https://doi.org/10.59893/bjc.23(2).021
Baltic J. Coleopterol. 23(2) 2023
ISSN 1407 – 8619

Two new fossil Silinae (Coleoptera, Cantharidae) from Baltic amber

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Bukejs A., Fanti F. 2023. Two new fossil Silinae (Coleoptera, Cantharidae) from Baltic amber. *Baltic J. Coleopterol., 23 (2): 331 - 339.*

Based on inclusions in Eocene Baltic amber, two new fossil species of the family Cantharidae, namely *Podosilis groehni* sp. nov. (the second fossil species of the genus) and *Silis* (*Silis*) *carsteni* sp. nov., are described and illustrated. These new species are compared with the other known taxa of both genera from various amber deposits.

Key words: soldier beetles, paleoentomology, new taxa, Eocene, fossil resin

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INTRODUCTION

The soldier beetle subfamily Silinae Mulsant, 1862 (Cantharidae) is rare in the present-day Europe and represented by three species only, *Silis ruficollis* (Fabricius, 1775), *S. mingrelica* (Kazantsev, 1994) and *Autosilis nitidula* (Fabricius, 1792) (Delkeskamp 1977; Kazantsev & Brancucci 2007). The subfamily is more diverse in the Eocene Baltic forest. Three extinct genera, *Curche* Alekseev et Kazantsev, 2014, *Electrosilis* Kazantsev, 2013, and *Markus* Fanti et M.J. Pankowski, 2018, have been described from this fossil resin (Kazantsev 2013; Alekseev & Kazantsev 2014; Fanti & Pankowski 2018). Furthermore, one fossil species of the extant genus *Autosilis* Kazantsev, 2011 (Fanti & Damgaard 2018), one species of *Podosilis* Wittmer, 1978 (Kazantsev 2020), and two species of *Silis* Charpentier, 1825 (Parisi & Fanti 2019; Fanti & Pankowski 2022) are known. Additionally, representatives of *Silis* have been reported from Baltic amber without detailed descriptions (Klebs 1910; Bachofen-Echt 1949; Fanti 2017).

The genus *Silis* is also known from the Miocene Dominican amber (Fanti & Pankowski 2021) and the Miocene Mexican amber (Wittmer 1963). A species of the subfamily Silinae was also described based on adpression fossil from Florissant, USA (Wickham 1914). A specimen of the extant *Silis ruficollis* (Fabricius, 1775) was reported from the Holocene deposit of Sweet Track, United Kingdom (5200–5100 years old) (Girling 1979).

Silis is widely distributed in the present-day Holarctic and is particularly common in the Neotropical region (Delkeskamp 1977;

Ramsdale 2002; Kazantsev & Brancucci 2007; Constantin 2009, 2017), while the genus *Podosilis* is distributed in south-eastern Palaearctic and Oriental regions and includes about 60 species (Wittmer 1978, 1997; Kazantsev 2019).
In the current paper, two new species of Silinae belonging to *Podosilis* and *Silis* are described.

MATERIALS AND METHODS

The material examined is deposited in the collection of Carsten Gröhn (Glinde, Germany) [CCGG], separately deposited in the Center of Natural History (Centrum für Naturkunde – CeNak; formerly Geologisch-Paläontologisches Institut und Museum der Universität Hamburg) [GPIH], Hamburg, Germany.

The amber pieces were polished manually with emery papers of different grit sizes, allowing improved views of the included specimens, and were not subjected to any supplementary fixation.
The specimens observations were made using a Nikon SMZ 745T stereomicroscope. The photographs of the holotype were taken using a Canon 90D camera with a macro lens (Canon MPE-65 mm). Extended depth of field at high magnifications was achieved by stacking multiple images from a range of focal planes using Helicon Focus v. 6.0.18 software, and the final images were edited to create figures using Adobe Photoshop 7.0. Measurements of specimens were made using an ocular micrometer on a stereomicroscope.

SYSTEMATIC PALEOENTOMOLOGY

Family Cantharidae Imhoff, 1856
Subfamily Silinae Mulsant, 1862
Genus *Podosilis* Wittmer, 1978

***Podosilis groehni* sp. nov.**
(Fig. 1)

Type material. Holotype: GPIH no. 5202, CCGG no. 8701 (ex coll. Jonas Damzen JDC-12438); adult, male. A complete beetle with partially exposed metathoracic wings is included in a transparent, yellow amber piece with dimensions of 36×19 mm and a maximum thickness of 6 mm; preserved without supplementary fixation. Syninclusions: one Brachycera (Diptera) specimen, two Nematocera (Diptera) specimen, seven? Acarina (Arachnida) nymphs, and few stellate Fagaceae trichomes.

Type locality. Amber mine in Yantarny settlement, the Sambian Peninsula, the Kaliningrad Region, Russia.

Type stratum. Baltic amber; Middle–Upper Eocene (Sadowski et al. 2017, 2020; Seyfullah et al. 2018; Bukejs et al. 2019; Kasiński et al. 2020).

Systematic placement. The specimen considered here was assigned to the genus *Podosilis* based on a combination of the following morphological characters: (1) internal claws of all legs apically bifurcate (simple in *Eusilis*, *Silis* and *Autosilis*, and only the internal claw of forelegs apically bifurcate in *Asiosilis*), (2) claws without denticle basally (all claws with large denticle in *Asiosilis*), and (3) tarsomere 4 is widest than others tarsomeres (narrow as others tarsomeres in *Eusilis*).

Differential diagnosis. *Podosilis groehni* sp. nov. differs from *P. gedaniensis* Kazantsev, 2020 (the single fossil species of the genus, the holotype is female) by the obsolete elytral humeral costae (distinct in *P. gedaniensis*); this character cannot be considered as sexual dimorphism. Also, the new species differs from the extant species of *Podosilis* in having a extremely smaller body size.

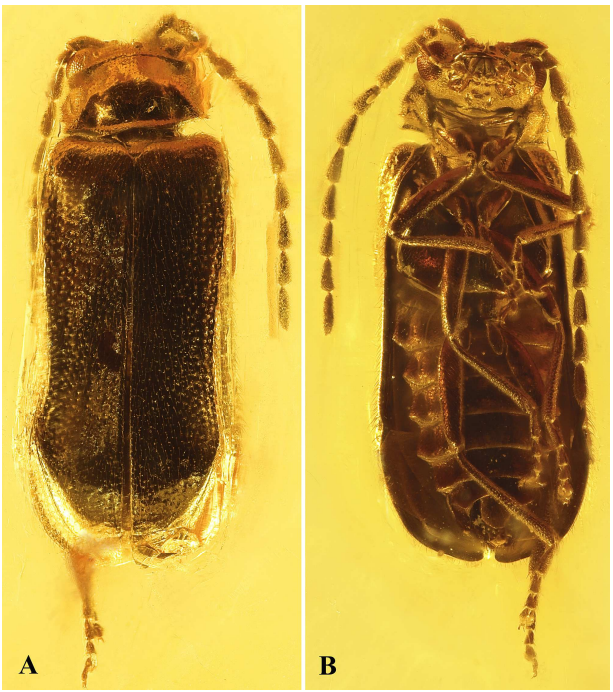

Fig. 1. *Podosilis groehni* sp. nov., holotype, No 5202 [GPIH]: A – habitus, dorsal view; B – habitus, ventral view.

Description. Body elongate-oval, slightly flatened dorsally; sparsely covered with homogenous, short, semierect setae; integument unicolorous brown (as preserved). Measurements: total body length 3.0 mm (from anterior margin of head to elytral apex); pronotum length 0.5 mm, pronotum maximum width 0.8 mm; elytra length 2.4 mm, elytra maximum width 1.2 mm, elytra width at base 1.0 mm.

Head short, transverse, pubescent, with fine punctation, partially covered by pronotum; frons convex. Compound eyes large, hemispherical and strongly prominent, inserted laterally. Mandibles large, simple, and falciform. Maxillary palpi 4-segmented, palpomeres unequal in length, terminal palpomere weakly securiform. Labial palps 3-segmented, terminal palpomere securiform. Antennae inserted far from inner margin of eyes, rather long, extending about to posterior one-third of elytral length; 11-segmented, filiform, all antennomeres covered with short, semierect setae; scape subcylindrical, dilated apically, elongate, 2.5× longer than wide, robust, curved; antennomere 2 shortest, subtrapezoidal, dilated apically, slightly elongate, 1.25× longer than wide, about 0.5× as long as scape; antennomere 3 subcylindrical, slightly dilated apically, elongate, 2.25× longer than wide, slightly shorter than antennomere 4; antennomeres 4–8 equal in size and shape, robust, subcylindrical, dilated apically, elongate, 2.5× longer than wide, about 2.0× as long as antennomere 2; antennomeres 9–10 equal equal in size and shape, robust, subcylindrical, dilated apically, slightly shorter than antennomere 8; antennomere 11 elongate-oval, 3.1× longer than wide, narrowly rounded at apex;

relative length ratios of antennomeres 1–1 equal to 10:5:9:10:10:10:10:10:9:9:11.
Pronotum subtrapezoidal, transverse, 1.6× wider than long, widest in posterior one-third of its length, slightly wider than head; punctation fine and sparse on disc, and distinctly denser laterally; disc convex, with subtriangular impressions basally and suboval impressions anterolaterally. Pronotal apical margin slightly rounded; basal margin almost straight; lateral margins rounded, incised near base and near anterior angles, protruding postero-medially with two small and obtuse tooth. Anterior angles obtuse, slightly projecting; posterior angles acute, distinctly projecting posteriad forming denticle. Prohypomera densely covered with fine punctation.

Scutellar shield subtriangular with widely rounded apex, with few fine punctutes. Elytra wider than pronotum, elongate-oval, 2.0× longer than wide, subparallel-sided in anterior half and slightly widened in posterior half, rounded apically, completely covering abdomen; humeral costae obsolete, slightly distinct in anterior two-thirds of elytral lenght; with large oval impression post-medially; elytral punctation small and rather dense, distance between punctures about 0.7–1.3× diameter of one puncture, punctures distinctly denser laterally. Metanepisternum subtriangular, narrowed posteriad, with fine punctation. Metaventrite wide, with rounded posterior margin, covered with fine punctation; disc convex, apparently with discrimen. Metathoracic wings fully developed.

Legs rather long, slender, pubescent. Procoxae conical, large; mesocoxae narrowly oval, convex; metacoxae narrow, strongly transverse. Trochanters elongate, convex. Femora narrow, slightly flattened, straight. Tibiae subcylindrical, apparently with two spines apically, pro- and mesotibiae nearly as long as pro- and mesofemora respectively, metatibiae distinctly longer than metafemora. Tarsal formula 5-5-5; tarsomere 1 longest, elongate, slightly dilated apically; tarsomere 2 shorter than tarsomere 1; tarsomere 3 subtriangular, dilated apically, shorter than tarsomere 2; tarsomere 4 widest, deeply bilobed; tarsomere 5 subcylindrical, elongate, curved, enlarged apically. Pretarsal claws without basal tooth, inner claw of all legs bifurcate apically.

Abdomen with seven visible sternites (ventrites), covered fine, inconspicuous punctation; sternite 7 with elongate lobe with rounded apex; ultimate tergite longer and wider than ultimate sternite, with prominent conical lateral processes.

Etymology. The specific epithet is a patronym; the new species is named in honor of Mr. Carsten Gröhn (Glinde, Germany), an enthusiast and specialist in Baltic amber.

Remark. The lateral margins of pronotum incised and denticulated, and the ultimate abdominal sternite long and narrow indicate that the specimen is male.

Genus *Silis* Charpentier, 1825
Subgenus *Silis* Charpentier, 1825

***Silis* (*Silis*) *carsteni* sp. nov.**
(Fig. 2)

Type material. Holotype: GPIH no. 5203, CCGG no. 8702, (ex coll. Jonas Damzen JDC-12439); adult, female. A complete beetle with partially exposed metathoracic wings is included in a transparent, yellow amber piece with dimensions of 31×16 mm and a maximum thickness of 5 mm; preserved without supplementary fixation. Syninclusions: few stellate Fagaceae trichomes.

Fig. 2. *Silis* (*Silis*) *carsteni* sp. nov., holotype, No 5203 [GPIH]: A – habitus, dorsal view; B – habitus, ventral view.

Type locality. Amber mine in Yantarny settlement, the Sambian Peninsula, the Kaliningrad Region, Russia.

Type stratum. Baltic amber; Middle–Upper Eocene (Sadowski et al. 2017, 2020; Seyfullah et al. 2018; Bukejs et al. 2019; Kasiński et al. 2020).

Systematic placement. The specimen considered here was assigned to the genus *Silis* based on a combination of the following morphological characters: (1) the pronotum non-incised at lateral sides (incised in females of *Podosilis*), with impressions (without impressions in *Autosilis*), (2) abdomen with six visible sternites (seven sternites in females of *Podosilis*), (3) tarsomere 4 wider than others tarsomeres (tarsomere 4 as wide as tarsomeres 1–3 in *Eusilis*), (4) claws simple, internal claw with obtuse and small tooth basally (all claws with large denticle basally in *Asiosilis*), and (5) the distal margin of ultimate tergite without conspicuous processes at lateral sides.

Differential diagnosis. A new species resembles *Silis* (*s. str.*) *boninoi* Fanti & M. G. Pankowski, 2022 (Baltic amber; male), but differs in flat and widely explanate pronotal lateral sides, pronotum widest basally (in contrast to pronotum widest in the middle in *S. boninoi*), obtuse posterior pronotal angles (in contrast to acute triangular porterior pronotal angles in *S. boninoi*), larger pronotum, different shape of antennomere 1, and elytra wider at humeri. *Silis* (*s. str.*) *carsteni* sp. nov. differs from *Silis* (*s. str.*) *lombardii* Parisi & Fanti, 2019 (Baltic amber; male) by the considerably smaller body size. A new species differs from Dominican amber species *Silis* (*s. str.*) *hegnai* Fanti & M. G. Pankowski, 2021 and *Silis* (*s. str.*) *curleri* Fanti & M. G. Pankowski, 2021 by distinctly smaller body size; and from *Silis* (*s. str.*) *chiapasensis* Wittmer, 1963 (described from Mexican amber) by the

smaller body size and the longer elytra comparated to abdominal length.

Description. Body elongate-oval, flatened; sparsely covered with homogenous, short, semierect to erect setae; integument unicolorous dark brown (as preserved). Measurements: total body length 2.8 mm (from anterior margin of head to elytral apex); pronotum length 0.5 mm, pronotum maximum width 1.0 mm; elytra length 2.3 mm, elytra maximum width 1.3 mm, elytra width at base 1.0 mm.

Head partially covered by pronotum, small, short, transverse, covered with fine punctation, distinctly narrower than anterior margin of pronotum. Compound eyes rather small, nearly hemispherical, strongly prominent, inserted in upper and lateral parts of head. Mandibles falciform, simple. Maxillary palpi 4-segmented, unequal in length, terminal palpomere securiform. Labial palps 3-segmented, terminal palpomere securiform. Antennae inserted far from from inner margin of eyes, relatively short, extending about to middle of elytra, 11-segmented, filiform, all antennomeres covered with short, semierect setae; scape longest, strongly elongate, about 3.0× longer than wide, not particularly robust, curved, dorso-apically enlarged and sligthly protruding forward; antennomere 2 shortest, cylindrical, about 0.6× as long as scape; antennomeres 3–5 equal in size and shape, subcylindrical, dilated apically, 2.4× as long as wide, robust, about 1.2× as long as antennomere 2; antennomeres 6–10 sub-equal in size and shape, subcylindrical, dilated apically, 2.5× as long as wide, slightly shorter than antennomere 5; antennomere XI elongate oval with acute and long apex, about 3.5× as long as wide; relative length ratios of antennomeres 1–1 equal to 9:5:6:6:6:5:5:5:5:5:7.

Pronotum trapezoidal, strongly transverse, about 2.0× wider than long, widest in posterior one-fourth of its length, distinctly wider than head; punctation fine and sparse on disc and denser laterally; disc convex, with subtriangular impressions basally and suboval impressions anterolaterally; pronotal sides widely explanate. Pronotal anterior margin rounded medially; posterior margin slightly concave laterally and distinctly protruding medially forming wide lobe; lateral margins weakly rounded, non-incised, with two obtuse and small tooth (one at anterior angles and one near posterior margin). Anterior angles obtuse, rounded, slightly projecting; posterior angles obtuse. Prohypomera covered with fine punctation,

Scutellar shield subtrapezoidal, rounded apically, with fine punctation. Elytra at humeri wide and slightly narrower than pronotum, while in posterior one-third of elytral length wider than pronotum, elongate-oval, 1.8× longer than wide, subparallel-sided in anterior two-thirds and strongly widened in posterior one-third, rounded apically, completely covering abdomen; humeri distinct; humeral costae sharp, distinct in anterior two-thirds of elytral lenght elytral punctation small and rather dense, distance between punctures apparently lesser than diameter of one puncture.

Metaventrite wide, with rounded posterior margin, covered with fine punctation; disc convex. Metathoracic wings fully developed, completely covered by elytra.

Legs rather long, slender, pubescent. Pro- and mesocoxae subconical, robust, metacoxae narrow, strongly transverse. Trochanters elongate with rounded apex. Femora slightly enlarged, flattened, slightly curved. Tibiae subcylindrical, with apical spur, nearly as long as femora. Tarsal formula 5-5-5; tarsomere 1 longest,

elongate; tarsomere 2 slightly shorter than tarsomere 1; tarsomere 3 subtrapezoidal, slightly dilated apically, wider than previous ones, shorter than tarsomere 2; tarsomere 4 widest, deeply bilobed; tarsomere 5 subcylindrical, strongly elongate, slender, curved. Pretarsal claws simple, internal claws with obtuse and small basal tooth.

Abdomen with six visible sternites (ventrites), covered with fine punctation; ultimate sternite wide, transverse, with emarginated posterior margin; ultimate tergite concave apically, longer and narrower than ultimate sternite.

Etymology. The specific epithet is a patronym; the new species is named in honor of Mr. Carsten Gröhn (Glinde, Germany), an enthusiast and specialist in Baltic amber.

Remark. The lateral margins of pronotum without long lobes or teeth, the proportions of elytra (lenght/widht ratio), widely explanate elytral margins, relatively short anttenomeres, as well as ultimate abdominal sternite wide and emarginated apically indicate that the specimen is female.

NOTE

Members of the subfamily Silinae are more diverse in the Eocene Baltic amber forests (Kazantsev 2013, 2020; Alekseev & Kazantsev 2014; Fanti & Damgaard 2018; Fanti & M.J. Pankowski 2018; Parisi & Fanti 2019; Fanti & M.G. Pankowski 2022) than in the fauna of present-day Europe. The group is apparently declined in Western Palearctic since Eocene. Three present-day species of the subfamily in Europe probably represent remains of species-rich ancient Paleogene fauna of Northern Hemisphere, which is better preserved in the refugia of East Asia and southern North America now than in Europe. Perhaps the subfamily fauna paucity in modern Europe is a consequence of less evolutionary competitiveness in re-settling territories after climatic fluctuations. Other lineages of Cantharidae known from Baltic amber and species-rich in Europe untill now (*e.g.*, Cantharinae, Malthininae), probably can more easily re-establish their distribution area after extirpation due climatic fluctuation. The taxa-rich Baltic amber assemblage of Silinae is the most diverse fossil fauna of this lineage at the moment. The knowledge from other time-space points of the Silinae evolution is too fragmentary for adequate comparison with European Eocene and creation of any hypotheses. The further studies and, probably, new findings in other fossil resins and Lagerstätten can resolve many questions concerning this peculiar group of Coleoptera.

ACKNOWLEDGEMENTS

We are sincerely grateful to Carsten Gröhn (Glinde, Germany) for the loan of interesting material, to Aleksej and Jonas Damzen (Vilnius, Lithuania) for photographic preparation and assistance during our amber research, and to Vitalii Alekseev (Kaliningrad, Russia) for critical comments and suggestions on an early version of manuscript. We also thank two anonymous reviewers for their valuable comments and corrections to this manuscript.

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Received: 23.09.2023.
Accepted: 08.12.2023.