

The First Record of Reed Beetles (Coleoptera, Chrysomelidae, Donaciinae) in the Early Paleocene of Amur Region

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Abstract—The earliest known reed beetle species is described from the Early Paleocene locality Arkhara, Amur Region, Russia. It is assigned to the genus *Donacia* based on the sculpture and shape of elytra (regular puncture rows, intervals between rows impunctate, apical margin obliquely truncated, sutural interval simple). This species is morphologically close to extant members of the subgenera *Donacia* s. str. and *Cyphogaster* in the smooth intervals between the elytral puncture rows and the carinate interval between rows 8 and 9 and differs from them in the narrow mesosternal process between the mesocoxae.

Keywords: leaf beetles, Donaciinae, Chrysomelidae, new taxon, Early Paleocene, Amur Region

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INTRODUCTION

Reed beetles (Donaciinae) were known to date in the fossil record beginning with the Late Paleocene (58 million years ago); it was believed that the earliest known species was *Donacia wightoni* Askevold, 1990, described from North America (Askevold, 1990a). A number of species were described from the Eocene of Europe (Haupt, 1956; Goecke, 1960), Oligocene of Europe and North America (Wickham, 1912; Goecke, 1943, 1960), Miocene and Pliocene of Europe (Goecke, 1943, 1960). Extant species begin to occur in the fossil record from Pliocene (Goecke, 1943; Hayashi, 2004). Both extant and extinct species occur in the Pleistocene of Europe and North America (Goecke, 1943; Pierce, 1950; Nazarov, 1984; Borowiec, 1984; Hayashi, 2004); only extant species are known from the Holocene (Morgan and Morgan, 1980; Nazarov, 1984; Hayashi, 1999; Geiser, 2006).

This study is based on reed beetles collected in the Lower Paleocene locality Arkhara (Amur Region, Arkhara District, Arkhara Station, bottom of Arkharinskaya Sopka quarry; Lower Paleocene, Danian, Tsagayan) and stored in the Arthropod Laboratory, Borissiak Paleontological Institute, Russian Academy of Sciences, Moscow (PIN). Other representatives of the order Coleoptera described from this locality include two species of whirligigs (Coleoptera: Gyridae) (Ponomarenko, 1977), one species of weevils (Coleoptera: Curculionoidea) (Legalov, 2010), and one species of jewel beetles (Coleoptera:

Buprestidae) (Alexeev, 1996). At least 85 undescribed beetle specimens are also stored in PIN, mostly isolated elytra that belonged to reed beetles; nearly half of them probably belonged to the new species described below.

The assignment of the new species to the family Donaciinae is based on the typical shape of the elytra, meso- and metasternum, and meso- and metacoxae: the elytra are elongate, parallel-sided, with 10 complete rows of punctures and one shortened scutellar row; the intervals between rows 1 and 2 and rows 2 and 3 are dilated towards the apex; the humeral tubercle is convex; the elytral epipleuron is convex; the metasternum is large, convex, with a deep longitudinal impression; the mesocoxae are rounded, separated by the narrow mesosternal process; and the metacoxae are transverse. This combination of characters is not known in beetles of any other taxon.

The assignment of the new species to the genus *Donacia* Fabricius, 1775 is based on the shape of the sutural interval of the elytron not exposing the lower sutural margin (difference from the genus *Plateumaris*), the apical margin of the elytron simple, truncated, without spines on the external or internal angle (difference from the genera *Macroplea* Samouelle, 1819, *Neohaemonia* Székessy, 1941, *Sominella* Jacobson, 1908, and *Donaciasta* Fairmaire, 1901), and the punctuation of the elytra regular and without punctures in the intervals between rows (difference from *Donaciasta*) (Reitter, 1920; Grobbelaar, 2009).

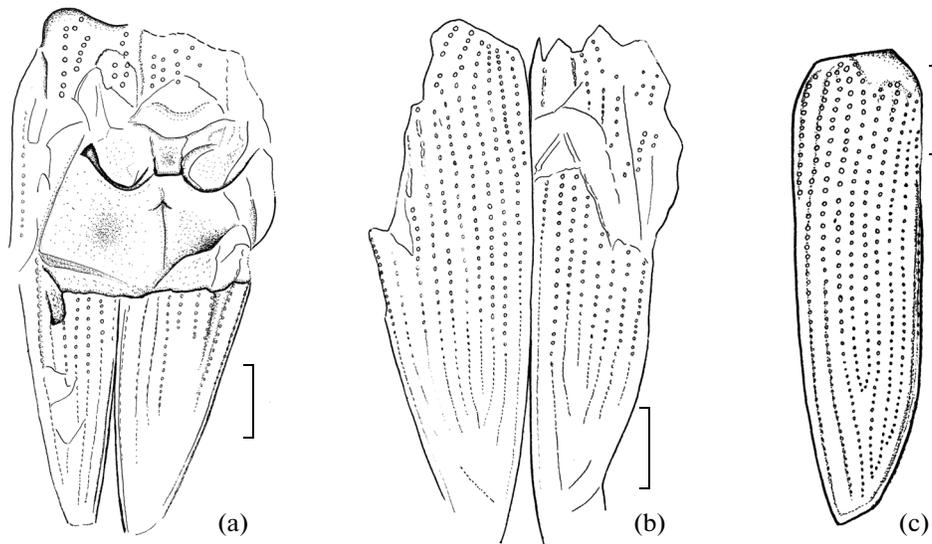


Fig. 1. *Donacia anetae* sp. nov.: (a) holotype PIN, no. 2055/164, (b) paratype PIN, no. 2055/124, (c) paratype PIN, no. 2055/36. Scale bar, 1 mm.

SYSTEMATIC PALEONTOLOGY

Family Chrysomelidae Latreille, 1802

Subfamily Donaciinae Kirby, 1837

Genus *Donacia* Fabricius, 1775

Donacia anetae Biéńkowski, sp. nov.

Plate 10, figs. 1–5

E t y m o l o g y. In honor Aneta Faindersch, who is interested in reed beetles.

H o l o t y p e. PIN, no. 2055/164 (Fig. 1a; Pl. 10, figs. 1a–1c); positive impression of two elytra (bases and apical halves) and negative impression metasternum and meso- and metacoxal cavities; Arkhara locality; Lower Paleocene, Danian, Tsagayan.

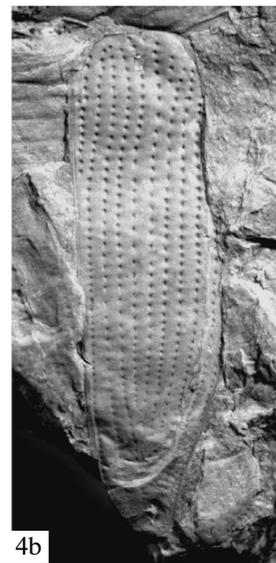
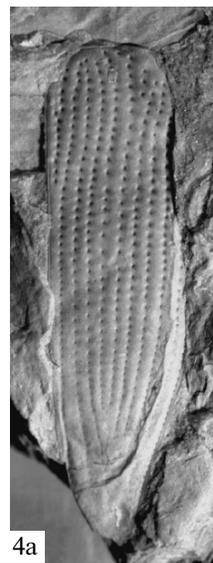
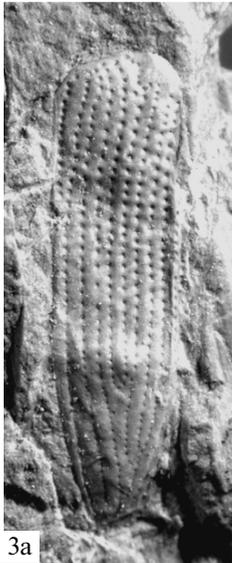
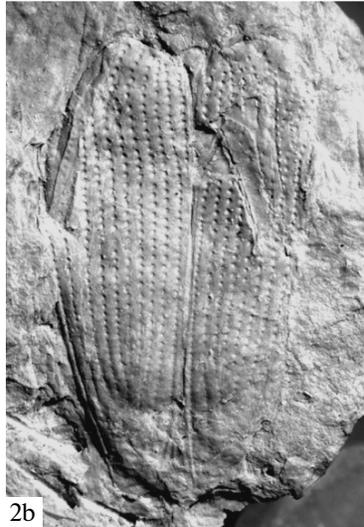
Description. (Fig. 1). In the holotype, the elytra are elongate, obliquely truncated outward apically; the humeral tubercle is convex, impunctate; the sutural interval is narrow, simple (with the sutural interval of the elytron not exposing the lower sutural margin), carinate in the apical half. Nine regular rows of punctures, running at equal distances from each other, are visible on the elytron (row 10 near the external margin of the elytron is not visible, because it is tucked onto the underside); the punctures become finer towards the apex. The intervals between the puncture rows are smooth, in the basal part of the elytron 2.5 times as wide as the puncture diameter.

The metasternum is long, smooth, impunctate; the suture separating the metasternum from the metepisternum is straight; the metasternum was strongly convex, with a narrow and deep median longitudinal impression (conversely, in the negative impression the metasternum is concave and the longitudinal impression is shaped as a narrow carina). The metacoxal cavities are transverse, wide; the mesocoxal cavities are large, rounded; the mesosternal process separating the mesocoxal cavities is rectangular, half as wide as the mesocoxa.

In the paratypes, each elytron has ten complete puncture rows running at equal distances from each other and one shortened scutellar row of punctures. In the isolated elytra, rows 9 and 10 are poorly visible, because they are tucked onto the underside (possibly as a result of postmortem deformations). The intervals between the punctures in each row are 1–1.5 times as wide as the puncture diameter. The puncture rows are regular over their entire length; rows 1–5 reach the base of the elytron; rows 6–8 reach the humeral tubercle; rows 4 and 5 are fused in the apical third; rows 6, 7, and 8 are fused near the apex. Most of the intervals between rows are weakly convex; only the interval between rows 8 and 9 are carinate. The intervals between rows 1 and 2 and rows 2 and 3 are slightly dilated towards the apex. The elytral epipleuron is narrow, convex.

Explanation of Plate 10

Figs. 1–5. *Donacia anetae* sp. nov.: (1) holotype PIN, no. 2055/164, positive impression of elytra and negative impression of metasternum and meso- and metacoxal cavities; (2) paratype PIN, no. 2055/124, positive impression of elytra; (3) paratype PIN, no. 2055/36, positive impression of right elytron; (4) paratype PIN, no. 2055/41, positive impression of right elytron; (5) paratype PIN, no. 2055/152, positive impression of left elytron; Arkhara. Scale bar, 2 mm.



M e a s u r e m e n t s, mm. Holotype: elytron length, 7.8; elytron width, 1.8; mesosternal process width, 0.4. Paratypes: elytron length, 5.5–7.6; elytron width, 1.4–2.1.

C o m p a r i s o n. Identification of the specimens to subgenus is complicated by the incomplete preservation of the specimens (the pronotum, abdomen, appendages, and antennae are absent). All extant species of the genus *Donacia* are assigned to five subgenera (Warchałowski, 2010): *Askevoldia* Kippenberg, 1994, *Cyphogaster* Goecke, 1934, *Donacia* s. str., *Donaciella* Reitter, 1920, and *Donaciomima* L. Medvedev, 1973. Members of the last four subgenera have been described from fossils (Askevold, 1990a; Hayashi, 2004), but the majority of extinct species have not been assigned to any subgenus (Borowiec, 1984). The subgenus *Donaciella* is identified by the shape of the protibia and antennomeres (Bieńkowski and Orlova-Bienkowskaja, 2003), absent in the specimens treated in this study. However, in *Donaciella* the intervals between the elytral puncture rows are wrinkled, while in the new species they are smooth. The new species also cannot be assigned to the subgenus *Askevoldia*, the only (extant) member of which, *D. reticulata* Gyllenhal, 1817, has the elytron triangularly elongate apically, with wrinkled intervals between puncture rows (Warchałowski, 2003). Members of the subgenus *Donaciomima* are rather various morphologically, but differ from the new species in the characteristic relief of large or small wrinkles on the intervals between the elytral puncture rows. Species of the subgenera *Donacia* s. str. and *Cyphogaster*, rather similar to each other morphologically (distinguished by the absence or presence, respectively, of teeth on male abdominal sternite 1; Goecke, 1934; Warchałowski, 2010), are characterized by a rather smooth relief of the intervals between the elytral puncture rows and by the convex or carinate interval between rows 8 and 9. The new species can be considered close to one of the last two subgenera in the shape and sculpture of the elytra. Interestingly, Askevold (1990a), who described the earliest previously known reed beetle, *D. wightoni* (Upper Paleocene, North America), came to a similar conclusion. On the other hand, extant members of the suborder *Donacia* s. str. and some species of *Cyphogaster* have the mesosternal process between mesocoxae wide (wider than half the diameter of the mesocoxae). Askevold (1990b) interprets this state as apomorphic. At the same time, the ancestral state of this character, narrow mesosternal process, similar to that of *Sagrinae*, is found in the extant species *D. (Donaciella) tomentosa* Ahrens, 1810 and in some species of the subgenera *Donaciomima* and *Cyphogaster*. In contrast to *D. wightoni*, in the new species the interval between elytral puncture rows 8 and 9 is no wider than the other intervals, and punctures in the rows are sparser.

M a t e r i a l. Holotype and six paratypes from the type locality.

DISCUSSION

Reed beetles (*Donaciinae*) form a monophyletic group together with the leaf beetle subfamilies *Criocerinae* and *Sagrinae* and seed beetles (*Bruchidae*). In the opinion of Borowiec (1984), *Donaciinae* and *Sagrinae* diverged in the middle of the Cretaceous period. Species of these two subfamilies have very similar bacterial symbionts not found in the other related groups, *Criocerinae* and *Bruchidae* (Kölsch and Synefiaridou, 2012). There is also an alternative opinion, according to which *Donaciinae* are especially close to *Criocerinae*, and *Sagrinae* are especially close to *Bruchidae* (Reid, 1995). According to the calculations of Kölsch and Pedersen (2008) based on analysis of mitochondrial and nuclear DNA, the subfamily *Donaciinae* appeared 75–100 million years ago. This subfamily diverged from its relatives in relation to adaptation to living in waterbodies and feeding on aquatic and coastal herbaceous angiosperms. The food plants of extant reed beetles, such as *Typhaceae*, *Sparangiaceae*, *Cyperaceae*, and *Juncaceae*, existed as early as 90–100 million years ago, and *Nymphaeaceae* existed as early as 120 million years ago. The appearance of reed beetles in the Cretaceous coincides in time with the appearance of *Hadrosauridae*, which probably fed on the same aquatic plants; the teeth of these dinosaurs were adapted to chewing plant food with an admixture of sand (Ponomarenko, 2006; Ponomarenko and Prokin, 2013). Adult reed beetles probably initially fed on pollen, and later many species partly or entirely switched to feeding on leaves (Bieńkowski, 2011). Feeding of the earliest reed beetles on pollen is indicated by the fact that the mandibles and maxillae of extant reed beetles bear dense brushes of setae used for collecting pollen (Bieńkowski, 2010). Such brushes are found also in other beetles specialized on pollen consumption (Grinfeld, 1978). The larvae of *Sagrinae*, like reed beetles, build cocoons for pupation (Zaitsev and Dang Thi Dap, 1982). The larvae of reed beetles switched from living inside stems (as in *Sagrinae*) to living in the substrate on plant roots and in axils of leaves underwater (Bieńkowski and Orlova-Bienkowskaja, 2004).

The plant communities of coastal–aquatic and humid localities in the southeastern part of the Zeya–Bureya Depression, in which the Arkhara locality is situated, in the middle of the Middle Tsagayan included horsetails *Equisetum* sp., ferns *Onoclea hesperia* R.W. Braun, *Osmunda macrophylla* Penhallow, and monocotyledons *Zingiberopsis attenuata* Hickey et Peterson. The aquatic vegetation was represented by rooted plants with floating or submerged leaves, dicotyledons *Paranymphaea crassifolia* (Newb.) Berry,

Quereuxia angulata (Newb.) Krysht. and monocotyledons *Haemanthophyllum cordatum* Golovn. (T.M. Kodrul, pers. comm., 2014).

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