

A Revision of *Agonopterix rubrovittella* (Caradja, 1926) (Lepidoptera: Depressariidae) – Consolidation of its Systematic Status

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Abstract. *Agonopterix rubrovittella* (Caradja, 1926) was described from a single female specimen collected at Sutschansk, Russian Far East and based on the external features only. Afterwards, *Agonopterix mutuurai* Saito, 1980 was described from Honshu, Japan, based on both external appearance and male and female genitalia, all presented in black and white print. Comparing the photo of the holotype of *Agonopterix rubrovittella*, published online, and the images of *A. mutuurai*, Dubatolov et al. (2014) established that the latter is a junior synonym of *A. rubrovittella*. The examination of the female genitalia of the *Agonopterix rubrovittella* holotype, depicted for the first time in this paper, confirms this point of view, as well as other additional external and genitalia features, presented in the redescription of this species. The examination of *Agonopterix acuta* (Stringer, 1930) types shows that the synonymy of this species with *A. mutuurai*, proposed by Fujisawa (1985), is incorrect. In addition, biology, distribution, molecular data and related and similar species are presented, together with a discussion on potential confusions and misidentifications.

Key words: Depressariidae, established synonymy, Far East fauna, DNA barcodes.

INTRODUCTION

At the beginning of the 20th century, Aristide Caradja (1861–1955), at that time already a well-known Romanian entomologist, received a large number of micromoths collected in the Russian Far East. The processing of such a large and diverse material gave him the opportunity to describe a large number of previously unknown species. One species that drew his attention by its distinct, particular wing patterns was the one he decided to name *rubrovittella*. However, Caradja made only a concise description of the new species, comparing it with *Agonopterix petasitis* (Standfuss, 1851) and *A. arenella* (Denis & Schiffermüller, 1775). Even if correct and accurate, Caradja's description was far from being detailed enough to provide sufficient details to support a correct identification and exclude confusion with similar species. Also, there were no plates to complete this paper and to give us an image – even a poor one – of the specimen designated as type by Caradja.

Apparently without knowing Caradja's papers, in the early 1980s, Tosihisa Saito described four new species of *Agonopterix* Hübner, 1825. Providing a detailed description and extensive illustration, Saito increased the number of known Depressariidae from the Japanese archipelago by four. Still, in his paper, Saito made a few remarks on species similar to the newly described taxa. The obvious intention was to point out both the similarities and the differences with other *Agonopterix* species, without any attempt to establish their systematic position.

Several years later, Katsutoshi Fujisawa established the synonymy of the Saito's newly described species with *Agonopterix acuta*. Despite the fact that in his paper Fujisawa presents an image of a specimen together with drawings of both male and female genitalia, no comparison with *Agonopterix acuta* is presented.

At the beginning of the 21st century, in an effort of organizing and document the Lepidoptera type collection of "Grigore Antipa" National Museum of Natural History, the junior author published online images of Caradja's types, among them the holotype of *Agonopterix rubrovittella*. Shortly thereafter, the image of this specimen helped Dubatolov et al. (2014) to find out that *Agonopterix mutuurai* described by Saito (1980) was a junior synonym of *Agonopterix rubrovittella*. Establishing the new synonymy was made within the annotated list of the Lepidoptera recorded in the Zeya Reserve (Amur Basin, Russian Far East). Nothing is mentioned beyond the fact that Caradja's original description was made on a single female specimen deposited at "Grigore Antipa" National Museum of Natural History, Bucharest, and that the newly found identity between *Agonopterix rubrovittella* and *A. mutuurai* is based only on the comparison of the Caradja's holotype image with the black and white images provided by Saito (1980).

Following the revision of the Depressariidae material from the collections of "Grigore Antipa" National Museum of Natural History, the senior author found the poorly studied holotype of *Agonopterix rubrovittella* and decided to rigorously solve the problem of the synonymy with *A. mutuurai*. For this purpose, the genitalia of Caradja's holotype was examined and an extensive comparison between Caradja's holotype and Saito's description was carried out. Legs of 3 specimens were used to run DNA sequence analysis and hence provide more data on the systematic position of this species. The information thus obtained allowed the redescription of *Agonopterix rubrovittella*, the confirmation of the synonymy of *A. mutuurai* and it was used in an attempt to assess the real place of *A. rubrovittella* within the genus *Agonopterix* Hübner, 1825.

RESULTS

Specimens from the following collections were examined:

BMNH – Natural History Museum, London, U.K.

MGAB – "Grigore Antipa" National Museum of Natural History, Bucharest, Romania

NHMW – Natural History Museum, Vienna, Austria

ZINRAS – Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia

ZMB – Museum für Naturkunde, Berlin, Germany

ZMH – Zoological Museum, Helsinki, Finland

ZMUC – Zoological Museum of the University of Copenhagen, Denmark

Order Lepidoptera

Superfamily Gelechioidea

Family Depressariidae¹

Subfamily Depressariinae

Tribe Depressariini

Genus *Agonopterix* Hübner, 1825

¹Depressariidae are here used in their extensive, revised and redefined sense, following Heikkilä & al. (2014).

Agonopterix rubrovittella (Caradja, 1926)
(Figs 1–6)

Type material: Holotype (fig. 1): ♀, Sutschansk, 8.(1)925 (MGAB); the specimen also has the identification label handwritten by Aristide Caradja (“*Depressaria rubrovittella* Car. Type”) (fig. 2).

Additional material examined: 1 ♂, Kisojihara, Nagawa Nagano (Japan), larva collected on 21.6.1985, adult emerged on 22.7.1985, Fujisawa leg. (BMNH, stored as *A. mutuurai* – fig. 4); 1 ♂, Karuisawa, Nagano (Japan), 6.8.1952, A. Mutuura leg. (ZMB, identified by T. Saito as *A. mutuurai*, same data as the holotype, but without paratype label, barcoded – MFN-29134-H09); 1 ♂, Sutschansk, (18)90, Dörries leg., ex coll. Staudinger (ZMB, det. Hannemann as *A. agyrella* (sic !), barcoded – MFN-29134-G09; fig. 13); 1 ♂, Tjoplyy Kljutch, Amursk, (Russia), 13.7.2014, leg. V. Dubatolov (ZINRAS, barcoded - TLMF Lep 23511); 1 ♂, Lazovski Reserve, Primorje (Russia), 9.8.1998, leg. J. Kullberg et al. (ZMH, barcoded - TLMF Lep 23473); 1 ♀, Baranovsky (Russia), leg. Dörries (ZMB, determined as “*assimilella* var.”).

Redescription: Head yellow, antenna dark brown. Labial palp predominantly yellowish, second segment with darker reddish-brown scales, mostly toward its base, third segment entirely yellowish (fig. 3). Thorax and tegulae predominantly yellowish; on thorax, a reddish-brown dorsal streak that tends to widen or to be forked towards rear end; tegulae with reddish brown scales on outer margin, especially on anterior sector. Forewings rather broad, termen straight or even slightly concave. Their pattern provides excellent features for identification: ground colour pale yellowish, with a pair of oblique, small black dots at 1/3 and an usually much larger, black central dot (usually 0.3 – 0.4 mm), devoid of any white outlines; distinct dots on termen between the veins, less distinct but present on distal half of costa; basal half of the costa pale, only the very base tending to become more or less darker reddish brown; ground



Fig. 1 – *Agonopterix rubrovittella*, holotype.



Fig. 2 – *Agonopterix rubrovittella* – holotype labels.



Fig. 3 – *Agonopterix rubrovittella* – holotype: head, lateral view.

colour interspersed with scattered black and reddish brown scales that do not form a distinct pattern, with the exception of 4 diffuse reddish brown lines described below, so characteristic that something similar is not encountered in any other similar species:

- one oblique line dividing the basal field from the rest of the forewing, starting from dorsum and fading along its way, without reaching costa (fig. 4a).
- a moderately distinct line, starting from dorsum at about 70 % toward basal field with an angle of about 10° against the dorsal edge, ending at about 25 % (fig. 4b).
- starting from the middle of the previously described line, a very distinct strip toward the area just below the central spot, which thickens along its way (fig. 4c).
- just in the area below the central spot, a distinct line running backwards to the dorsal edge, ending at about 80 % (fig. 4d).

Distal half of line b and lines c + d seem to delineate a pale-yellow triangle between them. Cilia of the forewing pale yellow; a darker subbasal line present, but sometimes hardly distinct.

Hindwings light to medium greyish, veins darker and therefore clearly visible, distinct dots between the veins present; cilia yellowish with a darker subbasal line.

Female genitalia (fig 5): Anterior margin of the 8th sternite somehow extends towards the bursa, with a structure not found in any other similar species²: this margin is slightly curved and thickened in the middle half like a bead, with its ends pointed on both sides at a small distance behind the anterior margin (red arrows in fig. 5a). Ostium round, located closer to the hinder margin. Ductus seminalis with about 3–4 turns, an unusual low number for this genus. Ductus bursae rather small, with several structures commonly encountered also in other *Agonopterix* species: its inner surface

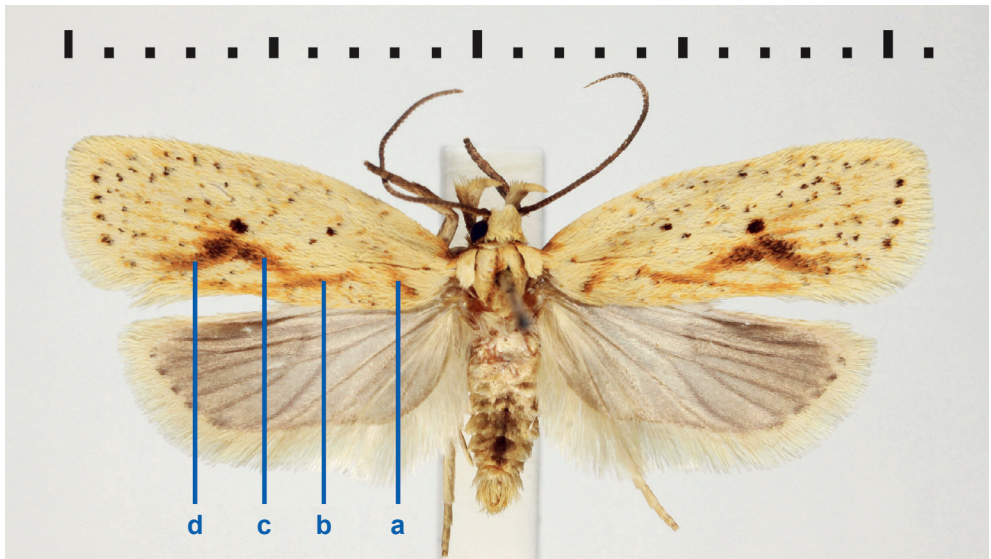


Fig. 4 – *Agonopterix rubrovittella* – male, Kisojihara (Japan), larva collected on 21.6.1985, adult emerged on 22.7.1985, Fujisawa leg. (in coll. BMNH as *A. mutuurai*. Scale intervals in mm.

²A similar structure can be found in several other not so closely related species, e.g. *Agonopterix rimantasi* Lvovsky, 1985, but the differences in all other features are enough to avoid the risk of a misidentification.



Fig. 5 – *Agonopterix rubrovittella* – female genitalia. Holotype, Sutschansk, 8.1925, coll. MGAB; a – detailed view of the VIIIth sternite.

is densely covered with tiny dots in its upper third and with irregularly folded surface in lower part, till it enlarges towards bursa. The lower portion of ductus bursae widens somewhat more sudden if compared with the one presented by Saito (1980: 334, fig. 12). Corpus bursae average in size (diameter about 4/5 of lateral extension of 8 sternite in standard preparation, i.e. dorsoventrally flattened), with a narrow ovate signum (lateral extension about 3 times of longitudinal extension) of average size (maximum diameter about 40 % of diameter of bursa). Signum's surface displays a number of triangular shaped teeth, of fairly even size.

Male genitalia (fig. 6): Cuiller rather long and narrow, S-shaped. However, the final shape in a slide depends on preparation details and may vary: if cuiller is not directly pressed on valva, it appears longer and less S-shaped and may even reach the valva's costa. Gnathos elliptic (length/width ratio about 2.5), not exceeding socii in standard preparation. Anellus broad elliptic with indistinct incision and without distinct appendices on its upper margin, leaving a broad gap to transtilla. Anellus lobes medium sized, only slightly exceeding and overlapping anellus. Transtilla narrow, parallel-sided, transtilla lobes small, not overlapping transtilla or anellus lobes. Outline of valva indistinctive, like many other *Agonopterix* species. Phallus slender (length/width-ratio in lateral view about 8 – 10), basal process with medium length (about 1/3 of phallus length), rather uniformly broad over all its length in ventral view.

Unlike female genitalia, there is no single distinctive feature of the male genitalia of this species. Usually, the combination of long, s-curved cuiller and narrow, parallel-sided transtilla should prevent confusion with most other species; however, keeping in mind the external features for determination is highly recommended.

Distribution: A Far Eastern species, found in Russia (the south of the Amur region and the Khabarovsk Krai, in Primorsky Krai), as well as in Japan. The presence of this species in north-eastern China and Korean Peninsula is very likely, however there are no reports to support this statement up to date. The northernmost site in which this species has been found is in Zeysky Reserve: 53° 59.4' N, 127° 04.5' E (Dubatolov et al., 2014).

Biology: Larvae feed between woven leaves on various composite flowers (Dubatolov et al., 2014). According to Saito (1980), specimens of the type series of *A. mutuurai* were reared on *Adenocaulon himalaicum* (Fam. Asteraceae).

Molecular data (fig. 7): Sequences from specimens of *Agonopterix rubrovittella* are found comparatively well separated in a cluster with different Asteraceae-feeding species like *A. pallorella* (Zeller, 1839), *A. kaekeritziana* (Linnaeus, 1767), *A. broennoensis* (Strand, 1920) and *A. squamosa* (Mann, 1864). Since *Agonopterix rubrovittella* also exhibits similarities in both appearance and male genitalia with these Asteraceae-feeding species, indicating a close affinity, this genetic placement is not a surprise. Moreover, molecular data helps to better support the systematic assignment of *Agonopterix rubrovittella* within the group of Asteraceae-feeding *Agonopterix* species. However, it is worth noting that within this cluster, *Agonopterix rubrovittella* has the most distant location (longest horizontal branch) which, following the geographic distribution of the species, is also not surprising. This position suggests that *Agonopterix rubrovittella* emerged and separated earlier in the evolution of this Asteraceae-feeding *Agonopterix* species-group, but more data on other *Agonopterix* species are required to have a complete picture of how different groups of species have evolved within this genus.

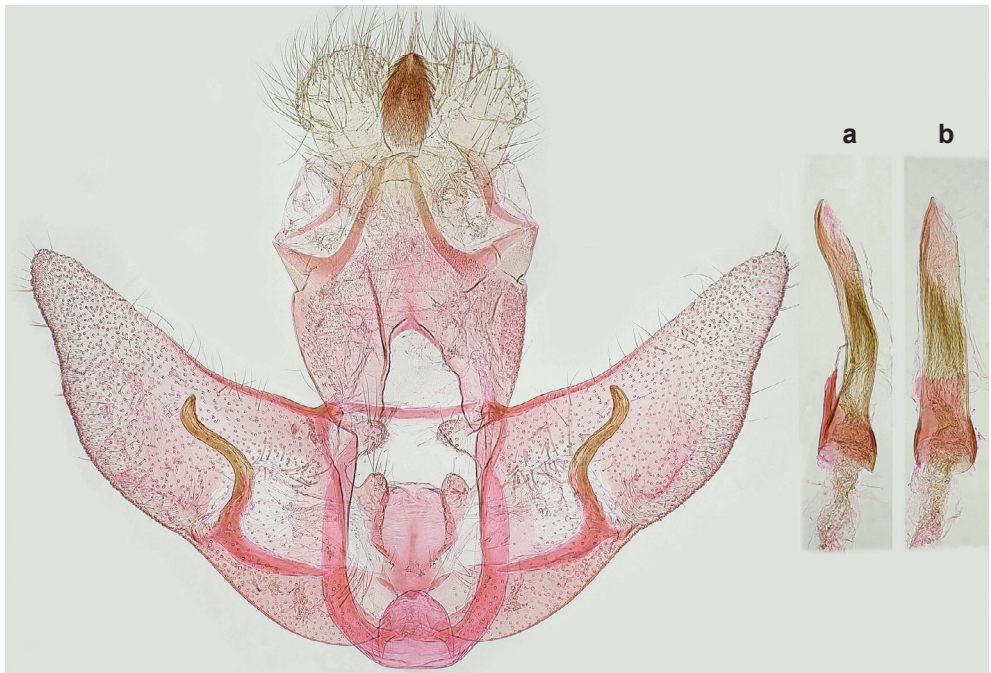


Fig. 6 – *Agonopterix rubrovittella* – male genitalia. Karuisawa, Nagano (Japan), 6.8.1952, A. Mutuura leg., coll. ZMB; phallus presented lateral (a) and ventral (b).

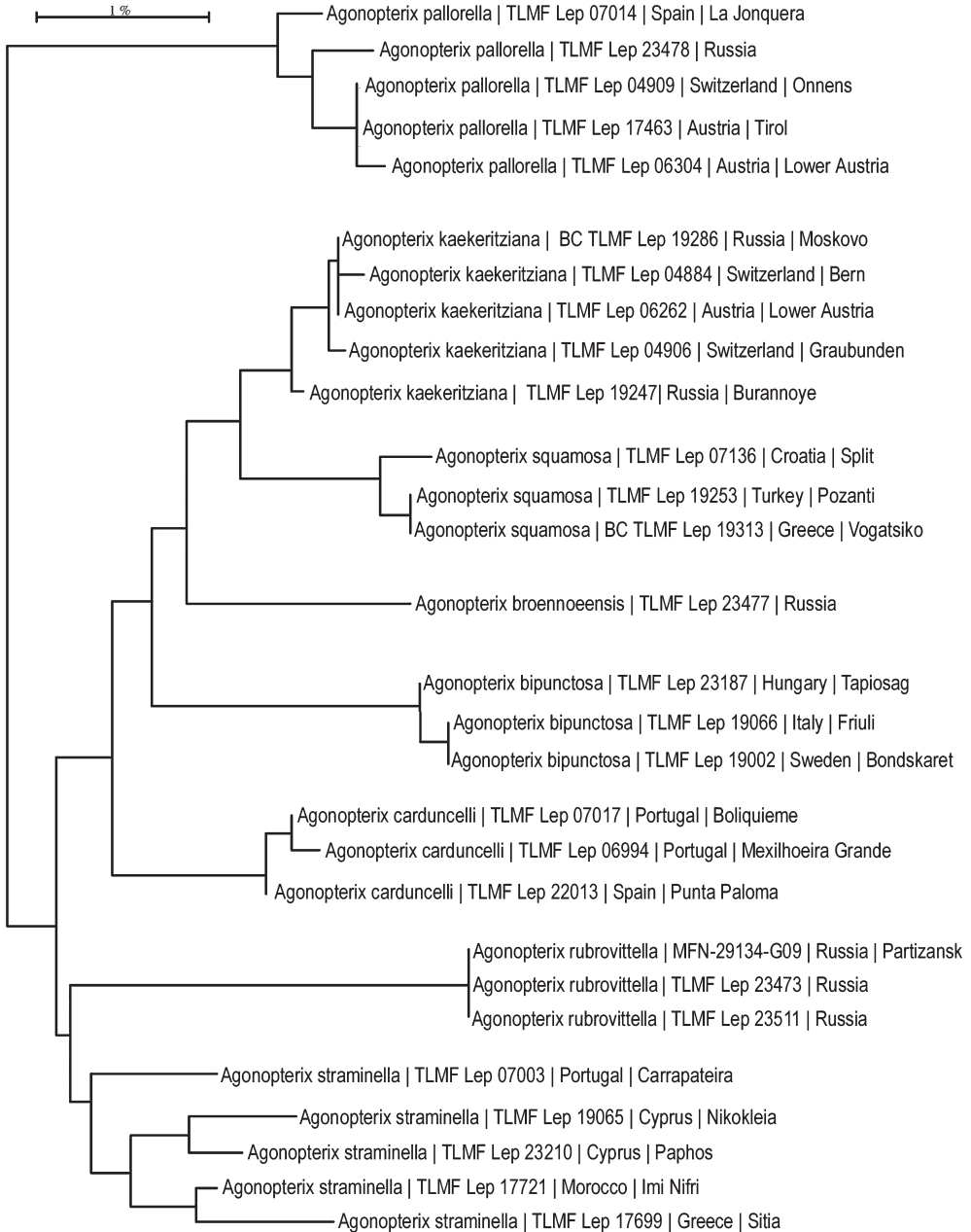


Fig. 7 – Neighbour-joining tree of *Agonopterix rubrovittella* and related species. Details can be accessed via the public dataset DEEUR339 (http://www.boldsystems.org/index.php/Public_SearchTerms?query=DS-DEEUR339).

Similar species within the genus *Agonopterix* Hübner, [1825]

Externally, the closest similar species to *Agonopterix rubrovittella* is *A. kaekeritziana* (fig. 8a), mentioned also by Saito in the description of *A. mutuurai*. However, in this species, the reddish-brown pattern elements on the forewing exhibit a wide range of intensity (whilst the specimen depicted in fig. 8 has rich markings, in other specimens markings may be nearly absent). In *Agonopterix bipunctosa* (Curtis, 1850), reddish brown elements are generally weak or absent, whilst in *A. broennoeensis* they are concentrated or even restricted to a spot beneath the central dot. In all these species the central dot on the forewing is small and there is only one inner dot, which may be larger than the central dot, quite the opposite in *Agonopterix rubrovittella*.

When looking at the male genitalia, especially at the shape of the cuiller, of the three above mentioned species *Agonopterix rubrovittella* most resembles *A. bipunctosa* (fig. 9a). The best difference between these two species can be found in the shape of the phallus (however, note that in fig. 9a it is somewhat compressed, so it appears slightly wider than it really is). *Agonopterix kaekeritziana*, with a similar shape of cuiller, has an obviously wider, more pronounced bent phallus and a shorter basal process (fig. 9b). If compared with other species in neighbour-joining tree, cuiller is sturdy and not S-curved, as is the case with *Agonopterix broennoeensis* (fig. 9c).

The female genitalia of *Agonopterix rubrovittella* sharply differs by the presence of bead-like structure in the middle of the anterior margin of 8th sternite, which is absent in all the species from the neighbour-joining tree with which it is compared, as is the case with *A. kaekeritziana* (fig. 10a) and *A. bipunctosa* (fig. 10b).

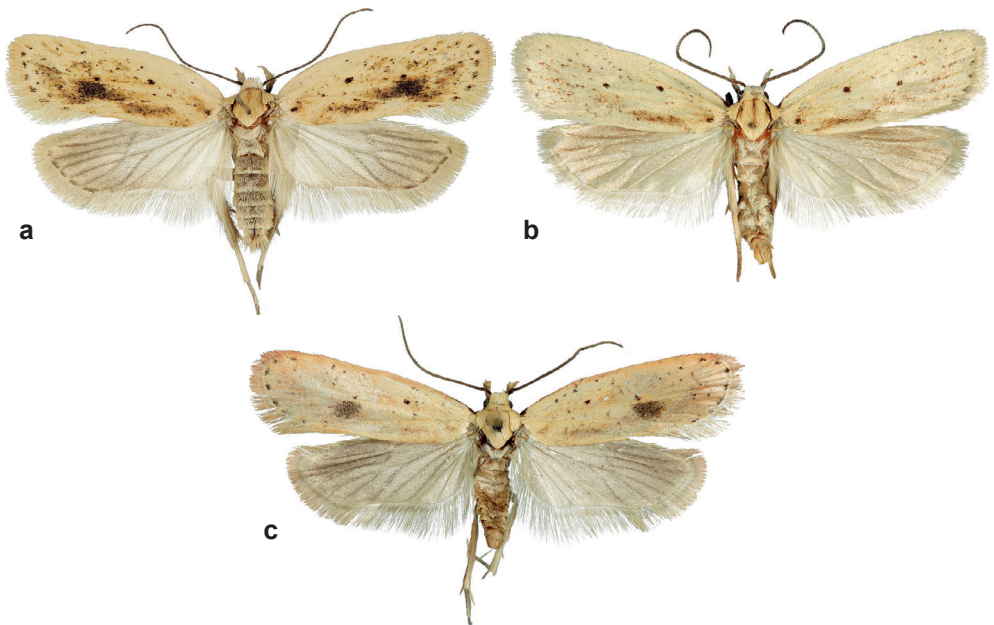


Fig. 8 – *Agonopterix* species similar to *Agonopterix rubrovittella*: a. *A. kaekeritziana* – Lower Austria, 22.6.2011, leg. & coll. W. Stark; b. *A. bipunctosa* – Ronneby, Sweden, 4.7.1971, I. Svensson leg., coll. ZMUC; c. *A. broennoeensis* – Saltdal, Norway, 28.6.1982, K. Larsen leg., coll. ZMUC.

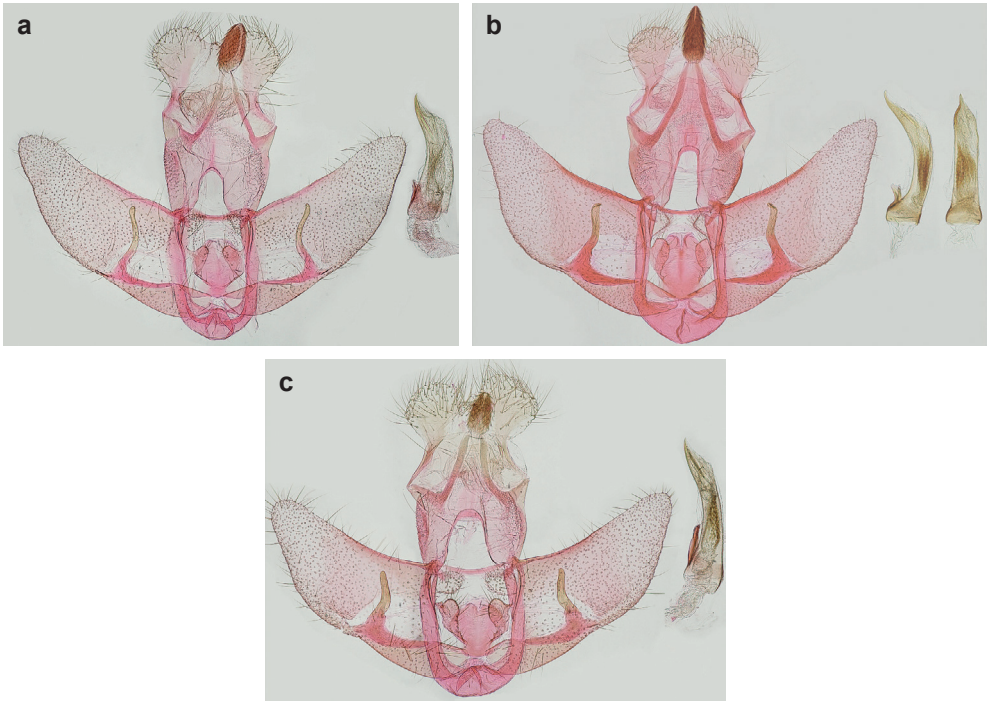


Fig. 9 – Male genitalia at *Agonopterix* species similar to *Agonopterix rubrovittella*: a. *A. bipunctosa* – Ronneby, Sweden, 4.7.1971, I. Svensson leg., coll. ZMUC; b. *A. kaekeritziana* – Lower Austria, 24.7.2012, leg. & coll. P. Buchner; c. *A. broennoeensis* – Russia, Kola Peninsula, 16.8.2001, M. Kozlov leg., coll. ZMUC.

Note on several identification problems found around *Agonopterix rubrovittella*

During the preliminary research that preceded this study, the senior author noticed several incorrect identifications, among them one serious mistake due to Hans J. Hannemann. Despite the fact that he dissected the genitalia of the male specimen collected by Fritz Dörries in Sutschansk, (at first in Otto Staundinger's collection, currently at ZMB), Hannemann misidentified *Agonopterix rubrovittella* with *A. agyrella* (Rebel, 1917). Today, Hannemann's misidentification may appear hard to understand. But it happened in 1953, and it is worth comparing this situation with the present.

Hannemann never visited MGAB, although he has received for study several specimens of *Depressariidae* from the Aristide Caradja's collection, mailed to him from Bucharest during 1950s. There are no evidences that among the specimens shipped to Hannemann would have been also the type of *Agonopterix rubrovittella*. But he had studied *Depressariidae* from the Natural History Museum in Vienna (NHMW), and he had dissected several type specimens, among them the one designated for *Depressaria agyrella* Rebel, 1917 (fig. 11).

In his original description, Rebel (1917) states: "Diese kleine Art ...steht der *A. quadripunctata* Wck. nahe..." ["This small species ...is close to *A. quadripunctata* Wck...."]. Despite being still poorly known, it is clear that the species complex around *Agonopterix quadripunctata* (Wocke, 1857) is far from the *Asteraceae*-feeding species

group around *A. kaekeritziana* which includes *A. rubrovittella*. The larvae of the *quadripunctata* species-group feeds on Apiaceae, and the adults of these species have certain characters allowing a clear decision about the species group (e.g. the central dot on the forewings tends to be white centred, trantilla is markedly broadened in the middle and the basal process of phallus has a slender base, becoming broader toward its end, if only to mention the clearest among them – fig. 12). Hence, there are also features which can be found in both groups, such as the shape of the cuiller. Likewise, the external appearance varies markedly (fig 11–12) leading Hannemann to accept (in many cases without dissection) that specimens which are externally different might be conspecific.

Having this in mind, Hannemann dissected the specimen presented in fig. 13 and found a cuiller very similar to that of the type specimen of *Agonopterix agyrella* he had previously dissected few months before. Without taking account of the external appearance of the specimen from ZMB, Hannemann mistakenly considered that this was a male of *Agonopterix agyrella*.

From the view presented above, it appears that determining a specimen of *Agonopterix rubrovittella* as *A. agyrella* is an excusable and understandable error, particularly since Hannemann never saw a specimen of *Agonopterix rubrovittella* nor a picture in a published paper, and the genitalia of this species were unknown in 1953.

Note on the synonymy of *Agonopterix mutuurai* Saito, 1980 with *Agonopterix acuta* (Stringer, 1930)

This synonymy was established by Fujisawa (1985), in a short remark on the page 33 in his paper:

“*Agonopterix acuta* (Stringer, 1930) (Fig. 2)

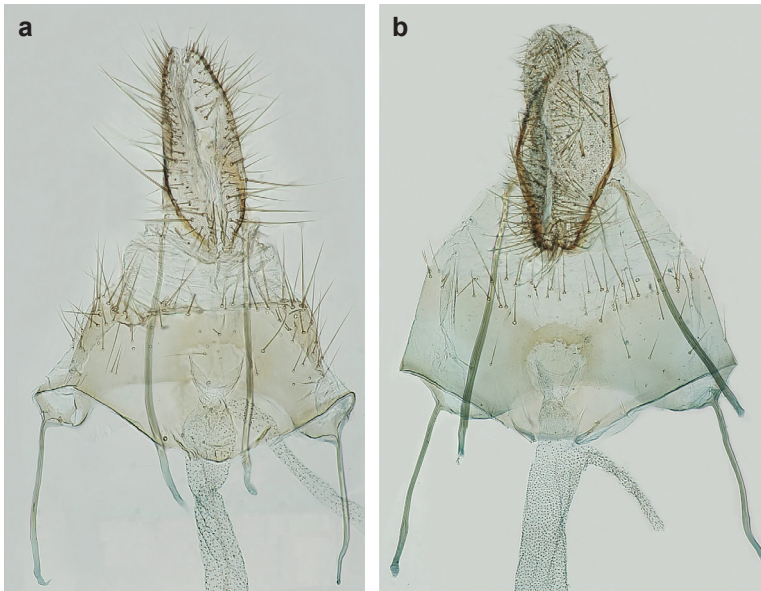


Fig. 10 – Female genitalia at *Agonopterix* species similar to *Agonopterix rubrovittella*: a. *A. kaekeritziana* – Lower Austria, 19.8.2009, leg. & coll. P. Buchner; b. *A. bipunctosa* – Friuli, Italy, 24.8.1999, leg. & coll. L. Morin.



Fig. 11 – The type specimen of *Depressaria agyrella*, coll. NHMW; on the right, the genitalia dissected by Hans J. Hannemann (357).



Fig. 12 – Specimen from ZMB, determined by Hans J. Hannemann without dissection as *Agonopterix agyrella*; on the right, the genitalia dissected by Peter Buchner (GP. 5721), confirming it belongs to the *Agonopterix quadripunctata*-species group, although it must remain open if it is *Agonopterix agyrella*.



Fig. 13 – Male specimen of *Agonopterix rubrovittella* – Sutschansk, (18)90, Dörries leg., ex. coll. Staudinger (ZMB, erroneously determined by Hans J. Hannemann as *A. agyrella*); on the right, the genitalia dissected by Hans J. Hannemann (428).



Fig. 14 – *Agonopterix acuta*, holotype, BMNH. Scale intervals in mm.



Fig. 15 – *Agonopterix acuta*, paratype (“allotype”), BMNH. Scale intervals in mm.

Depressaria acuta Stringer, 1930, *Ann. Mag. nat. Hist.* (10) 6: 417

Agonopterix mutuurai Saito, 1980, *Tinea* 10: 335, figs 4, 8, 12. *Syn. nov.*”

The mentioned figure 2 (Fujisawa, 1985, page 34) depicts indeed a specimen of *Agonopterix mutuurai* (syn. *A. rubrovittella*) with the caption “*Agonopterix acuta* male. Usui pass, Gumma Pref.”. In the same paper, figures 10 and 17 are showing the male and respectively the female genitalia of *Agonopterix mutuurai* (syn. *A. rubrovittella*).

The origin of this opinion is unknown to the authors, but it is obviously not relying on the study of the types of *Agonopterix acuta* (fig. 14–15).

The comparison of the types of *Agonopterix acuta* with the type of *A. rubrovittella* (syn. *A. mutuurai*) clearly shows that these specimens are not conspecific. Hence, *A. mutuurai*, a synonym of *A. rubrovittella*, is not a synonym of *A. acuta*.

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