Baltic J. Coleopterol. 21(2) 2021
ISSN 1407 - 8619

The first record of Cupedidae (Coleoptera: Archostemata) from Eocene Rovno amber: *Cupes groehni* Kirejtshuk, 2005 examined using X-ray microtomography

Andris Bukejs, Vitalii I. Alekseev, Kristaps Kairišs

Bukejs A., Alekseev V.I., Kairišs K. 2021. The first record of Cupedidae (Coleoptera: Archostemata) from Eocene Rovno amber: *Cupes groehni* Kirejtshuk, 2005 examined using X-ray microtomography. *Baltic J. Coleopterol., 21(2): 111 - 116.*

Archostematan species *Cupes groehni* Kirejtshuk, 2005 is recorded from Upper Eocene Rovno amber. It is the first record of the family Cupedidae from this *Lagerstätte* and the ninth coleopteran species common to Baltic and Rovno ambers. Specimen is examined and illustrated using X-ray micro-computed tomography (μCT).

Key words: palaeocoleopterology, reticulated beetles, Cenozoic, Paleogene, fossil resin, X-ray micro-CT.

Andris Bukejs. Institute of Life Sciences and Technologies, Daugavpils University, Vienības 13, Daugavpils, LV-5401, Latvia; e-mail: carabidae@inbox.lv

Vitalii I. Alekseev. Shirshov Institute of Oceanology, Russian Academy of Sciences, Nahimovskiy prospekt 36, Moscow, 117997, Russia; e-mail: alekseew0802@yahoo.com
Kaliningrad Regional Amber Museum, Marshal Vasilevskii square 1, Kaliningrad, 236016, Russia
Institute of Living Systems, Immanuel Kant Baltic Federal University, Nevskogo Street 14, Kaliningrad, 236016, Russia

Kristaps Kairišs. Institute of Life Sciences and Technologies, Daugavpils University, Vienības 13, Daugavpils LV-5401, Latvia; e-mail: kr.kairiss@gmail.com

INTRODUCTION

Cupedidae or reticulated beetles is a small family within the suborder Archostemata (Beutel et al. 2008; Bouchard et al. 2011) containing nine extant genera and about 40 species distributed in South and North America, Africa, Madagascar, Japan, SE Asia, Australia and Oceania (Neboiss 1984; Hörnschemeyer 2009, 2016). Fossil representatives are most numerous with 19 genera and 67 species known from Mesozoic and Cenozoic deposits (Kirejtshuk 2020).

The genus *Cupes* Fabricius, 1801 includes one extant Nearctic species, *Cupes capitatus* Fabricius, 1801, occurring in eastern North America from south-eastern Ontario (Canada) to Georgia (USA) (Hörnschemeyer 2016) and 20 fos-

sil species recorded from different Cenozoic deposits (Kirejtshuk 2020). Most diversity of fossil cupedines has been described from Eocene (Priabonian-Bartonian) Baltic amber (Kirejtshuk 2005; Kirejtshuk et al. 2016) and from Eocene (Lutetian) outcrops of Grube Messel Pit (Hessen, Germany) and Eckefeld Maar (Hessen, Germany) (Kirejtshuk 2020).

Records of Archostemata are unknown from Upper Eocene Rovno amber. In the present paper, we provide the first record of Cupedidae from this *Lagerstätte*. Female of *Cupes groehni* Kirejtshuk, 2005 was examined and illustrated using X-ray micro-CT.

MATERIAL AND METHODS

The material examined is deposited in the private collection of Jonas Damzen (Vilnius, Lithuania) [JDC]. The amber pieces were polished by hand, allowing improved views of the included specimens, and was not subjected to any supplementary fixation.

Deposits of Rovno or so-called Ukrainian amber are situated in the north of the Rovno and Zhitomir regions within the boundaries of Ukrainian Polesie as well in the south of Belarus (the Belarus Polesie) (Perkovsky et al. 2003, 2007). The most productive is the locality near Klesov in Ukraine, but over outcrops are also known (Dubrovitsa, Vladimirets etc.) (Perkovsky 2017). The area where amber-bearing deposits developed is situated at the periphery of the northwestern part of the Ukrainian Crystalline Shield. The stratigraphy and age of amber-bearing strata is described by Perkovsky et al. (2003) in detail. The relationship between the Rovno and Baltic amber deposits and subjectiveness of present-day results of the beetle assemblage research are briefly discussed in Bukejs et al. (2020).

The X-ray micro-CT (iCT) observations of specimen were conducted at the Daugavpils University, Daugavpils, Latvia using Zeiss Xradia 510 Versa system. Scans were performed with a polychromatic X-ray beam at an energy of 30 kV and power of 2 W. Sample to detector distance was set to 22.4 mm and source to sample distance 29.53 mm. Tomographic slices were generated from 1601 rotation steps through a 360-degree rotation, using a 4× objective, and exposure time during each projection was set to 14 seconds. Variable exposure was set to 2 times at thickest part of the amber to achieve similar amounts of photon throughput over whole sample. Acquired images were binned (2×2×2) giving a voxel size of 3.8 ìm. Since specimen length was bigger than the field of view for selected parameters, we carried out image acquisition using automated vertical stitch function for four consecutive scans with identical scanning parameters. Between those scans field of view was set to overlap 38 % of data between adjacent fields of view. Images were imported into Dragonfly PRO (ver. 2020.1) software platform for interactive segmentation and 3D visualization. Prior to the full scan, a 75-minute warmup scan was conducted with identical stitch parameters, but with reduced rotational steps (201) and exposure time was set to 2seconds.

Observations of this specimen were made using a Nikon SMZ 745T stereomicroscope. The photographs of specimens were taken using a Canon 70D camera with a macro lens (Canon MPE-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, and the resulting images were edited to create figures using Adobe Photoshop CS5.

RESULTS AND DISCUSSION

Suborder Archostemata Kolbe, 1908
Family Cupedidae Laporte, 1836
Subfamily Cupedinae Laporte, 1836
Genus *Cupes* Fabricius, 1801

***Cupes groehni* Kirejtshuk, 2005**
(Figs. 1–3)

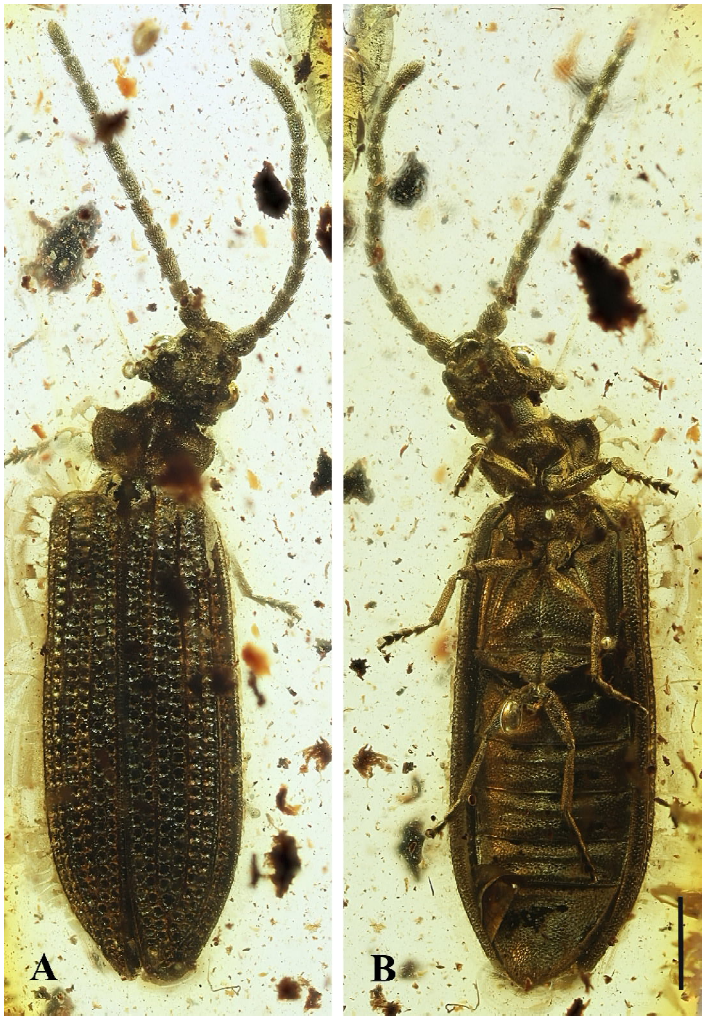

Fig. 1. Photomicrographs of *Cupes groehni* Kirejtshuk, 2005, Rovno amber, JDC 8373 [JDC], habitus: A – dorsal view; B – ventral view. Scale bar represents 1.0 mm.

Material examined. One specimen with collection number "JDC 8373" [JDC]; adult, sex female. A complete beetle included in a transparent, yellow amber piece with dimensions of 21 mm × 10 mm and a maximum thickness of 6 mm, preserved without supplementary fixation. Syninclusions: a few stellate fagacean trichomes, and numerous small detritus particle.

Strata. Rovno amber, Upper Eocene.

Locality. Rovno **[**Rivne] Region (without locality), Ukraine.

Measurements: body length 6.9 mm; head length 1.2 mm; pronotum length 0.8 mm, pronotum maximum width 1.2 mm; elytra length 4.9 mm, elytra maximum combined width 1.9 mm.

Cupes groehni was described from Eocene Baltic amber based on five specimens with certain variability in size and density of scales, shape of posterior tubercles on head, pronotal width, and body length (Kirejtshuk 2005). The specimen JDC 8373 is morphologically similar to *C. groehni* (according to Kirejtshuk 2005) and is identified as a

probable female, showing the sexually dimorphic characters of wider pronotum, more subcircular elytral cells and smaller body size.

A check-list of the described Coleoptera from Rovno amber has been compiled recently (Bukejs et al. 2020). The importance of studies on the coleopteran assemblage and a special attention to the species common to different Eocene ambers was discussed and pointed out. Taking into account the data from recent papers (Bukejs & Legalov 2020; Sokolov & Perkovsky 2020; Kupryjanowicz et al. 2021; Legalov et al. 2021) and our record of *Cupes groehni*, 62 species of 24 families are reported from Rovno amber (as of 21 May 2021). Nine coleopteran species common

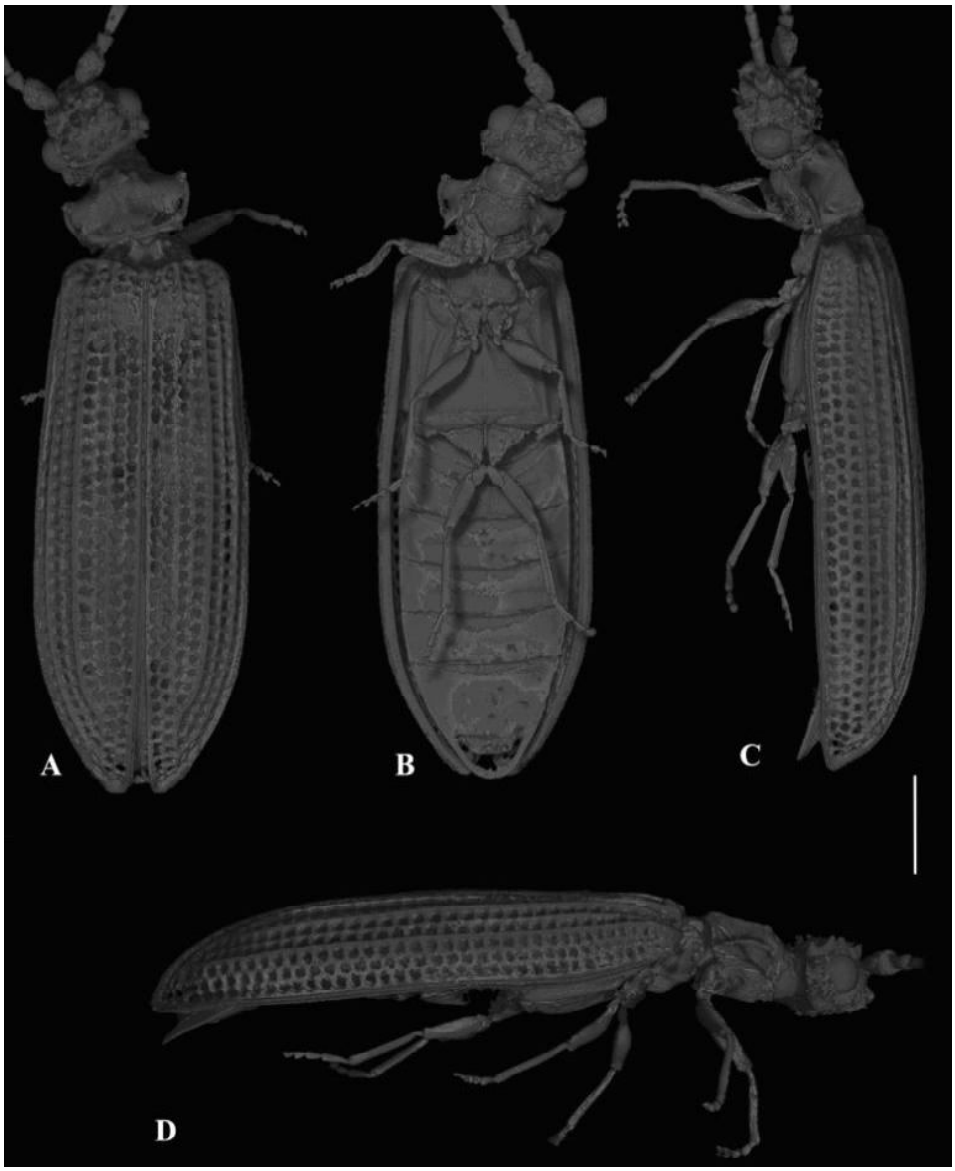

Fig. 2. X-ray micro-CT renderings of *Cupes groehni* Kirejtshuk, 2005, Rovno amber, JDC 8373 [JDC], habitus: A – dorsal view; B – ventral view; C – left lateral view; D – right lateral view. Scale bar represents 1.0 mm.

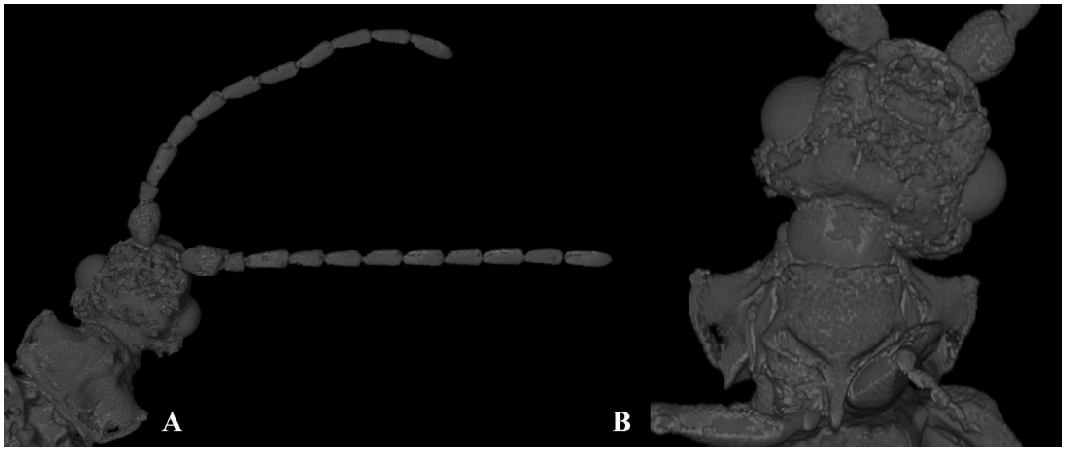

Fig. 3. X-ray micro-CT renderings of *Cupes groehni* Kirejtshuk, 2005, Rovno amber, JDC 8373 [JDC]: A – pronotum and head, dorsal view; B – details of forebody, ventral view. Not to scale.

to Baltic and Rovno ambers, including the current finding, are known. The newly reported specimen represents the first documented finding of the archostematan family Cupedidae in Rovno amber, as well a small argument confirming the evident space-time closeness of Baltic and Rovno amber.

ACKNOWLEDGEMENTS

We are sincerely grateful to Mr. Jonas Damzen (Vilnius, Lithuania) for the loan of the interesting fossil material, assistance during our amber research and permission to use photographs of studied specimen, and to Dr. Alexander G. Kirejtshuk (Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia) for constructive advice and comments on the studied specimen. We thank two anonymous reviewers for valuable suggestions that improved the manuscript.

The study of VIA was done with a support of the state assignment of IO RAS (Theme No. 0128-2021-0012).

REFERENCES

Beutel R.G., Ge S., Hörnschemeyer T. 2008. On the head morphology of *Tetraphalerus*, the phylogeny of Archostemata and the basal branching events in Coleoptera. Cladistics 24: 270–298.

Bouchard P., Bousquet Y., Davies A.E., Alonso-Zarazaga M.A., Lawrence J.F., Lyal C.H.C., Newton A.F., Reid C.A.M., Schmitt M., Ślipiński A. 2011. Family-group Names in Coleoptera (Insecta). ZooKeys 88: 1–972.

Bukejs A., Háva J., Alekseev V.I. 2020. 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. Fossil Record 23: 95–104.

Bukejs A., Legalov A. A. 2020. The first record of Brentidae (Coleoptera) in Eocene Rovno amber with description of a new fossil species of *Toxorhynchus* Scudder, 1893. Fossil Record 23: 169–177.

Hörnschemeyer T. 2009. The species-level phylogeny of archostematan beetles—where do

Micromalthus debilis and *Crowsoniella relicta* belong? Systematic Entomology 34: 533–558

Hörnschemeyer T. 2016. 5. Archostemata Kolbe, 1908. In: Beutel R.G., Leschen R.A.B. (eds.): Handbook of Zoology. Arthropoda: Insecta. Coleoptera, Beetles. Vol. 1. Morphology and Systematics (Archostemata, Adephaga, Myxophaga, Polyphaga partim). 2nd edition. Walter de Gruyter, Berlin/Boston. pp. 41–61.

Iablokoff-Khnzorian S.M. 1960. New beetles from Baltic amber. Paleontologicheskij Zhurnal 3: 90–101. (in Russian)

Kirejtshuk A.G. 2005. A revision of the genus *Cupes* Fabricius, 1801 from Baltic amber and some notes on taxonomy and composition of the family Cupedidae (Coleoptera, Archostemata). Mitteilungen aus dem Geologisch-Paläontologischen Institut der Universität Hamburg 89: 55–84.

Kirejtshuk A.G. 2020. Taxonomic review of fossil coleopterous families (Insecta, Coleoptera). suborder Archostemata: superfamilies Coleopseoidea and Cupedoidea. Geosciences, 10 (2): 73.

Kirejtshuk A.G., Nel A., Kirejtshuk P.A. 2016. Taxonomy of the reticulate beetles of the subfamily Cupedinae (Coleoptera: Archostemata), with a review of the historical development. Invertebrate Zoology 13 (2): 61–190.

Kupryjanowicz J., Lyubarsky G.Yu., Perkovsky E.E. 2021. *Heterhelus buzina* sp. n. (Coleoptera: Kateretidae) from Rovno amber: the first proxy for *Sambucus* in the Eocene of Eastern Europe. Invertebrate Zoology 18 (1): 16–24

Legalov A. A., Nazarenko V. Y., Perkovsky E. E. 2021. A new species of the genus *Glaesotropis* Gratshev and Zherikhin, 1995 (Coleoptera, Anthribidae) from Rovno amber. *Fossil Record* 24: 1–7.

Neboiss A. 1984. Reclassification of *Cupes* Fabricius (*sensu lato*), with descriptions of new genera and species (Cupedidae, Coleoptera). Systematic Entomology 9: 443–477.

Perkovsky E.E. 2017. Rovno amber caddisflies (Insecta, Trichoptera) from different localities, with information about three new sites. Vestnik zoologii 51 (1): 15–22.

Perkovsky E. E., Zosimovich V. Y., Vlaskin A. P. 2003. Rovno amber insects: first results of analysis. Russian Entomological Journal 12: 119–126.

Perkovsky E. E., Rasnitsyn A. P., Vlaskin A. P., Taraschuk M. V. 2007. A comparative analysis of the Baltic and Rovno amber arthropod faunas: representative samples. African Invertebrates 48: 229–245.

Sokolov A. V., Perkovsky E. E. 2020. The first Eocene species of *Bacanius* (Coleoptera: Histeridae: Dendrophilinae) from Rovno amber. Russian Entomological Journal 29: 157–160.

Appendix 1. *Cupes groehni* Kirejtshuk, 2005, Rovno amber, JDC 8373 [JDC], X-ray microtomography volume rendering of the habitus.
Supplementary Video:
https://doi.org/10.5281/zenodo.5044906

Received: 28.08.2021
Accepted: 21.12.2021
Published: 30.12.2021