

On the morphology and systematics of *Bembecia jakuta* (Herz, 1903) (Lepidoptera, Sesiidae)

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Abstract

The description and illustrations of *Bembecia jakuta* (Herz, 1903) are given. In order to stabilize the species epithet, fix the taxonomic status and the type locality of this least studied species of clearwing moths (Lepidoptera, Sesiidae) of the Palearctic, a neotype is designated here. A detailed analysis of the external morphology, as well as the structure of the male genitalia, showed that this species is very close to *B. aktashica* O. Gorbunov, 2018, but differs from it quite clearly in the colouration of some body parts and the structure of the transparent areas of the forewing. In addition, these two species have slight differences in the structure of the male genitalia. The female, host plants and features of the biology of the larvae remain unknown.

Keywords

Clearwing moths, Palearctic realm, Lepidoptera, Synanthedonini, *Bembecia jakuta*, systematics, neotype

Introduction

The genus *Bembecia* Hübner 1819 is the largest genus of the Sesiidae family in the Palearctic realm. *Bembecia* currently consists of more than one hundred species (Pühringer & Kallies 2004; Gorbunov et al. 2017; Gorbunov and Efetov 2018; Gorbunov 2019b, 2020a, 2023a–b, 2024).

To date, only 19 species of this genus are known from Russia (Gorbunov 1994, 2008, 2018a, 2019b, 2020a, 2024; Efetov et al. 2012; Gorbunov and Efetov 2016, 2018), of which only seven are found east of the Ural Mountains (Herz 1903; Kozhantschikov 1936; Gorbunov and Arita 1995; Špatenka et al. 1999; Karalius et al. 2000; Gorbunov 2018a, 2019a). Until recently, of these “eastern” ones, viz. *B. jakuta* (Herz, 1903), *B. strandi* (W. Kozhantschikov, 1936) and *B. bestianeli* (Căpușe, 1973) remained virtually unknown. Only very recently it has been possible to collect a small series of *B. strandi* and make a detailed morphological description of this species and identify its related ones (Gorbunov in press).

Bembecia jakuta was described from a single male collected “... am 6. Juli bei Ytyk-haja ...” (Herz 1903: 19) by B. Poppius’ expedition to the Lena River in 1901. The route of the expedition was described by Hämet-Ahti (1970), who provided maps of stopping points and a table with the names of localities in Roman and Cyrillic spellings. From this work we clearly determine the exact location of the area “Ytyk-haja”, and in the work of Vinokurov (2020) we find a clarification: “Ytyk-Khaya Mt. (Kangalasskie Kamni cliffs), 40 verst N of Yakutsk [62°22'N, 130°01'E]”.

In preparation of the monograph on the Palaearctic Sesiidae we examined various museums in Europe and Japan in order to find and fix nomenclatural types (Špatenka and Laštůvka 1988, 1990; Arita 1991; Gorbunov 1992; Špatenka 1992). Unfortunately, the type specimen of *B. jakuta* has not been found anywhere (Špatenka et al. 1999) and until 2024 this species was known only from a single male collected by S. Sazonov in the Yakutsk Botanical Garden at the end of June 1989.

I made two special expeditions to the Sakha Republic (Yakutia) to search *B. jakuta* in 2023 and 2024. Only in June 2024 I managed to collect four males of this legendary species using synthetic sex attractants. As I have already pointed out many times, the use of synthetic sex attractants for Sesiidae and some other groups of Lepidoptera allows not only to discover new species for science and to clarify in detail the distribution of some species, but also to replenish collections with specimens rare in collections (Gorbunov 2015, 2017, 2018b–c, 2019c, 2020b, 2021, 2022, 2023c; Efetov and Gorbunov 2021, 2024; Gorbunov and Efetov 2024a–b).

Since the only specimen of *B. jakuta* mentioned in the original publication (Herz 1903: 19) is considered lost (Špatenka et al. 1999: 212), in order to stabilize the species epithet, fix the taxonomic status and type locality of this least studied species of clearwing moths (Lepidoptera, Sesiidae) of the Palaearctic, a neotype is designated here in full compliance with the requirements of Article 75 of the International Code of zoological nomenclature (ICZN 1999).

Materials and methods

The morphological examinations were made using a Leica EZ4 stereomicroscope with LED illumination. All images of moths and their habitat were taken with a Sony α450 DSLR camera equipped with a Minolta 50 mm f/2.8 macro lens. The

genitalia were photographed using a Keyence BZ-9000 Bioevo fluorescence microscope. The processing of all illustrations was finalized using Adobe Photoshop CC2020 software.

All labels of the neotype are cited verbatim. The labels with geographical data, data on photos and preparation numbers of the genitalia are printed on white paper, but the type label of the holotype and paratypes are printed on red paper. Each label is separated by a semicolon (“;”) lines in a label are separated by a slash (“/”). All pictures of specimens are labelled with a number, consisting of letters and digits: name of the family, two consecutive digits separated by an n-dash and a year following the m-dash (e.g. SESIIDAE pictures No 0015-0016–2025). These letters and digit codes correspond to the numbering system of the figured specimens in the author’s archive. Each preparation of the genitalia is stored in a microtube with glycerol pinned under the specimen. The dissected genitalia are equipped with the corresponding number placed in the microtube. This number as a label (e.g. Genitalia preparation No OG–001-2025) is pinned under the specimen and listed in the author’s archive.

The names of plants were verified with the Plantarium (2025).

The material studied or mentioned herein, including the neotype, is kept in the collection of the A.N. Severtsov Institute of Ecology and Evolution of the Russian Academy of Sciences, Moscow, Russia (COGM).

Results

Bembecia jakuta (Herz, 1903)

Figs 1–14

“*Sesia jakuta* nov. sp.” – Herz 1903: 19, figs. Type locality: Russia, Yakutiya, Yakutsk, Botanical Garden, 62.025266°N, 129.613083°E, 98 m, (by neotype, designated here).

Literature. Bartel 1912: 396 (*Dipsosphencia*); Dalla Torre and Strand 1925: 65 (*Dipsosphencia*); Heppner and Duckworth 1981: 39 (*Bembecia*); Špatenka et al. 1993: 99 (*Bembecia*); Gorbunov and Tshistjakov 1995: 15 (*Bembecia*); Špatenka et al. 1996: 8 (*Bembecia*); Špatenka et al. 1999: 177 (key), 212, text-fig. 140 (*Bembecia*); Gorbunov and Tshistjakov 1999: 305, fig. 176, 11–14 (*Bembecia*); Pühringer and Kallies 2004: 35 (*Bembecia*); Gorbunov 2008: 111 (*Bembecia*); Averenskiy and Tshistjakov 2011: 180 (*Bembecia*); Gorbunov 2018: 273 (*Bembecia*); Gorbunov 2019: 160 (*Bembecia*); Gorbunov 2020: 554 (*Bembecia*).

Material. Neotype (designated here) – ♂ (Figs 1–2) with labels: “Russia, Yakutiya, / Yakutsk, Botanical Garden, / 62.025266°N, 129.613083°E, / 98 m, 27.VI.2024, O.G. Gorbunov leg.”; “SESIIDAE / Pictures No / 0015-0016–2025 / Photo by O. Gorbunov”; “NEOTYPUS ♂ / *Bembecia jakuta* / (Herz, 1903) / O.G. Gorbunov”.

nov des., 2025”; 1♂, Russia, Yakutiya, Yakutsk, Botanical Garden, 62.025266°N, 129.613083°E, 100 m, 30.VI.1989, S.K. Sazonov leg. (Pictures №№ / 0013-0014–2025; genitalia preparation No OG–001-2025); 1♂, same locality, 62.025833°N, 129.612267°E, 98 m, 24.VI.2024, O.G. Gorbunov leg. (Pictures No / 0019-0020–2025); 1♂, same locality, 62.025266°N, 129.613083°E, 98 m, 27.VI.2024, O.G. Gorbunov leg. (Pictures No / 0011-0012–2025); 1♂, Russia, Yakutiya, Yakutsk, Chochur-Muran, 62.022204°N, 129.603134°E, 106 m, 27.VI.2024, O.G. Gorbunov leg. (Pictures No 0017-0018–2025).

Redescription. Male (neotype) (Figs 1–2). Wings span 19.6 mm; body length 11.3 mm; forewing 9.0 mm; antenna 6.0 mm.

Head with flagellum black with dark blue-violet sheen, scapus dark brown with bronze sheen; frons dark gray-brown with several white scales medially; vertex black with dark greenish-violet sheen mixed with white, long, hair-like scales; basal palpomere of labial palpus black with few yellow scales externally, remaining palpomeres yellow with broad black stripe ventroexternally; occipital fringe mixed with black and yellow scales; neck plate black with bright greenish-blue sheen.

Thorax with patagium black with bright greenish sheen and several yellow scales laterally; tegula black with blue-violet sheen and with small yellow spot with golden tint at base of forewing; meso- and metathorax completely black with dark blue-violet sheen; besides this, tegula, meso- and metathorax densely covered with white, long, hair-like scales masking background colouration; thorax laterally black with bright blue-violet sheen and several yellow scales with golden tint at base of forewing; posteriorly, both metepimeron and metameron black, densely covered with white, long, hair-like scales.

Legs with fore coxa black with blue-purple sheen, densely covered with black, long, hair-like scales; fore femur black with blue-violet sheen, with black, long, hair-like scales at posterior margin; fore tibia ventrally pale yellow with golden tint, dorsally black with blue-violet sheen and narrowly orange at anterior margin; fore tarsus ventrally pale yellow with golden tint, dorsally yellow with several black scales on basal and two apical tarsomeres; mid coxa black with blue-violet sheen; mid femur black with blue-violet sheen and with white, long, hair-like scales at posterior margin; mid tibia black with bright blue-violet sheen and with small orange spot medioexternally and several orange scales dorsodistally; spurs yellow with golden tint; mid tarsus yellow with golden tint with several black scales with violet sheen externally on basal tarsomere; hind coxa black with blue-violet sheen; hind femur black with blue-violet sheen and with white, long, hair-like scales at posterior margin; hind tibia orange, both basally and distally broadly black with blue-violet sheen; spurs yellow with golden tint; hind tarsus yellow-orange with golden tint.

Forewing dorsally with basal part black with dark blue-violet sheen; costal margin up to tip of vein R_3 black with dark greenish-blue sheen; CuA-stem black with dark violet sheen and several orange scales; anal margin up to distal margin of discal spot orange further black with bronze-violet sheen; discal spot black with dark greenish-violet sheen in basal two third and orange in distal third; veins within

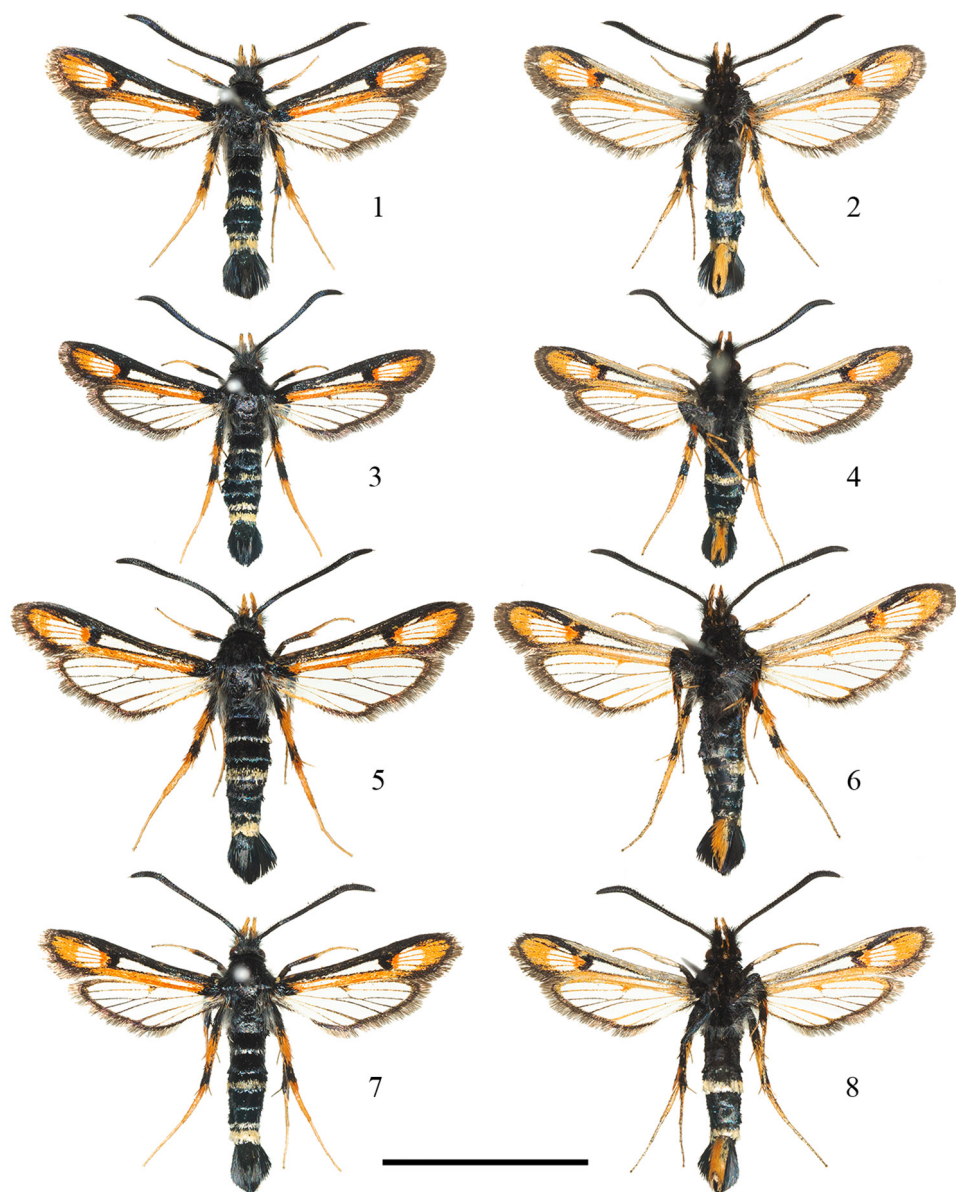
external transparent area orange; apical area orange with dense admixture of black scales with dark violet sheen between veins R_3 – R_4 and on veins R_5 , M_2 and M_3 distally; outer margin extremely narrow, black with bronze-violet sheen; cilia gray-brown with bronze sheen; ventrally costal margin up to tip of vein R_1 pale yellow; CuA-stem and anal margin yellow-orange with golden tint; margins of anterior transparent area narrowly black with dark violet sheen; discal spot black with dark violet sheen in basal half and orange in distal half; surface between veins R_1 and R_3 black with dark violet sheen and few orange scales; surface between veins CuA_1 and CuA_2 mixed with yellow-orange and black scales; veins R_4 and R_5 black with several yellow-orange scales; apical area yellow-orange; cilia gray-brown with bronze sheen; transparent areas rather well-developed, but densely covered with translucent scales with light golden-greenish tint; posterior transparent area short, only slightly extending distad to level of discal spot of hindwing; external transparent area rather small, rounded distally, divided into five cells between veins R_3 and CuA_1 , level to vein M_2 about twice as broad as discal spot and apical area; cilia brown with bronze sheen.

Hindwing transparent; dorsally vein M_2 orange with several black scales with bronze sheen, vein CuP mixed with orange and black scales, remaining veins black with bronze sheen; discal spot extremely narrow, cuneiform, reaching base of common stem of veins M_3 – CuA_1 , orange and with several black scales; outer margin dark brown with bronze-violet sheen, about 0.3 times as broad as cilia; ventrally discal spot, veins M_2 and CuP yellow-orange, remaining veins dark brown with bronze sheen and admixture of yellow-orange scales; outer margin dark brown with bronze-violet sheen; cilia brown with bronze sheen, white anally.

Abdomen black with greenish-violet sheen; dorsally tergites 4 and 7 each with rather broad yellow stripe with golden tint distally; tergite 2 with several pale yellow scales distally; tergite 6 with narrow yellow stripe distally; ventrally sternite 4 with broad yellow stripe with golden tint distally; sternite 7 with narrow yellow stripe distally; sternites 5 and 6 each with several pale yellow scales both medially and distally; anal tuft black with greenish-violet sheen dorsally and yellow-orange medioventrally.

Male genitalia (genital preparation No OG-001-2025) (Figs 9–13). Tegumen-uncus complex relatively broad; scopula androconialis well-developed, about 0.5 times as long as length of tegumen-uncus complex (Fig. 9); crista gnathi medialis broad, semi-oval; crista gnathi lateralis slightly narrower, semi-cordate (Fig. 9); valva (Fig. 10) trapeziform-oval, crista sacculi compaund with two distinct parallel ridges: ventral ridge short, dorsal one long, densely covered with strong, pointed setae; caudal end of dorsal ridge and ventral ridge with group of fat-topped setae; saccus (Fig. 11) visibly broadened basally with rounded base, long, about 1.8 times as long as vinculum; aedeagus (Fig. 12) rather narrow, straight, about as long as length of valva; vesica with numerous strong cornuti (Fig. 13).

Female. Unknown.



Figures 1–8. Males of *Bembecia jakuta* (Herz, 1903). 1–2 – Neotype. Sesiidae picture No 0015-0016–2025. 3–4 – Sesiidae picture No 0017-0018–2025. 5–6 – Sesiidae picture No 0011-0012–2025. 7–8 – Sesiidae picture No 0019-0020–2025. 1, 3, 5, 7 – dorsal view; 2, 4, 6, 8 – ventral view. Scale bar: 10.0 mm.

Individual variability. Males somewhat vary in the number of yellow-orange and orange scales on the abdomen and forewing (compare Figs 1–8). Besides this, the transparent areas of the forewing are slightly variable as well (compare Figs 1, 3, 5, and 7). Individual size is variable as follows: wings span 18.5–22.8 mm; body length 10.5–13.1 mm; forewing 8.4–10.5 mm; antenna 5.8–7.0 mm.

Differential diagnosis. This species seems to be the closest to *B. aktashica* O. Gorbunov, 2018 (type locality: Russia, Altai Republic, Altai Mts, Aktash, 50° 20' N, 87° 35' E, 1400 m), from which it can be distinguished in the colouration of the frons (black with greenish-violet sheen in the species compared, vs. dark gray-brown with several white scales medially in *B. jakuta*), patagium (entirely black with greenish-violet sheen in *B. aktashica*, vs. black with bright greenish sheen and several yellow scales laterally in *B. jakuta*), and abdomen (dorsally tergites 2 and 4 each with a few yellow scales distally; tergites 6 and 7 each with a narrow yellow to yellow-orange stripe distally; ventrally sternites 4 and 7 each with a narrow yellow stripe distally in *B. aktashica*, vs. dorsally tergites 4 and 7 each with rather broad yellow stripe with golden tint distally; tergite 2 with several pale yellow scales distally; tergite 6 with narrow yellow stripe distally; ventrally sternite 4 with broad yellow stripe with golden tint distally; sternites 7 with narrow yellow stripe distally; sternites 5 and 6 each with several pale yellow scales both medially and distally in *B. jakuta*), as well as the conformation of the forewing (transparent areas poorly-developed, posterior transparent area nearly undeveloped, anterior transparent area rather small; external transparent area relatively small, divided into four cells between veins R_{4+5} and CuA_1 , level to vein M_2 about as broad as discal spot and about twice broader than apical area in the species compared, vs. transparent areas rather well-developed, posterior transparent area short, only slightly extending distad to level of discal spot of hindwing; external transparent area rather small, divided into five cells between veins R_3 and CuA_1 , level to vein M_2 about twice as broad as discal spot and apical area in *B. jakuta*; cp. Figs 1, 3, 5 and 7 in this article with figs 21, 23, 25 and 27 in Gorbunov 2018). In addition, these two species have some differences in the structure of the genitalia. Compare Figs 9–13 in this article with figs 42–46 in Gorbunov (2018).

B. jakuta differs from *B. strandi* (W. Kozhantschikov, 1936) (type locality: Russia: Krasnoyarsk Krai, Minusinskiy Distr., Tagarskiy Island) in the colouration of the frons (dark gray-brown with several white scales medially in *B. jakuta*, vs. white to pale yellow with golden tint and admixture of several black scales medially in *B. strandi*), fore coxa (black with blue-purple sheen, densely covered with black, long, hair-like scales in *B. jakuta*, vs. pale yellow with golden tint and several black scales medially in *B. strandi*), CuA -stem of the forewing dorsally (black with dark violet sheen and several orange scales in *B. jakuta*, vs. CuA -stem orange in *B. strandi*; cp. Figs 1, 3, 5 and 7 in this article with figs 7, 9, 11 and 13 in Gorbunov, in press) and abdomen (dorsally tergites 4 and 7 each with rather broad yellow stripe with golden tint distally; tergite 2 with several pale yellow scales distally; tergite 6 with narrow

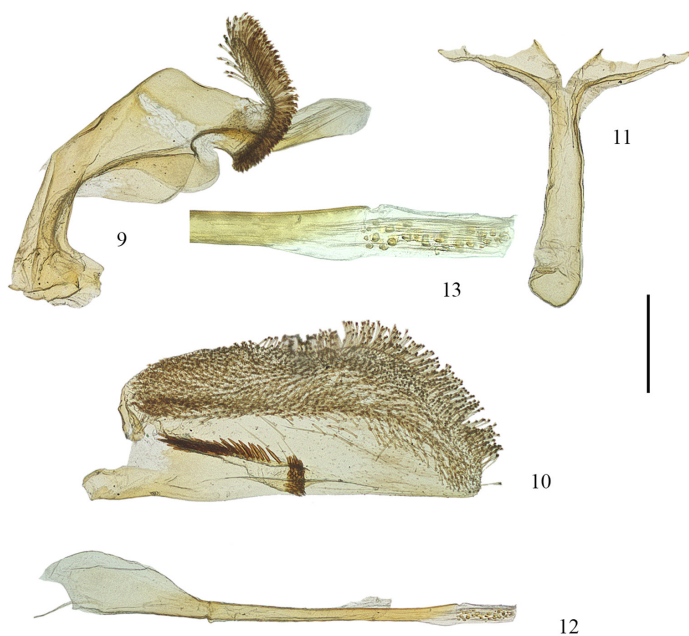
yellow stripe distally; ventrally sternite 4 with broad yellow stripe with golden tint distally; sternites 7 with narrow yellow stripe distally; sternites 5 and 6 each with several pale yellow scales both medially and distally in *B. jakuta*, vs. dorsally tergites 2, 4, 6 and 7 each with rather broad yellow stripe with golden tint distally; tergites 3 and 5 each with admixture of yellow scales with golden tint in distal half; ventrally sternite 4 with broad yellow stripe with golden tint distally; basal sternite and sternites 5–7 each with admixture of yellow scales with golden tint distally; sternite 3 with several thin, yellow-orange scales medially in *B. strandi*; cp. Figs 1–8 in this article with figs 7–14 in Gorbunov in press). In addition, these two species differ significantly from each other in the structure of the transparent areas of the forewing (anterior transparent area well-developed, not divided into two parts by extremely narrow scaled line; external transparent area rather small, rounded distally, divided into five cells between veins R_3 and CuA_1 , level to vein M_2 about twice as broad as discal spot and apical area in *B. jakuta*, vs. anterior transparent area divided into two parts by extremely narrow scaled line; external transparent area rather small, rounded distally, divided into five cells between veins R_3 and CuA_1 , level to vein M_2 about 1.25 times as broad as discal spot and about 1.7 times broader than apical area in *B. strandi*; cp. Figs 1, 3, 5 and 7 in this article with figs 7, 9, 11 and 13 in Gorbunov in press) and the shape of the valva in the male genitalia (cp. Fig. 16 in this article with text-fig. 10 in Gorbunov in press).

B. jakuta can easily be separated from all other East Palearctic congeners in the colouration of various parts of the body and wings, conformation of the transparent areas of the forewing and some details of the male genitalia.

Bionomics. The larval host plant is unknown. Moths on the wings from the second half of June to the first half of August. Males came to lures with unspecific synthetic sex attractants in the first half of the day from about 10 am to 1 pm.

Habitat (Fig. 14). All the studied material was collected on the territory of the Yakutsk Botanical Garden, located on the second floodplain terrace of the Lena River. Most of the botanical garden is covered with steppe and meadow-steppe vegetation. Among the legumes noted for this botanical garden (Nikolaeva et al. 2015), the following species should be considered the most likely host plants of *B. jakuta*, viz. *Astragalus suffruticosus* Pall., *A. angarensis* Turcz. ex Bunge, *A. inopinatus* Boriss., *Hedysarum dasycarpum* Turcz. and *Oxytropis candicans* (Pall.) DC. I found these species and examined them carefully for traces of larval habitation, but unfortunately, I did not find any.

Distribution. Currently this species is known only from a few localities on the left bank of the Lena River in the vicinity of Yakutsk, Republic of Sakha (Yakutia), Russia.



Figures 9–13. Male genitalia of *Bembecia jakuta* (Herz, 1903). Genitalia preparation No OG-001-2025. **9** – tegumen-uncus complex; **10** – valva; **11** – saccus; **12** – aedeagus; **13** – vesica. Scale bar: 0.5 mm for **9–12** and 0.2 for **13**.



Figure 14. Habitat and the type locality of *Bembecia jakuta* (Herz, 1903). Russia, Republic of Sakha (Yakutiya), Yakutsk, Botanical Garden, view of Chochur-Muran, 62.025266°N, 129.613083°E, 98 m, 27.VI.2024.

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