (coll. MD).

**TYPE LOCALITY:** Mt. Kephart.

**DIAGNOSIS:** Distinguished from other species of the *nebulosus*-group by small size (3.1-3.7 mm), pale colouration, small eyes and small, acute or rectangular angled basal angles of the pronotum. Furthermore characterized by remarkable, unique form of aedeagus and form of parameres: aedeagus rather small and thick, in dorsal view strongly S-shaped with very asymmetric and elongate apex strongly twisted to right side; in lateral view apex is up-turned, but not hooked or reflexed; internal sack covered by dense, small-sized scales, which perfectly cover copulatory pieces; copulatory pieces consisting of two parts of rather simple triangular form but of very different size. Parameres asymmetrically cut off apically.

**DISTRIBUTION:** Endemic in the Central Part of the GSM, but the distribution is insufficiently known. The populations listed by BARR (1979: pg. 63) in his 'Discussion' belong to at least 3 distinct species. Nevertheless, it can be assumed that this species could be found as far as Mt. LeConte.

**HABITATS:** The specimens were sifted in several places from wet leaf litter around springs along the hiking path from Newfound Gap to Mt. Kephart together with *T. nebulosus* and other *Microtrechus* of the *vandykei*-group. Common!

**6. *Trechus (Microtrechus) clingmanensis* sp.n. (Fig. 11, 14, 17, 20)**

**TYPE MATERIAL:** Holotype ♂ and 1 ♀ Paratype: USA, TN/NC, Sevier/Swain CO, GSM, Clingmans Dome, 5.VI.2004, leg. MD (coll. MD).

**DIAGNOSIS:** Most characteristics identical with those of *T. valentinei* (to which *T. clingmanensis* is certainly closely related), but distinguished by larger body size, less asymmetric aedeagus in dorsal view with broader and non-parallel apex; in lateral view apex less up-turned; parameres as in *T. valentinei*.

**DESCRIPTION OF HOLOTYPE:** Habitus as in fig. 11; length 3.9 mm, male significantly larger than female (3.5 mm). Body broad ovate and rather flat. Body entirely pale reddish. Legs and antenna entirely pale, not contrasting much with body.

Head with strong microsculpture. Elytra and pronotum shinier and with less developed microsculpture (examined with 40 x). Antenna slender, ca. 50% of BL. Eyes strongly reduced in size, rather small but not flat, length of temples slightly longer than eye diameter.

Pronotum comparatively slender, moderately rounded laterally, slightly convex on disc, maximal width before the middle, moderately constricted and sinuate before the rectangular basal angles, anterior and posterior margins nearly straight; front angles rounded and not prominent; basal foveae present and strongly impressed; median line distinct, almost extended to margins.

Elytra broadly ovate, strongly flattened on disc, shoulders completely rounded and not prominent; inner striae (1-3) moderately impressed, posterior and lateral (4-6) increasingly shallow, but still clearly visible; outermost striae indistinct.



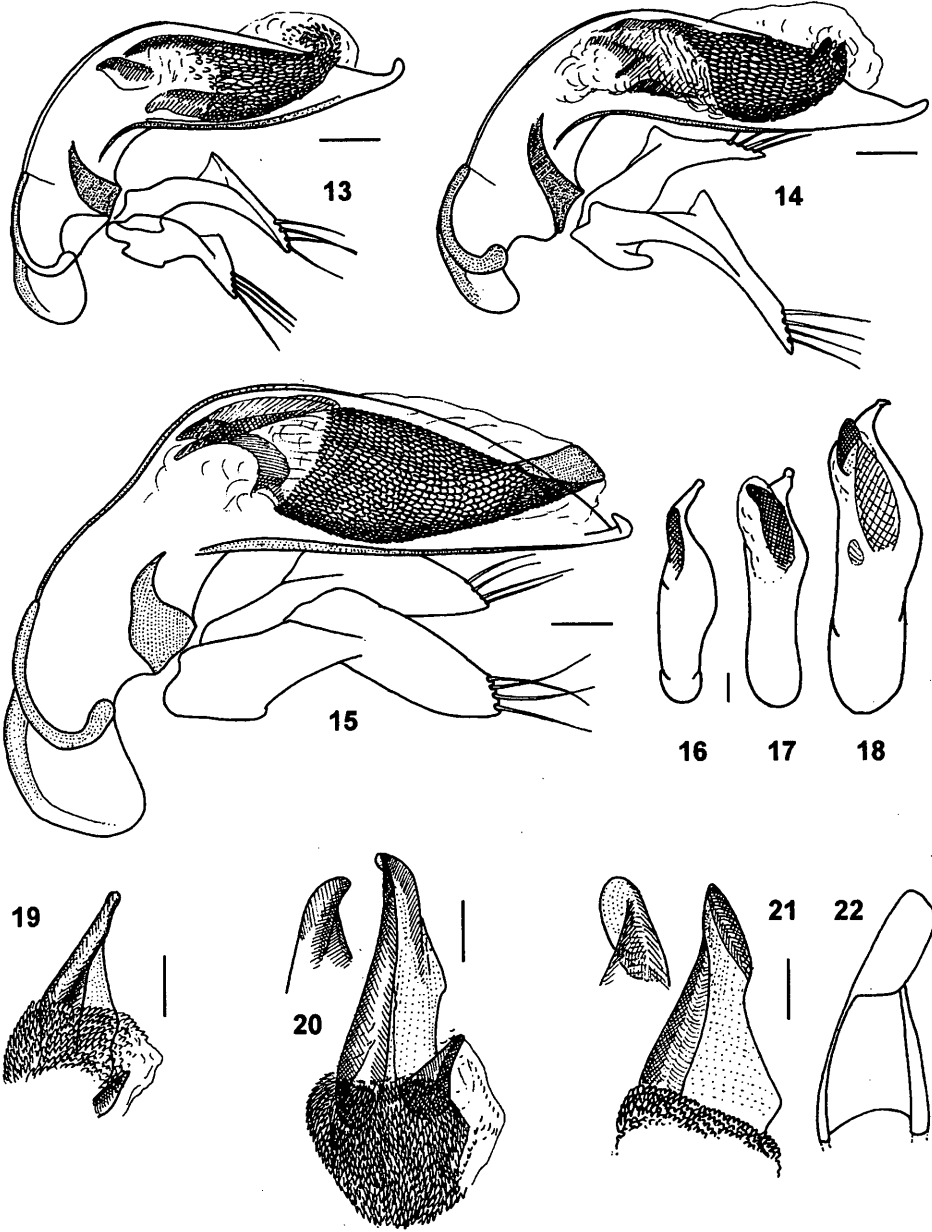


Fig. 13-22: Aedeagus in lateral (13-15) and dorsal (16-18) view, copulatory pieces (19-22), scale = 0.1 mm: 13+16+19) *T. valentinei* (Mt. Kephart); 14+17+20) *T. clingmanensis* sp.n. (Clingmans Dome); 15+18+21+22) *T. ramseyensis* sp.n. (Ramsey Cascade).

**AEDEAGUS** (Fig. 14, 17, 19): General form of aedeagus and form of parameres extremely similar to those of *T. valentinei*: aedeagus in dorsal view less strongly S-shaped, with very asymmetric but less elongate, broader and strongly constricted apex twisted to right side; in lateral view apex up-turned, but neither hooked nor reflexed; internal sack covered by dense, small-sized scales, which perfectly cover copulatory pieces; copulatory pieces consisting of two parts of rather simple triangular form but of very different size. Parameres slender and asymmetrically cut off apically.

**DISTRIBUTION**: Known only from the type locality, very likely strictly endemic to the central GSM around Clingmans Dome.

**HABITATS**: Not known exactly. *T. clingmanensis* sp.n. coexist with at least 7 other species (four of the *nebulosus*-group, one of the *uncifer*-group and at least two of the *vandykei*-group) in the spruce-fir forests on the highest elevations on Clingmans Dome.

***Trechus (Microtrechus) sp.***

**MATERIAL**: 3 ♀♀: USA, TN/NC, Blount/Swain CO, GSM, Thunderhead Mtn., 8.VI.2004, leg. MD (coll. MD).

Due to lack of male specimens a correct assignment is not possible: the specimens might belong to *T. clingmanensis* sp.n. or represent a new species.

**7. *Trechus (Microtrechus) ramseyensis* sp.n. (Fig. 12, 15, 18, 21, 22)**

**TYPE MATERIAL**: Holotype ♂: USA, TN, Sevier CO, GSM, Ramsey Cascade, 6.VI.2004, leg. MD (coll. MD).

**DIAGNOSIS**: Most characteristics identical with those of *T. valentinei* and *T. clingmanensis* (to which *T. ramseyensis* is certainly closely related) but distinguished by significantly larger body size, much larger aedeagus with reflexed apex and much broader parameres.

**DESCRIPTION OF HOLOTYPE**: Habitus as in fig. 12; length 4.5 mm. Body broad ovate and rather flat. Body entirely reddish piceous. Legs and base of antenna pale, contrasting with body. Antennomeres 3-11 darker.

Head with strong microsculpture. Elytra and pronotum shinier and with less developed microsculpture (examined with 40 x). Antenna slender, ca. 55% of BL. Eyes moderately reduced in size, convex, length of temples slightly shorter than eye diameter.

Pronotum comparatively small, strongly rounded laterally, slightly convex on disc, maximal width before the middle, stronger constricted to base than in the two previous species and sinuate before rectangular basal angles, anterior and posterior margins nearly straight; front angles rounded and not prominent; basal fovae present and strongly impressed; median line distinct, almost extended to margins.

Elytra broadly ovate, strongly flattened on disc, shoulders completely rounded and not prominent; inner striae (1-3) strongly impressed, posterior and lateral (4-5) increasingly shallow, but still clearly visible; outermost striae indistinct.

**AEDEAGUS** (Fig. 15, 18, 21, 22): General form of aedeagus and form of parameres extremely similar to those of *T. valentinei* and *T. clingmanensis*: aedeagus very large, in dorsal view less strongly S-shaped than in *T. valentinei*, with very asymmetric but less elongate, broader and strongly constricted apex twisted to right side; in lateral view apex reflexed; internal sack covered by dense, small-sized scales covering copulatory pieces. Larger copulatory piece significantly larger and ends in much more complex way than in

the two previous species (Fig. 21, 22). Parameres very broadly and asymmetrically cut off apically.

**DISTRIBUTION:** Known only from the type locality.

**HABITATS:** The unique specimen was sifted from wet leaf litter at the base of a wet, vertical cliff directly beside the Ramsey Cascade together with *T. stupkai*.

**The *nantahalae*-subgroup:** The following species are certainly monophyletic. They are characterized by pale colour, small eyes and remarkable form of strongly curved and slender copulatory pieces of the internal sack, normal styliform parameres and unmodified aedeagal apex.

#### **8. *Trechus (Microtrechus) tennesseensis tennesseensis* BARR, 1962**

No material studied. This subspecies is known solely from Berry Cave, a sink hole/cave far outside of the Southern Appalachians at very low elevation. For further information please refer to BARR (1962). A re-examination of the male genitalia might show that this and the following subspecies should be treated as distinct species.

#### **9. *Trechus (Microtrechus) tennesseensis tauricus* BARR, 1962 (Fig. 23, 27, 31, 35)**

**MATERIAL:** 38 ex.: TN, Blount Co., GSM, Cades Cove Mountain, Entry of Bull Cave, 7.VI.2004, leg. MD (coll. MD).

**DISTRIBUTION:** Known from the entry of Bull Cave (type locality) in the Cades Cove Mountains, a low ridge not inhabited by any other *Trechus* due to lack of suitable habitats.

**HABITATS:** The specimens were sifted from wet and rotten leaf litter or were taken under stones in the cave entry in a large sink hole beside a small creek. This creek follows the cave and ends up in the Tuckaleechee Caverns, the type locality of *T. tuckaleechee*.

#### **10. *Trechus (Microtrechus) thomasbarri* sp.n. (Fig. 24, 28, 32, 36)**

**MATERIAL:** Holotype ♂: NC/TN, Graham/Monroe Co., Unicoi Mts., Haeo Lead, 10.VI.2004, leg. MD (coll. MD).

**DIAGNOSIS:** Distinguished from other species of the *nebulosus*-group by pale reddish colouration, small eyes, and prominently sharp basal angles of pronotum. Furthermore characterized by form of aedeagus: internal sack with well-defined area of dense scales covering copulatory pieces; both copulatory pieces strongly curved and of equal length, clearly projecting out of aedeagus; in dorsal view apex significantly different from all closely related species by short, simply converging sides (all other species of *nantahalae*-subgroup have a subapical constriction and apex is almost parallel-sided).

**DESCRIPTION:** Habitus as in fig. 36; length 4.1 mm, comparatively flatter and more elongate than in previous species. Body entirely reddish piceous, elytra shiny with slight bluish lustre. Legs and antenna entirely pale, not contrasting much with body.

Head with strong microsculpture. Elytra and pronotum shinier and with slightly less well-developed microsculpture (examined with 40 x). Antenna slender, ca. 50% of BL. Eyes reduced in size, small and almost flat, length of temples and eye diameter equal.

Pronotum comparatively broader, more rounded laterally, slightly convex on disc, maximal width before the middle, clearly constricted and sinuate before acute and prominent basal

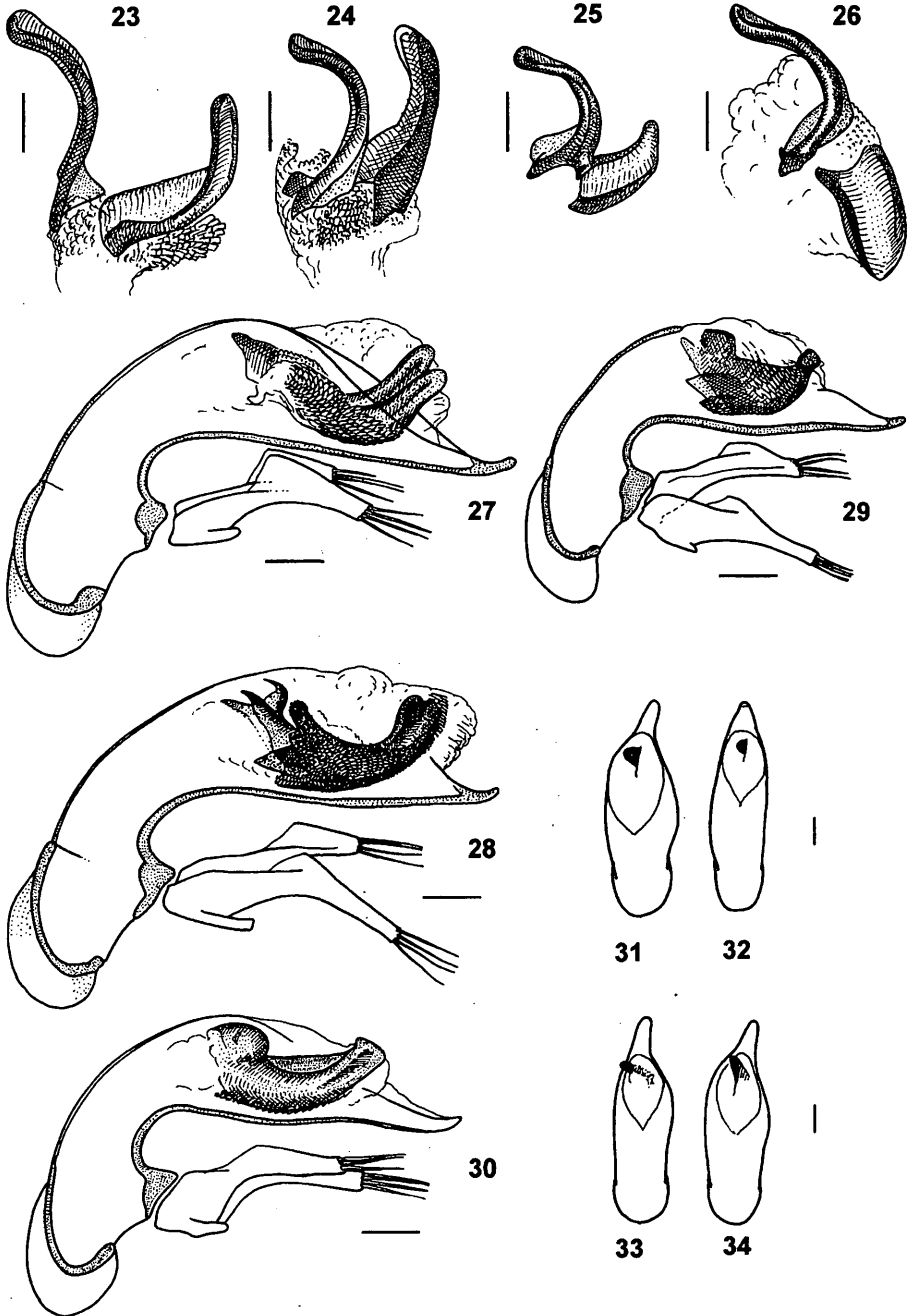


Fig. 23-34: Copulatory pieces (23-26), aedeagus in lateral (27-30) and dorsal (31-34) view, scale = 0.1 mm: 23+27+31) *T. tennesseensis tauricus* (Bull Cave); 24+28+32) *T. thomasbarri* sp.n. (Haoe Lead); 25+29+33) *T. snowbirdensis* sp.n. (Joanna Bald); 26+30+34) *T. nantahalae* (Copper Ridge Bald).

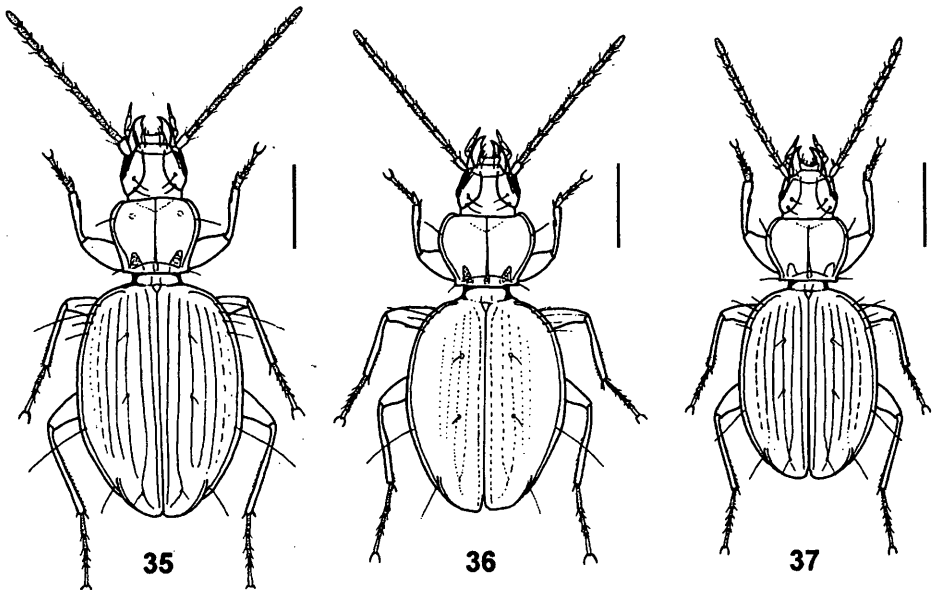


Fig. 35-37: Habitus, scale = 1 mm: 35) *T. tennesseensis tauricus* (GSM); 36) *T. thomasbarri* sp.n. (Haoe Lead); 37) *T. snowbirdensis* sp.n. (Joanna Bald).

angles, anterior and posterior margins nearly straight; front angles rounded and not prominent; basal angles acute and moderately large; basal fovae present and strongly impressed; median line distinct, almost extended to margins.

Elytra elongate ovate, moderately convex, shoulders completely rounded and not prominent; inner striae (1-3) weakly impressed and slightly irregularly punctate, posterior and lateral (4-6) shallow, but still visible; outermost striae indistinct.

**AEDEAGUS** (Fig. 24, 28, 32): Extremely similar to that of *T. tennesseensis tauricus* but with different aedeagal apex in dorsal view. Aedeagus in lateral view thick, simple, aedeagal apex showing no modifications in lateral view. Parameres styliform, normal. Internal sack covered by dense, small-sized scales. Copulatory pieces very characteristic within the *nebulosus*-group, comparatively solely with the previous species: both copulatory pieces very long, of equal length and strongly curved, one thin and elongate, the other very convex, much broader and folded around the first. In dorsal view, aedeagus easily separable from previous species by different form of aedeagal apex, which is not constricted subapically and not parallel-sided (compare fig. 31 and 32).

**DISTRIBUTION:** Haoe Lead, probably endemic on this peak like the two other endemic taxa *T. haoae* and *T. luculentus haoeleadensis* ssp.n.

**HABITATS:** The single specimen was taken under a thick layer of moss and roots at the base of a vertical cliff on the hiking path to Haoe Lead together with *T. haoae* and *T. talequah*.

**ETYMOLOGY:** named for Prof. T.C. Barr, who described the vast majority of Trechinae in the eastern USA. His publications inspired me to visit the southern Appalachians.

**11. *Trechus (Microtrechus) snowbirdensis* sp.n. (Fig. 25, 29, 33, 37)**

**MATERIAL:** Holotype ♂ and 21 Paratypes: NC, Graham Co., Snowbird Mts., Joanna Bald, 19.V.2004, leg. MD (coll. MD).

**DIAGNOSIS:** Distinguished from other species of the *nebulosus*-group by smaller body size, pale reddish colouration, small eyes and prominently sharp basal angles of pronotum. Furthermore characterized by form of the aedeagus, especially form of copulatory pieces: internal sack without well-defined area of dense scales; both copulatory pieces consisting of one very strongly curved (almost U-shaped) and elongate piece and another piece of approximately half length (difference to *T. thomasbarri* sp.n. and *T. tennesseensis tauricus*), which is flat, very convex and curved apically (difference to *T. nantahalae*).

**DESCRIPTION:** Habitus as in fig. 37; length 3.3–3.9 mm, significantly smaller than the two previous species and very similar to *T. nantahalae*, doubtless the most closely related species. Body entirely reddish piceous, disk of pronotum sometimes slightly darker, in average paler than in *T. nantahalae*, elytra shiny with slight bluish lustre. Legs and antenna entirely pale, not contrasting much with the body.

Head and pronotum with strong microsculpture. Elytra shinier and with slightly less well-developed microsculpture (examined with 40 x). Antenna slender, ca. 50% of BL. Eyes reduced in size, small and almost flat, length of temples equal or longer than eye diameter.

Pronotum moderately rounded laterally, slightly convex on disc, maximal width before middle, strongly constricted and sinuate before acute and prominent basal angles, anterior and posterior margins nearly straight; front angles rounded and not prominent; basal angles acute and rather small (smaller than in the syntopic *T. luculentus joannabaldensis* ssp.n.); basal foveae present and strongly impressed; median line distinct, almost extended to margins.

Elytra broadly ovate, convex, shoulders completely rounded and not prominent; inner striae (1-5) impressed and slightly irregularly punctuate, posterior and lateral shallow, but still visible; outermost striae indistinct.

**AEDEAGUS** (Fig. 25, 29, 33): Extremely similar and comparable to that *T. nantahalae* but with different copulatory pieces. Aedeagus in lateral view shorter and thicker, apex simple. Internal sack armed with two copulatory pieces: one thin, elongate and extremely curved, almost U-shaped, significantly stronger curved and therefore shorter than in *T. nantahalae*; second piece shorter than previous, approximately half its length, very convex and much broader, basal part straight, but apex curved (not so in *T. nantahalae*). In dorsal view, aedeagus constricted subapically, apex almost parallel sided, copulatory piece clearly projecting on left side.

**DISTRIBUTION:** Very likely strictly endemic on Joanna Bald in the Snowbird Mts., because it is replaced by similar species on the surrounding peaks.

**HABITATS:** The specimens were sifted from wet leaf litter in two locations together with the very similar *T. luculentus joannabaldensis* ssp.n. around a spring on the southern slope directly beside the forest street and in a muddy seep on the northern slope. Although this species looks like an endogean, extremely specialized insect, all specimens have been taken in strictly epigeal microhabitats. Not rare.

***Trechus (Microtrechus)* sp.**

**MATERIAL:** 1 ♀: USA, NC, Graham/Swain CO, GSM, Cheoah Bald, 11.VI.2004, leg. MD (coll. MD).

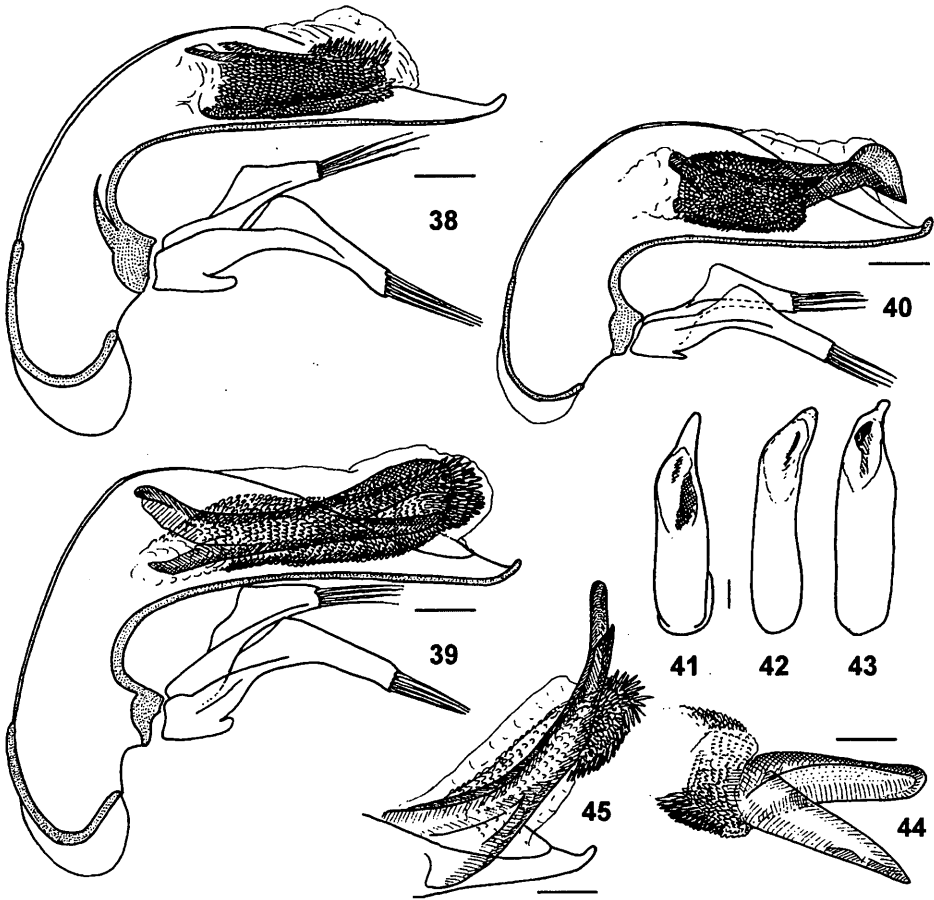


Fig. 38-45: Aedeagus in lateral (38-40) and dorsal (41-43) view, copulatory pieces of aedeagus (44-45), scale = 0.1 mm: 38+41+44) *T. pseudonovaculosus* sp.n.; 39+42+45) *T. novaculosus*; 40+43) *T. nebulosus* (both from Clingmans Dome).

Due to lack of male specimens a correct assignment is not possible. The specimen is extremely similar to *T. snowbirdensis* sp.n. and *T. nantahalae* and could represent a new species.

**12. *Trechus (Microtrechus) nantahalae* BARR, 1979 (Fig. 26, 30, 34)**

**MATERIAL:** 16 ex.: USA, NC, Macon CO, Copper Ridge Bald – Burningtown Gap, 21.V.2004, leg. MD (coll. MD).

**DISTRIBUTION:** Known only from the type locality, very likely strictly endemic on Copper Ridge Bald.

**HABITATS:** The specimens were sifted from layers of wet leaf litter or taken under stones beside a river between Burningtown Gap and Copper Ridge Bald on the NW-slopes of the ridge together with *T. luculentus wayahensis* and *T. barberi*.

**The *novaculosus*-subgroup:** This species group is perhaps not monophyletic, because it is characterized by microhabitat preferences and characteristics of low taxonomic value (form of basal angles). All species are restricted to the spruce-fir forests along the highest elevations of the GSM and represent the strictly 'subalpine' species of the *nebulosus*-group. Body size from medium to very large, colour piceous or reddish piceous, never pale. Pronotum not sinuate before basal angles. Eyes normal or slightly reduced. Aedeagus with two complex copulatory pieces making all species easily identifiable, smaller one of remarkable size, and internal sack always covered with scales.

**13. *Trechus (Microtrechus) pseudonovaculosus* sp.n. (Fig. 38, 41, 44, 46)**

TYPE MATERIAL: Holotype ♂ and 4 Paratypes (3 ♂♂, 1 ♀): USA, TN/NC, Servier/Swain CO, GSM, Clingmans Dome, 5.VI.2004, leg. MD (coll. MD).

DIAGNOSIS: Distinguished from other species of the *nebulosus*-group by large body size, reddish piceous colouration, small eyes and convergent sides of pronotum without situation before large, obtuse basal angles. Therefore extremely similar solely to *T. novaculosus*, but slightly smaller body, smaller eyes, elytra more parallel-sided with more pronounced shoulders, less convex disc and last but not least, differences in aedeagus: apex in dorsal view of different shape (compare fig. 41 and 42), much shorter, broader and straight copulatory pieces (not 'razor shaped'), and different position of spine-like scales in internal sack.

DESCRIPTION: Habitus as in fig. 46; large, length 4.1-4.5 mm, very similar to *T. novaculosus*, which is, doubtless, the most closely related species, but more elongate, more parallel-sided and less convex. Body entirely reddish piceous, slightly paler than in *T. novaculosus*, disk of pronotum sometimes darker, elytra shiny with slight bluish lustre, paler along suture. Legs and antenna entirely pale reddish, contrasting with body.

Head with strong microsculpture, pronotum and elytra shinier due to less well-developed microsculpture (examined with 40 x). Antenna slender, ca. 50% of BL. Eyes strongly reduced in size, small and almost flat, length of temples equal or longer than eye diameter.

Pronotum moderately rounded laterally, less convex on disc, maximal width before middle, moderately constricted and NOT sinuate before large and obtuse basal angles, anterior and posterior margins nearly straight; front angles rounded and not prominent; basal foveae present and strongly impressed; median line distinct, almost extended to margins.

Elytra elongately ovate, more parallel-sided, convex but less so than in *T. novaculosus*, shoulders more prominent; inner striae (1-5) stronger impressed, posterior and lateral shallow, but still visible; outermost striae indistinct.

AEDEAGUS (Fig. 38, 41, 44): Externally similar and comparable to that of *T. novaculosus*, but with different copulatory pieces and different apex in dorsal view. Aedeagus large, slender, strongly curved in basal half, straight in apical half, apex simple, slightly up-turned. Apex in dorsal view simple, moderately constricted before subparallel apex, which turned slightly to the right. Internal sack covered with dense scales in lateral view, entirely hiding copulatory pieces, longer scales spine-like, located on dorso-apical part. Both copulatory pieces significantly shorter than in *T. novaculosus*, less than half of aedeagus length, one triangular and pointed apically, the other more parallel-sided and rounded apically, convex and covering first one.

DISTRIBUTION: Known only from the type locality, very likely strictly endemic to the Central GSM.



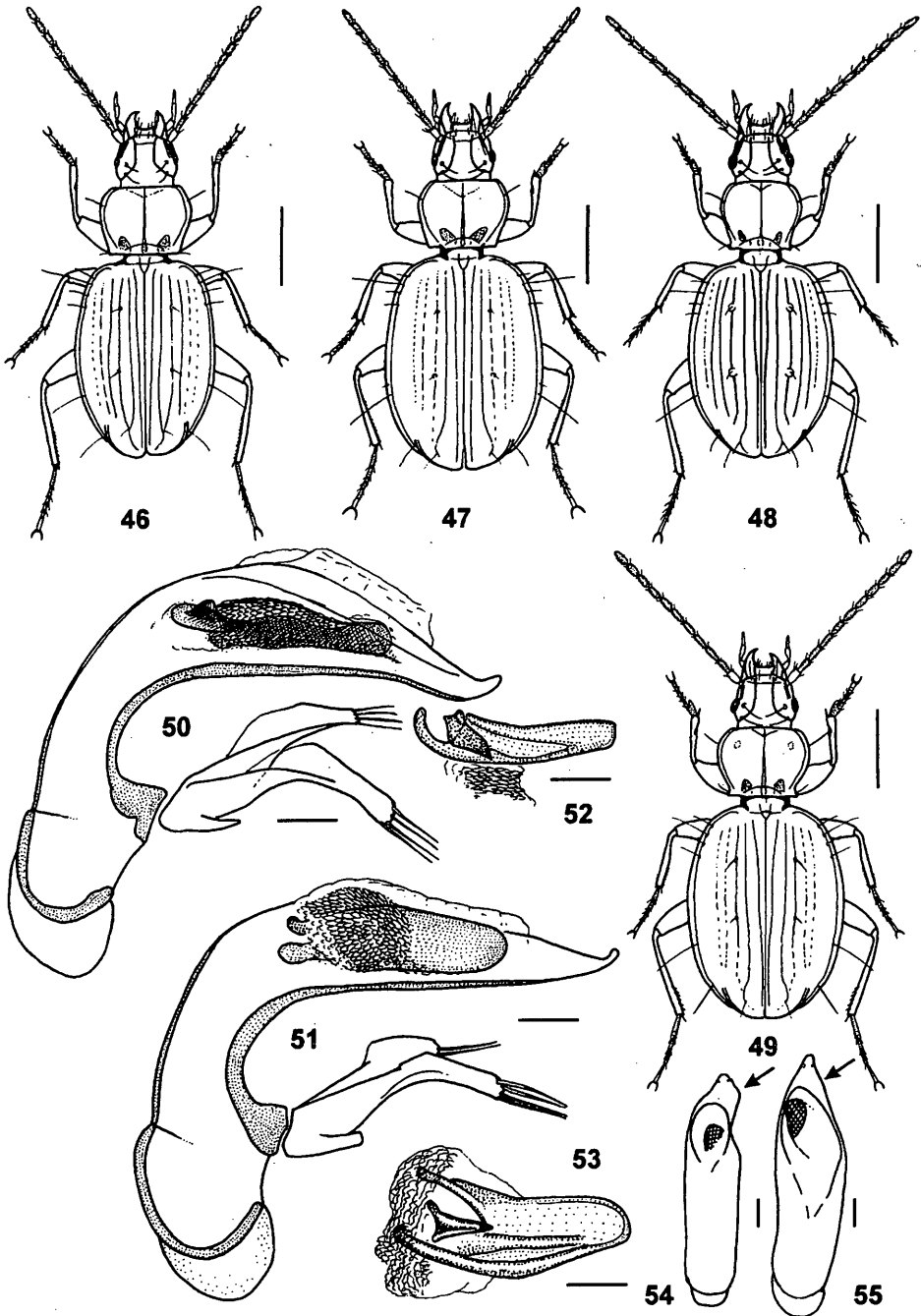


Fig. 46-55: Habitus (46-49), aedeagus in lateral (50-51) and dorsal (54-55) view, copulatory pieces of aedeagus (52-53), scale for habitus 1 mm, otherwise 0.1 mm: 46) *T. pseudonovaculosus* sp.n. (Clingmans Dome, GSM); 47) *T. novaculosus* (Clingmans Dome); 48+50+52+54) *T. haoeleadensis* sp.n. (Haoe Lead, Unicoi Mountains); 49+51+53+55) *T. unicoi* stat.n. (Haw Knob, Unicoi Mountains).

**HABITATS:** The specimens were taken together with *T. luculentus luculentus*, *T. nebulosus*, *T. clingmanensis* sp.n., *T. novaculosus* (all from the *nebulosus*-group) and three other species of *Microtrechus* in the spruce-fir forest around the summit of Clingmans Dome in wet places at the base of steep cliffs covered by moss. Rare!

**14. *Trechus (Microtrechus) novaculosus* BARR, 1962 (Fig. 39, 42, 45)**

**MATERIAL:** 24 ex.: USA, TN/NC, Sevier/Swain CO, GSM, Clingmans Dome, 5.VI.2004, leg. MD (coll. MD).

**DIAGNOSIS:** Distinguished from other species of the *nebulosus*-group by large body size (ca. 4.5 mm, 5.5 mm reported by BARR, 1979!), reddish piceous colouration, medium-sized eyes and convergent sides of pronotum not sinuate before large, obtuse basal angles. Therefore extremely similar solely to *T. pseudonovaculosus*, but more convex and less parallel-sided with less stringly impressed striae on elytra, internal sack with very elongated, razor-shaped copulatory pieces.

**DISTRIBUTION:** Recorded from the spruce-fir forest zone of the GSM: Clingmans Dome (type locality, W of Newfound Gap), Mt. Kephart and Mt. Leconte (E of Newfound Gap). Unfortunately I did not take any specimens on Mt. Kephart and I did not visit Mt. Leconte. Specimens from east of Newfound Gap should be examined carefully – there is a good chance that these populations represent a distinct subspecies or species.

**15. *Trechus (Microtrechus) nebulosus* BARR, 1962 (Fig. 40, 43)**

**MATERIAL:** 36 ex.: USA, TN/NC, Sevier/Swain CO, GSM, Clingmans Dome, 5.VI.2004, leg. MD (coll. MD); 21 ex.: USA, TN/NC, Sevier/Swain CO, GSM, Newfound Gap - Mt. Kephart, 9.VI.2004, leg. MD (coll. MD).

**DIAGNOSIS:** This species can be recognized by darker colour, comparatively smaller body size of 3.2-4.0 mm, well-developed eyes, sides of pronotum not sinuate before obtuse basal angles. Especially characteristic by smaller and thicker aedeagus with internal sack covered by dense scales and armed with extraordinary copulatory pieces strongly projecting out of aedeagus: end of copulatory pieces not covered by scales and shaped like bird head.

**DISTRIBUTION:** Known from the central GSM, east and west of Newfound Gap, strictly endemic in this area.

**HABITATS:** All specimens have been taken at the highest elevations of the GSM ridge. The specimens were sifted in wet places and taken from beneath moss mats covering rocks.

**Incertae sedis:** The next two species are very characteristic, certainly not related to each other and of uncertain relationship to other species. Both are endemic in the Plott Balsam Mountains and mark the easternmost limit of the *nebulosus*-group.

**16. *Trechus (Microtrechus) rosenbergi* BARR, 1962 (Fig. 74, 75, 80)**

**MATERIAL:** 8 ex: USA, NC, Haywood/Jackson CO, Waterrock Knob, 24.V.2004, leg. MD (coll. MD).

**DIAGNOSIS:** Large (ca. 4.5 mm), reddish piceous species, pronotum strongly sinuate before acute basal angles, aedeagus well characterized by large and complex copulatory pieces.

**DISCUSSION:** This remarkable species is reported by BARR (1962) from a second location, Richland Balsam in the Pisgah Ridge. I tried twice to collect specimens there, but

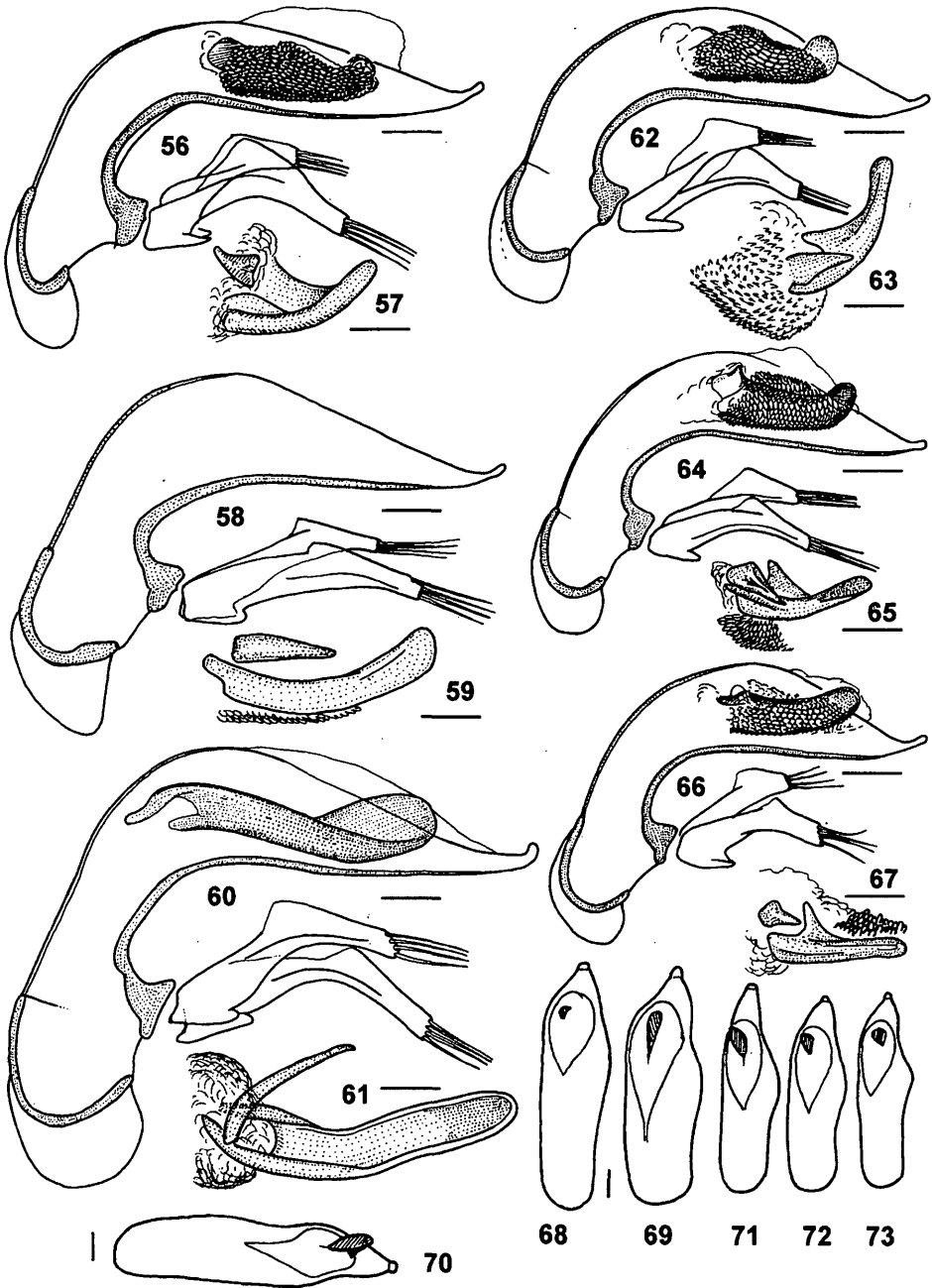


Fig. 56-73: Aedeagus in lateral view with ejected copulatory pieces (56-67) and in dorsal view (68-73), scale = 0.1 mm: 56+57+68) *T. luculentus luculentus* (Clingmans Dome); 58+59+69) *T. stefanschoedli* sp.n. (Thunderhead Mountain); 60+61+70) *T. tobiasi* sp.n. (Tusquitee Bald); 62+63+71) *T. luculentus wayahensis* (Wayah Bald); 64+65+72) *T. luculentus joannabaldensis* (Joanna Bald); 66+67+73) *T. luculentus cheoahbaldensis* ssp.n. (Cheoah Bald).

unfortunately failed. There is a good chance that this population represents a distinct species or subspecies, because the *Trechus*-fauna of both mountains is significantly different.

**DISTRIBUTION:** Endemic on Waterrock Knob in the Plott Balsam Mountains and on Richland Balsam in the Western Great Balsam Mountains (second location needs confirmation).

**HABITATS:** The few specimens were taken together with the smaller *T. balsamensis* in the spruce-fir forest on the summit of Waterrock Knob under large stones and under moss carpets covering rocks. Due to the severe damage of the spruce-fir forest by air pollution and insect pests the appropriate habitats are inaccessible (fallen and rotting logs) or destroyed. Rare.

**17. *Trechus (Microtrechus) balsamensis* BARR, 1962 (Fig. 74, 75, 78)**

**MATERIAL:** 1 ♂: USA, NC, Haywood/Jackson CO, Waterrock Knob, 24.V.2004, leg. MD (coll. MD).

**DIAGNOSIS:** Distinguished from *T. rosenbergi* immediately by smaller and more convex body (ca. 3.7 mm), darker colour, larger eyes, pronotum only very shallowly sinuate before basal angles, elytra with extremely shallow striae, and by totally different shape of aedeagus and copulatory piece (smaller second copulatory piece missing, which is unique within the *nebulosus*-group). BARR (1979) compares this species with *T. nebulosus*, which is of similar size and colour and with similarly shaped pronotum, but aedeagus shows many differences. Therefore a close relationship is doubtful.

**DISTRIBUTION:** Endemic on Waterrock Knob in the Plott Balsam Mountains.

**HABITATS:** The single specimen was taken together with the larger *T. rosenbergi* in the spruce-fir forest on the summit of Waterrock Knob.

**The *luculentus*-subgroup:** The following species group is certainly monophyletic and well characterized by dark piceous colouration, large eyes, pronotum strongly sinuate before very acute and projecting basal angles. Aedeagi of all species very similar in external view with simple, slightly up-turned apex (never hooked or reflexed), normal styliform parameres and two rather simple copulatory pieces: one of medium size, very variable in shape, second piece like a small tooth or more elongate spine, always simple, straight, without modifications and much smaller than the other piece (difference to *nantahalae*-subgroup).

All species share a common preference for microhabitats: The species live close to the surface beside springs and small creeks or in muddy areas under stones or layers of wet leaf litter. An altitudinal preference is poorly developed; specimens were taken on the highest elevations in the GSM as well as close to the base of the mountains beside cool rivers.

This group is highly diverse and taxonomically very difficult to describe. No doubt all species look very similar to each other and even the aedeagi show no relevant differences in lateral view. Furthermore the internal sack is often not transparent and hides the copulatory pieces. It is therefore necessary to extract the copulatory pieces for a correct determination and to prepare the aedeagus in a way that allows study of the apex in dorsal view.

**18. *Trechus (Microtrechus) tobiasi* sp.n. (Fig. 60, 61, 70, 83)**

**TYPE MATERIAL:** Holotype ♂ and 32 paratypes (17 ♂♂, 15 ♀♀): USA, NC, Macon/Clay CO, Tusquitee Bald, 20.V.2004, leg. MD (coll. MD).

**DIAGNOSIS:** Immediately distinguished from other species of the *luculentus*-subgroup by large body size, large aedeagus, aedeagal internal sack not covered by scales (therefore transparent), and strongly elongate copulatory pieces.

**DESCRIPTION:** Habitus as in fig. 83; large, length 3.7-4.7 mm. Body entirely dark piceous, elytra shiny with slight bluish lustre, paler along suture. Legs reddish, sometimes partly darkened on femur, antenna reddish piceous, darker than legs.

Head with strong microsculpture, pronotum and elytra shinier due to less well-developed microsculpture (examined with 40 x). Antenna slender, ca. 50% of BL. Eyes fully developed in size, large and slightly projected, length of temples shorter than eye diameter.

Pronotum strongly rounded laterally, convex on disc, maximal width before middle, strongly constricted and strongly sinuate before large and acute basal angles, anterior and posterior margins nearly straight; front angles rounded and not prominent; basal fovae present and strongly impressed; median line distinct, almost extended to margins.

Elytra broadly ovate, convex on disc, shoulders not prominent; inner striae (1-3) well impressed, irregularly punctuate, 4-5 less impressed but still developed; outermost striae almost indistinct.

**AEDEAGUS** (Fig. 60, 61, 70): Externally extremely similar and comparable to that of *T. luculentus luculentus* but with different copulatory pieces and different apex in dorsal view. Aedeagus large, slender, strongly curved in basal half, straight in apical half, apex simple, slightly up-turned. In dorsal view, apex rather simple, more or less symmetrical and regularly constricted to pointed end. Internal sack not covered with scales in lateral view, copulatory pieces therefore clearly visible. Both copulatory pieces significantly longer and more elongate than in the other species of this subgroup: larger one nearly parallel-sided, slightly rotate, broadly rounded apically; smaller one very elongated and straight, spine-like. Larger copulatory piece strongly projects out of the aedeagus.

**DISTRIBUTION:** Known only from the type locality, very likely strictly endemic on Tusquitee Bald in the Nantahala Mountains because at least two other endemic *Microtrechus* species exist there. This remarkable new species is the westernmost representative of the *nebulosus*-group.

**HABITATS:** This interesting new species was collected together with *T. tusquitensis*, *T. barberi*, and *T. tusquitee* near springs.

**ETYMOLOGY:** *Trechus tobiasi* sp.n. is named for my son Tobias who was with us in his mother's belly. He was born on October 11, 2004.

### **19. *Trechus (Microtrechus) haoeleadensis* sp.n. (Fig. 48, 50, 52, 54)**

**TYPE MATERIAL:** Holotype ♂ and 3 Paratypes (1 ♂, 2 ♀ ♀): USA, NC/TN, Graham/Monroe Co., Unicoi Mtns., Haoe Lead, 10.VI.2004, leg. MD (coll. MD).

**DIAGNOSIS:** Distinguished from other species of the *luculentus*-subgroup by medium body size, slender pronotum and ovate, very convex elytra with deeply impressed striae, sides of pronotum strongly constricted to base and strongly sinuate before acute and prominent basal angles. Aedeagus similar to that of *T. unicoi*, but aedeagal apex in dorsal view strongly sinuate on right side and with straight, more slender copulatory pieces, totally covered by scales.

**DESCRIPTION:** Habitus as in fig. 48; large, length 3.7-4.1 mm, very similar to *T. unicoi*, but slightly smaller with more elongated pronotum and more convex elytra with much stronger impressed striae. Body entirely piceous, more reddish on head and along the suture, elytra

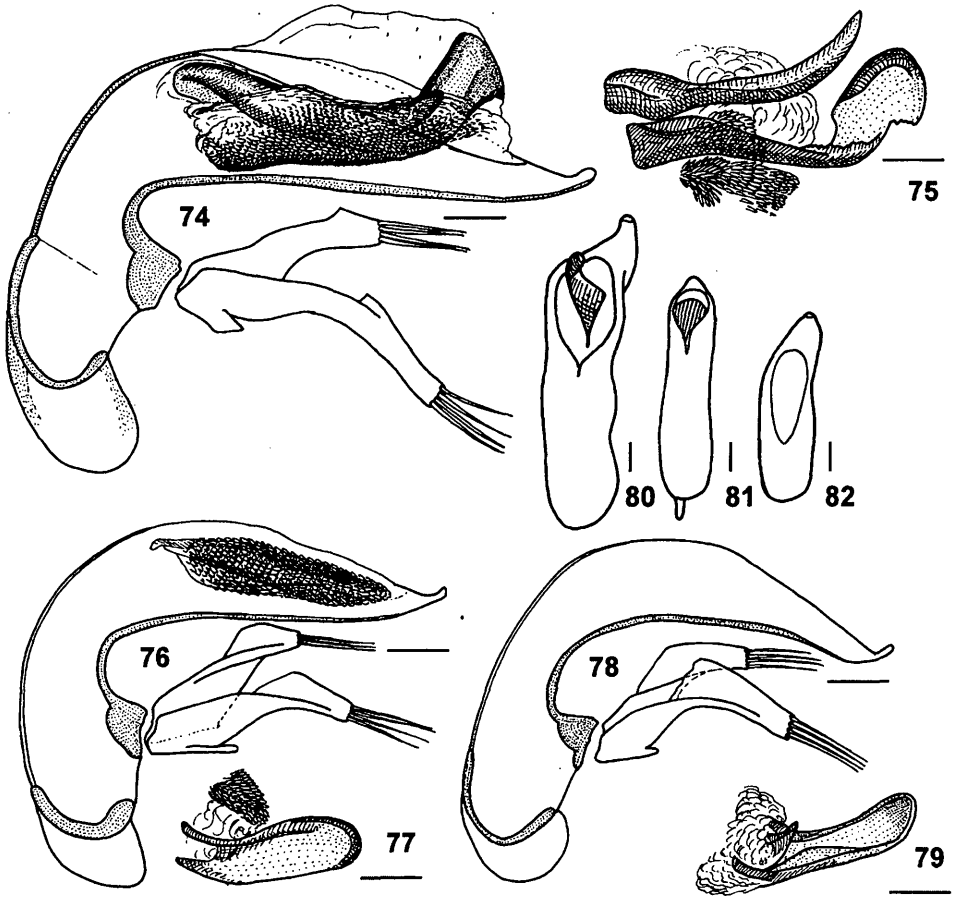


Fig. 74-82: Aedeagus in lateral view and ejected copulatory pieces (74-79) and in dorso-apical view (80-82), scale = 0.1 mm: 74+75+80) *T. rosenbergi* (Waterrock Knob); 76+77+81) *T. balsamensis* (Waterrock Knob); 78+79+82) *T. cheoahensis* sp.n. (Cheoah Bald).

very shiny with slight bluish lustre. Legs entirely pale reddish, strongly contrasting with body, antenna darker than legs.

Head with strong microsculpture, pronotum and elytra much shinier due to less developed microsculpture (examined with 40 x). Antenna slender, ca. 55% of BL. Eyes well developed and projecting, length of temples shorter than eye diameter.

Pronotum narrow, strongly rounded laterally, less convex disc, maximal width before the middle, strongly constricted and sinuate before large and acute basal angles, anterior and posterior margins nearly straight; front angles rounded and not prominent; basal fovae present and strongly impressed; median line distinct, almost extended to margins.

Elytra elongately ovate, very convex on disc, shoulders not prominent; inner striae (1-5) deeply impressed, posterior and lateral more shallow, but still clearly visible; outermost striae indistinct.

**AEDEAGUS** (Fig. 50, 52, 54): Externally extremely similar and comparable to that of *T. unicoi* but with different copulatory pieces and different aedeagal apex in dorsal and lateral view. Aedeagus large, slender, strongly curved in basal half, straight in apical half, apex simple, slightly up-turned. Apex in dorsal view with very characteristic projecting convexity on the right side (missing in *T. unicoi*), apex pointed, which is turned slightly to right. Internal sack is covered with dense scales in lateral view, completely hiding copulatory pieces. Both copulatory pieces of different length and form: one very short and triangular and pointed apically; the other rather slender and much longer, rather straight and rounded apically. Larger copulatory piece significantly more slender than in *T. unicoi*.

**DISTRIBUTION**: Known only from the type locality, very likely strictly endemic in the Unicoi Mountains, probably endemic on Haoe Lead, a prominent peak in the eastern part of the Unicoi Mountains (perhaps replaced by *T. unicoi* in the western part).

**HABITATS**: All specimens were collected beside a small spring at comparatively low elevations on the Haoe Lead trail under stones.

**DISCUSSION**: Due to differences in habitus, the apex of the aedeagus and in the form of the copulatory pieces, I have no doubt that *T. unicoi* stat.n., *T. luculentus* and *T. haeoleadensis* sp.n. should be treated as distinct species. Further investigations are required to determine, if locations exist, where both species can be found together or where the exact borders of distribution are (watersheds or altitudinal preferences?). Nevertheless the western and the eastern part of the Unicoi Mountains are inhabited by at least one other pair of distinct species (not yet described).

#### **20. *Trechus (Microtrechus) unicoi* BARR, 1962 stat.n. (Fig. 49, 51, 53, 55)**

**MATERIAL**: 22 ex.: USA, NC/TN, Graham/Monroe Co., Unicoi Mountains., Haw Knob, 19.V.2004, leg. MD (coll. MD); 9 ex.: USA, NC/TN, Graham/Monroe Co., Unicoi Mountains, Johns Knob, 19.V.2004, leg. MD (coll. MD).

**DIAGNOSIS**: Habitus as in fig. 49, very similar to the majority of the *luculentus*-subgroup, characterized by different copulatory pieces, which are much broader than in all other species except *T. tobiasi* sp.n. From this species it can be distinguished by significantly shorter copulatory pieces and scales covering basal half of internal sack in lateral view.

**DISTRIBUTION**: Endemic in the Unicoi Mountains.

**DISCUSSION**: *T. unicoi* was described as subspecies of *T. luculentus*, what should be changed due to significant differences in copulatory pieces.

#### **21. *Trechus (Microtrechus) stefanschoedli* sp.n. (Fig. 58, 59, 69)**

**TYPE MATERIAL**: Holotype ♂ and 10 Paratypes (2 ♂♂, 8 ♀♀): USA, TN/NC, Blount/Swain CO, GSM, Thunderhead Mtn., 8.VI.2004, leg. MD (coll. MD).

**DIAGNOSIS**: Immediately distinguished from all other species of the *luculentus*-subgroup by its large aedeagus, being significantly thicker than in *T. luculentus luculentus* (the only other representative in the GSM) and form of copulatory pieces consisting of an elongate, slightly curved piece, not enlarged at the base, and a smaller one, significantly longer than in most other species.

**DESCRIPTION**: Habitus not figured, but very similar to fig. 49; large, length 3.8-4.4 mm. The description is otherwise identical to *T. tobiasi* sp.n. (and therefore not repeated) with the following exception: striae of elytra more shallow, inner striae (1-3) slightly impressed, irregularly punctuate, 4-5 even less impressed; outermost striae almost indistinct.

**AEDEAGUS** (Fig. 58, 59, 69): Externally extremely similar and comparable to that of *T. luculentus luculentus* but significantly thicker in lateral and dorsal view and with different copulatory pieces. Aedeagus large, slender, strongly curved in basal half, straight in apical half, apex simple, slightly up-turned. Apex in dorsal view rather simple, more or less symmetric and regularly constricted to the pointed end. Internal sack covered with scales in lateral view. Both copulatory pieces significantly longer than in *T. luculentus luculentus*: larger one nearly parallel-sided, elongate, broadly rounded apically and NOT enlarged at the base; smaller piece much longer, elongate, straight spine.

**DISTRIBUTION**: Known only from the type locality, very likely strictly endemic in the Western GSM.

**ETYMOLOGY**: This species is dedicated to Dr. Stefan Schödl (entomologist at the Natural History Museum in Vienna) to commemorate his untimely death in 2005.

**DISCUSSION**: A lot of collection efforts are required to clarify the correct taxonomic status of the *luculentus*-subgroup in the GSM. The scarce material at hand is showing significant aedeagal differences. Furthermore Thunderhead Mountain is inhabited by some other, strictly endemic *Microtrechus*. These facts support the assumption that *T. stefanschoedli* sp.n. is a good species. More material from areas between Thunderhead Mountain and Clingmans Dome is certainly needed to clarify the taxonomic status and the distribution areas.

## **22. *Trechus (Microtrechus) luculentus luculentus* BARR, 1962 (Fig. 56, 57, 68)**

**MATERIAL**: 64 ex.: USA, TN/NC, Servier/Swain CO, GSM, Clingmans Dome, 5.VI.2004, leg. MD (coll. MD).

**DIAGNOSIS**: All subspecies of *T. luculentus* are characterized by the similar form of the aedeagus: internal sack covered all over with dense scales in lateral view, larger copulatory piece short, slender, straight or moderately curved and strongly extended towards the base (different to all other species of the *luculentus*-subgroup).

*T. luculentus luculentus* can be separated from *T. luculentus cheoahbaldensis* ssp.n. and *T. luculentus joannabaldensis* ssp.n. by significantly larger body size (all male specimens are > 4 mm) and more strongly curved copulatory pieces. I was not able to find any diagnostic character to distinguish it from *T. luculentus wayahensis* despite the complete geographic isolation. BARR (1979) states: "The nominate race is distinguished from the other subspecies by a combination of smaller basal angles of the pronotum, usually five longitudinal elytral striae, and the small aedeagus." I can only confirm differences in the basal angles of pronotum, which are smaller and less acute than in *wayahensis*.

**DISTRIBUTION**: Central GSM. I could not find any specimens east of Newfound Gap.

## **23. *Trechus (Microtrechus) luculentus wayahensis* BARR, 1979 (Fig. 62, 63, 71)**

**MATERIAL**: 54 ex.: USA, NC, Macon CO, Nantahala Mts., Wayah Bald, 17.V.2004, leg. MD (coll. MD); 8 ex.: USA, NC, Macon CO, Copper Ridge Bald – Burningtown Gap, 21.V.2004, leg. MD (coll. MD).

**DISTRIBUTION**: Endemic in the Nantahala Mountains around Wayah Bald.

**DISCUSSION**: The population of the area around Wayah Bald was described as a subspecies of *T. luculentus*. The description of a new subspecies from Cheoah Bald (which is much better characterized and located between the GSM and Wayah Bald) requires the retention of the strongly isolated *T. luculentus wayahensis* as a subspecies.



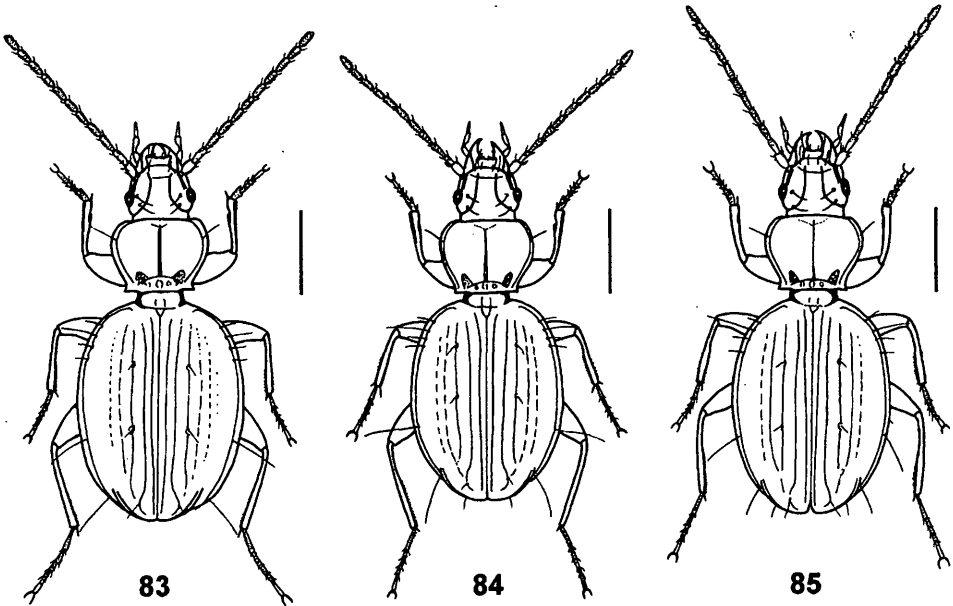


Fig. 83-85: Habitus, scale = 1 mm: 83) *T. tobiasi* (Tusquitee Bald); 84) *T. luculentus cheoahbaldensis* ssp.n. (Cheoah Bald); 85) *T. cheoahensis* sp.n. (Cheoah Bald).

**24. *Trechus (Microtrechus) luculentus joannabaldensis* ssp.n. (Fig. 64, 65, 72)**

TYPE MATERIAL: Holotype ♂ and 30 Paratypes: USA, NC/TN, Graham/Cherokee Co., Snowbird Mountains, Joanna Bald, 19.V.2004, leg. MD (coll. MD).

DIAGNOSIS: Immediately distinguished from the subspecies *luculentus* s.str and *wayahensis* by significantly smaller body size of 3.4-3.9 mm, paler colour, smaller aedeagus and less curved copulatory pieces. Elytra with deeper striae than in the previous subspecies, basal angles smaller, similar to the nominate form.

DISTRIBUTION: Known only from the type locality, very likely strictly endemic on Joanna Bald in the Snowbird Mountains.

**25. *Trechus (Microtrechus) luculentus cheoahbaldensis* ssp.n. (Fig. 66, 67, 73, 84)**

TYPE MATERIAL: Holotype ♂ and 17 Paratypes: NC, Graham/Swain Co., Cheoah Bald, 11.VI.2004, leg. MD (coll. MD).

DIAGNOSIS: Distinguished from all other subspecies by small body size (3.5-4.0 mm) and a straight (instead of curved) larger copulatory piece, externally extremely similar to the previous subspecies.

DISTRIBUTION: Known only from the type locality, very likely strictly endemic on Cheoah Bald.

DISCUSSION: The population of Cheoah Bald is more or less found between Wayah Bald and Joanna Bald, but the shape of the copulatory piece is not intermediate between those of *wayahensis* and *joannabaldensis* ssp.n. and therefore does not reflect the geographic position.

**25. *Trechus (Microtrechus) cheoahensis* sp.n. (Fig. 78, 79, 82, 85)**

TYPE MATERIAL: Holotype ♂ and 1 ♀ Paratype: NC, Graham/Swain Co., Cheoah Bald, 11.VI.2004, leg. MD (coll. MD).

DIAGNOSIS: Distinguished from the syntopic *T. luculentus cheoahbaldensis* ssp.n. by slightly larger body size, slightly more elongate body, strongly curved aedeagus with different copulatory pieces (larger, broader, not enlarged at the base). Form of aedeagus and of copulatory pieces are strongly reminiscent of those of *T. haoeleadensis* sp.n. (which seems to be the most closely related species), but aedeagus clearly less sinuate before apex on right side in dorsal view, copulatory pieces broader and elytral striae shallower.

DESCRIPTION: Habitus as in fig. 85; moderately large, length 4.0-4.2 mm. The description is otherwise identical to *T. tobiasi* sp.n. and therefore not repeated here.

AEDEAGUS: In lateral view, aedeagus (Fig. 78) strongly curved throughout; apex simple, slightly up-turned (stronger than in *T. luculentus cheoahbaldensis* ssp.n.); apex in dorsal view slightly broader, otherwise rather similar; larger copulatory piece (Fig. 79) larger and much broader, not enlarged at base and therefore more similar to those of *T. tobiasi* sp.n., *T. unicoi*, and *T. haoeleadensis* sp.n. than to the subspecies of *T. luculentus*; smaller copulatory piece very short and pointed apically. Unfortunately I dissected the copulatory pieces before making a line drawing of the internal sack in lateral view.

DISTRIBUTION: Known only from the type locality, very likely strictly endemic on Cheoah Bald and occurring there together with two other species of the *nebulosus*-group.

DISCUSSION: This population is geographically well isolated from the closely related *T. haoeleadensis* sp.n. from the western Unicoi Mountains. The *Trechus*-fauna of both Mountains is totally different with the exception of the widespread *T. barberi*. Therefore, I feel confident in treating *T. cheoahensis* sp.n. as a distinct species. Nevertheless it is still possible that intermediate populations can be detected in the Snowbird and Unicoi Mountains. The taxonomic status should then be re-evaluated based on more specimens.

### Discussion

The *Trechus nebulosus*-group is by far the most diverse clade within the subgenus *Microtrechus* with respect to number of taxa and morphological diversity. The extremely different forms and structures of aedeagi are remarkable. This radiation into – at present – 26 species and subspecies (not counted the many other *Trechus* species belonging to other groups) in an area approximately 80 km in diameter is unique. This fact will, I hope, attract some more investigators in the future. There is still a lot to do: Several mountains have never been investigated, distributional barriers are unexplored, and more specimens should be collected from several populations to prepare better taxonomic descriptions and a phylogenetic analysis of the *nebulosus*-group and the two other species groups of *Microtrechus*. Highly interesting results can be expected in the future.

My trip was planned as a vacation with my pregnant wife and not as a full investigation of the *Trechus* fauna of the southern Appalachians. A second trip would have been helpful to collect additional specimens and visit some other areas. However, it may take years to realize this and I therefore decided to describe all the 12 new taxa now.

### LITERATURE

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**Table of measurements (mm) and proportions of new taxa**

	BL	HW	PWM	PWA	PWB	PWA	PL	EW	EL	ANL	AEL	EL/	PWM	ANT	AEL	PWM	PWA	PWB	PWA
									EW	ANL	AEL	EW	/PL	/BL	/EL	/HW	/PWM	/PWM	/PWA
<b>3. <i>T.(M.) woyanbaldensis</i> sp.n. (3 ♂♂; 2 ♀♀)</b>																			
Avg	3.76	1.01	0.74	0.69	0.78	1.65	2.24	1.92	0.89	1.36	1.30	0.51	0.38	1.39	0.73	0.68	1.07		
Min	3.45	0.70	0.95	0.70	0.65	0.70	1.53	2.05	1.75	0.88	1.34	1.25	0.36	1.36	0.70	0.66	1.03		
Max	4.05	0.75	1.08	0.75	0.73	0.83	1.75	2.45	2.03	0.93	1.40	1.36	0.39	1.43	0.76	0.71	1.11		
<b>6. <i>T.(M.) elingmanensis</i> sp.n. (1 ♂; 1 ♀)</b>																			
♂	3.90	0.75	1.08	0.83	0.70	0.83	1.80	2.45	2.05	1.03	1.36	1.30	0.53	0.42	1.43	0.77	0.65	1.18	
♀	3.55	0.73	0.98	0.75	0.63	0.75	1.55	2.18	1.90		1.40	1.30	0.54	1.35	0.78	0.64	1.20		
<b>7. <i>T.(M.) raussevicensis</i> sp.n. (1 ♂)</b>																			
♂	4.50	0.88	1.25	0.88	0.78	0.95	2.08	2.70	2.55	1.33	1.30	1.32	0.57	0.49	1.43	0.70	0.62	1.13	
<b>10. <i>T.(M.) thomasturri</i> sp.n. (1 ♂)</b>																			
♂	4.20	0.75	1.13	0.75	0.75	0.80	1.83	2.55	2.15	1.05	1.40	1.41	0.51	0.41	1.50	0.67	1.00		
<b>11. <i>T.(M.) snowbirdensis</i> sp.n. (5 ♂♂; 2 ♀♀)</b>																			
Avg	3.66	0.71	0.99	0.69	0.68	0.76	1.66	2.21	1.92	0.82	1.33	1.30	0.53	0.37	1.39	0.70	0.68	1.02	
Min	3.30	0.65	0.93	0.65	0.63	0.70	1.50	2.00	1.80	0.80	1.23	1.25	0.51	0.36	1.29	0.66	0.66	1.00	
Max	3.85	0.78	1.05	0.70	0.70	0.80	1.75	2.38	2.05	0.85	1.36	1.33	0.55	0.38	1.45	0.72	0.72	1.04	
<b>13. <i>T.(M.) pseudonovoculatus</i> sp.n. (4 ♂♂; 1 ♀)</b>																			
Avg	4.24	0.81	1.16	0.85	0.74	0.85	1.78	2.48	2.18	1.14	1.39	1.36	0.52	0.46	1.44	0.74	0.64	1.16	
Min	4.15	0.75	1.05	0.83	0.65	0.80	1.70	2.40	2.03	1.10	1.33	1.31	0.48	0.46	1.20	0.72	0.62	1.13	
Max	4.45	0.88	1.25	0.90	0.80	0.90	1.88	2.63	2.38	1.20	1.43	1.39	0.54	0.46	1.55	0.79	0.65	1.27	
<b>18. <i>T.(M.) tobii</i> sp.n. (3 ♂♂; 3 ♀♀)</b>																			
Avg	4.20	0.83	1.15	0.80	0.78	0.89	1.93	2.53	2.26	1.18	1.31	1.29	0.54	0.44	1.38	0.70	0.68	1.02	
Min	3.75	0.80	1.05	0.73	0.73	0.83	1.73	2.23	2.00	1.15	1.26	1.20	0.53	0.42	1.24	0.66	0.65	1.00	
Max	4.70	0.88	1.25	0.88	0.85	1.00	2.13	2.85	2.30	1.20	1.35	1.34	0.55	0.47	1.44	0.79	0.76	1.03	
<b>19. <i>T.(M.) havelandensis</i> sp.n. (2 ♂♂; 2 ♀♀)</b>																			
Avg	3.96	0.79	1.04	0.73	0.73	0.79	1.79	2.30	2.21	0.99	1.29	1.32	0.56	0.41	1.33	0.70	0.70	1.00	
Min	3.75	0.75	0.98	0.70	0.70	0.75	1.70	2.13	2.00	0.98	1.25	1.27	0.54	0.41	1.30	0.67	0.67	1.00	
Max	4.10	0.80	1.08	0.75	0.75	0.83	1.88	2.40	2.30	1.00	1.31	1.39	0.57	0.42	1.34	0.72	0.72	1.00	
<b>21. <i>T.(M.) stefanschoedli</i> sp.n. (3 ♂♂; 3 ♀♀)</b>																			
Avg	4.08	0.83	1.10	0.75	0.74	0.80	1.82	2.40	2.15	1.06	1.32	1.37	0.53	0.41	1.33	0.68	0.67	1.02	
Min	3.85	0.78	1.00	0.70	0.70	0.75	1.70	2.20	2.00	1.03	1.29	1.29	0.51	0.41	1.18	0.67	0.64	1.00	
Max	4.35	0.95	1.20	0.80	0.80	0.88	2.00	2.63	2.38	1.08	1.35	1.41	0.56	0.41	1.41	0.70	0.70	1.03	
<b>24. <i>T.(M.) luculentus foarnaldensis</i> sp.n. (3 ♂♂; 3 ♀♀)</b>																			
Avg	3.63	0.75	0.97	0.70	0.68	0.78	1.65	2.17	1.90	0.88	1.32	1.25	0.53	0.39	1.29	0.72	0.70	1.02	
Min	3.40	0.73	0.93	0.65	0.65	0.75	1.50	2.00	1.75	0.88	1.29	1.23	0.52	0.38	1.27	0.68	0.68	0.96	
Max	3.85	0.78	1.03	0.75	0.70	0.80	1.78	2.30	2.00	0.88	1.35	1.28	0.54	0.40	1.32	0.74	0.72	1.07	
<b>25. <i>T.(M.) luculentus cheonbaldensis</i> sp.n. (3 ♂♂; 3 ♀♀)</b>																			
Avg	3.74	0.77	1.03	0.71	0.69	0.78	1.66	2.23	1.90	0.85	1.34	1.33	0.51	0.37	1.34	0.69	0.67	1.03	
Min	3.50	0.73	1.00	0.68	0.65	0.75	1.55	2.08	1.75	0.83	1.29	1.26	0.49	0.37	1.30	0.67	0.65	1.00	
Max	4.00	0.83	1.08	0.75	0.73	0.85	1.78	2.38	2.10	0.88	1.39	1.39	0.55	0.37	1.38	0.73	0.70	1.07	
<b>26. <i>T.(M.) cheonbaldensis</i> sp.n. (1 ♂; 1 ♀)</b>																			
♂	4.20	0.85	1.13	0.75	0.75	0.83	1.85	2.50	2.25	0.9	1.35	1.36	0.54	0.36	1.32	0.67	0.67	1.00	
♀	4.00	0.83	1.10	0.78	0.78	0.88	1.88	2.40	2.25	0.9	1.28	1.26	0.57	0.33	1.33	0.70	0.70	1.00	

AVG – Average; MIN – Minimum; MAX – Maximum; BL – Body length from labrum to apex of elytra; HW – Head width including eyes; PWM – maximal width of Pronotum; PWB – Width of pronotum between basal angles; PWA – Width of pronotum between front angles; PL – Length of pronotum; EL – Length of elytra; ANL – Length of antenna; AEL – Maximal length of oedeagus in lateral view (diagonal).

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