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Molecular phylogeny and taxonomic review of *Epaphius limacodes* (Coleoptera: Carabidae: Trechini) from the Eastern Alps

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Abstract

The polytypic taxon *Epaphius* (*Alpinoepaphius*) *limacodes* (Dejean, 1831), placed in the genus *Trechus* until recently, is reviewed and three species are recognized. Original material of *Trechus limacodes* var. *latiusculus* K. Daniel & J. Daniel, 1898 was re-examined and a lectotype is designated; its current status is elevated to a valid species, *E.* (*A.*) *latiusculus* stat.n. Also *Trechus limacodes longiusculus* Jeannel, 1927 is elevated to a valid species, *E. longiusculus* stat.n. The synonymy of *Trechus limacodes jucundus* Csiki, 1912 with *Trechus* (*Dinarotrechus*) *cavernicola* Frivaldsky, 1881 is discussed. Detailed genetic, faunistic, and ecological data support these taxonomic actions.

Key words: Alps, Austria, Slovenia, Trechinae, Trechini, *Trechus*, *Epaphius*, taxonomy, lectotype designation, endemism.

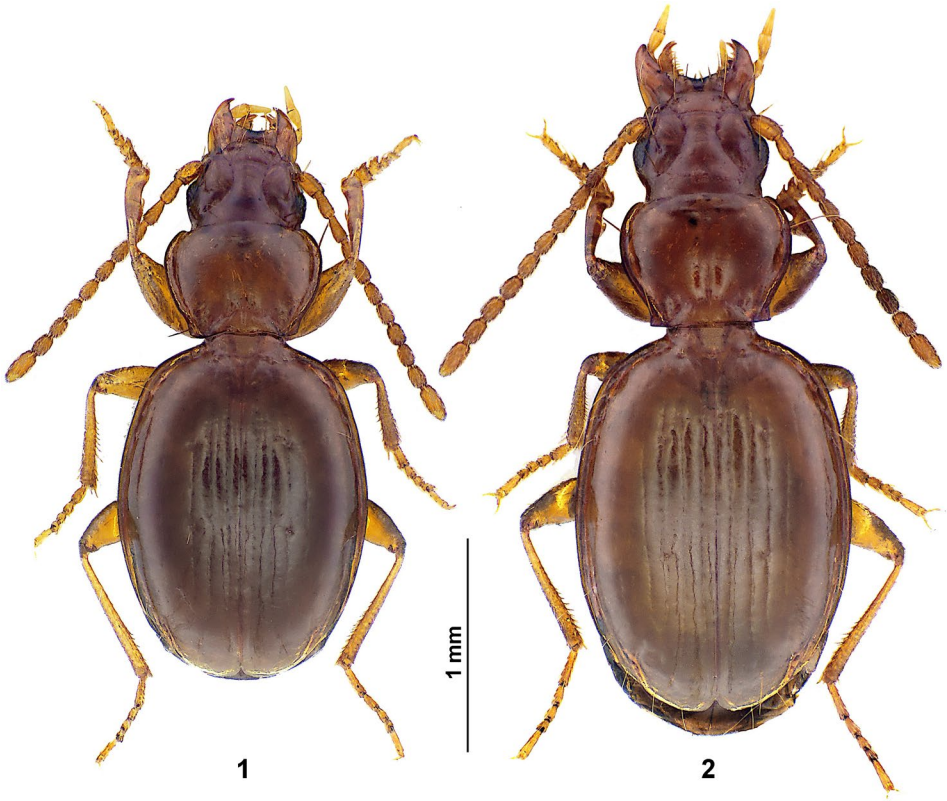
Zusammenfassung

Das polytypische Taxon *Epaphius* (*Alpinoepaphius*) *limacodes* (Dejean, 1831), bis vor Kurzem in die Gattung *Trechus* gestellt, wird untersucht und drei Arten können erkannt werden. Von *Trechus limacodes* var. *latiusculus* K. Daniel & J. Daniel, 1898 wird ein Lektotypus designiert und der Status zu *E.* (*A.*) *latiusculus* stat.n. angehoben. *Trechus limacodes longiusculus* Jeannel, 1927 wird zur Art *E.* (*A.*) *longiusculus* stat.n. erhoben. Die Synonymie von *Trechus limacodes jucundus* Csiki, 1912 mit *Trechus* (*Dinarotrechus*) *cavernicola* Frivaldsky, 1881 wird diskutiert. Detaillierte Daten zur Genetik, Faunistik und Ökologie unterstützen diese taxonomischen Entscheidungen.

Introduction

Epaphius (*Alpinoepaphius*) *limacodes* (Dejean, 1831) was assigned to the megadiverse genus *Trechus* until recently (Donabauer 2019). It is a common endemic trechine ground beetle of the Eastern Alps, easily recognized by the unusually small size (< 3 mm) and pale colour (Figs. 1–2, 7–16). The aedeagus – essential for determination of Trechini – is simple (Figs. 19–30). *Epaphius limacodes* sensu lato reportedly occurs in a variety of humid and cool habitats between 900 and 2800 m altitude (Figs. 4–5). The distribution ranges in the Central Alps from Wechsel in the East to the Schobergruppe in the Hohe Tauern in the West and to Northern Slovenia in the South (Fig. 6).

Within this area, occasionally at the same location, a significant morphological variability can be observed (Figs. 1, 2), which led to descriptions of subspecies and varieties in the



Figs. 1–2: Habitus, syntopic occurrence on Saualpe, Ladinger Alm, 1700 m a.s.l.: (1) *Epaphius* (*Alpinoepaphius*) *limacodes*; (2) *E.* (*A.*) *latiusculus*.

past. Unfortunately, these descriptions are very short and incomplete resulting in great difficulties regarding the delimitation of these taxa. Thus, the taxonomic situation was unsatisfying (Lompe 2004, Paill & Kahlen 2009) and required revision.

New impulses came as a side effect of genetic analysis (Donabauer 2019, Möst et al. 2020), which painted a surprisingly clear picture. Targeted excursions in 2020 and 2021 delivered more precise insights into distribution and ecology of the problematic "subspecies". This work intends to resolve the confusing history of this taxon with an integrative approach combining genetics, ecology, distribution, and morphology.

Historical background

Compared to other Trechini from the Eastern Alps, the taxonomic history of *E. limacodes* is complicated and confusing. The taxon was described from the mountain Koralpe (eastern Alps, Austria). Daniel & Daniel (1898) described a local variety *latiusculus* from the mountain Saualpe (Figs. 2, 16), just west of the Koralpe. According to the original description, this local "race" occurs together (!) with the nominate form (Fig. 1) at the type locality and can be distinguished by the shape of pronotum and elytra.

Later, in his monograph of Trechini, Jeannel (1927) accepted *latiusculus* as a subspecies and added a second subspecies, *longiusculus*, from the mountain Kleiner Königstuhl (Fig. 13) in the mountain range Nockberge (Austria). It is characterized by more elongate elytra and smaller eyes. The distribution of the three taxa remained unclear.

Another problematic subspecies is *jucundus* Csiki, 1912 from the Velebit (Croatia), far away from the main distribution area in the eastern Alps. Jeannel (1927) treated this taxon in his monograph but could not examine specimens.

Schweiger (1950, 1955) contributed to the subalpine *Trechus* of the Eastern Alps. In 1950, he stated about *limacodes:* "it is completely impossible, to distinguish any geographical races." Five years later, the same author (Schweiger 1955) changed his mind and split *limacodes* into two subspecies with allopatric distribution, a northern (*limacodes* s. str. including *longiusculus*) and a southern (*latiusculus*); he separated them by the shape of the elytra. He ignored the sympatric occurrence of both forms mentioned from the Saualpe (Daniel & Daniel 1898). About *jucundus*, he suspected a confusion of location and that *jucundus* is a synonym of *limacodes* s. str.

This work (Schweiger 1955) was overlooked by subsequent catalogues, while in the current catalogue (Belousov 2017) all taxa are reported as in Jeannel (1927), including erroneous distribution records. Repeated false records from Italy, Croatia, Serbia, and finally from Argentina caused additional confusion (see Donabauer 2017).

Experts on Trechini from the Alps could not be convinced by any of the proposals. Lompe (2004) wrote: „Highly variable species with several described races", not even quoting the names. Paill & Kahlen (2009) stated that the taxon seemed in need of revision and preliminarily considered it as one uniform taxon.

Material and methods

This study is based on approximately 2,000 specimens of *Epaphius limacodes* s. l., collected by the author (MD in material examined sections) in the past 25 years and stored in his private collection. Large series from the type localities of *Trechus limacodes* s. str. and *Trechus limacodes longiusculus* were available. Type material of *Trechus limacodes* var. *latiusculus* Jeannel, 1927 was borrowed from the Bavarian State Collection of Zoology (ZSM).

Molecular sequences from the study of Möst et al. (2020) were analysed with the software Mega 9. The stacked habitus photographs were taken with a 5.0 Mpixel MicroQ digital microscope ocular camera attached to a Nikon SMZ 745T binocular microscope and processed with GIMP 2.10.24 software. The photographs of male genitalia were taken with the same camera attached to a BTC Student-12 Microscope.

Phylogenetic analysis

Several extensive genetic studies on European Trechini are available, summarized by Donabauer (2019) in respect to the former genus *Trechus*. The systematic position of *E. limacodes* s.l. had to be revised completely. The relationships within the taxon *limacodes* have not yet been published in detail and are presented herein (Fig. 3).

1. "*Trechus*" *limacodes* is genetically much closer to *Epaphius secalis* (Paykull, 1790) – type species of the genus *Epaphius* Leach, 1819 – than compared to *Trechus quadristriatus* (Schrank, 1781), type species of the genus *Trechus* Clairville, 1806. This result is further

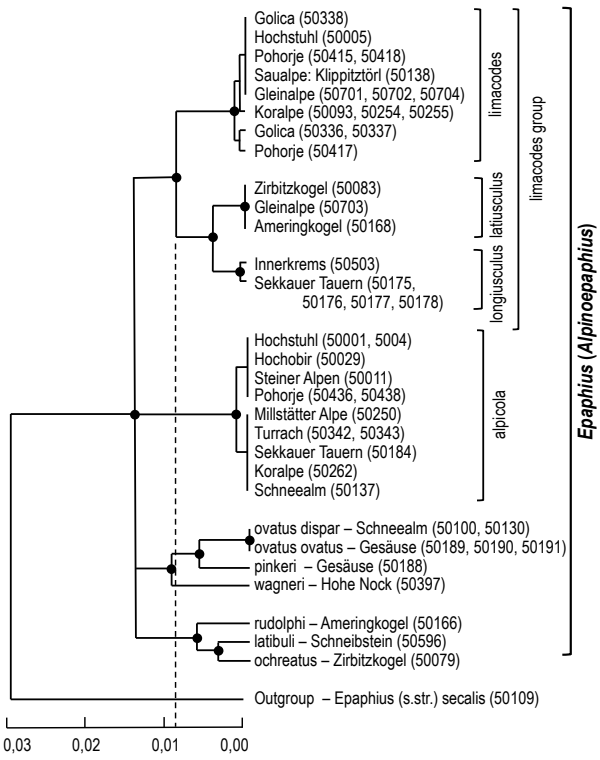


Fig. 3: Phylogeny of subgenus *Alpinoepaphius* calculated by an UPGMA model on partial mitochondrial COI sequences. Nodes with high statistical support are marked with a black circle.

supported by the configuration of male aedeagi. Subsequently, the species was transferred to genus *Epaphius* (Donabauer 2019).

2. *Epaphius limacodes* is closely related to seven other endemic species (Fig. 3) of the eastern Alps, forming a clade within *Epaphius* (Donabauer 2019). Therefore the species was transferred to the subgenus *Alpinoepaphius* Donabauer, 2019.

3. COI sequences (Fig. 3) as well as COI + 28S in combination are available for all *Alpinoepaphius* taxa. These sequences form four well-supported species groups: (1) *E. limacodes* group (see below); (2) *E. alpicola* (monotypic); (3) *E. ovatus* group: *E. ovatus* (including ssp. *dispar*) + *E. pinkeri* + *E. wagneri*; (4) *E. ochreatus* group: *E. rudolphi* + *E. latibuli* + *E. ochreatus.*

4. Within the *E. limacodes* group, there are 33 COI sequences available (Fig. 3), forming three clusters with significant distance to each other and with low variation within each cluster. The distance between these three clusters is significantly larger than within the similarly distributed *E. alpicola* (Sturm, 1825), and is better comparable to those seen within the *E. ovatus* group or the *E. ochreatus* group, consisting of morphologically well separable species. The 28s sequences are usually not able to separate closely related species. In this case, the same topology is reproduced with insufficient support of nodes.

5. On the mountain Gleinalpe, two clusters of the *E. limacodes* group coexist.

Summary interpretation: *E. limacodes* s.l. consists of three species, two of which coexist at least on the Mountain Gleinalpe.

These results reject the concept of Schweiger (1955) without doubt, because populations from Saualpe (ssp. *latiusculus* sensu Schweiger 1955) and from Koralpe (ssp. *limacodes*) could not be separated. Either both taxa are identical, or two species coexist in the region as already figured out by Daniel & Daniel (1898), but unfortunately one of those two was not included in the COI samples on Saualpe but on Zirbitzkogel, Ameringkogel and Gleinalpe in closest vicinity instead.

Figs. 4–5: Typical habitats on Zirbitzkogel, mid-July 2020: (4) humid montane spruce forest at ca. 1500 m a.s.l., with high population density of *Epaphius limacodes*, *E. alpicola*, *Trechus rotundipennis, T. constrictus*, and *Reicheiodes alpicola*; (5) humid, northeast-exposed slope below summit at ca. 2300 m a.s.l. with a strong population of *Epaphius latiusculus* and the local endemic, strictly alpine *E. ochreatus*.

Results from ecology and distribution

In addition to genetics, both distribution and ecology strongly suggest that *E. limacodes* consists of more than one taxon. The following findings have never been described before.

In the southern and eastern parts of the distribution area, along the eastern border of the Alps, *E. limacodes* s. l. can be regularly and commonly found in humid leaf and needle litter in the upper forest region above 1000 m. Highest frequencies were observed in dense spruce forests on northern slopes around 1500 m, where imagines can be found under cones and twigs on the forest floor (Fig. 4). They frequently coexist with *E. alpicola*, *Trechus constrictus*, or *Reicheiodes alpicola*. Imagines are present almost all year around with highest abundances between end of May and mid-July, as well as from September to October.

In the western part of the distribution area (Nockberge, Hohe Tauern, Niedere Tauern) *E. limacodes* s. l. is absent from dense spruce forests. Here, alpine meadows above 2000 m are inhabited, where specimens occur under deeply embedded stones in permanently humid meadows on well-developed soils. In general, this alpine form is significantly rarer and more localized than the forest-dwelling form described above. Only in *Alnus* shrubs in the vicinity of mountain streams this form occasionally occurs at lower altitudes. Thus, these populations are similar in their ecological preference to *E. pinkeri* Ganglbauer, 1891 and not as strictly confined to alpine habitats as several other specialized *Trechus* or *Epaphius*. Maximum of activity was recorded between mid-June and end of July.

Interestingly, on the mountains east and west of the Lavant valley, both alpine and forest populations exist on the same mountain. As an example, on the mountain Zirbitzkogel, a strong population just below the summit (ca. 2300 m a.s.l.; Fig. 5) was observed in syntopy with the strictly alpine *E. ochreatus*. Even more individuals of *E. limacodes* s. l. have been found in the forests (ca. 1500 m a.s.l.; Fig. 4) together with *E. alpicola* and some other typical subalpine *Trechus*.

Finally, a gap in distribution is worth mentioning: Between the Seetaler Alpen (Zirbitzkogel) and the pass Flattnitz, south of the city of Murau there is no evidence of *E. limacodes* s. l. Intensive research on the mountain Kreischberg/Frauenalpe did not provide any specimens, confirming the gap seen in already published maps (Schweiger 1955, Paill & Kahlen 2009).

Results from morphology

To positively determine closely related species of the tribe Trechini on external characteristics alone is a difficult if not fruitless undertaking. Due to a hidden mode of life, these specialized small ground dwellers possess a simplified morphology and show several reductions (e.g., pigmentation, size of eyes, hind wings). The loss of flight capability significantly reduces their distributional potential, preventing interbreeding of populations. Thus, a certain variability between populations is frequently observed and should not be misinterpreted (Donabauer 2017). Since Jeannel (1927), the males' aedeagi are in special focus of taxonomy, because these organs usually provide reliable characteristics for species delimitation.

In the special case of *E. limacodes*, however, neither external characteristics nor the highly simplified shape of the aedeagus allow reliable and easy separation of previously described taxa. Triggered by the significant genetic and ecological differences, the rich material at hand was re-examined carefully.

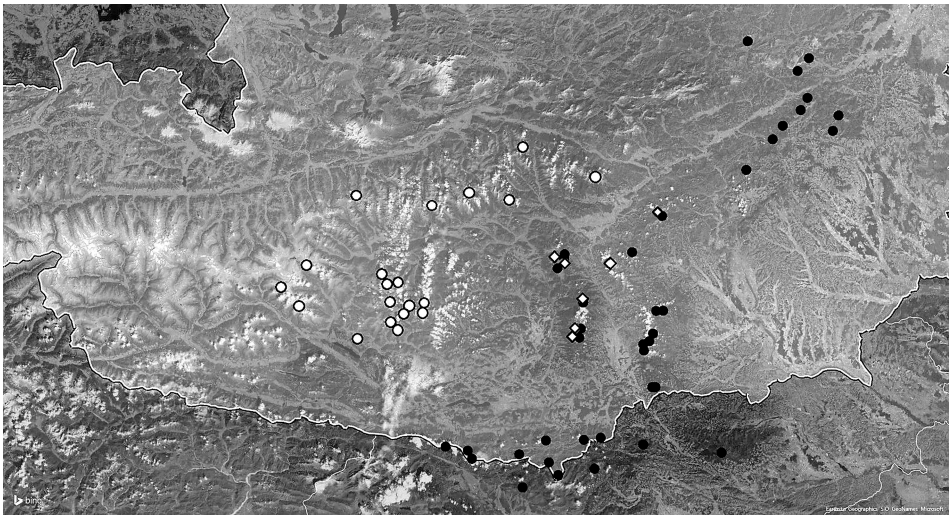


Fig. 6: Collection sites of examined material from the Eastern Alps of Austria (highlighted) and Slovenia: *E. limacodes* (dots); *E. latiusculus* (diamonds); *E. longiusculus* (circles).

The numerous specimens from the type locality of *E. limacodes*, the mountain Koralpe (several sites from Hebalm in the north, along the summit crest down to the pass Soboth in the south), confirmed the conclusion of all previous authors: All specimens (even from the alpine zone, where the species is exceedingly rare) belong to a single species. Both, aedeagi and habitus are consistent. Of special interest are (1) the broad triangular form of the hyaline structure in the internal sac of the aedeagus in lateral view, (2) the lateral borders of the pronotum hardly curved before relatively small basal angles, and (3) elytra evenly convex along disc and lateral sides. Multiple preparations of aedeagi (Figs. 19–22) from the mountain Wechsel in the east to the Seetaler Alps in the west, the Saualpe (according to genetic findings and Daniel & Daniel 1898) and from the entire southern range (Fig. 6) belong here as well. The conclusions of Schweiger (1955), that populations from the east and from the south can be separated by the shape of elytra, are thereby found to be incorrect (compare Figs. 7 and 9). This material belongs to *E. limacodes* and is identical to the common, forest dwelling form.

Daniel & Daniel (1898) recognized a second form: "*Trechus limacodes* Dej. var. *latiusculus* nob. The typically quite convex *Trechus limacodes* with markedly heart-shaped pronotum was collected numerously by Prof. Speiser on the mountain Saualpe near Wolfsberg in Carinthia in a form, occurring sporadically together with the typical form, but appearing here as a local race. It is distinguished from the typical form by broader, more flattened elytra, pronotum laterally much more convex, maximum of width shifted forward and with usually sharper basal angles." (Own translation from German.)

An examination of the type series and of targeted, recently collected material confirm the existence of this second form in the high subalpine and alpine zones of the mountains Saualpe, Seetaler Alps, Gleinalpe, and Ameringkogel, always together with the nominate form at lower altitudes. Surprisingly, no specimen could be found on the mountain Koralpe, despite intensive and targeted search. This form, although very similar, can be constantly

distinguished from the nominate form by (1) genetics (Fig. 3); (2) the mode of life (Fig. 5); (3) different shape of the internal sac of aedeagus with a comma- or Y-shaped fold in the centre (Figs. 23–26); (4) slightly larger size; (5) the shape of pronotum as described in the original description with more prominent basal angles; and (6) elytra more flattened on disc (Figs. 2, 10–12, 17).

The name *latiusculus* (meaning quite broad) is highly misleading because this taxon is not at all broader than *E. limacodes*. Possibly the authors referred to the less ovate elytra with slightly more pronounced shoulders. On the contrary, *latiusculus* appears to be more elegant and slender, which is elusive in simple ratios. The name presumably led Schweiger (1955) to erroneous interpretations of this form.

However, the status of a valid species instead of subspecies is justified, because both species have been collected in sympatry at three sites: (1) Saualpe at Ladinger hut (sympatry on Saualpe already reported by Daniel & Daniel 1898); (2) Zirbitzkogel near Sabathy hut along Leierbach; (3) Gleinalpe near Gleinalm hut.

The western populations of the Tauern range and the Nockberge (including type locality of *longiusculus* Jeannel, 1927) form a third consistent complex, well separated from the distribution (Fig. 6) and genetics (Fig. 3) of the previously discussed species. The mode of life and the configuration of the fold in the internal sac are almost identical to those seen in *E. latiusculus*, confirmed to be the closest related taxon by genetics. Morphological characterization is difficult, because there is some variability in size and in shape of elytra within the wide distribution range (Figs. 13–15). However, it can be characterized by a higher morphological adaptation to alpine habitats as (1) more reduced eye size; (2) more flattened elytra on disc; (3) entirely paler; (4) aedeagus smaller and more slender than in *E. latiusculus* (Figs. 13–15, 28–30).

Based on genetic analysis, the well-separated distribution areas (distributional gap described above), and slight morphological differences, the classification of *latiusculus* and *longiusculus* as two allopatric species seems to be appropriate, corresponding to the usual treatment of species of *Trechus* in the Alps (e.g., *Trechus noricus* from Ameringkogel and Gleinalpe and *T. regularis* from Koralpe).

Determination key to the *Epaphius* (*Alpinoepaphius*) *limacodes* group

1 Internal sac of aedeagus in lateral view with ill-defined, darker triangular field with distal border darker and more elongate, ventral border shorter and subparallel. Lateral border of pronotum less curved and constricted in front of smaller and less pronounced basal angles. Elytra slightly more convex on both disc and along lateral border, frequently somewhat darker than pronotum. Eastern border of Eastern Alps, common in forests and above, 1000+ m. ..... ***E. limacodes***

– Internal sac of male aedeagus in lateral view similar but with a short and steep fold in central position, shaped like a comma. Lateral border of pronotum more convex, more constricted towards base; basal angles more pronounced. Elytra of same colour than forebody, slightly flattened on disc; lateral borders less rounded. Central eastern Alps, above 1500 m, predominately in alpine habitats above 2000 m. Two sibling, allopatric species by genetic data. **2**

2 On average slightly larger (2.8 – 3.3 mm). Aedeagus larger and broader in lateral view. Body colour uniformly reddish pale with apex of elytra frequently lighter. Eyes reduced in size, not projecting. High subalpine and alpine zone of Saualpe, Seetaler Alpen, Packalpe and Gleinalpe, not common and localized. ..... ***E. latiusculus***

– On average smaller (2.6 – 3.0 mm). Aedeagus smaller, more slender in lateral view. Body yellowish pale, hardly contrasting with legs. Elytra even more flattened on disc. Eyes on average smaller, frequently slightly projecting. High subalpine and alpine zone of Tauern and Nockberge. ..... ***E. longiusculus***

Taxonomic actions and material examined

Epaphius (*Alpinoepaphius*) *limacodes* (Dejean, 1831) (Figs. 1, 7–9, 19–22)

Trechus limacodes Dejean, 1831: type locality: Koralpe.

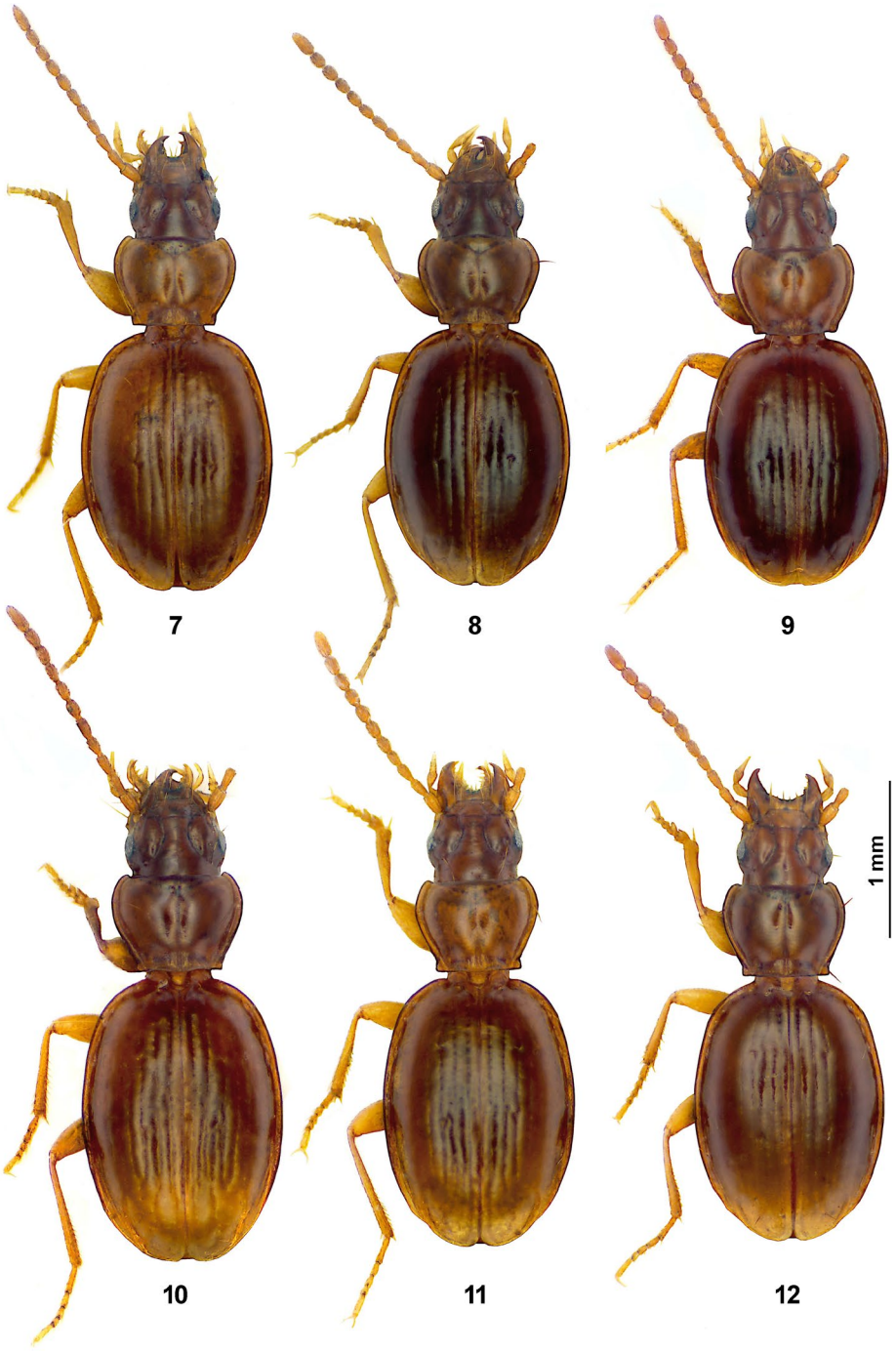
= *Trechus decorus* Grimmer, 1841: type locality: Steiermark.

= *Trechisibus parvulus* Allegro & Giachino, 2016: type locality (erroneous): Argentina, Neuquen, península de Quetrihué.

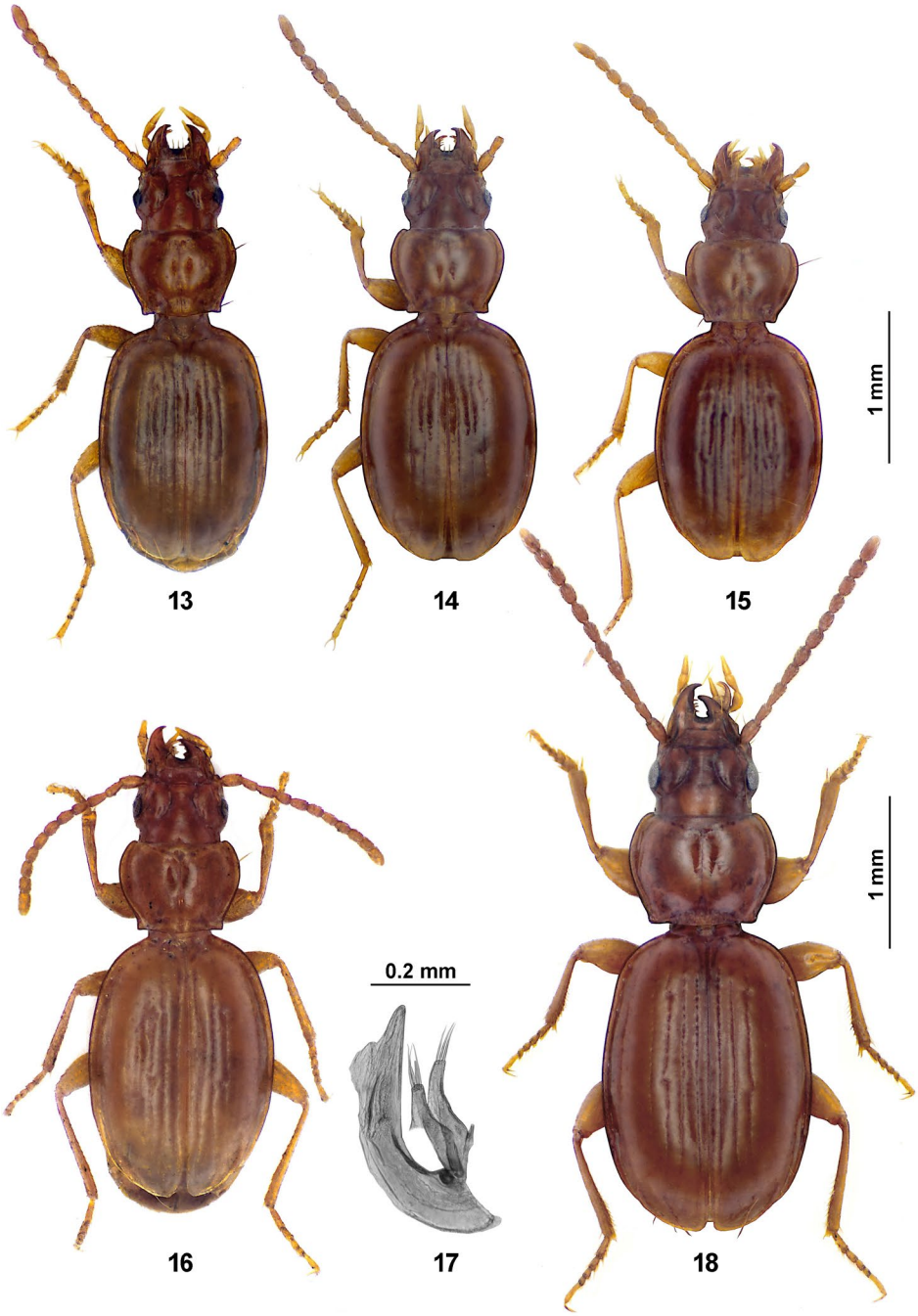
Distribution: Austria, Slovenia.

Material examined: Steirische Nordalpen: 6 ex.: Rax, Preiner Gscheid, 1000 m a.s.l., 19.V.2020, leg. MD. 2 ex.: Rax, Seilbahn Bergstation, 1500 m a.s.l., 20.X.2001, leg. MD. 12 ex.: Lahnsattel, 1000 m a.s.l., 19.V.2020, leg. MD. – Wechsel, Fischbacher Alpen, Grazer Bergland: 23 ex.: Wechsel, VI.2007, leg. MD. 27 ex.: Stuhleck, 1000–1500 m a.s.l., 27.X.2002, leg. MD. 9 ex.: Pretul, 1500 m a.s.l., 1.XI.1989, leg. MD. 21 ex.: Alpl, 1000 m a.s.l., 20.V.2020, leg. MD. 26 ex.: Fochnitz auf der Schanz, 1000 m a.s.l., 20.V.2020, leg. MD. 1 ex.: Mönichwald Umg., 29.IV.2007, leg. MD. 6 ex.: Teichalm, 1000 m a.s.l., 10.VI.2019, leg. MD. – Gleinalpe: 42 ex.: Gleinalpe, 1000–1500 m a.s.l., VI.2016, leg. MD. – Pack, Stubalpe: 20 ex.: Gaberl, 1300–1600 m a.s.l., 28.V.2020, leg. MD. 18 ex.: idem, 17.V.2003, leg. MD. – Seetaler Alpen: 230 ex.: Sabathyhütte, Leirerbach, 1600 m a.s.l., 26.VII.2020, leg. MD. – Saualpe: 188 ex.: Reisbergerbach, 1600 m a.s.l., 4.VI.2020, leg. MD. 48 ex.: Ladinger Hütte, 1700 m a.s.l., 4.VI.2020, leg. MD. 1 ex.: Klippitztörl, leg. MD. – Koralpe: 42 ex.: Hebalm, 1400 m a.s.l., 6.VI.2010, leg. MD. 106 ex.: Hebalm, 1400 m a.s.l., 28.V.2020, leg. MD. 5 ex.: Speikkogel, 1800+ m a.s.l., 30.VII.2011, leg. MD. 30 ex.: idem, 4.VIII.1998, leg. MD. 10 ex.: Weinebene, 1500 m a.s.l., 8.VII.2006, leg. MD. 13 ex.: Weinebene, 1300–1500 m a.s.l., 23.V.1998, leg. MD. 11 ex.: E Weinebene, 1200 m a.s.l., 14.VIII.1998, leg. MD. 3 ex.: Poms Wasserfall, 1500–1800 m a.s.l., 17.VII.2012, leg. MD. 18 ex.: Koralpe Gipfel Ostseite, 2000 m a.s.l., 23.VII.2021, leg. MD. 20 ex.: Soboth, 1450 m a.s.l., 25.VII.2004, leg. MD. 16 ex.: Soboth, 1350 m a.s.l., 2.VIII.2020, leg. MD. Pohorje: 11 ex.: Rogla, 1500 m a.s.l., 9.V.2006, leg. MD. 38 ex.: idem, 19.VI.2006, leg. MD. 7 ex.: idem, 29.IX.2007, leg. MD. 39 ex.: idem, 20.VI.2015, leg. MD. – Steiner Alpen, Karawanken: 38 ex.: Petzen, Luschasattel, 2.VIII.2020, leg. MD. 9 ex.: idem, 1200 m a.s.l., 1.VIII.2006, leg. MD. 15 ex.: Petzen, 1700 m a.s.l., 10.VI.2017, leg. MD. 7 ex.: Raduha, 1500 m a.s.l., 3.VIII.2008, leg. MD. 2 ex.: Ravne na Korosce, Urslja gora, 1000–1300 m a.s.l., 2.VIII.2006, leg. MD. 1 ex.: Vellacher Kotschna, Seetaler Sattel, 1500 m a.s.l., 21.VI.1997, leg. MD. 1 ex.: Kärntner Storschitz, 6.VII.2012, leg. MD. 12 ex.: Hochobir, 25.IX.1994, leg. MD. 3 ex.: Koschuta, 10.VII.1997, leg. MD. 1 ex.: Storzic, 1000 m a.s.l., VIII.1997, leg. MD. 2 ex.: Golica, 1000–1500 m a.s.l., 26.V.2015, leg. MD. 1 ex.: Zell Pfarre, ca. 750 m, 22.VII.2003, leg. MD. 19 ex.: Bärental, 1000–1200 m a.s.l., 24.V.2001, leg. MD.

Notes: No type material examined. The description of Grimmer (1841) is extremely short and insufficient. *Trechisibus parvulus* belongs here without doubt as demonstrated by the excellent photos of habitus and male aedeagus (Allegro & Giachino 2016: fig. 12, Allegro & Giachino 2017, Donabauer 2017).



Figs. 7–12: Habitus of *E. limacodes* from (7) Lahnsattel; (8) Zirbitzkogel; (9) Petzen, Luschasattel. Habitus of *E. latiusculus* from (10) Zirbitzkogel; (11) Ameringkogel; (12) Gleinalpe.



Figs. 13–18: Habitus of *E. longiusculus* from (13) Kleiner Königstuhl, Salzburg; (14) Etrachsee; (15) Seckauer Tauern. Lectotype *E. latiusculus* from Saualpe: (16) habitus; (17) aedeagus. (18) Habitus of *Trechus cavernicola* from Velebit.

Epaphius (*Alpinoepaphius*) *latiusculus* (K. Daniel & J. Daniel, 1898) stat.n.
(Figs. 2, 10–12, 16, 17, 23–26)

Trechus (s.str.) *limacodes* var. *latiusculus* K. Daniel & J. Daniel, 1898: type locality: Saualpe.

Distribution: Austria.

Type material examined: Lectotype (male; hereby designated, Figs. 16, 17): "Saualpe \ Spsr. 84" [handwritten], "Sammlung \ Dr. K. Daniel", "Lectotypus \ Trechus limacodes var. latiusculus \ K. Daniel & J. Daniel \ des. M. Donabauer 2021" [red label, printed], stored in the Bavarian State Collection of Zoology (ZSM). Additional 12 specimens pinned on 10 needles with identical labels (ZSM), labelled as paralectotypes. None of the 13 specimens was labelled as *latiusculus* or type, thus the assignment is a result of the position in the collection and the match to the original description concerning morphology and labelling (date, locality, and collector).

Additional material examined: Saualpe: 15 ex.: Ladinger Hütte, 1700 m a.s.l., 4.VI.2020, leg. MD. 2 ex.: Ladinger Spitz, 2000 m a.s.l., 10.VII.2012, leg. MD. 7 ex.: Klippitztörl N, 1500–1850 m a.s.l., 25.VII.2008, leg. MD. – Seetaler Alpen: 80 ex.: Sabathyhütte, Leirerbach, 1600 m a.s.l., 26.VII.2020, leg. MD. 6 ex.: Zirbitzkogel, 1600–2200 m a.s.l., VI.1995, leg. MD. 3 ex.: Zirbitzkogel, 1500 m a.s.l., 10.VII.1995, leg. MD. 96 ex.: Zirbitzkogel Gipfel NO, 2200+ m a.s.l., 25.VII.2020, leg. MD. 15 ex.: Zirbitzkogel, Lindersee env., ca. 2000 m a.s.l., 9.VIII.1959, leg. H. Teppner. 4 ex.: Greiskogel, 1900 m a.s.l., 22.IX.2003, leg. MD. – Packalpe: 2 ex.: Ameringkogel, 26.V.1995, 2000–2150 m a.s.l., leg. MD. 7 ex.: idem, 26.VI.2010, leg. MD. 71 ex.: idem, 26.VI.2010, leg. MD. – Gleinalpe: 8 ex.: 27.VI.1998, leg. MD. 12 ex.: 1500+ m a.s.l., VI.2016, leg. MD.

Epaphius (*Alpinoepaphius*) *longiusculus* (Jeannel, 1927) stat.n. (Figs. 13–15, 27–30)

Trechus (s.str.) *limacodes longiusculus* Jeannel, 1927: type locality: Kleiner Königstuhl.

Distribution: Austria.

Material examined: Nockberge: 22 ex.: Wintertaler Nock, 2300–2400 m a.s.l., 16.VI.2021, leg. MD. 4 ex.: Bretthöhe, 2000+ m a.s.l., 30.VIII.2001, leg. MD. 72 ex.: Kleiner Königstuhl, 2100 m a.s.l., 19.VI.2021, leg. MD. 1 ex.: Kleiner Königstuhl, leg. Hicker. 47 ex.: Großer Königstuhl, 2150+ m a.s.l., 6.VII.2021, leg. MD. 34 ex.: Rinsennock, 2300 m a.s.l., 11.VII.2021, leg. MD. 16 ex.: Turracher Höhe, 1500 m a.s.l., 15.IX.2002, leg. MD. 9 ex.: idem, 17.VI.2021, leg. MD. 3 ex.: Innerkrems, Mehrlhütte env., VI.2008, leg. MD. 12 ex.: Bundschuh Umg., 47.034278° N, 13.733986° E, 17.VI.2021, leg. MD. 8 ex.: Klomnock, 6.VIII.2000, leg. MD. 43 ex.: Klomnock NW-Seite, 2100–2300 m a.s.l., 10.VII.2021, leg. MD. 1 ex.: Moschelitzen, 2250 m a.s.l., 9.VII.2021, leg. MD. 1 ex.: Millstätter Alpe, 2050 m a.s.l., 8.VII.2021, leg. MD. – Hohe Tauern: 12 ex.: Reißeck, Kleiner Mühldorfersee, 2500 m a.s.l., 13.VIII.2009, leg. MD. 30 ex.: Dösener See, 2300 m a.s.l., VIII.2019, leg. MD. 1 ex.: Hafnergruppe, Kattowitzer Hütte, 26.VII.1966, leg. Holzschuh. – Niedere Tauern: 56 ex.: Schladminger Tauern, Kalkspitze, 2300 m a.s.l., VII.1998, leg. MD. 2 ex.: Etrachsee env., 1.VI.2020, leg. MD. 24 ex.: Talkenschrein, 2300 m a.s.l., 20.VI.2021, leg. MD. 1 ex.: Bösenstein, 10.VIII.2008, leg. MD. 1 ex.: Schießeck, 23.VI.2002, leg. MD. 35 ex.: Seckauer Tauern, Seckauer Zinken, 1500+ m a.s.l., 26.VII.2003, leg. MD. 7 ex.: idem, IX.2012, leg. MD.

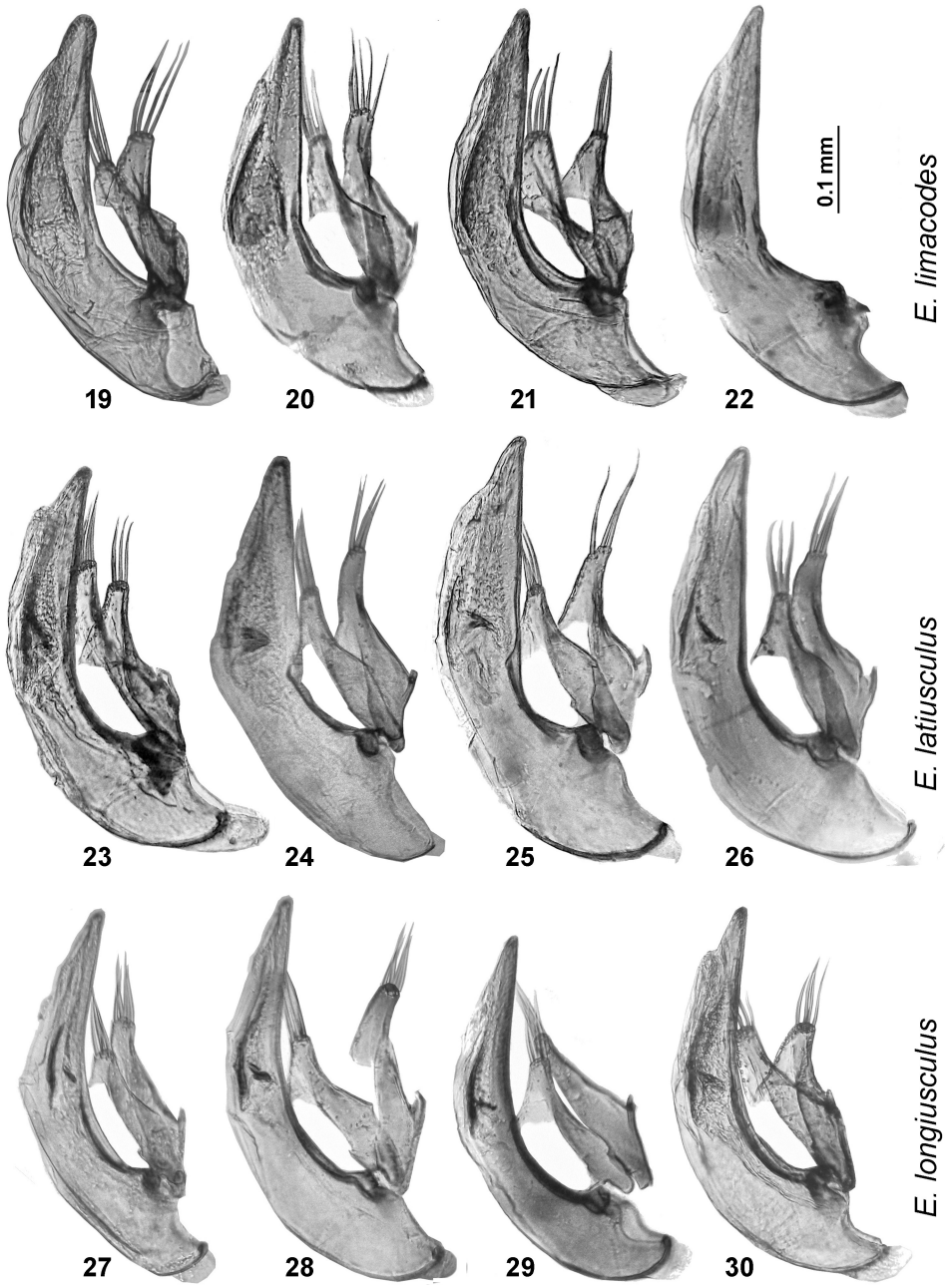
Trechus (*Dinarotrechus*) *cavernicola* Frivaldszky, 1881 (Fig. 18)

Trechus cavernicola Frivaldszky, 1881: type locality: Croatia, Velebit.

? = *Trechus limacodes jucundus* Csiki, 1912: type locality: Croatia, Velebit, Alancic.

Distribution: Croatia.

Material examined: 2 ex.: Croatia, Velebit, Baske Ostarije, 1.VI.2017, leg. MD.



Figs. 19–30: (19–22) Aedeagi of *E. limacodes* from (19) Koralpe; (20) Zirbitzkogel; (21) Alpl, Fischbacher Alpen; (22) Saualpe. (23–26) Aedeagi of *E. latiusculus* from (23) Gleinalpe; (24) Ameringkogel; (25) Zirbitzkogel; (26) Saualpe. (27–30) Aedeagi of *E. longiusculus* from (27) Turracher Höhe; (28) Steirische Kalkspitze; (29) Seckauer Tauern; (30) Klomnock.

Notes: A special problem is the taxon *jucundus*, described from Croatia and unknown to all specialists. According to Jeannel (1927), type depository is the Museum in Budapest. There is no evidence for the existence of *E. limacodes* or a closely related species outside the Alps. Schweiger (1955) suggested that *jucundus* was described based on mislabelled and aberrant specimens from the Central Alps and treated it as synonym of his *limacodes*. Donabauer (2017) formalized his statement and synonymized *jucundus* with *limacodes*.

Jeannel (1927: 515) stated in comparison to *limacodes*: "I don't know the race *jucundus* from Croatia, the pronotum is broader and shorter, elytra are more elongate compared to the nominate form." (own translation from French). Thus, it could be a synonym of *Trechus cavernicola* (Fig. 18), a rare local endemic of the mountain range Velebit, with some similarity to *E. limacodes*, though unrelated. Any other species occurring in the Velebit (*T. croaticus* Dejean, 1831, *T. priapus* K. Daniel, 1902, *T. validipes* K. Daniel, 1902) hardly come into consideration.

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