

**Revision of the genus *Dzhugesia* WEHRLI, 1936 (stat. n.),
with description of a new species
(Lepidoptera: Geometridae: Ennominae)**

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Abstract

Crocallis (Dzhugesia) rjabovi WEHRLI was described from Armenia; however, Turkmen moths are distributed in collections under this name. We prove the status of *Dzhugesia* and the identity of populations from west and east of the Caspian Sea. *Dzhugesia* (stat. n.) is a valid genus with a distinctive set of morphological traits and its own distribution area. *Dzhugesia miatleuski* sp. n. is described from the Kopet Dag mountains in Turkmenistan.

Introduction

A group of ennomine genera (Geometridae: Ennominae) share an enigmatic characteristic – male antennae are thickly pectinated with long pectinations up to the apical segments. Some of these genera are widespread and rich in species, such as *Dyscia* HÜBNER, 1825 and *Crocallis* TREITSCHKE, 1825 whereas some others are monotypic and of limited distribution, such as *Apocolotois* WEHRLI, 1936 in East Asia. A few genera within this assemblage share another characteristic – cornuti at the base of the vesica hanging outside the aedeagus sheath: *Odontopera* STEPHENS, 1831 (Fig. 1), *Crocallis* (Figs 2, 3), *Dzhugesia* WEHRLI, 1936, and *Scodionima* STAUDINGER, 1892 (Fig. 4). DANTART (1993), STADIE & FIEBIG (2014), and also SIHVONEN & SKOU (2017) have mentioned the need for a revision of this group. DANTART (1993) dealt with Iberian species of *Crocallis*, STADIE & FIEBIG (2014) with the *Crocallis elinguarua* (LINNAEUS) species group, and KRÜGER (2002) with the South African relatives *Odontopera* and *Aethiopodes* WARREN, 1902.

WEHRLI (1936) described *Dzhugesia* as a subgenus of *Crocallis*, describing the particular species as an Armenian late-season moth, naming it in honour of the collector (M. A. RJABOV) – *Crocallis (Dzhugesia) rjabovi* WEHRLI. This species differs from other Palearctic *Crocallis* species in the bipectinate antennae of females, and also hairy tibiae of the male hind legs.

STAUDINGER (1892) described the genus *Scodionima* for a Turkmen late-season moth that was similar to *Crocallis* TREITSCHKE in its yellow colour but differing from this genus and *Scodiona* BOISDUVAL (now *Dyscia* HÜBNER) in the slenderer shape of the wings, making its abdomen therefore seem fairly long.

E. P. WILTSHIRE has described many new taxa from the Near East and Central Asia, including the yellow-coloured *Scodionima afghana* WILTSHIRE, and a *Crocallis klapperichi* which has grey wings (WILTSHIRE 1961).

Material

We have dealt with dried and mounted moth material during this study, searching various scientific collections for this purpose. JV had three specimens in the IZBE collection since the nineties and has looked through looper moth collections in ZMUH (Helsinki, Finland), ZMUC (Copenhagen, Denmark) and ZFMK (Bonn, Germany). IK had the moths in the collection of ZMKU (Kyiv, Ukraine) and searched for additional material in Karlsruhe, Stuttgart and Munich. Dr P. IVINSKIS and R. FERENCA searched Lithuanian museums for collections by J. MIATLEUSKI. Dr V.G. MIRONOV found a "topotype" of *D. rjabovi* in the collection of ZISP (St Petersburg, Russia). Dr M. ESPELAND and Ms U. KLEIKAMP were helpful and sent the photographs of the type specimens of *D. rjabovi* and genital slide from the collection by WEHRLI in ZFMK.

Methods

The species of *Dzhugesia* stat. n. are easily identifiable by their wing pattern and structure of antennae. We use an integrative approach, synergy from look for correlations between different morphological traits for judging about species or subspecies level diversity (LINDT et al. 2018). We propose species level divergence between two populations differing in configuration of wing markings, and the build of antennae, legs. Differences in build of female genitalia support the differentiation of *Dzhugesia rjabovi* and *D. miatleuski* sp. n. described below.

Acronyms

IZBE	Insect collection of the former Institute of zoology and botany of the Estonian Academy of sciences, deposited now at the Estonian University of Life Sciences, Tartu, Estonia.
ZFMK	Zoologisches Forschungsmuseum A. Koenig, Bonn, Germany.
ZISP	Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia.
ZMKU	Zoological Museum of the Taras Shevchenko National University, Kyiv, Ukraine.
ZMUC	Zoological Museum, Natural History Museum of Denmark, Copenhagen, Denmark
ZMUH	Finnish Museum of Natural History, University of Helsinki, Finland
ZSM	Bavarian State Collection of Zoology, Munich, Germany

Dzhugesia WEHRLI, 1936, stat. n.

Crocallis (Subgenus *Dzhugesia*) WEHRLI, 1936: 145; WEHRLI, 1953: 348.

The main distinguishing characters of *Dzhugesia* are as follows: female antennae are bipectinate, the rami longer than diameter of antennal segments, and male hind tibiae provided with a yellowish grey hair pencil (WEHRLI 1936, 1953). WEHRLI also described a hair pencil that hangs from the antenna base over the eye, long palpi and long vestiture on head. The ante- and postmedian fasciae on wings are not smooth but accentuated by sharply angulate vein-spots, and the vein M1 is connate with radial veins on forewing and stalked with Rs in hind wing (WEHRLI 1953). The slightly sinuous shape of the forewing postmedial fascia and the reduction of the signum in female genitalia distinguish this genus and *Scodiomima* from *Crocallis*. The distal tips of the processes of the juxta are triangular or straight-cut in *Scodiomima* species but produced, short and curved cow-horn-shaped in *Dzhugesia*. The aedeagus is as long as the valve costa and provided with four or five short cornuti at the base of the vesica in *Dzhugesia*; but the cornuti are longer than the diameter of the aedeagus sheath and vary in number and length in *Scodiomima*. The antrum is large and ring-shaped in both genera but with a broad-edged, roundish, V-shaped ventro-medial incision in *Dzhugesia*, and with a flat ventral edge in *Scodiomima*.

Diagnosis. *Dzhugesia* is opposed to *Crocallis* s. str. by its long palpi and long vestiture of head, bipectinate female antennae, by hairy male hind tibiae and greyish black wing pattern. The related genera *Crocallis* and *Scodiomima* have yellow or off-white wings with brown or grey pattern, filiform female antennae and smooth and slender male hind legs. *Dzhugesia* and *Scodiomima* share the sinuous shape of the forewing postmedial fascia but differ in male genitalia: the cornuti are longer than the width of aedeagus and the black tips of juxta are triangular plates in *Scodiomima*, while curved, short, cow-horn shaped in *Dzhugesia* (stick shaped, long in *Crocallis*) and cornuti not longer than aedeagus width. The transverse fasciae are smooth in *Scodiomima* and *Crocallis*, but dentate at veins in *Dzhugesia*.

Dzhugesia rjabovi WEHRLI, 1936 (Figs 5–7, 11, 13)

Crocallis (*Dzhugesia*) *rjabovi* WEHRLI, 1936: 145; WEHRLI, 1953: 348, pl. 27f.

Material. Digital images of male Holotype ("Dzhuga nr. Dzhulfa, [on] Arax [river], Armen[ia] Rjabov 3.XI 931", "5977" [WEHRLI'S genital slide number]) and female Allotype (Transkauk[asus] riv[er] Arax Dzhuga 1.XI 931 Rjabov) from ZFMK. One Topotype female (labelled "fl. Arax st. Dzhuga 1.XI 931 Rjabov", "Dzhugesia ♀ rjabovi WEHRLI det Rjabov", Genit. pr. 548 I. Kostjuk) from ZISP. [Dzhuga is now renamed Gölüstan, Nakhchivan AR, Azerbaijan].

Description. Wingspan 30–32 mm (Figs 5–7). The typical male from Nakhchivan is dark grey (Fig. 5), whilst the female paratype appears greyish yellow with the pattern reduced (Fig. 6). The medial area of forewing is broad. Male hind tibia is provided with hair pencil. Male genitalia (Fig. 11) with the uncus curved hook-like, the valva with costa slightly convex, a subcostal stripe of short setae, which are more numerous at the triangular tip of the valva. The distal tips of the juxta are short, black, curved hooks.

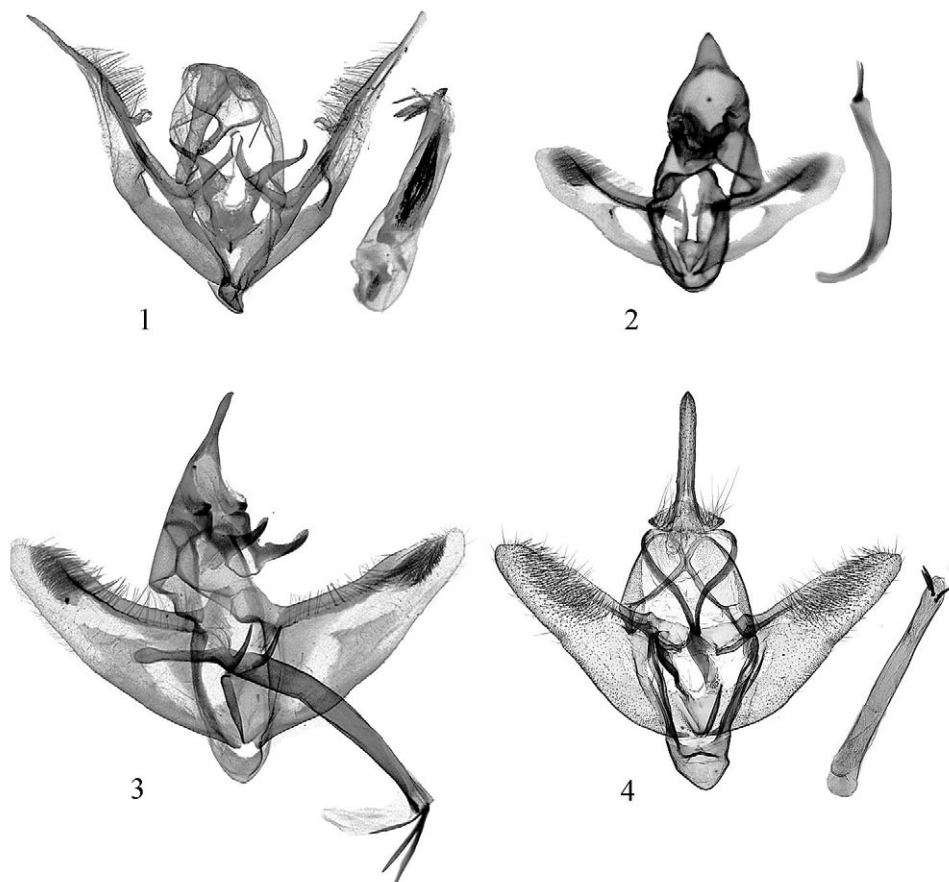


Plate 1. Male genitalia of the genera related to *Dzhugesia*. **1:** *Odontopera bidentata* ssp. *exul* (TSHETVERIKOV) (Tuva); **2:** *Crocallis mirabica* BRANDT (Kopet Dag Mts.); **3:** *Crocallis pototskii* VIIDALEPP (Hissar Mts.); **4:** *Scodiumima tadjikistanica* VIIDALEPP.

Aedeagus straight, 2 mm long, five short, thin cornuti projecting from the tip of the aedeagus sheath. Female genitalia 5 mm long (Fig. 13): the antrum is large, rounded V-shaped with the edge conspicuous. A deep incision of its ventral edge demarcated by triangular dilations dorsally. The ductus bursae membranous, bulbed distally, corpus bursae membranous. The signum absent.

Diagnosis. Wings greyish-yellow with dark, grey and brown-grey markings which are conspicuous in males. The forewing postmedial fascia is conspicuous, outwardly dentate on veins in males, but fragmented into grey, triangular vein-spots on lighter yellowish ground in females. Females of *D. miatleuskii* are similar to their males. The medial area of forewing is wide on hind margin of wing but the medial area is constricted in *D. miatleuskii*. Hindwing above without discal spot which is distinct in the newly described species. Male genitalia with the costal edge of valva gently convex, cornuti number five (four in *D. miatleuskii* described below). Female genitalia delicate, membranous; the antrum large and cylindrical with a deep, rounded, V-shaped ventral expansion. The newly described species has more roundish antrum, ductus bursae sclerotised smooth and signum present.

Biology. The types were collected in November in the Araxes (Aras) river valley.

Distribution area: The territory of the Nakhchivan Autonomous Republic (belonged 1931 administratively to Armenia).

***Dzhugesia miatleuskii*, sp. n.** (Figs 8–10, 12, 14, 15, 16, 17)

Dzhugesia rjabovi (Turkmenistan) sensu BOLD Taxonomy browser (accessed 1.XI 2019).

Material. Holotype: Male, Turkmenia SW, Kopetdag, Garrygala env., XII 1994 leg. J. Miatleuski, ID IZBE0098128 (slide 563). Paratypes: 1♂1♀, Turkmenistan SW, Garrygala vic., 15–30.XI 1995 leg. J. Miatleuski (female slide 568) (IZBE0098124); 20♂♂♀♀, Turkmenistan SW, Garrygala vic., 1–15.XI 1995; 7♂♂♀♀, the same locality but 15–30.XI 1995; Turkmenistan SW, Mondrukty vil., 1000 m, 9–12.XI 1995; 15♂♂♀♀, Turkmenistan, Uzintokaj vil., 18–20.XI 1996 (all J. Miatleuski leg.) (T. Ivanauskas Zoological Museum in Kaunas, Lithuania); 4♂♂2♀♀, Turkmenistan SW, Kopetdag, Garrygala, 1994.10.20–11.10 leg. J. Miatleuski, one male additionally labelled "BC ZSM Lep 57900" (coll. Herbulot/ZSM); 1♂, USSR Turkmenia, Kopet Dagh Mts., Firjuza, 400–600 m, 58°05'E, 37°59'N, 8–13.11.1991, No L46, leg. M. Hreblay & G. Ronkay; 1♂, USSR Turkmenia, Kopet Dagh Mts., Chuli 5 km S, 700–800 m, 58°01'E, 37°56'N, 11.11.1991, M. Hreblay & G. Ronkay; 1♂, USSR Turkmenia, Kopet Dagh Mts., 15 km SE of Nochur, 1300–1400 m, 57°09'E, 38°21'N, 13–14.11.1991, M. Hreblay & G. Ronkay (ZMKU).

Description. Wingspan 30–33 mm (Figs 4–6). The moths are light grey with blackish fasciae delimiting the darker medial area of the forewing. The forewing postmedial fascia is dentate on veins, sinuous, outcurved near the discal cell, and incurved between the cell and hind margin of wing. Hindwing usually with a postmedian fascia. The discal spots on forewings as large as those on hindwings. Male antennae (Fig. 15) are pectinated to apical segments, female antennae are pectinated as well (Fig. 16), with thin rami which are longer than the antennomeres wide. Male genitalia similar to those in *D. rjabovi*. Four cornuti at distal end of aedeagus. Female genitalia 4 mm long (Fig. 14), the dark sclerotization around ostium smaller than in *D. rjabovi*, almost ring-shaped, its lateral edges with triangular dilations in the middle and at distal ends. The ductus bursae is smooth, slightly sclerotized, signum absent. Male hind tibia with spur pairs close together (Fig. 17), the distance between the pairs almost as long as the longer proximal spur.

Diagnosis. Wings grey with blackish-grey, conspicuous markings both in males and females. The medial area of forewing is constricted at the hind margin of wing. Hindwing with large discal spot. Male and female antennae pectinated as in *D. rjabovi*, females with rami longer than the width of shaft. Male hind tibiae with spur pairs close together and surrounded by a patch of thin hairs (Fig. 17). Male genitalia with the costa of valva straight, valva thinly setose along the costa but apex without the thicker patch of short setae characteristic for *D. rjabovi*. Female genitalia membranous, antrum cylindrical, broader than in *D. rjabovi*, its ventromedial incision more rounded than V-shaped and its lateral edges with two triangular dilations.

Biology. A late-autumn species, collected in November–December in valleys and at about 1400 m elevation.

Distribution area. Kopet Dagh range in Turkmenistan, possibly also in Iran.

Discussion and result

Comparing the characteristics of ennomine genera *Crocallis*, *Scodiomima*, *Dzhugesia* stat. n., *Aethiopodes* WARREN and *Odontopera*, we found that the two last genera are not close related with the three others. Palearctic *Odontopera* species have more elongated wings (SIHVONEN & SKOU 2017) and a completely different build of the female genitalia, with longitudinally striated and sclerotized ductus bursae and with a well ornamented signum in the bursa. The male antennae have shorter rami than those in *Crocallis*. The two clusters of thin cornuti (at the base and tip of the vesica) are much longer than the width of the aedeagus tip. *Odontopera* is not closely related to *Dzhugesia*.

The South African genus *Aethiopodes* WARREN is interesting in that there are paired intravincular sclerites dorso-distally to the sclerite of the juxta, and the cornuti are either in the aedeagus sheath, or hanging outside it at the base of the vesica (KRÜGER 2002). The cornuti are thin and numerous, clustered like in *Odontopera*.

Crocallis moths mostly have smooth-edged, yellow wings, and the forewing medial area is trapeze-shaped, brownish, and edged by smooth, straight or slightly convex lines (SIHVONEN & SKOU 2017). Male antennae are bipectinate, with long and dense pectinations up to the apical segments. The females of these species have a pair of roundish sclerites lateral to the ostium and a roundish signum with a rounded centrum like a window. *Crocallis* species have the following characteristics. The long distal uncus process in the male genitalia (Figs 2 & 3); a pair of short gnathi with upturned ends (*C. elinguaris* species group): STADIE & FIEBIG (2014), or a gnathos with a long, keel-shaped, dorsally spinose cochlear (*C. tusciaria* BORKHAUSEN species group); a V-shaped juxta with a pair of long, black, thorn-shaped distal processes. The slender, curved aedeagus, which often is longer than the valva and has a tubular vesica and 1–3 long needle-shaped cornuti attached to the base of the vesica outside the aedeagus sheath, is especially characteristic when compared to *Dzhugesia*..

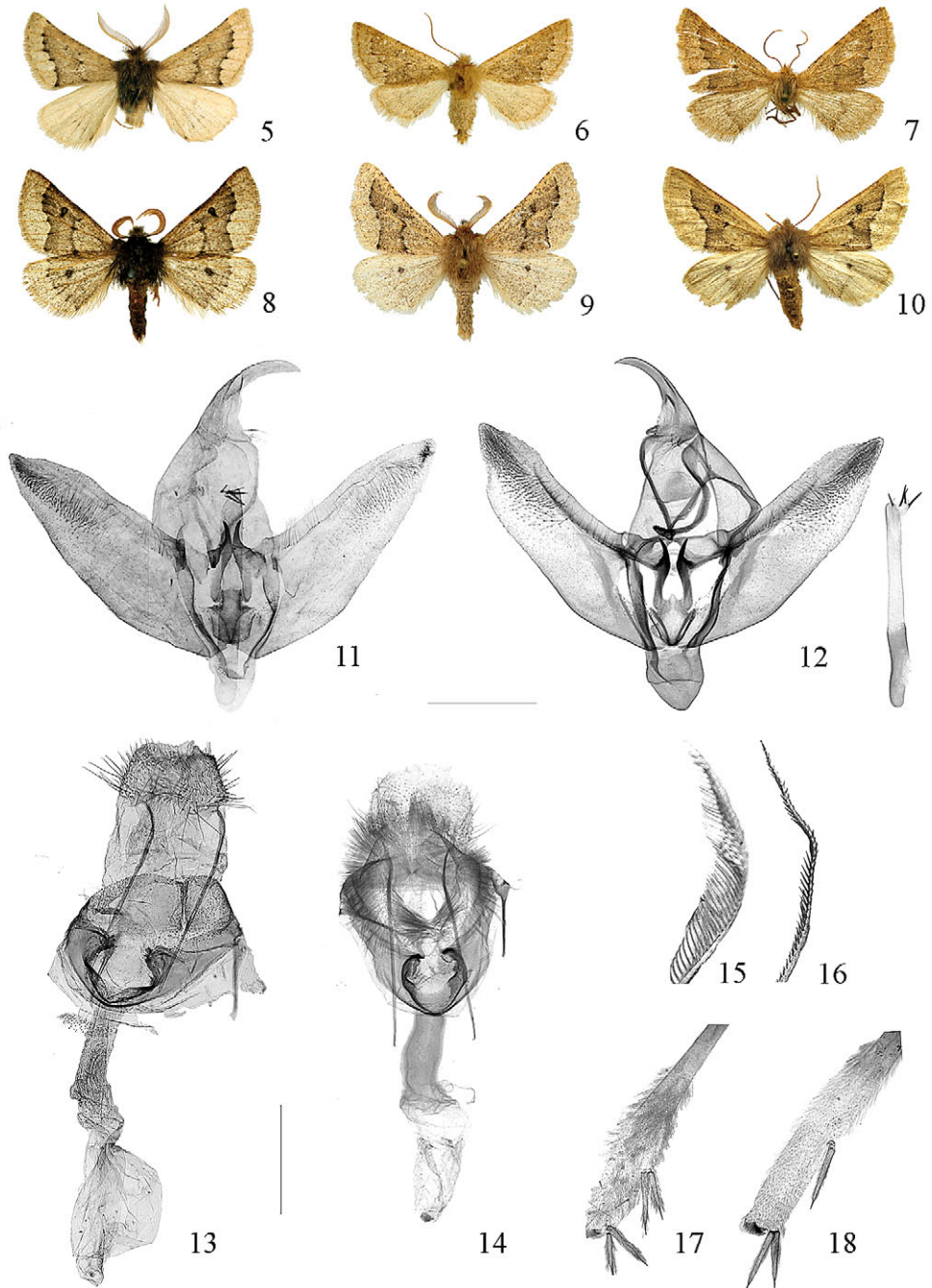


Plate 2. Figures 5–10: *Dzhugesia* moths. 5–7: *Dzhugesia rjabovi* WEHRLI (Transcaucasus, Nakhchivan): 5: Holotype male (ZFMK); 6: Paratype female (ZFMK); 7: "Topotype" female (ZISP). 8–10: *Dzhugesia miatleuskii*, sp. n. (Kopetdagh Mts., Turkmenistan): 8: Holotype male (IZBE); 9: Paratype male (ZMKU); 10: Paratype female (IZBE); Figures 11–12: Male genitalia; 11: *D. rjabovi* (Holotype, ZFMK); 12: *D. miatleuskii*, sp. n. (Holotype, IZBE); 13–14: Female genitalia; 13: *D. rjabovi* ("Topotype", ZISP); 14: *D. miatleuskii*, sp. n. (Paratype, IZBE); 15–16: male and female antennae of *Dzhugesia miatleuskii*, sp. n.: 15: male; 16: female; 17–18: Fragment of male hind tibia: 17: *D. miatleuskii* (Paratype), 18: *Scodiomima crocallaria* STAUDINGER.

As said above, *Dzhugesia* has an unique trait – the female antennae are bipectinated. The long vestiture on the head, the presence of a hindtibial hair pencil in males, and the dense, short spines on the tarsi (WEHRLI 1936) are also diagnostic. The markings on the smooth-edged wings of *Dzhugesia* are grey or blackish on a yellowish-grey or pale grey ground colour (Figs 5–10). The sinuous shape of forewing postmedial fascia is shared with *Scodiomima* which has pale yellowish wings.

Scodiomima as genus was substantiated by its slenderer wings and the longer abdomen than in *Crocallis*. Male hind tibia as in *Crocallis*, smooth and with spur pairs wide apart (Fig. 18). Regarding male genitalia, *Dzhugesia* has the uncus distal process conical and shorter (Figs 11, 12), but it is longer and usually digitate in *Scodiomima* (Fig. 4). The gnathos is a loop provided with a long, keel-shaped cochlear in both genera, while the V-shaped juxta has short, black, cow-horn-shaped tips in *Dzhugesia* and short, flat, triangular tips in *Scodiomima*. The aedeagus of *Dzhugesia* is straight, as long as the costa of the valva, and provided with four or five equal-length, short, pointed cornuti at the base of the vesica, outside the aedeagus sheath. *Scodiomima* species have at least some cornuti thin, needle shaped and much longer than the width of aedeagus. Male genitalia: uncus with a long, digitate distal process; gnathos loop with a long, keel-shaped cochlear; juxta V-shaped with a pair of short, truncated or triangular, black distal tips. The aedeagus is as long as the valva or shorter, with one to seven spine-shaped long cornuti at the base of the vesica, outside the aedeagus tube. Female antennae are filiform, male antennae bipectinate with long rami reaching up the last antennomeres.

Dzhugesia stat. n. is morphologically different from the genera *Crocallis* and *Scodiomima*.

Summary

Dzhugesia WEHRLI (**stat. n.**) is raised from subgenus of *Crocallis* TREITSCHKE to genus rank substantiated by differences in wing pattern of moths, pectinated female antennae, hairy male hind tibiae with spur pairs close together and structures of male and female genitalia. Turkmenian moths differ from types of Armenian *D. rjabovi* in presence of prominent discal spots on hind wings, in less experienced sexual dimorphism and in shorter female genitalia with differently shaped ostium. The new species is named *Dzhugesia miatleuskii*, **sp. n.** after the collector of first specimens. The type specimens are registered in the PlutoF database.

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Zusammenfassung

Dzhugesia WEHRLI war begründet als eine Untergattung von *Crocallis* TREITSCHKE. Viele Verschiedenheiten in Morphologie, wie die gekämmten weiblichen Fühler, die behaarten und verkürzten männlichen Hintertibien mit genäherten Sporen-Paaren, die Flügelfärbung usw. zeigen, dass *Dzhugesia* eine selbstständige Gattung (**stat. n.**) ist. Durch Typenvergleich war es möglich zu zeigen, dass die *Dzhugesia rjabovi*-ähnlichen Spanner aus Turkmenien zu einer anderen Art, *Dzhugesia miatleuskii* **sp. n.**, gehören.

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