New species of the *Trechus* (*Microtrechus*) *vandykei* group from the southern Appalachians  
(Coleoptera: Carabidae: Trechinae)

Martin DONABAUER

**Abstract**

Two new species of the *Trechus* (*Microtrechus*) *vandykei* group are described from the southern Appalachians in North Carolina and Tennessee (USA): *T. pseudobarberi* sp.n. (Eastern Great Smoky Mountains, Plott Balsam Mountains); *T. pseudosubtilis* sp.n. (Eastern Great Smoky Mountains).

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

**Zusammenfassung**

Zwei neue Arten der *Trechus* (*Microtrechus*) *vandykei*-Gruppe werden aus den südlichen Appalachen in North Carolina und Tennessee (USA) beschrieben: *T. pseudobarberi* sp.n. (Eastern Great Smoky Mountains, Plott Balsam Mountains); *T. pseudosubtilis* sp.n. (Eastern Great Smoky Mountains).

**Introduction**

The southern Appalachians are inhabited by a unique diversity of species of the genus *Trechus* CLAIRVILLE, 1806. About 60 species and subspecies are known from this comparatively small area. All taxa are wingless and restricted to cool and moist habitats in the forest zone. Therefore most of them are endemics of a single mountain peak or have limited ranges above 1000 m a.s.l. The faunal composition of *Trechus* has been revised in several studies by BARR (1962, 1979, 1985) and DONABAUER (2005a, 2005b). Nevertheless, there are still more species 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 and several new species. The main purpose of this third paper is to summarize the results of these collections with respect to the *T. vandykei* group (sensu BARR 1962) of the subgenus *Microtrechus* JEANNEL, 1927.

Abbreviations: CO – County; NC - North Carolina; GSM - Great Smoky Mountains; TN – Tennessee.
Method

Full taxonomic descriptions are provided for new species. For described species please refer to the original descriptions. Descriptive statistics for measurements and proportions are provided in tables at the end of the paper. The body length is measured from anterior margin of labrum to apex of elytra. All specimens, including holotypes and paratypes, have been collected by the author and are stored in his collection.

_Trechus (Microtrechus) vandykei_ group (sensu Barr 1962)

All species belonging to this group are immediately separable from other _Microtrechus_ by very small or small body size (< 3 mm, exceptionally slightly larger), convex sides of elytra and convex on disc and the typical shape of aedeagus (please refer to the following key and figures). With respect to the uniform shape of the aedeagus and habitus (see Figs. 1-6) the _T. vandykei_ group is likely monophyletic.

_Trechus vandykei_ is the type species of _Microtrechus_ and among the smallest within this subgenus. The name “_Microtrechus_” is highly misleading. The body size within _Microtrechus_ varies significantly, and the largest species having body length up to 5.5 mm.

Notes: Correct determination of taxa is difficult and always requires extraction of male aedeagi, clearing of aedeagi to make the internal sac visible, examination at magnification of at least 100x, and finally the equipment for taking exact measurements.

Habitats: All species are moderately hygrophilous, much less than other _Microtrechus_. Most species are restricted to cool habitats at the highest altitudes of the southern Appalachians, inhabiting a wide spectrum of microhabitats on forest floor surface (leaf litter, needle duff, moss carpets, beyond rotten logs, beside streams, etc.). Several species are locally extremely abundant. Wherever they exist, they outnumber representatives of the _T. uncifer_ group and _T. nebulosus_ group significantly, up to 100 times.

At least _T. barberi_ occurs at lower elevations than most other _Microtrechus_. Therefore, some of the populations seem to be less isolated, resulting in a comparatively large distributional area.

Distribution: The members of the _T. vandykei_ group are spread all over the entire distribution area of _Microtrechus_ (Fig. 46; with the exception of two isolated lowland cave dwelling species). An interesting fact is that on Cataloochee Balsam in the GSM five species coexist (Figs. 1-5, 46), which is a very helpful argument for the validity of those species. In the majority of the area two species coexist. The highest diversity of taxa can be found in the GSM.

Catalogue (in alphabetical order):

- _T. (M.) barberi_ Jeannel, 1931 widespread, south of French Broad River (= _rivulis_ Dajoz, 2005)
- _T. (M.) bowlingi_ Barr, 1962 GSM
- _T. (M.) haoe_ Barr, 1979 Unicoi Mountains
- _T. (M.) pisgahensis_ Barr, 1979 Pisgah Ridge, Whiteside Mountain
- _T. (M.) pseudobarberi_ sp.n. Eastern GSM, Plott Balsam Mountains
- _T. (M.) pseudosubtilis_ sp.n. Eastern GSM
Trechus (Microtrechus) subtilis BARR, 1962  
Notes: This “large”-sized species is very rare, wherever other species of the T. barberi subgroup exist. On Tennessee Bluff however it is the only species and locally abundant at
Figs. 1 - 6: Habitus and shape of extracted aedeagus (scale = 1 mm) and enlarged aedeagus in lateral view (scale = 0.1 mm) representing five sympatric species from the summit of Cataloochee Balsam in the eastern GSM (1-5) and of the widespread *T. barberi* (6): (1) *T. subtilis*; (2) *T. pseudosubtilis* sp.n.; (3) *T. pseudobarberi* sp.n.; (4) *T. bowlingi*; (5) *T. vandykei* s.l.; (6) *T. barberi* (Pisgah Ridge, Devils Courthouse).
springs. *Trechus subtilis* can be separated by large body size (Fig. 1), very large aedeagus (Figs. 7-10) and the elongated apex in dorsal view (Fig. 22).

**Trechus (Microtrechus) pseudosubtilis** sp.n. (Table 1; Figs. 2, 11, 23, 46)
Type material: Holotype (♂) and 25 paratypes (14 ♂ ♂, 11 ♀ ♀): TN/NC, Swain /Haywood CO, GSM, Cataloochee Balsam (Summit), 27.V.2004.

**Diagnosis:** A large sized representative of the *T. vandykei* group (Fig. 2), most similar to *T. subtilis*, *T. pseudobarberi*, *T. barberi* and *T. tonitru*. Distinguished by aedeagal characteristics alone: aedeagus significantly shorter and smaller (0.53-0.55 mm, 30% of EL, Fig. 11), apex much shorter as well, best visible in dorsal view (Fig. 23), parameres broader than in *T. subtilis*, *T. pseudobarberi* and *T. barberi*.

**Description:** Habitus as in Fig. 2; length 2.9-3.2 mm. Body dark reddish piceous, paler on head, along suture and along sides of elytra; elytra shiny with strong bluish lustre; legs pale, contrasting with body; first segments of antenna pale, segment 3 or 4 and all following darker.
Head with strong microsculpture. Elytra and pronotum shinier and with less developed microsculpture (examined with 40 x). Antenna of normal length. Eyes slightly reduced in size, length of temples slightly shorter than eye diameter.

Pronotum normal, regularly rounded laterally, convex on disc, maximal width in anterior half, not strongly constricted and slightly sinuate anterior of small basal angles, anterior and posterior margins nearly straight; front angles rounded and not prominent; basal angles rectangular or slightly obtuse and small; basal foveae present and strongly impressed; median line distinct, almost extended to margins.

Elytra elongate ovate, strongly convex, shoulders completely rounded and not prominent; inner striae variable, 1-3 weakly impressed and not punctuate, posterior and lateral striae indistinct. Chaetotaxy normal.

Aedeagus (Figs. 2, 11, 23): Similar to that of *T. subtilis* (compare with Figs. 7-10) and of *T. barberi* (compare with Figs. 13-16) by sharing the general shape, but immediately distinguishable by smaller size, much shorter apex and broader parameres.

**Distribution:** Eastern GSM.

**Habitats:** All specimens sifted from wet or humid leaf litter.
Trechus (Microtrechus) tonitru Barr, 1962 (Figs. 12, 24, 46)


This is the most distinctive species in respect of aedeagal characteristics of the entire T. vandykei group and I hereby confirm the validity of this taxon. Strictly endemic on Thunderhead Mountain, eastern GSM.

Trechus (Microtrechus) barberi Jeannel, 1931 (Figs. 6, 13, 14, 15, 16, 25, 46)


A very common and unusually widespread species, distributed throughout the southern Appalachians outside the GSM and the Plott Balsam Mountains, where T. barberi is replaced by several similar species. On several mountains this species coexists with smaller species like T. pisgahensis, T. haoe or T. tusquitee, or is replaced by them at higher altitudes.

DAJOZ (2005) described T. rivulis from Buck Creek Road (see map of distribution). The provided description, the geographical position and low altitude of the type locality and the habitat description would perfectly fit to T. barberi. However the aedeagal figure (the quality is obviously poor) gives a different picture. He did not compare this species with T. barberi, although it is the most common and similar species of this area.
Trechus (Microtrechus) pseudobarberi sp.n. (Table 2; Figs. 3, 17, 18, 26, 46)

**Type material:** Holotype (♂) and 120 paratypes: NC, Haywood/Jackson CO, Waterrock Knob, 24.V.2004; 4 ex. (2 ♂ 2 ♀): TN/NC, Swain/Haywood CO, GSM, Cataloochee Balsam (Summit), 27.V.2004.

**Diagnosis:** A medium sized representative of the T. vandykei-group, replacing the more widespread T. barberi in the eastern GSM and on Waterrock Knob. Distinguished from this species by aedeagal characteristics alone: shape of aedeagus like in T. subtilis and T. barberi, but copulatory pieces smaller and internal sack clear, not covered by dense scales. Separated from T. pseudosubtilis and T. tonritu by more styliform parameres.

**Description:** Habitus as in Fig. 3; length 2.85 - 2.95 mm. Body rarely reddish piceous, in most specimens dark piceous, paler on head, along suture and along sides of elytra; elytra shiny with bluish lustre; legs paler, contrasting with body; first segments of antenna pale, segment 3 or 4 and all following darker.

Head with strong microsculpture. Elytra and pronotum shinier and with less developed microsculpture (examined with 40 x). Antenna of normal length. Eyes slightly reduced in size, length of temples slightly shorter than eye diameter.

Pronotum normal, regularly rounded laterally, convex on disc, maximal width in anterior half, not strongly constricted and slightly sinuate anterior of small basal angles, ante-

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Figs. 30 - 45: Aedeagus in lateral view of taxa related to T. vandykei of the T. vandykei group (scale = 0.1 mm): (30+31) T. tusquitee (Cheoah Bald); (32+33) T. tusquitee (Tusquitee Bald); (34) T. pisgahensis (Whiteside Mountain); (35) T. pisgahensis (Mt. Pisgah); (36) T. haoe (Unicoi Mountains, Haw Knob); (37) T. haoe (Unicoi Mountains, Haoe Lead); (38-44) T. vandykei s.l.; (38) GSM east, Thunderhead Mountain; (39) GSM central, Clingmans Dome; (40) GSM East, Ramsey Cascades; (41) GSM East, Cataloochee Bald; (42) GSM East, Baxter Trail; (43) Tennessee Bluff; (44) Camp Creek Bald; (45) Unaka Mountain.
rior and posterior margins nearly straight; front angles rounded and not prominent; basal angles rectangular or slightly obtuse and small; basal foveae present, strongly impressed; median line distinct, almost extended to margins. Elytra elongate ovate, strongly convex, shoulders completely rounded and not prominent; inner striae variable, 1-3 weakly impressed and not punctuate, posterior and lateral striae indistinct. Chaetotaxy normal. Aedeagus (Figs. 3, 17, 18, 26): Similar to that of the vicariant *T. subtilis* (compare with Figs. 7-10) and syntopic *T. barberi* (compare with Figs. 13-16) by sharing the general shape and styliform parameres, but immediately distinguishable by the smaller copulatory pieces and the internal sack not covered by dense scales.

**Distribution:** Eastern GSM and Waterrock Knob.

**Habitats:** By far the most common *Trechus* on Waterrock Knob, in a variety of microhabitats. Most specimens sifted from wet or humid leaf litter.

**Trechus (Microtrechus) bowlingi subgroup**

**Notes:** Easily identified by small body size (Fig. 4), obtuse basal angles of pronotum and characteristic shape of aedeagus: aedeagus in comparison to body length large, in dorsal view broader than in any of the previous species, large copulatory pieces, internal sac covered with dense, very small scales. Strictly endemic to the entire chain of GSM, common and widespread at high altitudes. The population of Thunderhead Mountain shows a consistently distinct aedeagal apex (Fig. 19).

**Trechus (Microtrechus) bowlingi** BARR, 1962 (Figs. 19, 20, 21, 27, 28, 29, 46)


**Trechus (Microtrechus) vandykei subgroup**

**Notes:** Kane et al. (1990) studied several isolates of this and the previous subgroup by genetic analysis. Based on these results five distinct species have been established. Unfortunately the results for *T. bowlingi* provide a doubtful picture. These authors erroneously assumed, that *T. bowlingi* entirely replaces the *T. vandykei* clade in the GSM. Four out of five of my samples from the GSM consist of *T. bowlingi* AND a representative of this subgroup. Therefore, I strongly believe that specimens used for genetic analysis represent a good mixture of several species and these results are inconclusive.

**Trechus (Microtrechus) tusquitee** BARR, 1979 (Figs. 30, 31, 32, 33, 46)


Endemic on Tusquitee Bald and Cheoah Bald. Significant genetic distance of these two populations has been shown by Kane et al (1990).
**Trechus (Microtrechus) pisaehensis** BARR, 1979 (Figs. 35, 46)


**Notes:** A moderately widespread species, mainly on the Pisgah ridge, very similar to *T. vandykei*, but distributionally isolated (see distribution map), and genetically isolated (KANE et al. 1990) and with slight differences in shape of pronotum and aedeagus (BARR 1979).

**Trechus (Microtrechus) vandykei** JEANNEL, 1927 (Figs. 44, 45, 46)


**Notes:** A widespread and common species north of the Asheville Basin.

**Populations similar to T. vandykei in the GSM** (Figs. 5, 38-43, 46)


The rich material at hand clearly demonstrates that *T. vandykei* s.l. is NOT absent from the GSM, as reported by BARR (1962, 1979) and KANE et al. (1990). In most places co-existence with the externally extraordinarily similar *T. bowling* was observed. The observed aedeagal variability (Figs. 38-45) is – from my point of view – inconclusive. The GSM populations may belong to *T. vandykei* or represent one ore more subspecies or distinct species. Further careful genetic analysis of all populations is required.

**Trechus (Microtrechus) haoe** BARR, 1979 (Figs. 36, 37, 46)


Endemic in the Unicoi Mountains. Possibly identical with *T. vandykei* or in the rank of a subspecies.

**Discussion**

As many as 50 taxa of *Microtrechus* have been described from an area measuring approximately 150 x 100 kilometres. The origin and relationship of *Microtrechus* within the tribe Trechini is still obscure. This massive, doubtless monophyletic radiation is best comparable with those found on oceanic islands or highly isolated mountain ranges, such as...
Tables of measurements (mm) and proportions of new taxa

Table 1: *T. pseudosubtilis* sp.n., Cataloochee Balsam (5 ♂♂, 5 ♀♀)

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AVG – average; MIN – minimum; MAX – maximum; N – number of measurements; SD – standard deviation; HW – Head width including eyes; PWM – maximal width of pronotum; PWB – width of pronotum between basal angles; PWA – width of pronotum between anterior angles; PL – length of pronotum; EW – maximal width of elytra; EL – maximal length of elytra; ANL – length of antenna; AEL – maximal length of aedeagus in lateral view (diagonal); BL – body length from anterior end of labrum to apex of elytra.
hose of Trechus on the Island Madeira (20 taxa) or Mount Elgon in Uganda (approx. 20). Although the split of Microtrechus from other Trechini might have taken place a very long time ago, most speciation events seem to have happened rather recently. This is clearly indicated by similar patterns of vicarious species. Additional twelve species of Trechus s.str. exist in the southern Appalachians (Barr 1979 and personal observations), forming another aberrant, monophyletic lineage of uncertain relationship and origin. All together, the southern Appalachian fauna represents approximately 80% of the known Trechus diversity in North America north of Mexico.

BARR T.C., 1979: Revision of the Appalachian Trechus (Coleoptera: Carabidae) – Brimleyana 2: 29-75.


KANE T.C., BARR T.C. & STRATTON G.E., 1990: Genetic pattern and population structure in Appalachian Trechus of the vandykei group (Coleoptera: Carabidae) – Brimleyana 16: 133-150.

Adress of the author: DI Martin DONABAUER, Castellezgasse 1/7, A-1020 Wien, Austria
e-mail: donabauer@gmx.at