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A new fossil species of *Attagenus* Latreille (Coleoptera: Dermestidae) in Rovno and Baltic ambers, with a brief review of known fossil beetles from the Rovno amber Lagerstätte

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Abstract. Based on two specimens originating from Eocene Rovno and Baltic ambers, *Attagenus (Aethriostoma) gedanicissimus* sp. nov. is described, illustrated and compared with the related fossil Mesozoic species *A. (Aethriostoma) turonianensis* Peris et Háva, 2016. The common beetle species for Baltic and Rovno ambers suggests the exceptional temporal and geographical closeness of palaeoecosystems that produced both amber deposits. An updated checklist of Coleoptera known from Rovno amber (57 species belonging to 20 families) is compiled and provided with a bibliography of the original descriptions. The registered Rovno amber beetle assemblage contains only eight species that also occur in Baltic amber (14 %), while the similarity at the generic level is 56 % at the moment. The relationship between the Rovno and Baltic amber deposits and subjectiveness of present-day results of the beetle assemblage research are briefly discussed (urn:lsid:zoobank.org:pub:289B5A43-C57A-4B75-8A15-6E61F4AFCD81).

1 Introduction

The problem of mutual affinity in the triad of the main European Palaeogene fossil resins (Baltic amber, Bitterfeld amber and Rovno amber) is still under discussion in the 20th century (Hoffeins and Hoffeins, 2003; Perkovsky et al., 2007; Weitschat, 2008; Szwedo and Sontag, 2009; Sontag and Szadziewski, 2011; Wolfe et al., 2016; Dunlop et al., 2018; Mänd et al., 2018; Kypke and Solodovnikov, 2018). All these fossil resins are succinites, and all originate from geographically proximate localities of central and eastern Europe (from the southern Baltic area, eastern Germany, and southern Belarus and northern Ukraine) (Perkovsky et al., 2010a; Weitschat and Wichard, 2010; Rappsilber, 2016; Bogri et al., 2018). All these fossil resins are rich in bioinclusions (Spahr, 1981; Poinar, 1992; Perkovsky et al., 2003, 2010b, 2012; Weitschat and Wichard, 2002; Perkovsky, 2016a; Alekseev, 2017; Rappsilber and Wendel, 2019; etc.). Unfortunately, the biodiversity of these ambers is unevenly studied: the known beetle assemblage of Baltic amber is more than 8 times larger than the known beetle assemblage of Rovno amber and more as than 30 times larger than the known beetle assemblage of Bitterfeld amber (Alekseev, 2013, 2017; Bukejs et al., 2016). Differences in volume of knowledge make data statistically incorrect and unreliable and also cannot provide any arguments concerning the discussion about the age of these ambers.

The Dermestidae (Coleoptera) contains about 1680 valid taxa worldwide (Háva, 2015) and fossil representatives of this family are relatively frequent in ambers. Taxonomic and morphological diversity of Cretaceous Dermestidae suggests an ancient origin of this group with some lineages showing remarkable evolutionary stasis for almost 100 million years (Deng et al., 2017). In total, nine extinct species of the genus *Attagenus* Latreille, 1802 from fossil resin are documented to date. Five species belonging to the nominative subgenus have

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been described previously from the Eocene Baltic amber: *A. hoffeinsorum* Háva, Prokop et Hermann, 2006; *A. balticus* Háva, Prokop et Hermann, 2008; *A. obesus* Háva, Prokop et Hermann, 2008; *A. yantarnyi* Háva et Bukejs, 2012; and *A. gorskii* Háva, 2014. Three species of nominative subgenus have been described from the Cenomanian Burmese amber: *A. burmiticus* Cai, Hava et Huang, 2017; *A. lundi* Háva et Damgaard, 2017; and *A. secundus* Deng, Ślipiński, Ren et Pang, 2017. One species of the subgenus *Aethriostoma* Motschulsky, 1858 is known from the Turonian New Jersey amber: *A. turonianensis* Peris et Háva, 2016.

In the current paper, the second extinct species of the subgenus *Aethriostoma* is described and illustrated from early Cenozoic amber (Rovno and Baltic). Data about the Coleoptera described from Rovno amber are summarized and briefly discussed.

2 Material and methods

The material examined is deposited in the following collections:

- the Museum of Amber Inclusions, University of Gdańsk (Poland, MAIG);
- the private collection of Anders Damgaard (Holstebro, Denmark, ADC), subsequently deposited in the Zoological Museum, University of Copenhagen, Denmark.

The amber pieces were polished by hand, allowing improved views of the included specimens, and they were not subjected to any supplemental fixation.

Observations of the specimens were made using a Nikon SMZ® 745T stereomicroscope. The photographs were taken using a Canon 70D® camera with a macro lens (Canon MP-E 65 mm). Extended depth of field at high magnifications was achieved by combining multiple images from a range of focal planes using Helicon Focus® v. 6.0.18 software. Measurements were taken using an ocular micrometer (expressed in millimetres).

3 Systematic palaeontology

Family **Dermestidae** Latreille, 1807

Subfamily **Attageninae** Casey, 1900

Tribe **Attagenini** Casey, 1900

Genus *Attagenus* Latreille, 1802

Subgenus *Aethriostoma* Motschulsky, 1858

Remarks

The studied amber beetles show the combination of characters unequivocally corresponding to Attagenini within Attageninae: prosternum not forming "collar", mouthparts free, antennal club with three compact antennomeres, abdomen with five visible ventrites and elytra not shortened.

The specimens considered here were assigned to the subgenus *Aethriostoma* within *Attagenus* based on the combination of the following characters: (1) disc of metaventrite nearly twice as wide as long and (2) body strongly convex and widely oval (in *Attagenus* s. str. disc of metaventrite nearly twice as long as wide, and body less convex and more narrowly obovate).

Attagenus (Aethriostoma) gedanicissimus sp. nov.

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Figs. 1–2

Type material

Holotype: 6278 (ex. coll. Jonas Damzen JDC 8531) (MAIG); Rovno amber; adult, sex unknown. Complete beetle is included in subtriangular, transparent amber piece, with dimensions of 25 mm × 19 mm × 16 mm and maximum thickness of 6 mm. Syninclusions consist of one specimen of Nematocera (Diptera) and numerous small to minute organic particles.

Paratype: "AlDlo 558" (ADC); Baltic amber; adult, sex unknown. Complete beetle is included in transparent amber piece, with dimensions of 23 mm × 21 mm and maximum thickness of 5 mm. Syninclusion consists of one specimen of Nematocera (Diptera).

Type strata

Rovno amber, upper Eocene (holotype); Baltic amber, middle Eocene (paratype).

Etymology

The epithet of the new species is the Latin adjective *gedanicus* in the superlative and is formed from *Gedanum*, the Latin name of Gdańsk where the specimen is deposited.

Differential diagnosis

Attagenus (Aethriostoma) gedanicissimus sp. nov. differs from the single known fossil representative of the subgenus, *Attagenus (Aethriostoma) turonianensis* Peris et Háva, 2016 (USA; Late Cretaceous: Turonian; New Jersey amber) in the following characters: antennomere 11 shorter than antennomeres 9–10 combined; pronotum strongly transverse, 3× as wide as long; abdominal sutures almost straight; and larger body size; while in *A. turonianensis* antennomere 11 as long as antennomeres 9–10 combined; pronotum transverse, 2.1× as wide as long; abdominal sutures concave; and distinctly smaller body size (1.81 mm).

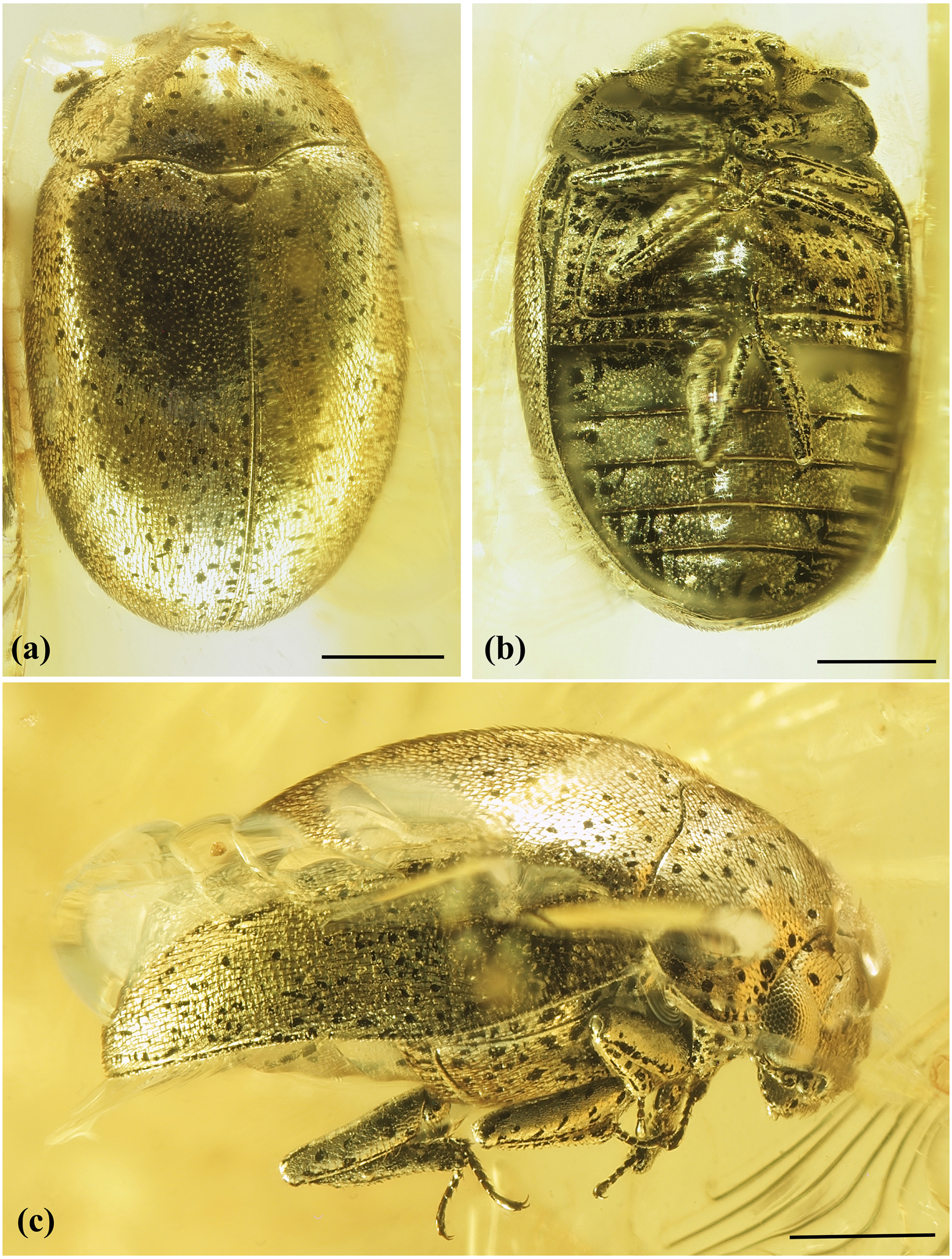

Figure 1. *Attagenus (Aethriostoma) gedanicissimus* sp. nov., holotype, 6278 (MAIG): **(a)** habitus, dorsal view; **(b)** habitus, ventral view; **(c)** habitus, right lateral view. Scale bars = 0.5 mm.

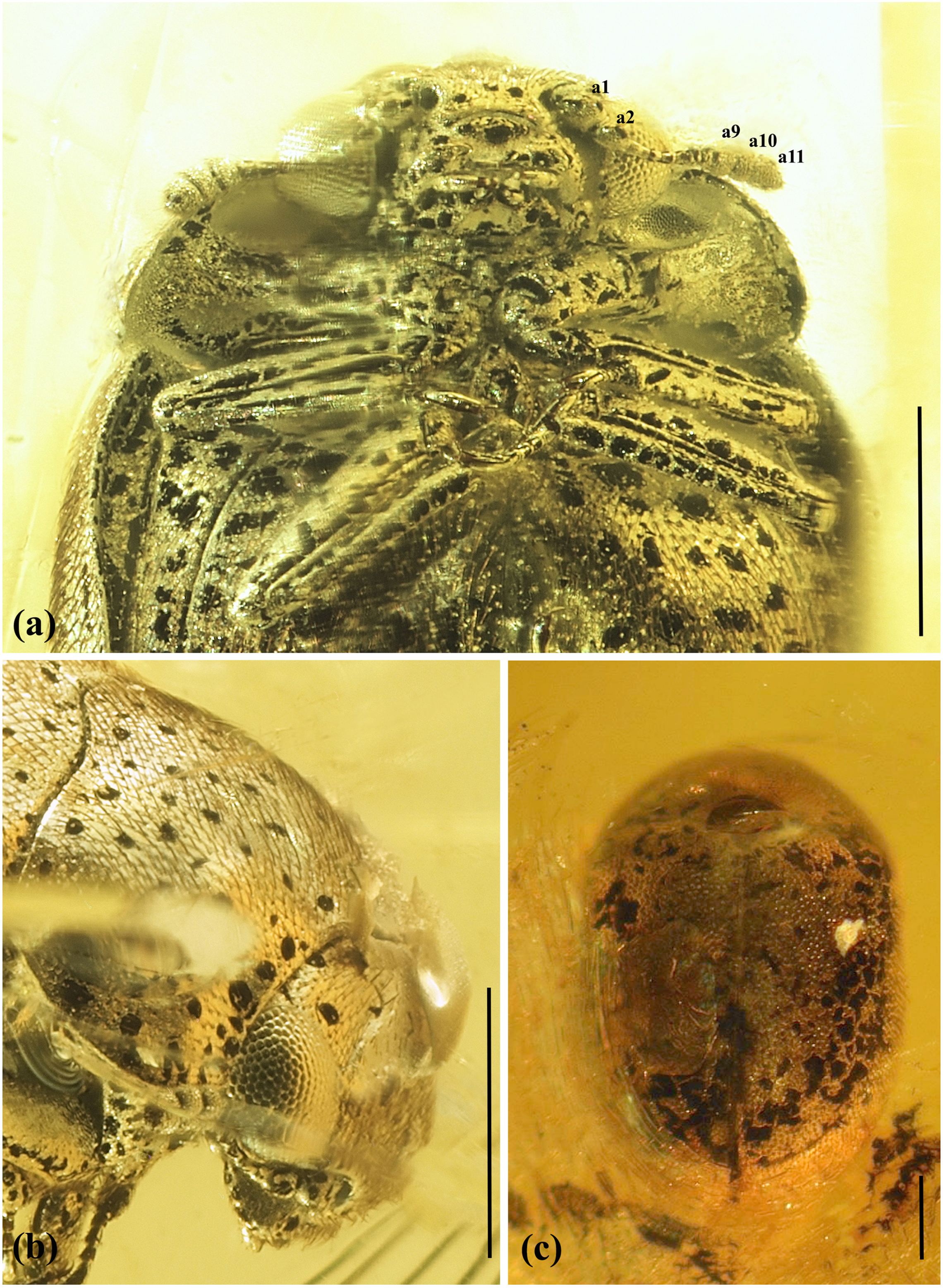

Figure 2. *Attagenus (Aethriostoma) gedanicissimus* sp. nov.: **(a)** details of forebody, ventral view, holotype, 6278 (MAIG); **(b)** head and pronotum, lateral view, holotype, 6278 (MAIG); **(c)** habitus, dorsal view, paratype AlDlo 558 (ADC). Scale bars = 0.5 mm. Abbreviations: a1–a11 are antennomeres 1–11 respectively.

The new Eocene species *A. (Aethriostoma) gedanicissimus* sp. nov. differs from extant representatives of the subgenus in the unicolour blackish body and appendages (in contrast to the rufous palpi and basis of antennae in *A. philippinensis* Háva, 2016 and the entirely rufous appendages in *A. sparsutus* (Reitter, 1881)) and uniform, dark and comparatively sparse setation of dorsum (in contrast to the golden setation of *A. philippinensis* Háva, 2016 distinctly denser on pronotal base). Dorsal setation does not form any light-coloured patterns: fasciae or maculae (in contrast to *A. undulatus* (Motschulsky, 1858) and *A. irroratus* (Blackburn, 1903)). Additionally, in new fossil species the antennomere 11 is slightly tapered beyond the midpoint.

Description of holotype

Measurements: total body length 2.8 mm; pronotal length 0.5 mm, pronotum maximum width 1.5 mm; elytral length 2.5 mm, elytral maximum width 1.7 mm.

Body widely oval, 1.6× as long as wide, convex; integument unicoloured, dark brown (as preserved); pubescence homogenous and moderately dense, consists of fine, short, recumbent, dark setae (pronotal and elytral disc and venter with finer pubescence); punctation homogenous, dense and fine.

Head hypognathous, much narrower than anterior margin of pronotum. Frons flat; frontal median ocellus apparently present. Compound eyes large, oval, prominent, entire, with distinct facets. Mouthparts free. Antennae slightly shorter than head wide (including eyes), sparsely pubescent; 11 antennomeres, clavate, with three antennomeres forming compact club and comprising about one-third of antennal length; scape large, subspherical, 1.2× as long as wide; pedicle subcylindrical, 1.5× as long as wide, smaller than scape, and distinctly wider than antennomere 3; antennomeres 3–6 cylindrical, elongate, 1.7–2.5 × as long as wide, narrow, about 0.6× as wide as pedicle; antennomeres 7–8 nearly as wide as long, slightly dilated apically; antennomeres 9–10 strongly transverse, 1.8–2.0 × as wide as long, dilated apically; antennomere 11 ovoid, about 1.1× as long as wide, with slightly pointed apex.

Pronotum strongly transverse, about 3× as wide as long, base of pronotum nearly as wide as elytral base; lateral margins of pronotum widely rounded, posterior margin bisinuated, narrowly bordered. Hypomeron with deep antennal cavity. Prosternum not forming “collar”, covered with strong microreticulation.

Scutellar shield large, triangular with rounded apex.

Elytra about 1.3× as long as wide, widest at middle of elytral length, slightly narrowed posteriad, with anterior margin deeply concave medially, humeral callus weak. Epipleura narrow, deeply impressed, widest at humeri, reaching anterior margin of abdominal ventrite 1. Metaventrite convex, with longitudinal median line, transverse, about 2× as wide as long; posterior margin slightly concave, anterior margin bisinuated, with subtriangular process medially. Metepisternum wide, 2.6× as long as wide anteriorly.

Legs slender, moderately long; covered with microreticulation and fine, short, recumbent setae. Femora flattened, with longitudinal groove ventrally. Tibiae almost straight (protibiae slightly curved), subcylindrical, with short spine apically, tibia and femora subequal in length; protibia slightly dilated apically, slightly shorter than meso- and metatibia. Tarsi thin, moderately long, about 0.5× as long as tibia; protarsus slightly shorter than meso- and metatarsus; relative length ratios of metatarsomeres 1–5 equal to 1–1–1–1–3. Claws thin and long, free, simple.

Abdomen with five visible ventrites; abdominal sutures almost straight (sutures between ventrites 3 and 5 slightly concave); ventrite 5 with widely rounded apical margin. Relative length ratios of ventrites 1–5 (medially) equal to 10–7–6–6–10.

Paratype

Measurements: total body length 2.8 mm; pronotal length 0.6 mm, pronotum maximum width 1.4 mm; elytral length 2.2 mm, elytral maximum width 1.9 mm.

4 Discussion

4.1 Rovno amber as a geographical variety of Baltic amber

Amber that is chemically similar to Baltic amber is widespread in the Dnieper River basin in Belarus and Ukraine (Savkevich, 1970), in the Kiev (upper Eocene) and Kharkov (lower Oligocene) formations, and in the Quaternary deposits (Zherikhin and Eskov, 1999). The most important amber deposits were discovered near Klesov and near Dubrovitsa in the Rovno region (Ukraine), where the amber has been mined since the 1980s. Some authors believe that this Rovno amber was transported to the Dnieper area from the north across the sea and thus originates from the same region as Baltic amber (e.g. Katinas, 1987). Others suggest a local origin from the Ukrainian shield (e.g. Perkovsky et al., 2007; Mänd et al., 2018). A comparison of inclusions may offer a clue to this problem (Zherikhin and Eskov, 1999), but in the current state of knowledge, the distribution of the different groups of insects gives equivocal results. “The faunas of Ceratopogonidae enclosed in amber from Rovno, Bitterfeld and the Baltic are very similar, showing that they inhabited similar palaeoenvironments in the same palaeogeographic region” (Sontag and Szadziewski, 2011, p. 781), whereas the data obtained from comparison of the Hymenoptera assemblages “provide evidence supporting the previously proposed suggestion on the different origin of four main European sources of succinite” (Perkovsky, 2018, p. 353). On the basis of comprehensive research on one systematic group of Rovno beetles, the Scydmaeninae, it is concluded that subtropical and tropical taxa were present in the region where Rovno amber formed, whereas the Baltic amber beetle assemblage was more hygrophilous and adapted to a colder climate in general (Jałoszyński and Perkovsky, 2016).

Taking into account the existence of many small Eocene amber outcrops in Poland, Ukraine and Belarus (and possible slight variability in their bioinclusions), the naming "Baltic amber sensu lato" for all these local types of succinites including Belarus amber, Rovno amber, etc., could be used. However, we follow the traditional view and use the name "Rovno amber" as separate from "amber type".

4.2 Checklist of Coleoptera known from Rovno amber

As an additional part of the study, a checklist of all known Coleoptera from Rovno amber is compiled and presented below. Synonymy for two taxa is provided according to Gimmel et al. (2019) and Reike et al. (2017).

Family Micromalthidae
1. *Micromalthus priabonicus* Perkovsky, 2016b

Family Leiodidae
2. *Prionochaeta gratschevi* Perkovsky, 2009

Family Ptiliidae
3. *Ptinella rovnoensis* Polilov et Perkovsky, 2004

Family Staphylinidae
4. *Baltostigus* cf. *horribilis* Jałoszyński, 2016
5. *Baltostigus substriatus* Jałoszyński et Perkovsky, 2019
6. *Cephennomicrus giganteus* Jałoszyński et Perkovsky, 2016
7. *Dysanabatium kechrimparense* Bogri, Solodovnikov et Żyła, 2018
8. *Euconnus palaeogenus* Jałoszyński et Perkovsky, 2016
9. *Glaesoconnus unicus* Jałoszyński et Perkovsky, 2016
10. *Leptusa* (*Protoleptusa*) *defuncta* Semenov, Perkovsky et Petrenko, 2001
11. *Orsunius electronefelus* Kypke et Solodovnikov, 2018
12. *Rovnoleptochromus ableptonoides* Jałoszyński et Perkovsky, 2016
13. *Rovnoscydmus frontalis* Jałoszyński et Perkovsky, 2016
14. *Rovnoscydmus microscopicus* Jałoszyński et Perkovsky, 2016
15. *Stenichnus proavus* Jałoszyński et Perkovsky, 2016
16. *Vertheia quadrisetosa* Jałoszyński et Perkovsky, 2016

Family Cantharidae
17. *Malthodes perkovskyi* Kazantsev, 2010
18. *Malthodes rovnoensis* Kazantsev et Perkovsky 2014
19. *Mimoplatycis notha* Kazantsev, 2013
20. *Cacomorphocerus meridionalis* Kazantsev et Perkovsky, 2020

Family Dermestidae
21. *Dermestes* (s. str.) *vetustus* Zhantiev, 2006
22. *Attagenus* (*Aethriostoma*) *gedanicissimus* sp. nov.

Family Ptinidae
23. *Sucinoptinus brevipennis* Bellés et Perkovsky, 2016
24. *Sucinoptinus rovnoensis* Bellés et Perkovsky, 2016

Family Malachiidae
25. *Protocephaloncus perkovskyi* Tshernyshev, 2016

Family Smicripidae
26. *Smicrips fudalai* Kupryjanowicz, Lyubarsky et Perkovsky, 2019

Family Cyclaxyridae
27. *Neolitochropus bedovoyi* (Lyubarsky et Perkovsky, 2011a)
= *Stilbus bedovoyi* Lyubarsky et Perkovsky, 2011b
= *Neolitochropus hoffeinsorum* Lyubarsky et Perkovsky 2016

Family Cryptophagidae
28. *Cryptophagus alexagrestis* Lyubarsky et Perkovsky, 2011a
29. *Cryptophagus harenus* Lyubarsky et Perkovsky, 2012b
30. *Micrambe sarnensis* Lyubarsky et Perkovsky, 2010
31. *Telmatophilus sidorchukae* Lyubarsky et Perkovsky, 2020

Family Erotylidae
32. *Xenohimatium rovnense* Lyubarsky et Perkovsky, 2012a

Family Latridiidae
33. *Latridius alexeevi* Bukejs, Kirejtshuk et Rücker, 2011
= *Latridius usovae* Sergi et Perkovsky, 2014

Family Melandryidae
34. *Orchesia rasnitzyni* Nikitsky, 2011

Family Mordellidae
35. *Glipostena ponomarenkoi* Odnosum et Perkovsky, 2009

Family Scraptiidae
36. *Anaspis* (*Spanisa*) *horaki* Perkovsky et Odnosum, 2009

Family Chrysomelidae
37. *Archealtica convexa* Nadein in Nadein, Perkovsky et Moseyko, 2015
38. *Crepidodera decolorata* Nadein et Perkovsky, 2010
39. *Manobriomorpha eocenica* Nadein in Nadein et Perkovsky, 2010
40. *Paleophaedon minutus* Nadein et Perkovsky, 2010
41. *Psyllototus progenitor* Nadein in Nadein et Perkovsky, 2010
42. *Taphioporus rovnoi* Moseyko et Perkovsky in Nadein, Perkovsky et Moseyko, 2015

Family Anthribidae
43. *Glaesotropis diadiasashai* Gratshev et Perkovsky, 2008
44. *Eduardoxenus unicus* Legalov, Nazarenko et Perkovsky, 2018

Family Rhynchitidae
45. *Pseudomesauletes groehni* Bukejs et Legalov, 2019a

Family Curculionidae
46. *Arostropsis perkovskyi* Bukejs et Legalov, 2019b
47. *Caulophilus martynovae* Legalov, Nazarenko et Perkovsky, 2019
48. *Caulophilus zherikhini* Nazarenko, Legalov et Perkovsky, 2011
49. *Dorytomus vlaskini* Legalov, Nazarenko et Perkovsky, 2019
50. *Klesovia pubescens* Petrov et Perkovsky, 2018
51. *Paonaupactus gracilis* Legalov, Nazarenko et Perkovsky, 2019
52. *Paonaupactus katyae* Legalov, Nazarenko et Perkovsky, 2019
53. *Protoceletes hirtus* Nazarenko et Perkovsky, 2016
54. *Rovnoslonik damzeni* Legalov, Nazarenko et Perkovsky, 2019
55. *Stenommatomorphus hexarthrus* Nazarenko in Nazarenko et Perkovsky, 2009
56. *Taphramites rovnoensis* Petrov et Perkovsky, 2008
57. *Xylechinus mozolevskae* Petrov et Perkovsky, 2008

The known assemblage of the Rovno amber Coleoptera composes 57 species belonging to 50 genera and 20 families. A total of 49 species are known only from this Lagerstätte, and eight species (*Anaspis horaki*, *Attagenus gedanicissimus* sp. nov., *Baltostigus horribilis*, *Dysanabatium kechrimparense*, *Latridius alexeevi*, *Mimoplatycis notha*, *Neolitochropus bedovoyi*, *Orchesia rasnitzyni*) are also known or are primarily described from Baltic amber (i.e. are common for these two ambers). From the listed beetle genera with described species, 28 genera (56 %) are common with Baltic amber, i.e. have described analogues; 13 genera are palaeoendemic for Rovno amber (26 %); and 9 genera (18 %) are recent but have no described species in Baltic amber.

The study of Rovno amber was focused first of all on new descriptions and on the search for new taxa, while studies on the similarities and differences with the assemblage of Baltic amber species were mainly beyond the scope of the current palaeontological papers. The ratio of 49 palaeoendemic species to eight species common with Baltic amber is a subjective present-day stage of research, but not an objective and real ratio of common and "endemic" Coleoptera in these ambers. The species list of the Rovno amber beetles does not contain any data on many species-rich beetle families in Baltic amber (Aderidae, Carabidae, Cerambycidae, Cleridae, Elateridae, and Scirtidae) at all: although these families are known in Rovno amber, the representatives are still without generic or specific attribution. We suppose that the lack of such information is a very important part of the general scarcity of reliable data for analysis at the moment.

Data availability. No data sets were used in this article.

Author contributions. AB and VIA conceived of the presented idea and wrote the manuscript with input from JH. AB designed the study and prepared the description of the new species, JH supervised the differential diagnosis of the new species, VIA performed the list of Rovno fossil beetles. All authors provided critical feedback and helped to shape the research, analysis and manuscript.

Competing interests. The authors declare that they have no conflict of interest.

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