



Discovery of a new extinct spider wasp (Hymenoptera, Pompilidae) from Eocene Rovno amber

VALERY M. LOKTIONOV^{1*}, ARKADY S. LELEJ¹, DMITRY V. VASILENKO^{2,3} & EVGENY E. PERKOVSKY⁴

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far East Branch of the Russian Academy of Sciences, Vladivostok, 690022, Russia.

✉ pompilidaefer@mail.ru; <https://orcid.org/0000-0002-8120-7788>

✉ lelej@biosoil.ru; <https://orcid.org/0000-0001-7501-0981>

² Cherepovets State University, Lunacharsky Prospect 5, Cherepovets, Vologda Region, 162600, Russia.

³ Paleontological Institute, Russian Academy of Sciences, Profsoyuznaya 123, Moscow, 117647, Russia.

⁴ Natural History Museum of Denmark, Universitetsparken 15, Copenhagen, 2100, Denmark.

✉ perkovsk@gmail.com; <https://orcid.org/0000-0002-7959-4379>

*Corresponding author.

Abstract

Paleogenia waichertae Loktionov, Lelej et Perkovsky, **sp. nov.** is a new species of extinct spider wasps. This new species is a second record of Pompilidae from Rovno amber, third yet known species of the extinct genus *Paleogenia* Waichert et Pitts, 2016 and 26th known extinct species of spider wasps. Sex of the holotype of the species *Paleogenia indomini* Colombo et Waichert, 2023 is clarified (male not female). A key to males of *Paleogenia* is provided.

Key words: fossils, taxonomy, new taxa, Pepsinae, key

Introduction

Up to date, 25 extinct species of spider wasps are known, 19 of them from compressions, five from amber, and one from ichnofossil of unclear age from earliest Ypresian (Waichert *et al.* 2019), to Messinian (55.5–5 million years); amber species represented in early Miocene Dominican amber (two species) and late Eocene Baltic amber (three species) (Rodriguez *et al.* 2017, Colombo *et al.* 2023). First pompilid reported from Rovno amber appears misidentified, yet undescribed crabronid genus (Antropov and Perkovsky 2009). A single pompilid correctly reported from late Eocene Rovno amber is *Pepsinites sclerosus* [not *sclerosus*] (Meunier, 1917) (Perkovsky 2018 and references therein, Rodriguez *et al.* 2017) from Dubrovitsa (Rivne region).

Rovno amber is the southern coeval of Baltic amber with more than 300 recorded species described; these species are mostly distinct from those described from Baltic amber (Kirichenko-Babko and Perkovsky 2023 and references therein). Until the last nine years, when the new taxa were described mostly from the new amber localities in Varash District of Rivne Region (Olmi *et al.* 2022a, Telnov *et al.* 2022), Perebrody (Sarny District) of Rivne Region (Dietrich *et al.* 2021), Volyn (Olmi *et al.* 2022b, Legalov *et al.* 2022) and Zhitomir (Melnitsky *et al.* 2021) regions of Ukraine, the Klesov deposit (Sarny District) was the most important and nearly single legal source of Rovno amber inclusions (Jenkins Shaw *et al.* 2023, Mitov *et al.* 2021 and references therein).

Paleogenia Waichert et Pitts, 2016 is an extinct genus of the subfamily Pepsinae of Pompilidae erected to hold *P. wahisi* Waichert et Pitts, 2016 (female and male) from Baltic amber (Rodriguez *et al.* 2016). Later, the second species, *P. indomini* Colombo et Waichert, 2023, was described from Baltic amber (Colombo *et al.* 2023). The description of the latter species is based on a single specimen. Colombo *et al.* (2023) identified this specimen as a female, although the antenna has 11 flagellomeres what is considered male feature in majority of Pompilidae (Day 1988). The authors (Colombo *et al.* 2023) supposed female sex based on their personal observations, that some species from a few spider wasp genera (*Pepsis* Fabricius, 1804, *Ageniella* Banks, 1912, *Caliadurgus* Pate, 1946,

and *Irenangelus* Schulz, 1906) deviate from this general pattern. In our point of view the authors also omitted the number of metasomal segments in the holotype. It is rather obvious, that the holotype *P. indomini* Colombo et Waichert, 2023 has seven visible terga and six sterna – another typical male features of in Pompilidae (Day 1988). Moreover, the apical portion of the hypopygium (sternum 8), which well-exposed beyond the tergum 7 and sternum 6 and rod-shaped (Figs 4, 5, consider arrows), was erroneously described as a sting-straight shaped. Such shape of hypopygium is common in the cleptoparasitic genera *Poecilagenia* Haupt, 1927, *Nipponodipogon* Ishikawa, 1965, and even some species of *Deuteroagenia* Šusterka, 1912 (Loktionov and Lelej 2014). So, based on the aforementioned facts, we consider the holotype of *P. indomini* Colombo et Waichert, 2023 a male.

During the study of fossils preserved in Klesov Rovno amber, deposited in Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine (Kiev, SIZK), we found two amber pieces with one species of spider wasps belonging to unknown species of the extinct genus *Paleogenia* Waichert et Pitts. Herein, we describe this species, as well as provide an updated key to *Paleogenia* males. The new species *Paleogenia waichertae* Loktionov, Lelej et Perkovsky **sp. nov.** is a first record of Pompilidae from Klesov, the third species of its genus, and 26th extinct species of spider wasps.

Material and methods

The two studied amber samples were obtained from Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine (Kiev). First sample (SIZK K-3286) was cut from amber piece with weight 41 g after the primary treatment, the second was cut from the piece weighted 1.1 g after the primary treatment. These samples were trimmed and polished which allowed to have clear view of the specimens with the stereomicroscope Olympus SZX16. Images of specimens were taken with the same stereomicroscope attached with digital camera Olympus DP74, and stacked using Helicon Focus software. The final illustrations were postprocessed for contrast and brightness using Adobe® Photoshop® software. The terminology for morphology is mostly based on the glossary provided by the Hymenoptera Anatomy Consortium (2013). Types are deposited in Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine (Kiev).

Taxonomy

Order Hymenoptera

Family Pompilidae Latreille, 1804

Subfamily Pepsinae Lepeletier de Saint Fargeau, 1845

Genus *Paleogenia* Waichert et Pitts, 2016

Paleogenia waichertae Loktionov, Lelej et Perkovsky, **sp. nov.**

Figs 1–10

Type material. Holotype, ♂: SIZK K-3286, Klesov, Rovno amber, late Eocene. Syninclusions: SIZK K-3287: Diptera (female of Ceratopogonidae), SIZK K-3288: Coleoptera, SIZK K-3289: Archaeognatha (Machilidae), 2 Hymenoptera (1 Mymarommatidae), 5 Acari (larvae of Parasitengona). Paratype, ♂: SIZK K-8178, Klesov, Rovno amber, late Eocene. Syninclusion: SIZK K-8179: Diptera.

Diagnosis. Male of the new species clearly differs from those of all other congeners in the combination of the following characters: the tibial spur $0.8\text{--}0.9 \times$ as long as the first tarsomere; the apical portion of the hypopygium well-exposed beyond the tergum 7 and the sternum 6, rod-shaped and slightly widened apically, bearing erect setae in ventral view (Figs 5, 6); the gena $0.2 \times$ wider than the eye in lateral view (Fig. 8). The female is unknown.

Description. MALE. Body length: 3.2 mm (holotype), 3.0 mm (paratype). Head without noticeable erect setae. Eyes large; eye $0.48 \times$ as wide as median interocular distance (head in frontal view) (Fig. 6). Clypeus large, convex

in dorsal view, trapezoid; $0.58 \times$ as long as wide; its apical margin nearly straight; its posterolateral corners rounded (Fig. 6). Mandible apex bidentate. Gena narrow, $0.2 \times$ as wide as eye (head in lateral view) (Fig. 8). Antenna shortened, with 11 cylindrical flagellomeres (Figs 2, 6, 8); apical flagellomere pointed.

Metapostnotum well developed, long (Figs 8, 9). Propodeum smooth, with dense micropubescence, in lateral view gently sloping, its posterior surface nearly flat (Figs 3, 9).

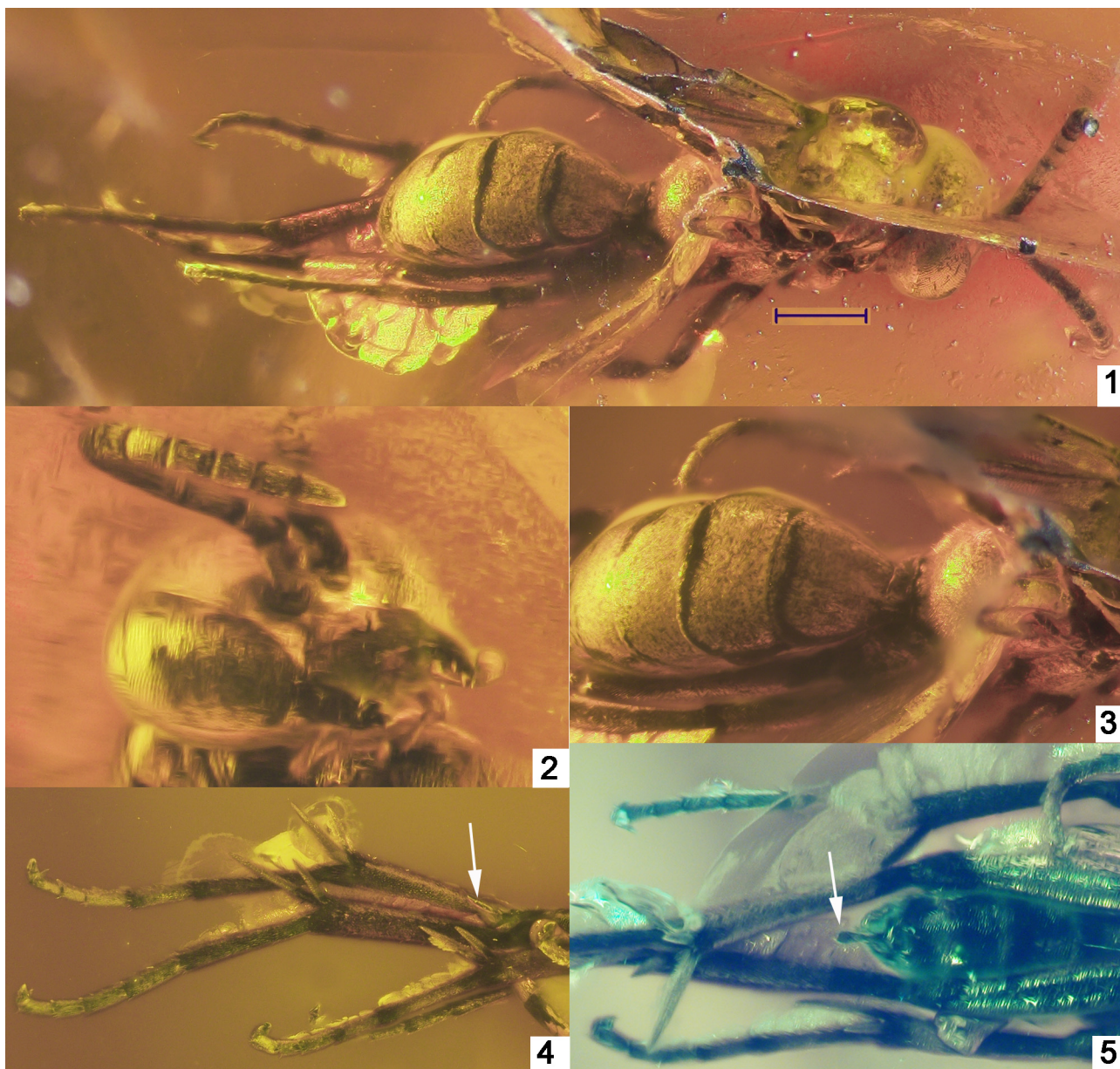
Tergum 1 not petiolate basally, gradually widening towards apex (Fig. 3). Terga with dense micropubescence (Fig. 3). Apical portion of hypopygium well exposed beyond tergum 7 and sternum 6, rod-shaped and slightly widened apically, bearing erect setae in ventral view (Figs 5, 6).

Legs without noticeable erect spines (Figs 4, 6, 10). Tibia with short apical spine-like setae. Tibial spur of meso- and metalegs $0.8\text{--}0.9 \times$ as long as basal tarsomere (Figs 4, 10). Tarsal claws very small, inner tooth indistinct.

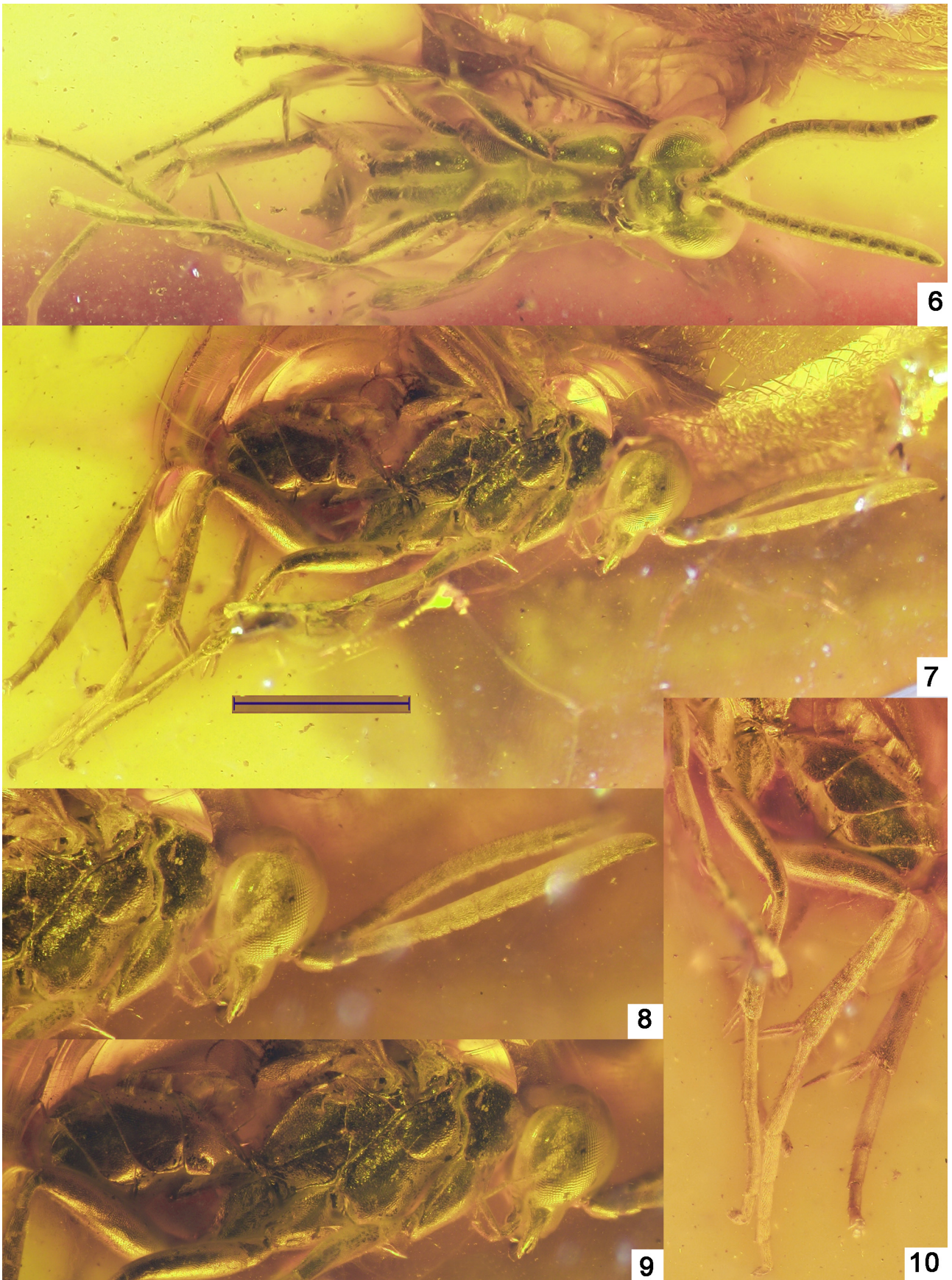
Wings crumpled (characters are invisible).

FEMALE is unknown.

Distribution and age. Rovno amber, Ukraine. Priabonian, 33.9–37.8 Ma, Upper Eocene (Colombo *et al.* 2021).



FIGURES 1–5. Holotype of *Paleogenia waichertae* Loktionov, Lelej et Perkovsky, **sp. nov.**, ♂, SIZK K-3286. **1**, habitus, total dorsolateral view. **2**, head and antenna, frontolateral view. **3**, propodeum and metasoma, dorso-lateral view. **4**, meso- and metatibia and tarsi, lateral view (arrow points hypopygium). **5**, apical portion of metasoma, hypopygium and legs part. (arrow points hypopygium), ventral view. Scale bar 1 mm (Figs 2–5 not to scale).



FIGURES 6–10. Paratype of *Paleogenia waichertae* Loktionov, Lelej et Perkovsky, *sp. nov.*, ♂, SIZK K-8178. **6**, habitus, total ventral view. **7**, habitus, total lateral view. **8**, mesosoma, head and antenna, lateral view. **9**, head, mesosoma and metasoma, lateral view. **10**, fore leg part., meso- and metalegs, lateral view. Scale bar 1 mm (Figs 6, 8–10 not to scale).

Etymology. The new species is named for Cecilia Waichert (Complexo Biopráticas, Universidade Vila Velha, Vila Velha, Brazil), one of the most active pompilid researchers that made a great contribution to the taxonomy of extant and extinct taxa.

Remark. Size of the piece and syninclusions clearly indicates that holotype was caught in the resin trap at the base of the trunk (see Perkovsky *et al.* 2012).

Key to the males of the genus *Paleogenia*

1. Tibial spur long, about 0.6–0.9× as long as basal tarsomere. Apical portion of hypopygium well-exposed tergum 7 and sternum 6, rod-shaped in ventral view (Figs 5, 6) 2
- Tibial spur noticeably shorter than basal tarsomere. Apical portion of hypopygium not exposed tergum 7 and sternum 6, its shape is unknown. Baltic amber *Paleogenia wahisi* Waichert et Pitts, 2016
2. Gena 0.5 × as wide as eye in lateral view. Clypeus with median pale line. Baltic amber *Paleogenia indomini* Colombo et Waichert, 2023
- Gena 0.2 × as wide as eye in lateral view (Fig. 8). Clypeus without median pale line (Figs 2, 6). Rovno amber *Paleogenia waichertae* Loktionov, Lelej et Perkovsky, *sp. nov.*

Discussion

The genus *Paleogenia* Waichert et Pitts, 2016 is the 59th non-ant hymenopteran genus reported from Rovno amber (of these, 24 genera (40.7%) are unknown from Baltic amber), and *Paleogenia waichertae* is the 52nd non-ant hymenopteran species (from 75, i.e., 69.3%) found in Rovno amber but unknown from Baltic amber (Simutnik *et al.* 2022a, b; Belokobylskij *et al.* 2023).

The main diagnostic characters of *Paleogenia* are as follow: the short antennomeres; the smooth propodeum; the apical tibial setae spine-like, short and regular; the fore-, meso- and metatibia not spinose; the cell 2*M* without an inflection at the base of *Cu* vein; the cells 1*R*s and 2*R*s about the same size; the marginal cell large, nearly touching the apical margin of the forewing (Rodriguez *et al.* 2016; Colombo *et al.* 2023).

Both studied specimens (holotype and paratype) of *Paleogenia waichertae* Loktionov, Lelej et Perkovsky, *sp. nov.* are well preserved and most of the external characters are clearly visible and match with the characters of *Paleogenia*. However, wings of both specimens are completely crumpled, so their characters remain unknown. Despite this we place the new species in *Paleogenia* based on the following characters: the antennal segments shortened, in male with 11 cylindrical flagellomeres; the propodeum smooth, in lateral view gently sloping; the tibia with apical spine-like setae short and regular; the fore-, meso- and metatibia not spinose; the apical portion of the hypopygium well exposed beyond the tergum 7 and the sternum 6, rod-shaped in ventral view; small body (3.0–3.2 mm).

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References

- Antropov, A.V. & Perkovsky, E.E. (2009) *Rovnoecus*, a new genus of digger wasps (Hymenoptera, Crabronidae, Pemphredoninae) from the Rovno Amber. *Paleontological Journal*, 43 (9), 1019–1023.
<https://doi.org/10.1134/S0031030109090044>

- Banks, N. (1912) Psammocharidae: Classification and Descriptions. *Journal of the New York Entomological Society*, 19 (4), 219–237.
- Belokobylskij, S.A., Simutnik, S.A., Vasilenko, D.V. & Perkovsky, E.E. (2023) First record of the parasitoid subfamily Doryctinae (Hymenoptera, Braconidae) in Rovno amber: description of a new genus and species with stigma-like enlargement on the hind wing of the male. *Journal of Hymenoptera Research*, 95, 59–72.
<https://doi.org/10.3897/jhr.95.96784>
- Colombo, W.D., Perkovsky, E.E. & Vasilenko, D.V. (2021) The first sclerodermine flat wasp (Hymenoptera: Bethyridae) from the upper Eocene Rovno amber Ukraine. *Alcheringa*, 45 (4), 429–434.
<https://doi.org/10.1080/03115518.2021.2006311>
- Colombo, W.D., Rodriguez, J. & Waichert, C. (2023) A puzzling spider wasp: description of an extinct species of *Paleogenia* Waichert and Pitts (Hymenoptera: Pompilidae) from the upper Eocene. *Historical Biology*. [published online]
<https://doi.org/10.1080/08912963.2023.2189109>
- Day, M.C. (1988) *Spider wasps Hymenoptera: Pompilidae*. Royal Entomological Society of London, Dorchester, 60 pp. [Dolling, W.R. & Askew, R.R. (Eds.), *Handbooks for the Identification of British Insects*, 6 (4)].
- Dietrich, Ch.H., Dmitriev, D.A. & Perkovsky, E.E. (2021) A new leafhopper (Hemiptera: Cicadellidae) from late Eocene Rovno amber described based on an adult and associated last-instar nymph from Perebrody (Ukraine). *Palaeoentomology*, 4 (5), 445–452.
<https://doi.org/10.11646/palaeoentomology.4.5.10>
- Evenhuis, N.I. (1997) *Literatura taxonomica dipterorum (1758–1930)*. Vol. I (A–K), Vol. II (L–Z). Backhuys Publishers, Leiden, 871 pp.
- Fabricius, J.C. (1804) *Systema Piezatorum secundum Ordines, Genera, Species adiectis Synonymis, Locis, Observationibus, Descriptionibus*. Carolus Reichard, Brunsvigae, xiv + 439 pp.
<https://doi.org/10.5962/bhl.title.10490>
- Haupt, H. (1927) Monographie der Psammocharidae (Pompilidae) von Mittel-, Nord- und Osteuropa. *Beiheft der Deutsche Entomologische Zeitschrift*, 1926–1927, 1–367.
<https://doi.org/10.1002/mmnd.48019260602>
- Hymenoptera Anatomy Consortium (2013) *Hymenoptera Glossary*. Available from: <http://glossary.hymao.org> (accessed 18 September 2023)
- Ishikawa, R. (1965) A preliminary revision of the Japanese species of the genus *Dipogon* Fox (I) (Hymenoptera, Pompilidae). *Mushi*, 38 (11), 87–100.
- Jenkins Shaw, J., Perkovsky, E.E., Ślipiński, A., Escalona, H. & Solodovnikov, A. (2023) An extralimital fossil of the genus *Diagrypnodes* (Coleoptera: Salpingidae: Inopeplinae). *Historical Biology*. [published online]
<https://doi.org/10.1080/08912963.2023.2206858>
- Kirichenko-Babko, M. & Perkovsky, E.E. (2023) The first neotropical ground beetle (Coleoptera, Carabidae) from the Eocene of Ukraine: Finding the first Old World ant nest beetle related to *Eohomopterus* in the Rovno amber. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh* [published online]
<https://doi.org/10.1017/S1755691023000105>
- Latreille, P.A. (1804) *Tableau méthodique des insectes. Nouveau dictionnaire d'histoire naturelle, appliquée aux arts, Principalement à l'Agriculture, à l'Economie rurale et domestique. Par une société de naturalistes et d'agriculteurs. Avec des figures tirées des trois Règnes de la Nature. Tome 24*. Déterville, Paris, 72 pp. [pp. 129–200, dates of publication after Evenhuis 1997].
- Legalov, A.A., Vasilenko, D.V. & Perkovsky, E.E. (2022) The American tribes Anypotactini and Eudiagogini (Coleoptera, Curculionidae) in Eocene of Europe as indicators of Eocene climate with description a new species. *Diversity*, 14, 767.
<https://doi.org/10.3390/d14090767>
- Lepeletier de Saint Fargeau, A.L.M. (1845) *Histoire naturelle des Insectes. Hyménoptères. Tome Troisième*. Encyclopédique de Roret, Paris, 646 + [4] pp.
- Loktionov, V.M. & Lelej, A.S. (2014) *Spider wasps (Hymenoptera: Pompilidae) of the Russian Far East*. Dalnauka, Vladivostok, 472 pp. [in Russian]
- Melnitsky, S.I., Ivanov, V.D. & Perkovsky, E.E. (2021) A new species of the fossil genus *Electrotrichia* (Insecta: Trichoptera: Hydroptilidae) from Rovno amber (Zhytomyr region, Olevsk amber locality). *Palaeoentomology*, 4 (5), 421–424.
<https://doi.org/10.11646/palaeoentomology.4.5.4>
- Meunier, F. (1917) Un Pompilidae de l'ambre de la Baltique. *Tijdschrift voor Entomologie*, 60 (1–2), 181–184. [15 July 1917]
- Mitov, P.G., Perkovsky E.E. & Dunlop, J.A. (2021) Harvestmen (Arachnida: Opiliones) in Eocene Rovno amber (Ukraine). *Zootaxa*, 4984 (1), 43–72.
<https://doi.org/10.11646/zootaxa.4984.1.6>
- Olmi, M., Eggs, B., Capradossi, L., van de Kamp, T., Perkovsky, E.E., Guglielmino, A. & Vasilenko, D.V. (2022a) A new species of *Bocchus* from upper Eocene Rovno amber (Hymenoptera, Dryinidae). *Journal of Hymenoptera Research*, 92, 257–272.
<https://doi.org/10.3897/jhr.92.87084>
- Olmi, M., Guglielmino, A., Vasilenko, D.V. & Perkovsky, E.E. (2022b) Discovery of the first apterous pincer wasp from amber, with description of a new tribe, genus and species of Apodyrininae (Hymenoptera, Dryinidae). *Zootaxa*, 5162 (1), 54–66.
<https://doi.org/10.11646/zootaxa.5162.1.3>

- Pate, V.S.L. (1946) The generic names of the spider wasps (Psammocharidae olim Pompilidae) and their type species. *Transactions of the American Entomological Society*, 72, 65–137.
- Perkovsky, E.E. (2018) Only a half of species of Hymenoptera in Rovno amber is common with Baltic amber. *Vestnik Zoologii*, 52 (5), 335–360.
<https://doi.org/10.2478/vzoo-2018-0037>
- Perkovsky, E.E., Rasnitsyn, A.P., Vlaskin, A.P. & Rasnitsyn, S.P. (2012) Contribution to the study of the structure of amber forest communities based on analysis of syninclusions in the Rovno amber (Late Eocene of Ukraine). *Paleontological Journal*, 46 (3), 293–301.
<https://doi.org/10.1134/S0031030112030136>
- Rodriguez, J., Waichert, C., von Dohlen, C.D. & Pitts, J.P. (2017) The geological record and phylogeny of spider wasps (Hymenoptera: Pompilidae): A revision of fossil species and their phylogenetic placement. *PLoS ONE*, 12 (10), e0185379.
<https://doi.org/10.1371/journal.pone.0185379>
- Rodriguez, J., Waichert, C., von Dohlen, C.D., Poinar, G. & Pitts, J.P. (2016) Eocene and not Cretaceous origin of spider wasps: Fossil evidence from amber. *Acta Palaeontologica Polonica*, 61 (1), 89–96.
<https://doi.org/10.4202/app.00073.2014>
- Schulz, W.A. (1906) *Spolia Hymenopterologica*. Albert Pape, Paderborn, 356 pp., 1 pl.
<https://doi.org/10.5962/bhl.title.59757>
- Simutnik, S.A., Perkovsky, E.E., Khomych, M.R. & Vasilenko, D.V. (2022a) Two new genera of Encyrtidae (Hymenoptera, Chalcidoidea) with reduced ovipositor sheaths. *Journal of Hymenoptera Research*, 89, 47–60.
<https://doi.org/10.3897/jhr.89.79180>
- Simutnik, S.A., Perkovsky, E.E. & Vasilenko, D.V. (2022b) *Electronoyesella antiqua* Simutnik, gen. et sp. nov. (Chalcidoidea, Encyrtidae) from Rovno amber. *Journal of Hymenoptera Research*, 94, 105–120.
<https://doi.org/10.3897/jhr.94.94773>
- Šusterka, O. (1912) Die paläarktischen Gattungen der Familie Psammocharidae (olim Pompilidae, Hymenoptera). *Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien*, 62, 171–213.
- Telnov, D., Perkovsky, E.E., Kundrata, R., Kairišs, K., Vasilenko, D.V. & Bukejs, A. (2022) Revealing Palaeogene distribution of the Ptilodactylidae (Insecta: Coleoptera): the first *Ptilodactyla* Illiger, 1807 records from Rovno amber of Ukraine. *Historical Biology*. [published online]
<https://doi.org/10.1080/08912963.2022.2136034>
- Waichert, C., Rodriguez, J., Rapoza, M. & Wappler, T. (2019) The oldest species of Pompilidae to date, a new fossil spider wasp (Hymenoptera: Pompilidae). *Historical Biology*, 33 (7), 1008–1111.
<https://doi.org/10.1080/08912963.2019.1675056>