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Notes on the morphology and bionomics of *Dipchasphecia rhodocnemis* O. Gorbunov, 1991 (Lepidoptera: Sesiidae)

К морфологии и биономии *Dipchasphecia rhodocnemis* O. Gorbunov, 1991 (Lepidoptera: Sesiidae)

O.G. Gorbunov
О.Г. Горбунов

A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Leninsky prospekt 33, Moscow 119071 Russia.
Институт проблем экологии и эволюции им. А.Н. Северцова РАН, Ленинский проспект, 33, Москва 119071 Россия.
Oleg Gorbunov: gorbunov.oleg@mail.ru; ORCID https://orcid.org/0000-0001-5706-621X

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КЛЮЧЕВЫЕ СЛОВА: Sesiidae, Synanthedonini, бабочки-стеклянницы, *Dipchasphecia rhodocnemis*, морфология, биология преимагинальных стадий, кормовое растение, Якутия, Палеарктический регион.

ABSTRACT. The morphology of the male and female genitalia of *Dipchasphecia rhodocnemis* O. Gorbunov, 1991, from the Republic of Sakha (Yakutia) are described and illustrated for the first time. It is established that the larvae of this species live in the roots of *Goniolimon speciosum* (L.) Boiss. (Plumbaginaceae: Limonieae). The biological features of the larvae are discussed and illustrated. Morphologically and in biological features, *D. rhodocnemis* is closest to *D. altaica* O. Gorbunov, 1991, but these two species differ from each other in the details of the colouration of various parts of the body, the structure of the transparent areas of the forewing, and the conformation of the genitalia of both the male and female.

РЕЗЮМЕ. Впервые приведено описание морфологии самца, а также гениталий самки *Dipchasphecia rhodocnemis* O. Gorbunov, 1991 из Республика Саха (Якутия). Установлено, что гусеницы этого вида живут в корнях *Goniolimon speciosum* (L.) Boiss. (Plumbaginaceae: Limonieae). Обсуждены и проиллюстрированы особенности биологии гусениц. Морфологически и особенностями биологии *D. rhodocnemis* наиболее близок к *D. altaica* O. Gorbunov, 1991, но эти два вида отличаются друг от друга деталями окраски различных частей тела, строением прозрачных полей переднего крыла, а также строением гениталий как самца, так и самки.

Introduction

With this article, the author continues a series of publications devoted to clearwing moths (Lepidoptera, Sesiidae) of the fauna of Russia and adjacent territories [Gorbunov, 2018a, 2019a–c, 2020a, 2022a–b, 2023a–b, 2024a–d, 2025a–b; Yata *et al*., 2018; Gorbunov, Efetov, 2018, 2024b; Efetov, Gorbunov, 2021, 2024; Gorbunov, Koshkin, 2023; Efetov *et al*., 2025; Gorbunov, Ivanov, 2024, 2025; etc.]. The article examines the morphology and bionomy of the very poorly studied *Dipchasphecia rhodocnemis* O. Gorbunov, 1991. It was described by me from a single female collected in Sergelyakh in the vicinity of Yakutsk (now the Yakutsk region) by the Yakut local historian N.N. Moskvin in 1925 [Gorbunov, 1991]. Until now, neither the males, nor the female genitalia, nor the flight period, nor the host plants of the larvae were known for this species. In 2023, I visited Yakutsk and its environs for the first time to collect clearwing moths. Unfortunately, I made this trip at the end of July, which turned out to be too late, and I only managed to collect eight males that were attracted by non-specific sex pheromones. I did not collect any larvae or pupae, but I did find a host plant with clear evidence of clearwing moth larvae activity. The following year I went to Yakutsk again, but about a month earlier. The trip was quite successful. Using artificial sex pheromones, I managed to collect males of *Bembecia jakuta* (Herz, 1903) [Gorbunov, 2025a], a dozen and a half males of *D. rhodocnemis*, and also collected larvae of this species, from which 13 males and 12 females were emerged.

It is appropriate to note here, as has already been repeatedly pointed out [Gorbunov, 2015, 2017, 2018b–c, 2019c, 2020b, 2022, 2023c; Efetov, Gorbunov, 2021; Gorbunov, Efetov, 2024a], the importance of using artificial pheromones for studying not only clearwing moths, but also some other groups of Lepidoptera, for which the meeting of the sexes for mating is ensured by the

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production of sex attractants by the female [Efetov *et al*., 2014a, 2019; Gorbunov, Efetov, 2024a]. The application of the female sex attractants for scientific purposes has one drawback: this method allows only males to be collected [Efetov *et al*., 2014a–b, 2016; Gorbunov, Efetov, 2018; Efetov, Gorbunov, 2021]. Females of clearwing moth species that require additional nectar feeding can be collected from flowers with an entomological net. Females of non-feeding species can be accidentally found resting on some substrate or flying near a host plant with the purpose of laying eggs. But the most productive method of collecting females of Sesiidae should be considered to be searching for larvae or pupae and then raising them. A striking example of such a method is this publication.

Material and methods

The description is made using a Leica EZ4 stereomicroscope with LED illuminations, and images is taken with a Sony® α450 DSLR camera equipped with a Minolta® 50 f/2.8 Macro lens. The figures of the genitalia are taken with a Keyence® BZ-9000 Biorevo Fluorescence Microscope. The processing of all illustrations is finalized with the Adobe® Photoshop® CC 2020 software.

All pictures of the specimens are labeled with a number, consisting of letters and digits: name of the family, two consecutive digits separated by n-dash and a year following m-dash (e.g. SESIIDAE pictures Nos 0051–0052-2025). These letter and digit codes correspond to the numbering system of the figured specimens in the author's archive. The genitalia preparation is stored in a microtube with glycerol and 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-005-2025) is pinned under the specimen and is listed in the archives of the author.

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

The names of plants were verified with the WFO [2025].

Taxonomic account

Dipchasphecia rhodocnemis O. Gorbunov, 1991
Figs 1–29.

"*Dipchasphecia rhodocnemis* spec. nov.": Gorbunov, 1991: 149 (key), 160, pl. XXIII, fig. 6. Type locality: "SE-Siberia, pr. Jakutsk, loc. Sergeljah, …" [= Russia: Republic of Sakha (Yakutia), Yakutsk, settlement Sergelyakh]. Holotype ♀ (COGM).

Literature. Averenskyi, 1972: 103 (*Chamaesphecia muscaeformis*); Špatenka *et al*., 1993: 104; Gorbunov, Tshistjakov, 1995: 16; Špatenka *et al*., 1996: 11; Špatenka *et al*., 1999: 283, pl. 41, fig. 335; Gorbunov, Tshistjakov, 1999: 307; Pühringer, Kallies, 2004: 40; Gorbunov, 2008: 112; Averenskyi, Tshistjakov, 2011: 181; Gorbunov, 2019d: 160.

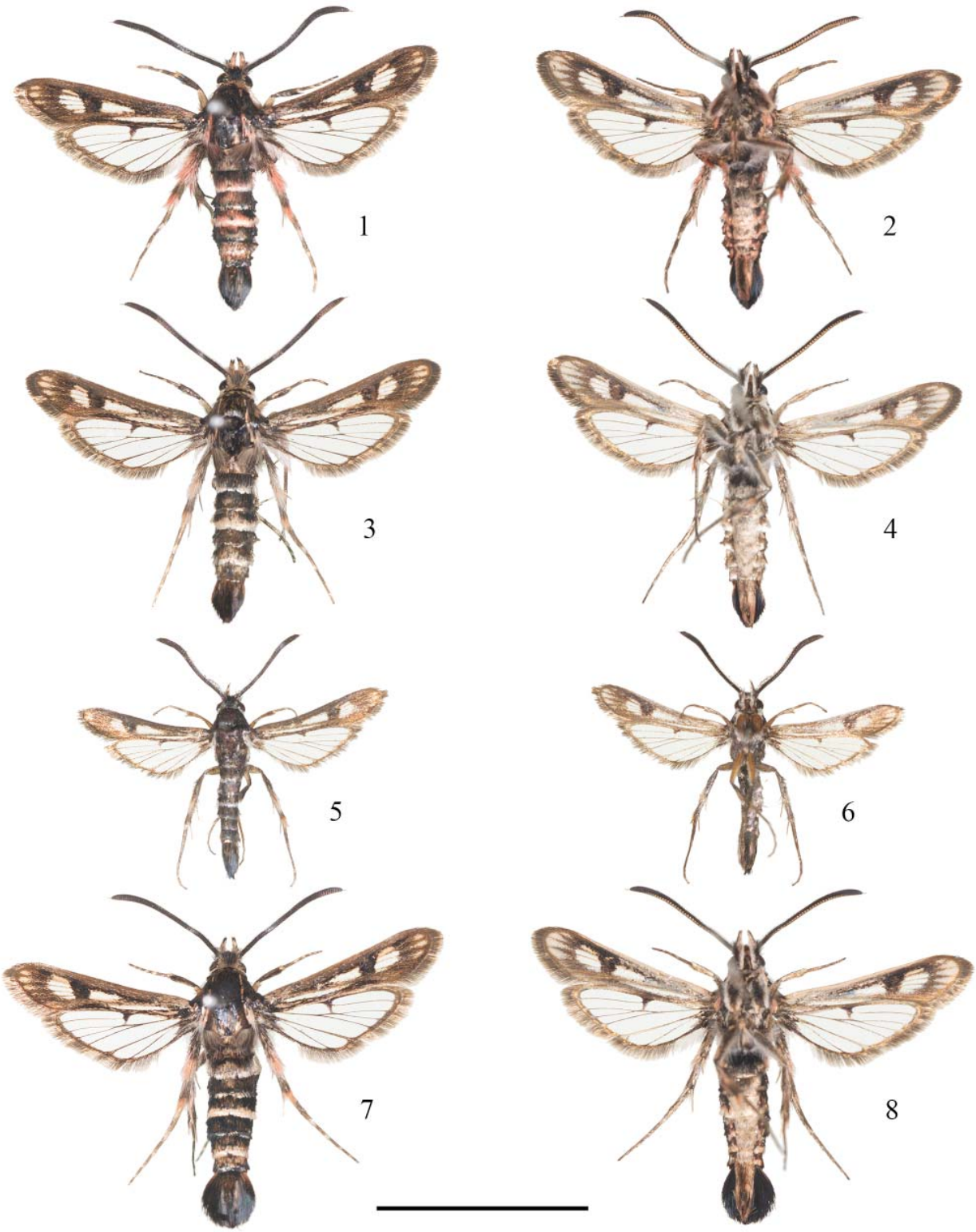
MATERIAL. 1 ♀ (holotype, Figs 9–10), SE-Siberia, pr. Jakutsk, loc. Sergeljah, 17.VIII.1925, N. Moskvin leg.; 1 ♂, Russia, Yakutiya, Yakutsk, Chochur-Muran, 62°1.262′N, 129°36.267′E, 100 m, 26.VII.2023, O.G. Gorbunov leg. (Sesiidae pictures Nos 0131–0132-2023); 7 ♂♂ (Figs 5–6), same locality, 62°1.299′N, 129°36.190′E, 107 m, 26.VII.2023, O.G. Gorbunov leg. (Sesiidae pictures Nos 0133–0138-2023; 0165–0170-2023; 1 ♂ with genitalia preparation No. OG-005-2025); 1 ♂, same locality, 62°2332′N, 129°36.942′E, 100 m, 27.VII.2023, O.G. Gorbunov leg. (Sesiidae pictures Nos 0163–0164-2023); 4 ♂♂, same locality, 62°1.299′N, 129°36.190′E, 100 m, 20.VI.2024, O.G. Gorbunov leg.; 2 ♂♂, same locality, 62°1.299′N, 129°36.190′E, 100 m, 21.VI.2024, O.G. Gorbunov leg.; 5 ♂♂, same locality, 62°2.430′N, 129°37.051′E, 117 m, 22.VI.2024, O.G. Gorbunov leg.; 1 ♂, same locality, 62°2.326′N, 129°36.939′E, 113 m, 22.VI.2024, O.G. Gorbunov leg.; 1 ♂, same locality, 62°2.138′N, 129°36.605′E, 100 m, 22.VI.2024, O.G. Gorbunov leg.; 1 ♂, same locality, 62°2.329′N, 129°36.943′E, 98 m, 26.VI.2024, O.G. Gorbunov leg.; 1 ♂, Russia, Yakutiya, Yakutsk, Botanical Garden, 62°1.332′N, 129°36.188′E, 98 m, 27.VI.2024, O.G. Gorbunov leg.; 13 ♂♂ (Figs 1–4, 7–8), 12 ♀♀ (11–16), same locality, 62°1.516′N, 129°36.785′E, 98 m, 27.VI.2024, ex pupae from roots of *Goniolimon speciosum* (Limoniaceae), moths emerged 5–17.VII.2024 (Sesiidae pictures Nos 0041–0052-2025; 1 ♂ with genitalia preparation No. OG-006-2025, 1 ♀ with genitalia preparation No. OG-009-2025) O.G. Gorbunov leg.

DESCRIPTION. Male (Figs 1–2). Wingspan 20.0 mm; body length 11.5 mm; forewing 8.9 mm; antenna 6.0 mm.

Head: flagellum black with dark blue-violet sheen and with dense admixture of pink scales ventrally, scapus black with bronze sheen and pink scales anteriorly; frons pale pink with several dark gray-brown scales medially; vertex black with dark violet sheen, several pink scales at margins and few white scales in front of ocellus; labial palpus pink with narrow black stripe with dark violet sheen exterior-ventrally; occipital fringe pale pink; neck plate pale pink with black scales medially.

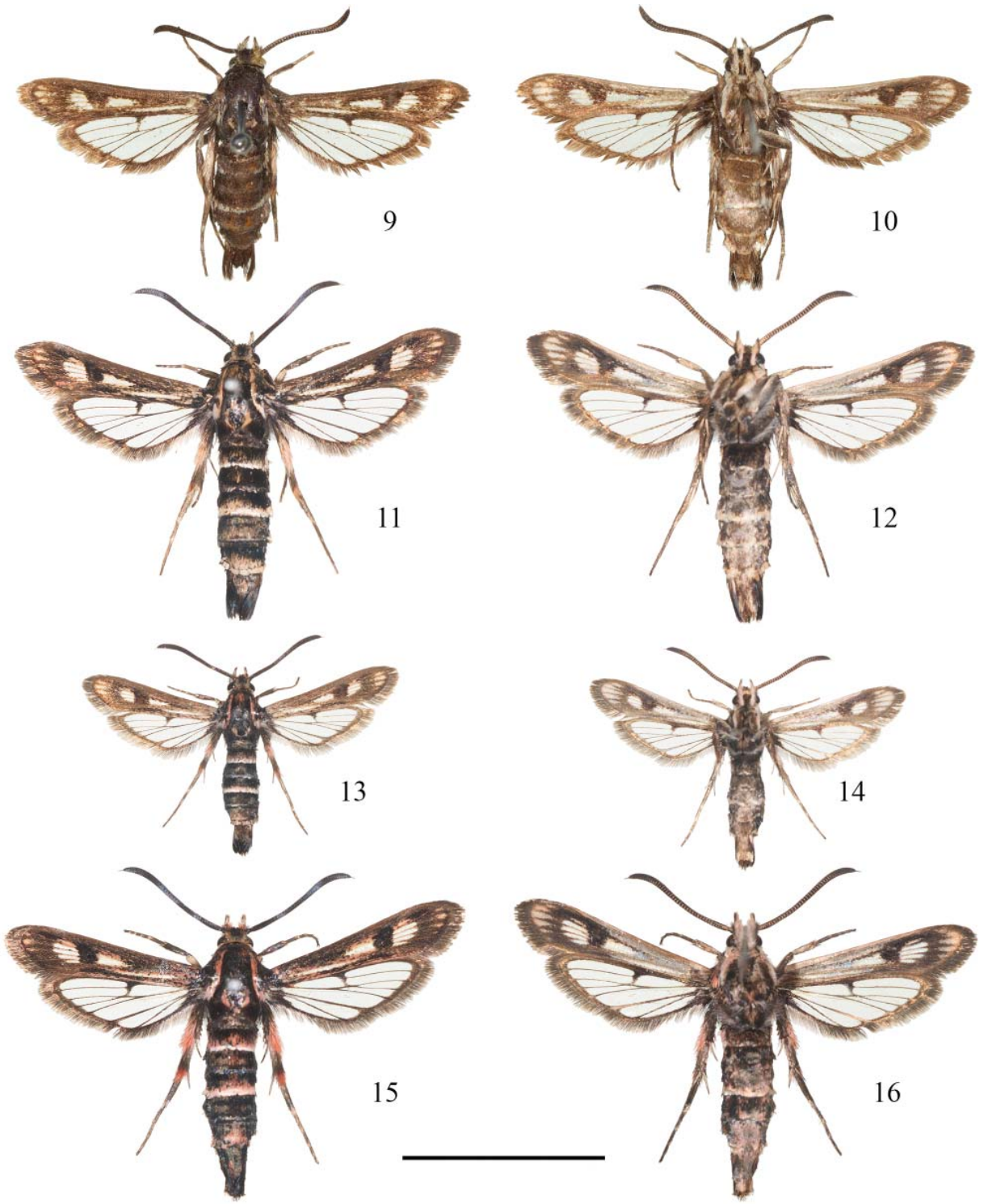
Thorax: patagium black with bright greenish-bronze sheen and pink scales anteriorly and ventrally; tegula black with bright greenish-bronze sheen, pink scales at inner margin, distally and at base of forewing; mesothorax black with bright greenish-bronze sheen and pink scales posteriorly; metathorax black with bright greenish-bronze sheen, pale pink scales medially and tuft of pale pink hair-like scales laterally; besides this, tegula and mesothorax densely covered with pale pink, long, hair-like scales masking background colouration; thorax laterally black with bright greenish-violet sheen and dense admixture of pale pink and pink scales; posteriorly, both metepimeron and metameron silvery white, densely covered with white, long, hair-like scales.

Legs: fore coxa black with greenish-violet sheen medially and pink at margins, densely covered with pale pink, long, hair-like scales masking background colouration; fore femur pale pink with golden tint, black with bronze sheen posterior margin and pale pink, long, hair-like scales at posterior margin; fore tibia ventrally dirty yellow, dorsally black with bronze-violet sheen; fore tarsus dark brown with violet sheen, dorsally basal tarsomere with small dirty yellow spot both basally and distally, tarsomeres 2–4 each with such spot distally; mid coxa black with greenish-violet sheen and several pink scales internally; mid femur externally pale pink with golden tint, black with bronze sheen posterior margin and pale pink, long, hair-like scales at posterior margin, internally white with golden tint; mid tibia exterior-dorsally black with bright greenish-violet sheen, large pink spot of elongated scales medially and pink elongated scales distally, interior-ventrally white with golden-pink tint; spurs white with golden-pink tint; mid tarsus dark gray-brown with bronze sheen, basal tarsomere interior-ventrally white with golden-pink tint and narrow white with golden-pink tint ring distally, tarsomeres 2–4 each with small white spot with golden-pink tint distally; hind coxa externally black with greenish-violet sheen and several pink scales dis-



Figs 1–8. Variability of males of *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 1–2 — Sesiidae pictures Nos 0047–0048-2025; 3–4 — Sesiidae pictures Nos 0049–0050-2025; 5–6 — Sesiidae pictures Nos 0137–0138-2023; 7–8 — Sesiidae pictures Nos 0051–0052-2025. 1, 3, 5, 7 — dorsal view; 2, 4, 6, 8 — ventral view. Scale bar: 10.0 mm.

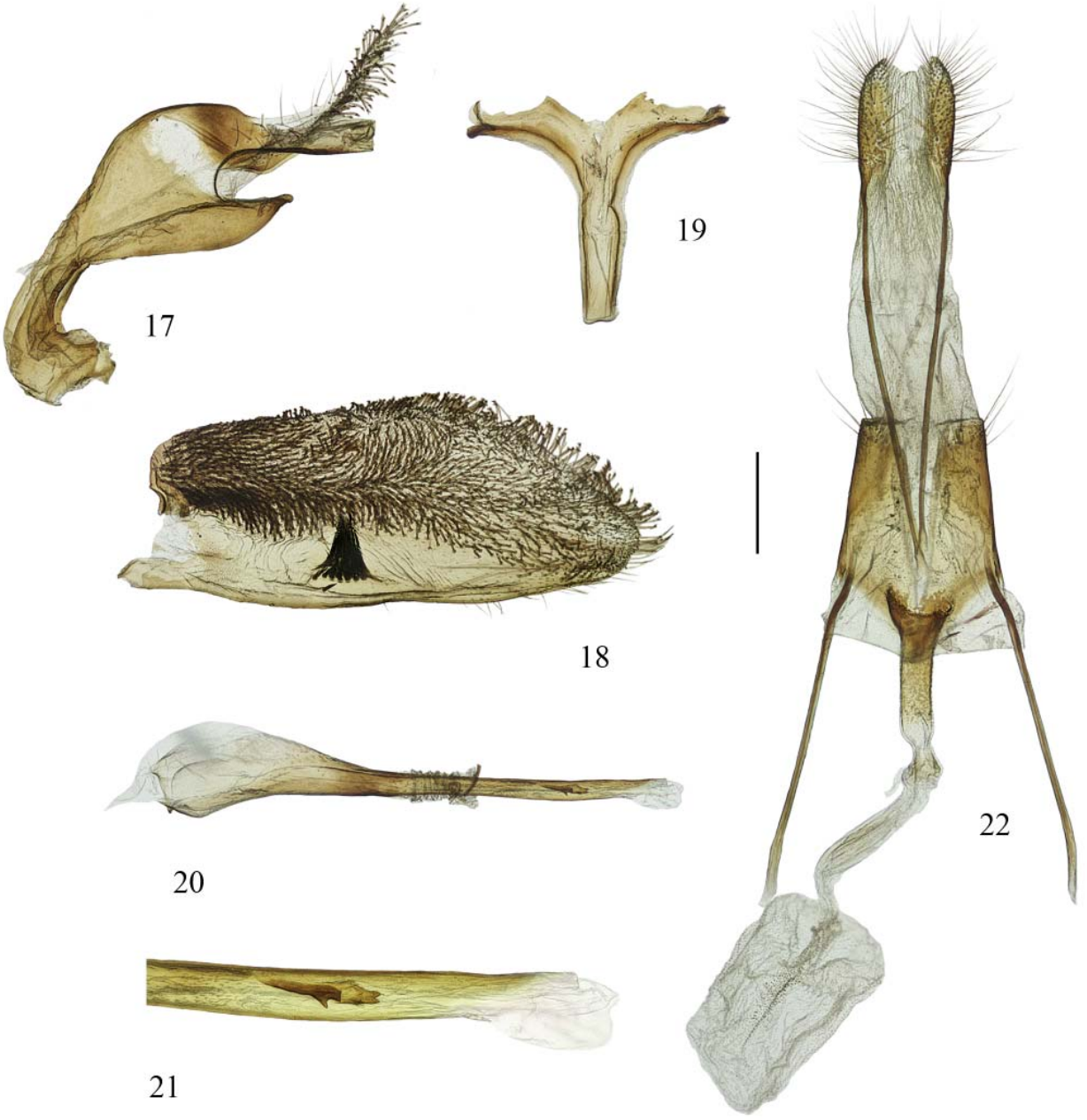
Рис. 1–8. Изменчивость самцов *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 1–2 — Sesiidae снимки №№ 0047–0048-2025; 3–4 — Sesiidae снимки №№ 0049–0050-2025; 5–6 — Sesiidae снимки №№ 0137–0138-2023; 7–8 — Sesiidae снимки №№ 0051–0052-2025. 1, 3, 5, 7 — вид сверху; 2, 4, 6, 8 — вид снизу. Масштаб: 10,0 мм.



Figs 9–16. Variability of females of *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 9–10 — holotype. Sesiidae pictures Nos 0137–0138-2013; 11–12 — Sesiidae pictures Nos 0041–0042-2025; 13–14 — Sesiidae pictures Nos 0045–0046-2025; 15–16 — Sesiidae pictures Nos 0043–0044-2025. 9, 11, 13, 15 — dorsal view; 10, 12, 14, 16 — ventral view. Scale bar: 10.0 mm.
Рис. 9–16. Изменчивость самок *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 9–10 — голотип. Sesiidae снимки №№ 0137–0138-2013; 11–12 — Sesiidae снимки №№ 0041–0042-2025; 13–14 — Sesiidae снимки №№ 0045–0046-2025; 15–16 — Sesiidae снимки №№ 0043–0044-2025. 9, 11, 13, 15 — вид сверху; 10, 12, 14, 16 — вид снизу. Масштаб: 10,0 мм.

tally, internally; hind femur black with bronze-violet sheen and sparse pale pink scales distally, with whitish, long, hair-like scales at posterior margin, internally white with golden tint; hind tibia exterior-dorsally black with greenish-violet sheen, large pink spot of elongated scales medially and small spot of such scales distally, exterior-ventrally brown-olive with golden sheen, interior-ventrally mixed with white, black and brown-olive scales; spurs white with golden-pink tint; hind tarsus brown-olive with golden sheen, basal tarsomere interior-ventrally white with golden-pink tint and narrow white with golden-pink tint ring distally, tarsomeres 2–4 each with small white spot with golden-pink tint distally.

Forewing dorsally in basal part black with dark blue sheen and admixture of individual pink scales; costal margin brown with bronze sheen and rare thin pink scales; CuA-stem brown with bronze sheen and several pale pink scales; anal margin



Figs 17–22. Genitalia of *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 17–21 — ♂. Genital preparation No OG-005-2025: 17 — tegumen-uncus complex; 18 — valva; 19 — saccus; 20 — aedeagus; 21 — vesica; 22 — ♀. Genital preparation No OG-009-2025. Scale bar: 0.5 mm for 17–20, 22 and 0.2 mm for 21.

Рис. 17–22. Гениталии *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 17–21 — ♂. Препарат гениталий № OG-005-2025: 17 — тегумен-ункусный комплекс; 18 — вальва; 19 — саккус; 20 — эдеагус; 21 — везика; 22 — ♀. Препарат гениталий № OG-009-2025. Масштаб: 0,5 мм для 17–20, 22 и 0,2 мм для 21.

Figs 23–26. Bionomics of *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 23 — a host plant damaged by a larva with the bore deposits pushed out. Russia, Republic of Sakha (Yakutiya), Yakutsk, Chochur-Muran, 19.VI.2024; 24 — a last instar larva in the root of a host plant. Russia, Republic of Sakha (Yakutiya), Yakutsk, Chochur-Muran, 20.VI.2024; 25 — freshly emerged male. Russia, Republic of Sakha (Yakutiya), Yakutsk, Chochur-Muran, 6.VII.2024; 26 — freshly emerged female. Russia, Republic of Sakha (Yakutiya), Yakutsk, Chochur-Muran, 8.VII.2024.
Рис. 23–26. Биология *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 23 — повреждённое гусеницей кормовое растение с вытолкнутой буровой мукой. Россия, Республика Саха (Якутия), Якутск, Чочур-Муран, 19.VI.2024; 24 — взрослая гусеница в корне кормового растения. Россия, Республика Саха (Якутия), Якутск, Чочур-Муран, 20.VI.2024; 25 — свежевыведшийся самец. Россия, Республика Саха (Якутия), Якутск, Чочур-Муран, 6.VII.2024; 26 — свежевыведшаяся самка. Россия, Республика Саха (Якутия), Якутск, Чочур-Муран, 8.VII.2024.

black with dark greenish sheen and few pale pink scales; discal spot black with greenish sheen and few brown scales; veins within external transparent area ocher with pink tint and admixture of individual brown scales more dense on vein R_{4+5}; apical area brown to dark brown with bronze sheen and small ocher spots with pink tint between veins R_4–M_2 distally; outer margin narrow, dark brown with bronze sheen; cilia brown with bright bronze sheen; ventrally costal margin up to tip of vein R_1 ocher with pink tint and black scales at margin of anterior transparent area; CuA-stem and anal margin whitish; distal spot and surface between veins R_1–R_3 black with dark violet sheen; veins within external transparent area ocher with pink tint; apical area dark brow to brown with bronze sheen and ocher with pink tint cuneiform spot between veins R3–CuA1 distally; outer margin brown to dark brown with bronze sheen; cilia brown with bright bronze sheen; transparent areas rather well-developed, but densely covered with translucent scales with pink tint (cells between veins R_3–R_{4+5} and M_3–CuA_1 completely covered with ocher scales with pink tint); posterior transparent area rather long, slightly not reaching discal spot; external transparent area rather small, oval, divided into five cells between veins R_3 and CuA_1, level to vein M_2 about 1.4 times as broad as discal spot and about 0.7 times broader than apical area.

Hindwing transparent; dorsally veins and outer margin brown with bronze sheen; discal spot black with dark violet sheen; ventrally costal margin and veins M_2 and CuP ocher with pink tint, remaining veins brown with bronze sheen; discal spot black with dark bronze sheen; cilia brown with bronze sheen, white with pink tint anally; discal spot narrow, cuneiform, reaching base of common stem of veins M_3–CuA_1; outer margin narrow, about 0.5 times as broad as cilia.

Abdomen dorsally black with bright greenish-violet sheen; tergites 2–4 each covered with pink, long, hair-like scales; tergites 2, 4 and 6 each with narrow pale pink to pink stripe distally; tergite 3 with several pink scales at distal margin; tergites 3–7 each with admixture of pink scales medially; ventrally black with dense admixture of brown-olive scales with bronze sheen; basal sternite and sternites 4–7 each with narrow pink stripe distally; anal tuft black with dark violet sheen, few pink scales laterally and brown-olive scales with bronze sheen and pink scales ventrally.

Male genitalia (genital preparation No OG-005-2025; Figs 17–21). Tegumen-uncus complex relatively broad; scopula androconialis rather well-developed, long, about 0.5 times as long as length of tegumen-uncus complex, covered with sparse bipointed setae (Fig. 17); crista gnathi medialis undeveloped; crista gnathi lateralis long, narrow, semilanceolate (Fig. 17); valva (Fig. 18) trapezoidal-oval, crista sacculi flat, covered with strong, pointed setae, situated ventromedial; saccus (Fig. 19) relatively thin, with flat base, long, about 1.5 times as long as vinculum; aedeagus (Fig. 20) rather narrow, straight, about as long as length of valva; vesica with two strong pointed cornuti (Fig. 21).

Female (Figs 9–16). Overall, slightly larger and noticeably more robust than males. The colouration of various parts of the body and wings is nearly the same as in males. The transparent areas of the forewing are somewhat smaller; they are covered, in addition to transparent scales with a pink tint, with a large number of white scales with a pink tint.

Female genitalia (genital preparation No. OG-009-2025; Fig. 22). Papillae anales relatively broad, covered with short and long setae; tergite 8 broad, triangular, with sparse short and long setae ventrally and distally; posterior apophysis slightly longer than anterior apophysis; ostium bursae funnel-shaped, well-sclerotized, situated on level of anterior angle of tergite 8, broad; antrum broad, short, about as long as length of tergite 8, and about one third of length of posterior apophysis, well-sclerotized; ductus bursae membranous, thin, slightly longer than length of antrum; corpus bursae oval, without signum.

INDIVIDUAL VARIABILITY. Both males and females vary in the number of pale pink, pink and white scales on the head, thorax, legs, abdomen and wings (Figs 1–16). Stale and worn-out specimens are noticeably paler than recently emerged ones. There are a few males (Figs 3–6) in which the pink and pale pink scales on the head, thorax, legs and abdomen are replaced by pale ocher scales with a vague pink tint. Individual size is variable as follows. Males: alar expanse 14.8–21.0 mm; body length 8.8–13.2 mm; forewing length 7.0–9.4 mm; antenna length 4.3–6.0 mm. Females: alar expanse 15.6–22.8 mm; body length 9.0–13.5 mm; forewing length 7.2–10.4 mm; antenna length 4.3–5.9 mm.

DIFFERENTIAL DIAGNOSIS. Currently, only two species of the genus *Dipchasphecia* Căpușe, 1973, are known from the territory of Russia: viz. *D. altaica* O. Gorbunov, 1991 (type locality: "Altai, Ongudai, …" (= Russia, Republic of Altai, Ongudai) and *D. rhodocnemis*. These species are very similar in appearance, but overall *D. rhodocnemis* is slightly smaller and brighter. The external transparent area of *D. altaica* is relatively larger, at the level of vein M_2 it is about 1.6 times wider than the discal spot and about the same width as the apical area, whereas in *D. rhodocnemis* it is about 1.4 times wider than the discal spot and about 0.7 times wider than the apical area. There are some differences in the genitalia of the male (shape of the valva and cornuti; cp. Figs 18, 21 in this article with figs 64, 67 in Gorbunov, 2018a) and the female (relative size of the anterior and posterior apophyses, shape of the ostium bursae and antrum; cp. Fig. 22 in this article with fig. 24 in Gorbunov, 1991). To clarify the systematic position of these species, further research is needed, possibly even with the use of molecular data.

BIONOMICS. The larval host plant is *Goniolimon speciosum* (L.) Boiss. (Plumbaginaceae, Limonieae) (Figs 27, 28). The larva lives in the root (Fig. 24), gnawing a tunnel up to 10 cm in length and pushing out bore deposits (Fig. 23). As a result of the larva's vital activity, the plant dries up completely. Such damaged plants are very noticeable, which makes them much easier to find and collect. The larva pupates in the upper part of the gallery, tightly braiding the walls with silk and closing it with a round lid. The result is something like a long cocoon. The development of the pupa lasts about three weeks. Moths are emerged in the morning hours from about 7:30 to 9:00 am (Figs 25, 26). Moths on the wings from the second half of June to the first half of August. Males came to lures with non-specific synthetic sex attractants in the first half of the day from about 10 am to 1 pm.

HABITAT. All the studied material was collected on the second floodplain and on the slopes of the above-floodplain terrace of the Lena River with steppe or meadow-steppe vegetation (Fig. 29). Host plants are concentrated in warmer areas, which lead to a highly localized distribution of this species.

DISTRIBUTION. Currently, this species is known from several localities in the vicinity of Yakutsk and on Teryut' Island at the mouth of the Olekma River (right tributary of the Lena River), Sakha Republic (Yakutia), Russia.

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Figs 27–29. Host plant and habitat of *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 27–28 — *Goniolimon speciosum* (L.) Boiss. (Plumbaginaceae). Russia, Republic of Sakha (Yakutiya), Yakutsk, Chochur-Muran, 27.VII.2023; 29 — Russia, Republic of Sakha (Yakutiya), Yakutsk, Botanical Garden, view of Chochur-Muran, 27.VI.2024.
Рис. 27–29. Кормовое растение и биотоп *Dipchasphecia rhodocnemis* O. Gorbunov, 1991: 27–28 — *Goniolimon speciosum* (L.) Boiss. (Plumbaginaceae). Россия, Республика Саха (Якутия), Якутск, Чочур-Муран, 27.VII.2023; 29 — Россия, Республика Саха (Якутия), Якутск, Ботанический сад, вид на Чочур-Муран, 27.VI.2024.

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