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Antennal sensilla in adult males of five species of *Coleophora* (Coleophoridae): Considerations on their structure and function

Michel J. Faucheux

Laboratoire d'Endocrinologie des Insectes Sociaux, Faculté des Sciences et des Techniques, 2 rue de la Houssinière, B. P. 92208, 44322 Nantes Cedex 3, France; faucheux.michel@free.fr

Abstract. A study of the antennae of five species of *Coleophora* Hübner, 1822 (Coleophoridae) has been carried out by scanning electron microscope in order to determine the morphological types of sensilla and to compare these results with those obtained for *C. obducta* (Meyrick). In adult males, eight types of sensilla were observed on the flagellum: uniporous sensilla chaetica, multiporous sensilla trichodea, three types of multiporous sensilla basiconica, multiporous sensilla coeloconica, aporous sensilla styloconica and aporous sensilla squamiformia. In view of their morphology, sensilla chaetica are contact chemoreceptors, sensilla squamiformia are tactile mechanoreceptors, sensilla styloconica are thermo-hygroreceptors, and sensilla trichodea, basiconica and coeloconica are olfactive chemoreceptors. No sensilla placodea have been observed. These results differ partially from those previously described for *C. obducta* in regards to the interpretation of the structure and function of some sensilla.

Résumé. L'étude des antennes de cinq espèces du genre *Coleophora* Hübner, 1822 (Coleophoridae) a été réalisée au microscope électronique à balayage afin de déterminer les types morphologiques de sensilles et de comparer ces résultats à ceux obtenus chez une autre espèce. Chez les mâles adultes, il y a huit types de sensilles sur le flagelle: des sensilles chétiformes à pore unique, des sensilles trichoïdes multipores, trois types de sensilles basiconiques multipores, des sensilles coeloconiques multipores, des sensilles styloconiques sans pore et des sensilles squamiformes sans pore. D'après leur morphologie, les sensilles chétiformes sont des chimiorécepteurs de contact et les sensilles squamiformes sont des mécanorécepteurs tactiles, les sensilles styloconiques sont des thermo-hygrorécepteurs, les sensilles trichoïdes, basiconiques et coeloconiques sont des chimiorécepteurs olfactifs. Aucune sensille placoïde n'a été observée. Nos résultats diffèrent partiellement de ceux décrits antérieurement chez *C. obducta* en ce qui concerne l'interprétation de la structure et de la fonction de certaines sensilles.

Introduction

Yang et al. (2009) describe nine types of sensilla (s.) from the antennae of *Coleophora obducta* (Meyrick, 1931), an important defoliator of larch in northeast China: s. placodea, s. basiconica, s. coeloconica, s. styloconica, s. trichodea, s. squamiformia, s. furcatea, terminal sensory pegs and Bohm's bristles. While most of these sensilla are recognised in Lepidoptera, the s. placodea occur only in Micropterigidae (Faucheux 1997, 2004) and the s. furcatea have so far not been observed in Lepidoptera (Faucheux 1999, Hallberg et al. 2003). Consequently, the presence of these structures needs to be confirmed in species other than *C. obducta*. Moreover, according to Yang et al., the s. styloconica are regarded as gustatory/mechanosensory receptors, which contradicts all contemporary views which attribute a thermo-hygroreceptive function to the s. styloconica found on antennae of adult lepidopterans (e.g. Hallberg et al. 2003). These results prompted me to examine the sensory equipment of the antennal flagellum of

several additional species of *Coleophora* by scanning electron microscopy in order to note the sensillum types and to compare them with those described by Yang et al. The results of the present investigation will be discussed together with the interpretations concerning *C. obducta*.

Material and methods

Material. *Coleophora pennella* (Denis & Schiffermüller, 1775): 1 ♂, France, Sainte Emilienne, Olonne sur mer, Vendée, 02/03.VI.2001, Drouet leg. – *C. fuscicornis* (Zeller, 1847) 1 ♂, France, Chemin du Seyran, Draguignan, Var, 24.IV.2006, Drouet leg. – *C. lixella* (Zeller, 1849) 1 ♂, France, Saint Generoux, Deux Sèvres, 07.VI.2008, Drouet leg. – *C. frischella* (Linnaeus, 1758) 1 ♂, France, Port de la Guittière, Talmont, Vendée, 28/29.VII.2002, Drouet leg. – *C. albella* (Thunberg, 1788) 1 ♂, France, Port-au-duc, Saint Fiacre sur Maine, Loire-Atlantique, 08/09.V.2002, Drouet leg.

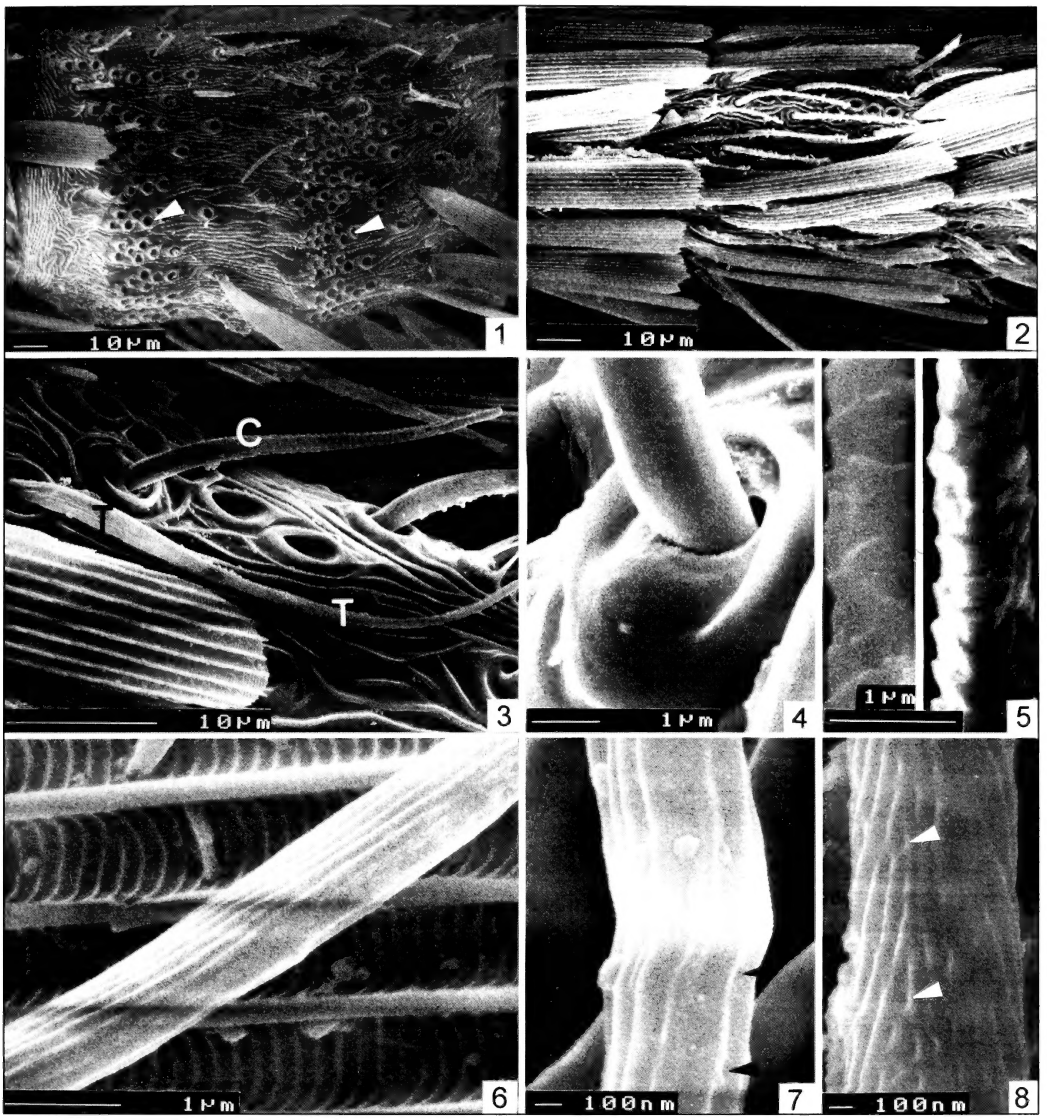
The five males examined were dry insects from Eric Drouet's collections. For SEM study, the antennae of each moth were cleaned in acetone, dehydrated into pure alcohol and mounted, one on the ventral and one on the dorsal face, on specimen holders. After coating with gold and palladium, preparations were examined in a Jeol J.S.M.6400 F SEM at 10 kV. Sensilla terminology follows Faucheux (1999) and Hallberg et al. (2003).

Results

The male antenna of all *Coleophora* species reaches to about the middle of the forewing costa. It consist of a large scape, a pedicel and a filiform flagellum composed on average of 24–30 flagellomeres in which the length is greater than the width. The dorsal and ventral surfaces of the flagellum have appressed lamellar scales. The sockets of most scales are grouped in two rings on each flagellomere: one subproximal ring and one subdistal ring (Fig. 1). Each ring is made up of some twenty roughly longitudinal rows of 3–6 scales each. A few rare scales are scattered between the two rings and in the distal region of the flagellomere. As a result of this arrangement, the scales of the two rings partially overlap. A window without scales is usually located on the ventral face of each flagellomere (Fig. 2). The integument of the flagellum is devoid of microtrichia but shows sinuous and clearly visible folds arranged longitudinally, and closely grouped together side by side (Figs 1, 3, 13).

The sensory structures of the flagellum comprise eight types of sensilla: uniporous s. chaetica, multiporous s. trichodea, multiporous s. basiconica types 1, 2 and 3, multiporous s. coeloconica, aporous s. styloconica, and aporous s. squamiformia. With few exceptions, no significant differences were observed between the five species regarding the morphological types and the number of sensilla.

Uniporous sensilla chaetica are long sensilla (range 24.7–28.3 μm); their diameter decreases steadily from base (1.5 μm) to apex (0.7 μm) (Fig. 3). They articulate into a basal cupola, which restricts the movement of the hair (Fig. 4). The latter is adorned with deep transverse furrows sometimes accompanied by a few longitudinal ridges (Fig. 5); this structure gives a ringed aspect to the hair. The blunt apex is pierced by a hardly visible pore (even with SEM). Unlike the other sensilla, which are more or



Figs 1–8. Antennal sensilla of *Coleophora* spp. **1.** Descaled dorsal surface of 13th flagellomere of *C. albella*. Arrowheads indicate the scale sockets. **2.** Area without scales on the ventral surface of 17th flagellomere in *C. frischella*. **3.** Uniporous sensillum chaeticum (C) and multiporous sensillum trichodeum (T) in *C. fuscicornis*. **4.** Base of sensillum chaeticum in *C. fuscicornis*. **5.** Two aspects of the wall of sensillum chaeticum in *C. fuscicornis*. **6.** Middle part of sensillum trichodeum in *C. fuscicornis*. **7.** Detail of sensillum trichodeum in *C. pennella* showing some pores (arrowheads). **8.** Lined pores of type 1 multiporous sensillum basiconicum (arrowheads) in *C. albella*.

less flattened against the antennal integument, s. chaetica are perpendicular to it or obliquely directed towards the antennal apex and are therefore the only ones to emerge between the scales. As a result, they can more readily make contact with the surrounding medium. They are evenly distributed and number from 4 to 6 per flagellomere.

Multiporous sensilla trichodea are the longest (range 34.2–39.7 µm) and the slenderest of all antennal sensilla (T, Fig. 3). Their diameter varies from 1.8 µm at the base

Table 1. Types of flagellar sensilla (s.) in *C. obducta* (Yang et al. 2009) and their reinterpretation based on the five other species of *Coleophora* examined in this study.

Coleophora obducta	*Coleophora* spp. (5 species)
s. basiconica	uniporous s. chaetica
s. placodea	multiporous s. trichodea
s. trichodea	multiporous s. basiconica 1
not described	multiporous s. basiconica 2
not described	multiporous s. basiconica 3
s. coeloconica	multiporous s. coeloconica
s. styloconica	aporous s. styloconica
s. squamiformia	aporous s. squamiformia
s. furcatea	not described
terminal sensory pegs	not described

to 0.9 μm at the apex. They are curved and often found in areas without many scales on each flagellomere (Fig. 2). The hair possesses longitudinal ridges which are present over the whole length (Fig. 6); the pores are visible in Fig. 7 and the pore density was estimated at 25 pores/μm^2. The number of sensilla is about 10–15 per flagellomere in the five species.

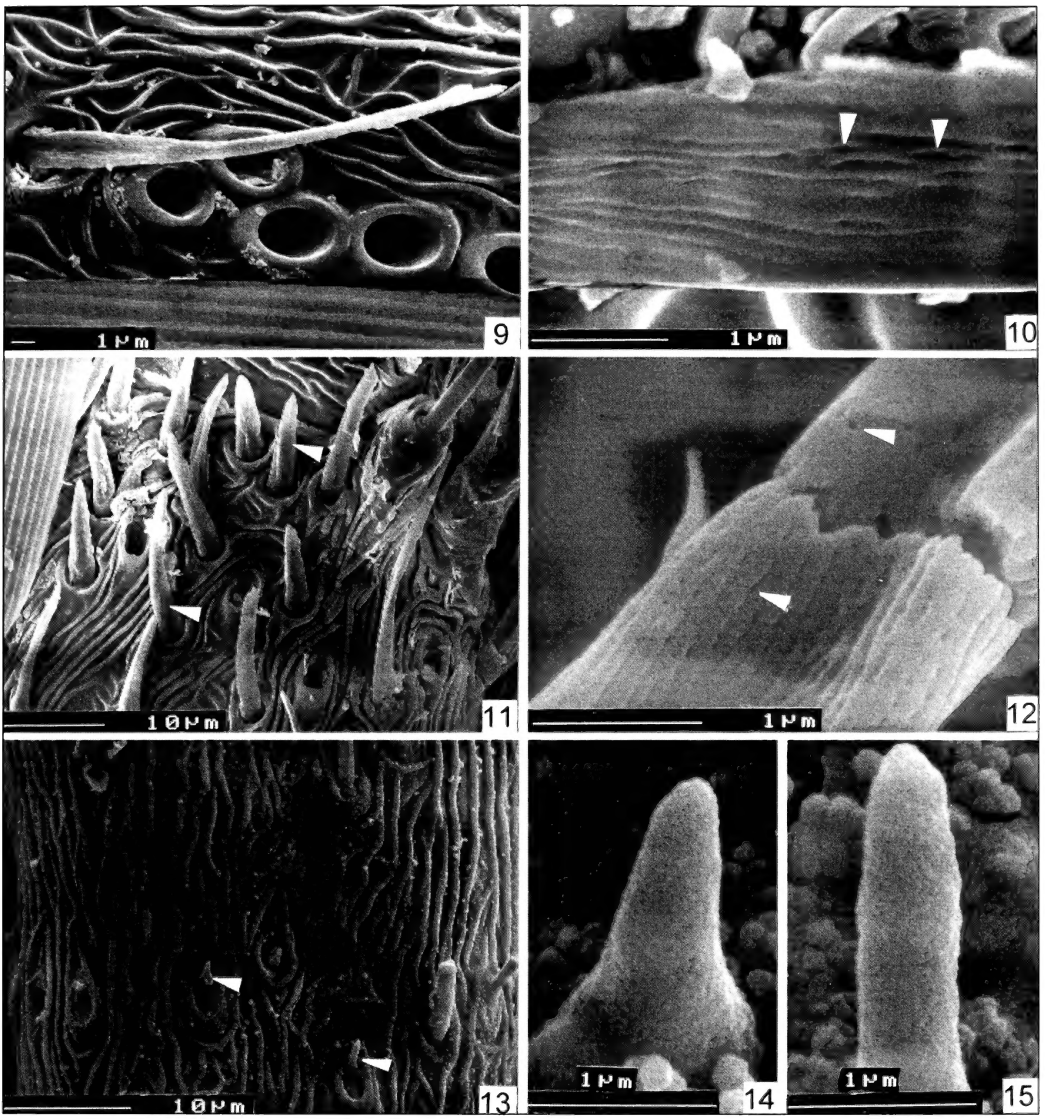
Multiporous sensilla basiconica type 1 are of similar length to that of the s. chaetica (range 19.1–26.5 μm) but differ by the absence of a cupola and the presence of wall pores (Figs 8–10). The proximal half of the hair is frequently flattened and adorned with barely visible pores (Fig. 10) whereas the distal half is more cylindrical and provided with pores arranged into longitudinal or oblique rows with a pore density of 53/μm^2 (Fig. 8). The maximum number of sensilla is 3–4 per flagellomere.

Multiporous sensilla basiconica type 2 are easily recognisable by their small size (length range 8.7–13.4 μm) and by the fact that they are grouped by 12 to 15 sensilla in the distal region of the flagellomere (Fig. 11). They are frequently flattened and in that case resemble s. auricillica. Their pores are arranged in longitudinal rows over the whole sensillum (Fig. 12). The thinness of the wall is visible on the break of the sensillum in Fig. 12. The pore density is 32/μm^2.

Multiporous sensilla basiconica type 3 are the smallest of the s. basiconica (range 1.5–2.4 μm) and have only been observed in *C. frischella*. With the usual technique for the preparation of samples for SEM work, the pores are invisible. The sensilla are located on the ventral face of the antenna in zones with large unscaled areas (Fig. 13). They take the form of a cone or a peg occupying a pit in the integument limited by a thick ridge (Figs 13, 14, 15).

Multiporous sensilla coeloconica are composed of a longitudinally grooved cone, 4.5 μm long, surrounded by a cuticular fringe of 13–15 microtrichia (Fig. 16). In the majority of species, they are mostly found latero-distally on each flagellomere and number 2–3 per flagellomere.

Aporous sensilla styloconica with a stylus of 21.5–25.8 μm in length are found on the lateral face of each flagellomere except for the basal and apical one (Fig. 17),



Figs 9–15. Antennal sensilla of *Coleophora* spp. 9. Multiporous sensillum basiconicum of type 1 in *C. fuscicornis*. **10.** Detail of lined pores in the same (arrowheads) **11.** Multiporous s. basiconica of type 2 in *C. albella* (arrowheads). **12.** Detail of lined pores (arrowheads). **13.** Multiporous s. basiconica of type 3 in *C. frischella* (arrowheads). **14, 15.** Detail of the preceding sensilla.

towards the distal end of the flagellomere. The cone without pore measures on average 3.5 µm (Fig. 18). There is only one sensillum per flagellomere.

Aporous sensilla squamiformia resemble lamellar scales but differ in their shorter length (30 µm versus 70 µm), and in their slender distal end (Fig. 19). Their ornamentation is similar to those of the scales (Fig. 20). They are rare, from 1 to 2 per flagellomere, with numerous flagellomeres without any.

Discussion

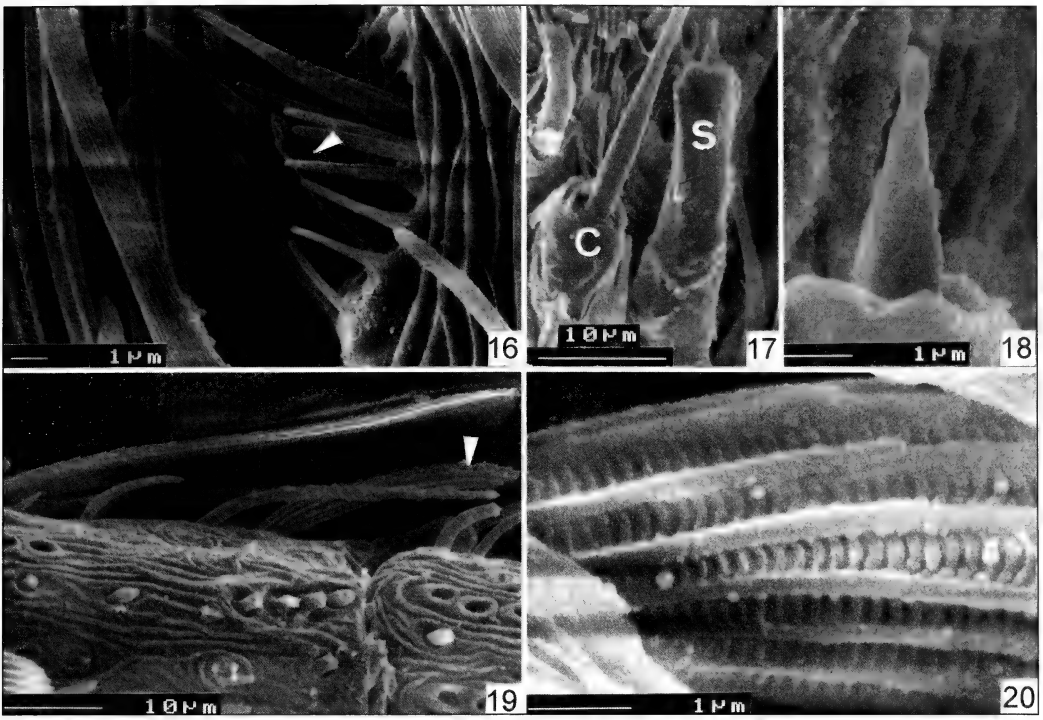
The antennae of the five examined *Coleophora* species possess the majority of the ubiquitous sensilla of Lepidoptera. Except for the s. trichodea, the other morphological types have common characteristics shared with all Lepidoptera. With the s. trichodea, those described so far show a ridge pattern that is helical at the base and more annular over the remaining length of the sensillum. Pores are located in the depressions between the ridges (Cuperus 1983, 1985; Faucheux 1999). On the contrary, in the five checked species of *Coleophora*, the sensilla show a longitudinal ridge pattern and pores arranged in longitudinal rows. However, a common characteristic is shared by the s. trichodea of *Coleophora* and those of other Lepidoptera species: their low pore density compared with that of s. basiconica (Steinbrecht 1973, Shields & Hildebrand 1999).

These results differ from those obtained by Yang et al. (2009) in *C. obducta* regarding the interpretation of the morphological types and their function (Table 1). The multiporous s. trichodea correspond to the alleged "sensilla placodea" of *C. obducta*. Indeed, like the latter, they represent the most extensively distributed type of male sensilla; they are generally curved and show the "characteristic pattern of vertical veins" described by Yang et al. (2009). The low magnification used by the authors made it impossible to observe the wall pores. The term "placodea" is inadequate because, by definition, this type is not hair-shaped but has the shape of a plate fixed by its base to the integumental surface and it is pierced by numerous pores. In Lepidoptera, s. placodea occur only in Micropterigidae (Faucheux 1997, 2004). Since the s. trichodea possess no terminal pore but only wall pores, and since wall-pore sensilla usually have an olfactory function, while the contact-chemoreceptory function appears to be limited to sensilla having pore only on their apex (Altner & Prillinger 1980, Hallberg et al. 2003), the hypothesis of contact-chemoreception in *C. obducta* advanced by Yang et al. (2009) cannot be confirmed. The large number of s. trichodea compared to other antennal sensilla observed in *C. obducta* and the five species from this study suggests a pheromone chemo-reception for these sensilla in males.

The multiporous s. basiconica type 1 resemble the "sensilla trichodea" of *C. obducta* in Yang et al. (2009). Although the pores are not mentioned, Yang et al. (2009: 235, fig. 6b) suggest their presence. These sensilla are olfactory receptors (Hallberg et al. 2003).

The uniporous s. chaetica are the "sensilla basiconica" of *C. obducta* in Yang et al. (2009). Yang et al.'s fig. 3e (2009: 233) is characteristic of s. chaetica with a terminal pore because of the existence of a thick wall (confused with the sensilla lymph lumen), and a cavity occupied by dendrites; moreover, the authors do not report the presence of wall pores. Functions attributed to the s. basiconica of other insect species, and in particular the "detection of related chemical compounds that constitute the plant fingerprint" (Yang et al. 2009) are unlikely to apply to these sensilla. Based on their similarity to morphologically characterized uniporous s. chaetica of other Lepidoptera, the s. chaetica of *Coleophora* are probably contact chemoreceptors.

The multiporous s. basiconica of type 2 and 3 are not described in *C. obducta* by Yang et al. (2009). The s. basiconica type 2, which have a cuticular wall that is thin



Figs 16–20. Antennal sensilla of *Coleophora* spp. **16.** Multiporous sensillum coeloconicum (arrowhead) in *C. lixella*. **17.** Aporous sensillum styloconicum (S) and uniporous s. chaeticum (C) in *C. albella*. **18.** Cone of sensillum styloconicum. **19, 20.** general view and detail of aporous sensillum squamiformium in *C. pennella*.

and pierced by numerous pores, may be considered to be the main receptors for plant volatiles (Den Otter et al. 1980, Lopes et al. 2002). A similar function is also possible for the s. basiconica type 3.

The multiporous s. coeloconica with a fringe of microtrichia have been observed in the five species studied while only the "naked" type is described in *C. obducta* by Yang et al. (2009). Their function is olfactive (Den Otter et al. 1978, Pophof 1997). In *Bombyx mori* (L.) the neurons of these sensilla are excited by some short-chain aliphatic acids and aldehydes and inhibited by some monoterpene alcohols; they do not respond to the moth's pheromones, and they may be involved in choosing oviposition sites (Pophof 1997, Hunger & Steinbrecht 1998).

Aporous s. styloconica are thermo-hygroreceptors in moths (Gödde & Haug 1990, Steinbrecht & Müller 1991, Steinbrecht 1998). Yang et al. (2009) attribute a combined gustatory/mechanosensory function to the s. styloconica of *C. obducta*. But this function supposes the presence of a terminal pore (Altner & Prillinger 1980) which is not described in this species. Moreover, Yang et al.'s fig. 5f (2009: 234), which is supposed to represent a tubular body characteristic of mechanoreceptors, is by no means demonstrative. While a terminal sensory pore is observed in the uniporous s. styloconica of the galeae of moths, all previous studies have revealed its absence in the antennal s. styloconica of Lepidoptera (Faucheux 1999, Hallberg et al. 2003). The apical

pore found on the s. styloconica of the antennae of some adult lepidopterans appears to be a moulting pore (Haug 1985), and there is no evidence that this kind of pore may transmit external stimuli to the sensory cells (Altner et al. 1983).

Aporous s. squamiformia resemble s. squamiformia present in *C. obducta*. A sole sensory neuron with a tubular body at the base of sensillum is described in these sensilla (Schneider & Kaissling 1957, Schneider 1964). S. squamiformia are involved in tactile mechanoreception (Faucheux 1999).

Most likely the s. furcatea in *C. obducta* as recorded by Yang et al. (2009) are only anomaly form of a sensillum basiconicum. Such anomalies are rare; in moths, they occur in the s. basiconica of *Monopis crocicapitella* (Clemens, 1859) (Tineidae) (Faucheux 1987) and the s. auricillica of *Pieris rapae* (Linnaeus, 1758) (Pieridae) (Faucheux 1996).

The existence of "terminal sensory pegs" in *C. obducta* is by no means confirmed by Yang et al. (2009: 236, fig. 10), and therefore currently their existence must be viewed as hypothetical.

In conclusion, the antennal sensory equipment of *Coleophora* species is typical for that of other Lepidoptera. The present study shows the need to carry out active research on the presence of pores, even if the latter are sometimes difficult to observe with SEM.

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References

Altner, H. & L. Prillinger 1980. Ultrastructure of invertebrate chemo-, thermo-, and hygroreceptors and its functional significance. – International Review of Cytology **67**: 69–139.

Altner, H., L. Schaller-Selzer, L. Stetter & I. Wohlrab 1983. Poreless sensilla with inflexible sockets. A comparative study of a fundamental type of insect sensilla probably comprising thermo- and hygroreceptors. – Cell and Tissue Research **234**: 279–307.

Cuperus, P. L. 1983. Distribution of antennal sense organs in male and female ermine moth, *Yponomeuta vigintipunctatus* (Retzius) (Lepidoptera: Yponomeutidae). – International Journal of Insect Morphology and Embryology **12**: 59–66.

Cuperus, P. L. 1985. Inventory of pores in antennal sensilla of *Yponomeuta* spp. (Lepidoptera: Yponomeutidae) and *Adoxophyes orana* F. V. R. (Lepidoptera: Tortricidae). – International Journal of Insect Morphology and Embryology **14**: 347–359.

Den Otter, C. J., M. Behan & F. W. Maes 1980. Single cell responses in female *Pieris brassicae* (Lepidoptera: Pieridae) to plant volatiles and conspecific egg odours. – Journal of Insect Physiology **26**: 465–472.

Den Otter, C. J., H. A. Schuil & A. Sander-Van Oosten 1978. Reception of host-plant odours and female sex pheromone in *Adoxophyes orana* (Lepidoptera: Tortricidae): electrophysiology and morphology. – Entomologia Experimentalis et Applicata **24**: 570–578.

Faucheux, M. J. 1987. Recherches sur les organes sensoriels impliqués dans le comportement de ponte chez deux Lépidoptères à larves kératinophages, *Tineola bisselliella* Humm et *Monopis crocicapitella* Clem. (Tineidae). – Thèse doctorat d'état, Université de Nantes. 511 pp.

Faucheux, M. J. 1996. Sensilles auricilliformes sur l'antenne des Rhopalocères. Etude de la Piéride de la rave, *Pieris rapae* L. (Lepidoptera: Pieridae). – Bulletin de la Société des Sciences Naturelles de l' Ouest de la France (n. s.) **18**: 93–97.

Faucheux, M. J. 1997. Sensory organs on the antennae of *Micropterix calthella* L. (Lepidoptera, Micropterigidae). – Acta Zoologica (Stockholm) **78**: 1–8.

Faucheux, M. J. 1999. Biodiversity and unity of sensory organs in Insecta Lepidoptera. – Société des Sciences Naturelles de l'Ouest de la France (ed.), Nantes. 296 pp.

Faucheux, M. J. 2004. Sensilla placodea on the antennae of Lepidoptera. – Annales de la Société entomologique de France (n.s.) **40**: 105–107.

Gödde, J. & T. Haug 1990. Analysis of the electrical responses of antennal thermo- and hygroreceptors of *Antheraea* (Saturniidae, Lepidoptera) to thermal, mechanical, and electrical stimuli. – Journal of Comparative Physiology A **167**: 391–401.

Hallberg, E., B. S. Hansson & C. Löfstedt 2003. Sensilla and proprioceptors. Pp. 267–288. – *In*: N. P. Kristensen (ed.), Lepidoptera, Moths and Butterflies, 2, Handbook of Zoology, IV, 36, de Gruyter, Berlin & New York.

Haug, T. 1985. Ultrastructure of the dendritic outer segments of sensory cells in poreless ("no-pore") sensilla of insects. A cryofixation study. – Cell and Tissue Research **242**: 313–322.

Hunger, T. & R. A. Steinbrecht 1998. Functional morphology of a double-walled multiporous olfactory sensillum: the sensillum coeloconicum of *Bombyx mori* (Insecta, Lepidoptera). – Tissue & Cell **30**: 14–29.

Lopes, O., E. N. Barata, H. Mustaparta & J. Arayo 2002. Fine structure of antennal sensilla basiconica and their detection of plant volatiles in the eucalyptus woodborer, *Phoracantha semipunctata* Fabricius (Coleoptera: Cerambycidae). – Arthropod Structure and Development **31**: 1–13.

Pophof, B. 1997. Olfactory responses recorded from sensilla coeloconica of the silkmoth *Bombyx mori*. – Physiological Entomology **22**: 239–248.

Schneider, D. 1964. Insect antennae. – Annual Review of Entomology **9**: 103–122.

Schneider, D. & K. E. Kaissling 1957. Der Bau der antenne des Seidenspinners *Bombyx mori* L. II. Sensillen cuticulare Bildungen und innerer Bau. – Zoologische Jahrbücher Abteilung für Anatomie und Ontogenie der Tiere **76**: 223–250.

Shields, V. D. C. & J. G. Hildebrand 1999. Fine structure of antennal sensilla of the female sphinx moth *Manduca sexta* (Lepidoptera: Sphingidae). I. Trichoid and basiconic sensilla. – Canadian Journal of Zoology **77**: 290–301.

Steinbrecht, R. A. 1973. Der Feinbau olfaktorischer Sensillen des Seidenspinners (Insecta, Lepidoptera). Rezeptorfortsätze und reizleitender Apparat. – Zeitschrift für Zellforschung und Mikroskopische Anatomie **139**: 533–565.

Steinbrecht, R. A. 1998. Bimodal thermo- and hygrosensitive sensilla. Pp. 405–422. – *In*: F. W. Harrison & M. Locke (eds), Microscopic Anatomy of Invertebrates, vol. 11 B, Insecta. Wiley-Liss, Inc., New York.

Steinbrecht, R. A. & B. Müller 1991. The thermo-/hygrosensitive sensilla in the silkmoth *Bombyx mori*: morphological changes after dry- and moist-adaptation. – Cell and Tissue Research **266**: 441–456.

Yang H., S.-C. Yan & D. Liu 2009. Ultrastructural observations on antennal sensilla of *Coleophora obducta* (Meyrick) (Lepidoptera: Coleophoridae). – Micron **40**: 231–238.

Laštůvka, Z. & J. Liška 2011. Annotated checklist of moths and butterflies of the Czech Republic (Insecta: Lepidoptera). – Brno, 146 pp. – ISBN 978-80-904254-1-5.

A new checklist of the Lepidoptera of the Czech Republic concisely summarizes regional checklists for the country published during the 1990s (Laštůvka 1993; Novák & Liška 1997) and the Czech checklist by Laštůvka (1998), as well as the online checklist by Laštůvka & Liška (2010) for the Czech Republic, presenting up-to-date knowledge on the subject. The entire book is written bilingually, in Czech and English, and thus can be easily used by a wide international readership. The book starts with an introductory part on history, zoogeography, invasive species, as well as changes of the Lepidoptera fauna – information that is not given along with the online checklist by Laštůvka & Liška (2010).

A short overview on the history of faunistic research on Lepidoptera in the 20th century and until present is provided, followed by a short outline of the zoogeography of Czech Lepidoptera with examples of characteristic species, e.g., thermophilic species which arrived in the Bohemian basin during the warm Atlanticum period (6,700–4,500 years ago) and survived the subsequent cooling becoming isolated populations. For invasive species, lists are provided for those species which became indigenous, have restricted occurrences to temperate places or so far did not establish long-term populations. Changes to the Lepidoptera fauna of the Czech Republic are analyzed in the context of slightly more than 100 years of faunistic research in the country, already counting 25 species that are known only from the records from before the middle of the 20th century, but there are even more declines at a sub-regional scale. On the other hand, the species that disappeared are partly outnumbered by new arrivals, though many of them are known only from singletons. At least for some species, the authors are closing the circle to zoogeography pointing to the fact that species occurring with isolated populations in the Bohemian basin cannot recolonize the area from the south.

The main checklist starts with a summary of the number of recorded species at the family level, provided separately for the entire Czech Republic, as well as its sub-regions Bohemia and Moravia. The checklist is arranged according to the up-to-date lepidopteran classification. Additional information is provided by symbols referring to regional occurrences, zoogeographic patterns, reliability of records, indigenous versus non-indigenous occurrences, extinctions and literature references. This concise style allows to print the checklist in two columns and to provide additional bilingual comments on selected species on the bottom of the same page. The book is completed with a list of 346 literature references and an index to scientific names referring to the taxon numbers used in the checklist and enabling quick finding of all the taxa. It is worth mentioning here that the comments and references are not provided in the online checklist by Laštůvka & Liška (2010).

Altogether, 3,429 species are listed for the Czech Republic. This informative book is easy to use and the introductory part is an interesting reading. It is recommended to anyone who is interested in faunistics, zoogeography and conservation of Central European Lepidoptera.

Matthias Nuss

References

Laštůvka, Z. 1993. Katalog motýlů moravskoslezského regionu. – Brno, 130 pp.
Laštůvka, Z. 1998. Seznam motýlů České a Slovenské republiky. – Brno, 118 pp.
Laštůvka, Z. & J. Liška 2010. Seznam motýlů České republiky. – www.lepidoptera.wz.cz.
Novák, I. & J. Liška 1997. Katalog motýlů (Lepidoptera) Čech. – Klapalekiana **33, suppl.**: 1–159.

Morphology and ontogeny of wing bud development during metamorphosis in females of the wingless bagworm moth *Epichnopterix plumella* (Denis & Schiffermüller, 1775) (Psychidae)

Shuhei Niitsu [1], Ian Sims [2] & Tsuyoshi Ishizaki [3]

[1] Department of Natural History, Tokyo Metropolitan University, Minami-Osawa 1-1, Hachioji, Tokyo, 192-0397, Japan; shu-30@aioros.ocn.ne.jp (corresponding author)

[2] Ecological Sciences, Jealott's Hill International Research Centre, Syngenta, Bracknell, Berkshire RG42 6EY, United Kingdom; ian.sims@syngenta.com

[3] Laboratory of Entomology, Tokyo University of Agriculture, Funako 1737, Atsugi, Kanagawa, 243-0034, Japan

Abstract. Female adults of the bagworm moths belonging to the subfamily Epichnopteriginae are vermiform in body shape, i.e., without external appendages. Larvae of the vermiform female *Eumeta variegata* (Snellen) belonging to the subfamily Oiketicinae have small wing rudiments, which do not grow but disappear during the prepupal stage. Herein we describe the morphology of wing buds in the wingless female bagworm moth *Epichnopterix plumella* (Denis & Schiffermüller), subfamily Epichnopteriginae and discusses the different developmental patterns underlying the vermiform structures in the two subfamilies. Using light microscopy, we show that the structure of the wing discs in the last larval instar is similar in both sexes. Scanning electron microscopy observations also show that the pupal wing cases of the female are much smaller than those of the male, and that female adults completely lack wing rudiments. We show that the three main wing tracheae, i.e., Radius, Media and Cubitus, in the female pupa extend nearly to the wing margin. Hence, our studies demonstrate that the loss of wings in the vermiform morph of the female adult in these exemplars of the subfamilies Oiketicinae and Epichnopteriginae is achieved through different developmental processes.

Introduction

Brachypterous (reduced wings) or apterous (no wings) adults are a recurrent phenomenon among several orders of holometabolous insects and are secondarily derived from a winged morph in their evolutionary histories. This secondary loss of wings in insects has typically been interpreted as an evolutionary adaptation to increase fecundity (Roff 1990, Wagner & Liebherr 1992). In Lepidoptera, female-specific wing degeneration occurs in many groups; that is, brachypterous or apterous forms are known in 25 of about 120 families (Sattler 1991). Globally, the family Psychidae comprises nearly 1000 species (Davis & Robinson 1999). The larvae of these moths construct larval cases from dead leaves, small twigs and/or other foreign bodies; hence, the members of this family are called bagworm moths. Adult females are usually wingless, but the females of the presumably earliest lineages have normal wings. Bagworm moths may have lost their wings during evolution due to their case-dwelling life style. We have reported the ontogenetic study of wing degeneration in several species of Japanese wingless bagworm moths. These degeneration processes were caused by apoptosis during the larval-pupal

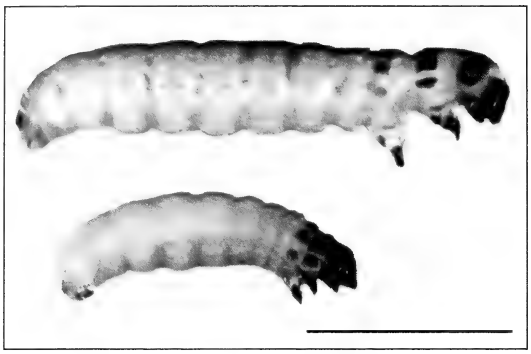

Fig. 1. Fully-grown female (upper) and male (lower) larvae of *Epichnopterix plumella*. The body length is about 12 mm in females and 7 mm in males. Scale bar: 5 mm.

development or pupal-adult development (Niitsu & Kobayashi 2008; Niitsu et al. 2008). However, the evolutionary and developmental processes underlying these dramatic changes in phenotype are still not fully understood.

In some derived groups, such as the subfamilies Oiketicinae and Epichnopteriginae, the female adults are vermiform, i.e., completely lacking wings and other appendages (Hättenschwiler 1985). The pupa of the wingless female bagworm moth *Epichnopterix plumella* (Denis & Schiffermüller, 1775) is illustrated by Patočka and Turčáni (2005). According to their study, the females of *E. plumella* are unique among the examined taxa in that the pupa possesses rudimentary wing cases while the adult lacks wings. Our knowledge of the morphology and ontogeny of the wing buds of this group is still poor, especially regarding histological details. This developmental pattern, i.e., the female pupa possessing wing cases but adult being apterous, has not been found in any other species of wingless bagworm moths. Therefore, to understand the evolution of wing reduction in the family, it is necessary to clarify the unique process of degeneration in wingless female epichnopterigines.

In this paper, we describe the postembryonic development of the wing bud in *E. plumella* and compare this in relation to the pattern of wing reduction in several other taxa of wingless bagworm moths. This is the first morphological and histological study of the process of wing reduction in Epichnopteriginae.

Material and Methods

Collection of Larvae. Several final instar larvae of *E. plumella* were collected in the United Kingdom (Hainault Forest, Essex) in April of 2009 and were kept at room temperature (about 20°C) for a few weeks. The mature larvae of *E. plumella* are easily sexed on the basis of size (Fig. 1). In order to check whether a last instar larva was a prepupa, its larval case was opened with scissors, following the criteria of Niitsu (2003). Both sexes spend about 5 days as a prepupa, during which the gut is purged of ingested food prior to pupation. At least three examples of female last instar larvae, prepupae, and pupae were fixed. Any males of last instar larvae were also fixed.

Histological Observations. For histological observations, the wing discs of larvae and pupal wings were removed and fixed in Karnovsky's fixative (2% paraformaldehyde and 2.5% glutaraldehyde), then buffered with 0.1M HCl-sodium cacodylate. They were then treated with 2% osmium tetroxide, dehydrated in a series of ethanol and propylene oxide and embedded in Epon 812 (TAAB). Semi-thin sections (1 μm thick) of the wing buds were prepared on a rotary microtome and mounted on microscope slides before

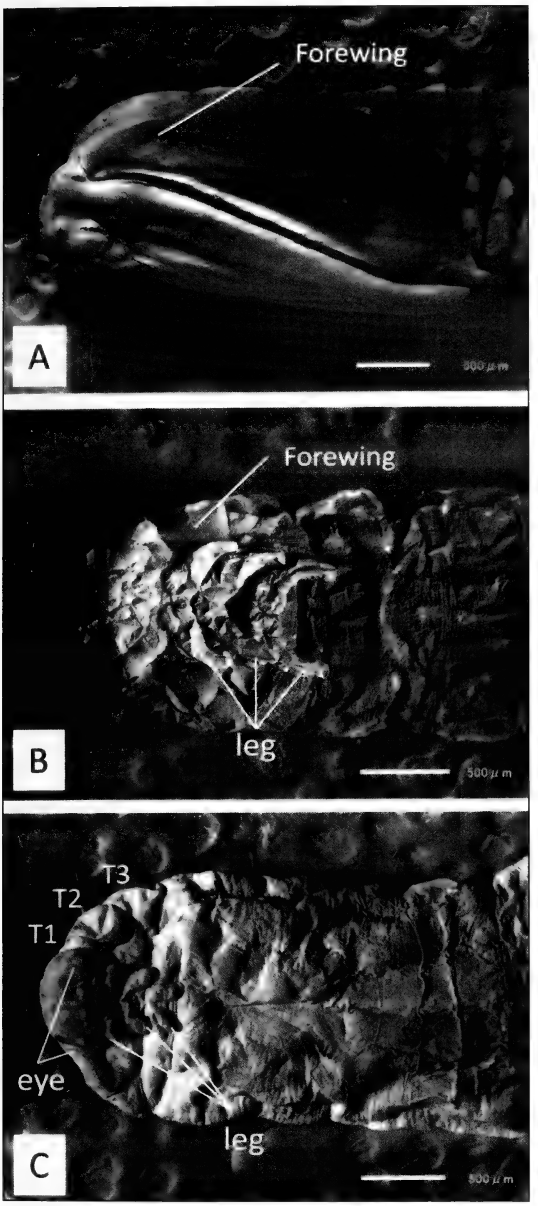

Fig. 2. Scanning electron micrographs of a male (**A**) and female pupa (**B**) and a wingless female adult (**C**) of *Epichnopterix plumella*. Anterior is left. Scale bars: 500 µm.

staining with Azur B. Slide-mounted tissues were observed using a NIKON OPTIOHOT microscope.

Scanning Electron Microscopy. Scanning electron microscopy (SEM) was used to examine the structure of pupae of both sexes, and the external structures of female adults. Samples were fixed in Karnovsky's fixtative, then treated with 2% osmium tetroxide and dehydrated in a graded series of ethanol (up to 100%). After critical-point drying, scanning electron micrographs were taken using a JSM-6510LV electron microscope (JEOL, JAPAN).

Results

Pupae of Both Sexes. The body length of the examined male pupa is 3.8 mm (Fig. 2A), while the female was 4.1 mm (Fig. 2B). Female pupal wing cases are extremely reduced, their length being about 0.5 mm. In contrast, the pupal wing cases of the males are well developed (Fig. 2A), the forewing length being about 3.0 mm.

Adult Females. The body length of the female adult *E. plumella* examine in the SEM (Fig. 2C) is 4.9 mm. They possess a pair of rudimentary eyes and have three pairs of small non-segmented legs. The head is strongly reduced, but the thoracic segments are easily recognized. Wings are completely absent.

Wing Imaginal Discs. To study female wing reduction in *E. plumella*, the development of wing discs during the last larval instar in the female was observed by dissection. In the middle stage of the last-larval instar, the wing imaginal discs were oval in shape for both sexes (Figs 3A, B). The development of the wing discs progressed in the same way for both sexes until the last larval stage when the female wing disc was evaginated during the prepupal stage. Just before pupation of the female larva, proliferation of the wing buds stopped and the wing epithelial cells secreted a new pupal

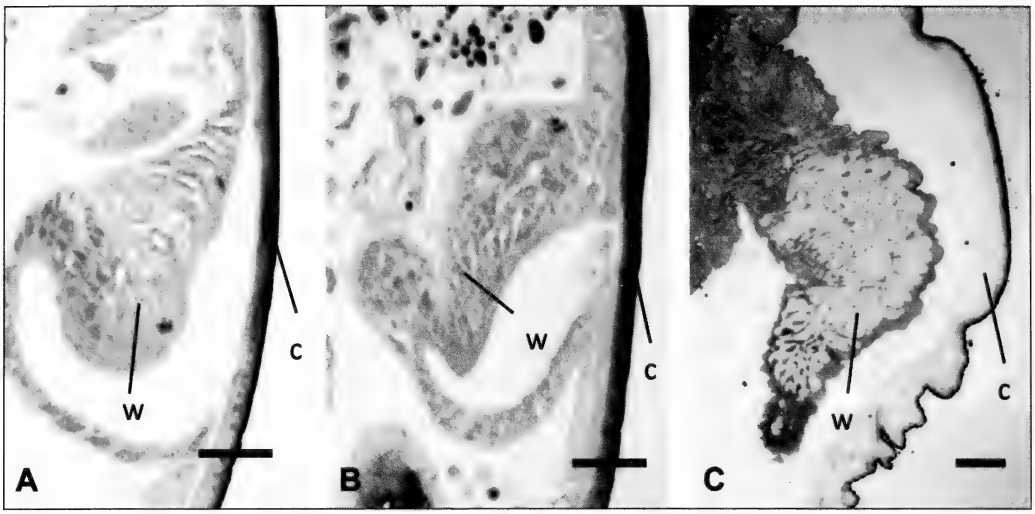

Fig. 3. Cross sections of the wing disc of *Epichnopterix plumella*. Sectioned (**A**) half way through the last larval instar of male; (**B**) half way through the last larval instar of female; (**C**) late female prepupa of the last instar (note the evaginated wing bud and the lamination of the new pupal cuticle). w-wing bud; c-cuticle. Scale bars: 20 μm (A, B) and 50 μm (C).

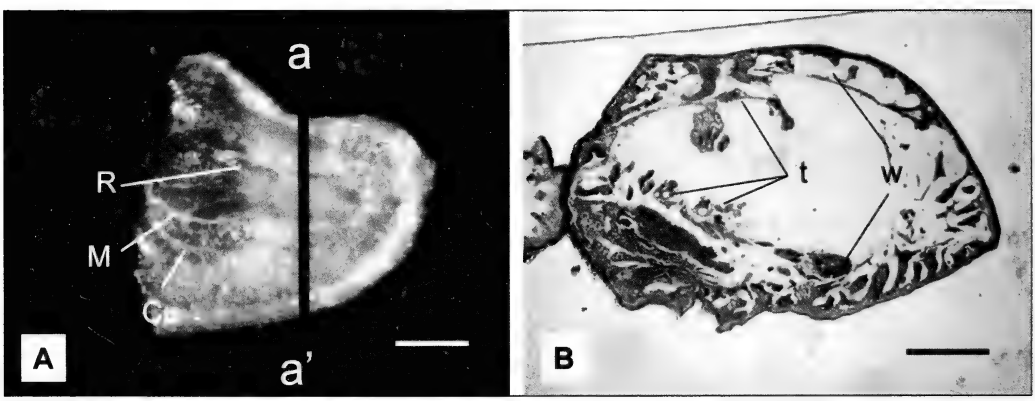

Fig. 4. Female pupal wings of *Epichnopterix plumella* just after pupation. (**A**) Female forewing dissected from pupa. (**B**) Pupal wings of female with a much simpler tracheal system than those of males. a-a' levels of the section depicted in Fig B. R-Radius; M-Media; Cu-Cubitus; t, trachea; w, pupal wing epithelium. Scale bars: 100 μm (A) and 50 μm (B).

cuticle (Fig. 3C). In this study, male wing buds were not examined. However, the male pupal wings demonstrate that the wing buds of males are larger than those of females.

Pupal Wings of Females. In the female pupa of *E. plumella*, the three main wing tracheae, i.e., those pertaining to R(adius), M(edia) and Cu(bitus), extended nearly to the margin of the wings (Fig. 4A). During the pupal stage (day 0), the wing epithelia of females are attached to the pupal cuticle (Fig. 4B). On day 2 (48h after pupation), the female wing epithelia had already retracted completely from the pupal wing case (not illustrated); hence the moth is now in the pharate adult stage.

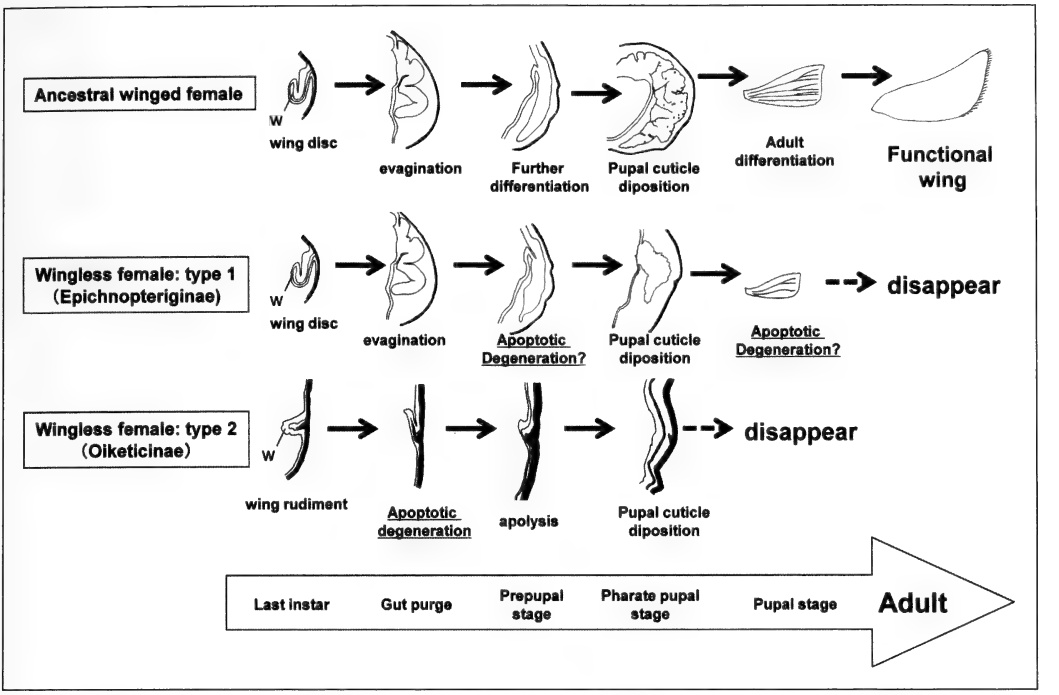

Fig. 5. Schematic diagram of differential wing formation and degeneration in Epichnopteriginae and Oiketicinae. w-wing discs or wing rudiments. The different methods of wing reduction between the two subfamilies are indicated.

Discussion

The present study demonstrates that females of *E. plumella* possess wing discs during larval-pupal and pupal-adult development. Although we could not confirm whether there is an apoptotic event during female wing development, our results suggest that female-specific wing degeneration occurs in two steps, i.e., in both the larval and pupal stages (Fig. 5). Niitsu & Kobayashi (2008) similarly reported that in females of three species of wingless but fully-legged bagworm moths, *Taleporia trichopterella* (Saigusa, 1961), *Bacotia sakabei* (Seino, 1981) and *Proutia* sp., wing buds were reduced due to apoptosis in the same two steps, i.e., during the larval and pupal stages. This study suggests that the female degeneration pattern is similar in all before-mentioned taxa.

Wing degeneration has been reported in females of several other psychid moths. In *Eumeta variegata* (Snellen, 1879), subfamily Oiketicinae, the external morphology of the female pupae is entirely different from the male: the female pupa is "vermiform" without wing cases and the female adult is apterous; the vestigial wing rudiments do not grow but disappear during the prepupal stage (Niitsu 2003). In the female of another oiketicine psychid *Pachytelia unicolor* (Hufnagel, 1766), the development of the wing discs is suppressed in an early larval instar (Fedotov 1939). It has been hypothesized that the vermiform state of the females in Psychidae was the most specialized (i.e., derived) condition in the evolution in the family and that wingless females evolved from winged females (Saigusa 1962, Yen et al. 2004). Our data on the presence of larval or

pupal wing buds in female wingless psychids is also compatible with the hypothesis that taxa with wingless females evolved from taxa with winged ones. We here classify the pattern of female wing reduction in several bagworm moths into two types (Fig. 5): 1) wingless female type 1, in which female-specific wing degeneration occurs in two steps, i.e. in the larval and pupal stages (subfamily Epichnopteriginae); 2) wingless female type 2, in which the minute wing rudiment does not grow and disappears during larval-pupal development (subfamily Oiketicinae).

In Lepidoptera, females with reduced wings are known in Geometridae, Noctuidae, Psychidae and several other families, and there have been some studies of these patterns of female-specific wing reduction (Common 1970, Hackman 1966, Hamilton 1978, Heppner 1991, Matsuda 1979, Sattler 1991). In the lymantriine *Orgyia leucostigma* (Smith, 1797), female wing discs are formed initially but are later destroyed by apoptosis during pupal-adult development (Nardi et al. 1991). In the congener *O. dubia* (Tauscher, 1806), the female pupa completely lacks pupal wing cases and the female adult is vermiform and apterous (Mostafa & Laila 1969), but nothing is known about the developmental process of wing reduction in this species. In yet another *Orgyia* species, *O. thyellina* Butler, 1881, the female wings show seasonal dimorphism. The autumn females have short wings whereas the summer females have normal wings (Sato 1977). In the winter moth *Nyssiodes lefuarius* (Erschoff, 1872) (Geometridae), female wing discs are fully developed but are destroyed suddenly by apoptosis in the late pupal stage (Niitsu 2001).

The ecdysone hormone, ecdysteroid, plays an important role in induction of female-specific wing degeneration among flightless lepidopterans (Lobbia et al. 2003). Niitsu et al. (2008) clarified that female-specific wing degeneration in *E. variegata* is triggered directly by ecdysteroids in female wing rudiment cultured in vitro. They have recently reported that female wing rudiment of *E. variegata* lose the ability for cell proliferation in response to the stimulus of 20-hydroxyecdysone (Niitsu et al. 2011). However, the molecular mechanisms causing female-specific winglessness in this species are not yet fully understood.

Conclusions

We have here demonstrated that the vermiform morph of the female adults in examined representatives of Oiketicinae and Epichnopteriginae have different developmental backgrounds, i.e., the evolutionary wing loss has been achieved in different ways. Whether these similar (vermiform) morphs, arising via two different pathways of wing loss, occurred as a result of parallel evolution, or whether they represent steps in a single transformation series can be fruitfully discussed only on the basis of a robust phylogeny of the family. Work towards this goal, together with further studies of developmental biology and comparative histology, should improve our understanding of the evolution of the female-specific wingless condition in Psychidae.

Acknowledgments

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References

Common, I. F. B. 1970. Lepidoptera (moths and butterflies). *In*: I. M. Mackerras (ed.), The Insects of Australia. – Melbourne University Press, Melbourne. 866 pp.

Davis, D. R. & G. S. Robinson 1999. The Tineoidea and Gracillarioidea. *In*: N. P. Kristensen (ed.), Lepidoptera, moths and butterflies, 1. Evolution, systematics, and biogeography. Handbook of Zoology IV. Arthoropoda: Insecta Part 35, Vol. 1. – Walter De Gruyter, Berlin. 491 pp.

Fedotov, D. M. 1939. On the phenomenon of regressive changes in some bagworm moths (Psychid). – Comptes Rendus de l'Académie des Sciences del'U.R.S.S. **24**: 616–619.

Hackman, W. 1966. On wing reduction and loss of wings in Lepidoptera. – Notulae Entomologicae **46**: 1–16.

Hamilton, W. D. 1978. Evolution and diversity under bark: *In*: L. A. Mound & N. Waloff (eds), Diversity of Insect Faunas. – Symposia of the Royal Entomological Society of London, London. 175 pp.

Hättenschwiler, P. 1985. Psychidae: *In*: M. Emmet & J. Heath (eds), The Moths and Butterflies of Great Britain and Ireland Volume 2. – Harley Books, Colchester. 460 pp., 14 pls.

Heppner, J. B. 1991. Brachyptery and aptery in Lepidoptera. – Tropical Lepidoptera **2**: 11–40.

Lobbia, S., S. Niitsu & H. Fujiwara 2003. Female-specific wing degeneration caused by ecdysteroid in the Tussock Moth, *Orgyia recens*: hormonal and developmental regulation of sexual dimorphism. – Journal of Insect Science **3.11**: 1–7.

Matsuda, R. 1979. Abnormal metamorphosis and arthropod evolution. *In*: A. P. Gupta (ed.), Arthropod Phylogeny. – Van Nostrand Reinhold Company, New York. 762 pp.

Mostafa, H. & E. S. Laila 1969. On the bionomics of *Orgyia dubia* Judaea STGR (Lepidoptera, Lymantriidae). – Bulletin de la Societe Entomologique d' Egypte **53**: 161–183.

Nardi, J. B., G. L. Godfrey & R. A. Bergstrom 1991. Programmed cell death in the wings of *Orgyia leucostigma*. – Journal of Morphology **209**: 121–131.

Niitsu, S. 2001. Wing degeneration due to apoptosis in the female of the winter moth, *Nyssiodes lefuarius*. – Entomological Science **4**: 1–7.

Niitsu, S. 2003. Postembryonic development of the wing imaginal disc in the female wingless bagworm moth, *Eumeta variegata* (Lepidoptera, Psychidae). – Journal of Morphology **257**: 164–170.

Niitsu, S. & Y. Kobayashi 2008. The developmental process during metamorphosis that results in wing reduction in females of three species of wingless-legged bagworm moths, *Taleporia trichopterella*, *Bacotia sakabei* and *Proutia* sp. (Lepidoptera: Psychidae). – European Journal of Entomology **105**: 699–708.

Niitsu, S., S. Lobbia, S. Izumi & H. Fujiwara 2008. Female-specific wing degeneration is triggered by ecdysteroid in cultures of wing discs from the bagworm moth, *Eumeta variegata* (Insecta: Lepidoptera, Psychidae). – Cell & Tissue Research **333**: 169–173.

Niitsu, S., S. Lobbia & T. Kamito 2011. In vitro effects of juvenile hormone analog on wing disc morphogenesis under ecdysteroid treatment in the female-wingless bagworm moth *Eumeta variegata* (Insecta: Lepidoptera, Psychidae). – Tissue and Cell **43**: 143–150.

Patočka, J. & M. Turčáni 2005. Lepidoptera Pupae. Text Volume. – Apollo Books, Stenstrup. 542 pp.

Roff, D. A. 1990. The evolution of flightlessness in insects. – Ecological Monographs **60**: 389–421.

Saigusa, T. 1962. On some basic concepts of the evolution of psychid moths from the points of view of the comparative ethology and morphology. – Tyo to Ga **12**: 120–143. [In Japanese with English summary]

Sato, T. 1977. Life history and diapause of the white-spotted tussock moth, *Orgyia thyellina* Bulter (Lepidoptera, Lymantriidae). – Japanese Journal of Applied Entomology and Zoology **21**: 6–14. [In Japanese with English summary]

Sattler, K. 1991. A review of wing reduction in Lepidoptera. – Bulletin of the British Museum (Natural History) (Entomology) **60**: 243–288.

Wagner, D. L. & J. K. Liebherr 1992. Flightlessness in Insects. – Trends in Ecology & Evolution **7**: 216–220.

Yen, S.-H., C. Lopez-Vaamonde, I. Sims & D. R. Davis 2004. Evolution of sexual dimorphism, host use and female case architecture in bagworm moths. Abstracts from the Young Systematist's Forum of the Systematic Association, NHM, London. http://www.systass.org/ysf/6th YSF.pdf

Lauri Kaila (with contributions by Kazuhiro Sugisima) 2011. Elachistine Moths of Australia (Lepidoptera: Gelechioidea: Elachistidae). – Monographs on Australian Lepidoptera Series 11. CSIRO Publishing, Collingwood, Victoria, Australia; www.publish.csiro.au, 456 pages. ISBN 9780643103054. Hardcover, cloth bound, format 250 × 175 mm. Price AU$ 150.00. E-book version available online for a similar price.

Biodiversity and its conservation have become biological, social, political, and even economic issues. Yet when we look beyond well-known flagship groups that engage the popular mind, vast spans of the world of six-legged and other unremarkable creatures remain sketchily known and barely catalogued. Elachistinae are such animals. They are small, drably coloured micromoths with leaf- or stem-mining larvae. With about 90% of the species feeding on monocotyledons, the group is one of the most successful lineages of Lepidoptera to exploit this class of plants. The known global diversity of elachistines is estimated at about 700. However, new species are discovered all the time, especially through surveys in suitable habitats in less well-explored parts of the world (a recent example in Sruoga & De Prins 2011 appeared after publication of the book). Kaila's book underscores the unaccounted diversity that may lie in such poorly studied groups: of the 148 species treated, no less than 128, or 86%, are newly described. The genus *Elachista* alone, one of three genera represented in Australia (the others are *Urodeta* and *Perittia*), comprises 143 of the total, a number that accounts for about 20% of the world fauna.

This book is a monograph at its best and a major landmark in Kaila's continued, high-quality work on the world fauna of Elachistinae. It gives comprehensive coverage of all known aspects of the morphology, taxonomy, biology and classification of the Australian fauna. The author's work on Elachistinae began about 15 years ago with a series of revisional papers comprehensively covering the Nearctic fauna, as well as several papers on the Palaearctic fauna and a review of the South American fauna. He also developed a phylogenetic framework for a global classification of the subfamily.

In spite of these impressive figures, the author describes the knowledge of the Australian Elachistines as "scanty" (p. 42). Most species are actually known from very few records, with about one-third of them known from a single record (a record being akin to a collecting event and may comprise several specimens). This is attributed in part to the strict habitat requirements of most species, which often occur only over certain microhabitats within the wider range of their host plants. In a brief, but eye-opening chapter on diversity, distribution and conservation, Kaila paints a disheartening picture of a fragile elachistine fauna which may already be critically imperiled in some parts of the continent due to excessive habitat fragmentation. A map shows a striking general distribution pattern where all elachistines occur at the periphery of the continent, in temperate, higher elevation, and humid areas.

In the methods chapter, the operational species concept is discussed in some detail, with reference to the peculiarities and limitations of the group under study. Species are treated as hypotheses subject to further testing with the addition of further data and observations. Taxonomy is not merely about observing similarities and differences and applying names and categories to the observed clusters. It must be subtended by a proper conceptual framework. This is something too rarely mentioned in taxonomic works, as if it went without saying. Of course, it is not necessary to expound one's operational concept in every paper that describes a few species. However, for large monographic works, this should be presented as a matter of course. There is often a big chasm between tacitly accepting, say, the biological species concept, and explaining how one applies it to specimens and incomplete morphological and biological observations to delineate species. Kaila is to be commended for clearly explaining his approach. He further stresses that in some groups the adults may not be reliably identifiable using morphology, or

even genetic traits, and that in those species-level distinctiveness comes from life history features. In the same chapter all technical aspects of studying these moths are presented with necessary details, including useful remarks on the particulars of genitalia preparation and rearing that apply to elachistines.

Following the introduction and methods is a chapter, co-authored with Sugisima[1], on the phylogeny, subfamily delineation, and generic classification. The cladistic analysis draws on more than 145 characters from both immature and adult stages and represents a significant revision of Kaila's (1999) previous analysis, rendered necessary by the discovery of so many new species. The characters and states used in the analysis are conveniently presented in an extensive table with alternatively white and shaded entries: the clarity of formatting makes it very easy to consult in conjunction with the phylogenetic trees that follow, a commendable quality for such data. Kaila is among the very few authors who have studied skeletal features of the lepidopteran thorax and used them in phylogenetic analysis. The overall impression is that the author studied the taxa in painstaking detail in an attempt to extract as much useful phylogenetic information as possible. Taking into consideration his earlier results on the phylogeny of Gelechoidea (Kaila 2004), there is also further testing of the monophyly of Elachistinae, which remains well supported although without unique synapomorphies.

There follows a chapter on morphology, abundantly illustrated and providing details for larvae, pupae, and adults. Genitalia figures show all the parts clearly labelled. The presentation sets the stage for the keys and descriptions of the taxonomic treatment in the following chapter.

Keys are provided for the Australian genera and for species within *Perittia* (3 species) and *Elachista* (143 species) (*Urodeta* includes only one named species and a second, unnamed species). The key to genera is for males only. Females of *Perittia* are unknown, thus precluding the presentation of a key to females, but the difference between females of *Urodeta* and *Elachista* is indicated. For the large number of species of *Elachista*, separate keys are given for males and females. The size of the keys can be daunting (129 and 94 couplets, respectively) and several of the differences are subtle. Although external features are used in some couplets, the vast majority refer to genital characters, making genital preparations a prerequisite for anyone attempting to identify these moths. There are no references to figures in the keys, and no indication of which page each species is located on. While this reduces potential clutter within the key, it makes it difficult to check characters on corresponding figures and to navigate to individual species treatments.

The large genus *Elachista* is divided into two subgenera (*Atachia* and *Elachista*), and hierarchically into further species groups, sections, and subordinate complexes within, reflecting the phylogeny. A diagnosis, description or presentation is given for each of these subdivisions. Each species treatment includes a description (with the subsections: wingspan range, head, colouration of thorax, colouration of abdomen, wing pattern, male genitalia, female genitalia, larva and pupa when known), diagnosis, biology, distribution, material examined, and, in several cases, remarks. Remarks mainly discuss species delineation issues. Navigation might have been enhanced by numbering species sequentially and applying the same numbers to the correspond-

[1] Contributing author Sugisima was a young, emerging Japanese systematist who had begun to publish carefully crafted papers on Gelechioidea in the early 2000s. As he explained in a kind of farewell letter to several corresponding colleagues, lack of funding and professional opportunities in systematics forced him in 2006 to exit science altogether in order to earn a living. It is most regrettable that such talented students are forced out of the field of systematics, a situation that has become more common in recent years, in a worrisome trend that parallels the worsening biodiversity crisis.

ing figures for each category of illustrations, as has been applied successfully in other series (Microlepidoptera of Europe by Apollo Books). Although several of the new names are evidently derived from some obvious aspect of the species (host, colour, patronym), many are not. It would have been nice to state their derivation, as recommended by the Code.

Immatures are presented as far as known, with nearly all data newly obtained by the author himself over the course of four visits to Australia totalling over 18 months, during which he conducted extensive fieldwork. Contributing author Sugisima also added significantly to this targeted effort in separate fieldwork. The combined result, the rearing of more than 70 species (42% of the recorded fauna), enabled to reach taxonomic conclusions for what Kaila terms "bewildering species complexes" where morphology alone did not provide answers. Larvae and pupae are described and illustrated in a standardized fashion, again something uncommon in microlepidoptera works.

A short section at the end of the taxonomic treatment treats six species that are newly excluded from Elachistinae. There are two appendices. The first lists all the taxonomic changes that were effected in the work, which amounts to a listing of new combinations and new species arranged taxonomically as they would be in a checklist. This arrangement is little unfortunate because it is difficult to locate any particular taxon name. An alphabetical listing would have been preferable. The second appendix is the data matrix used in the cladistic analysis. An index concludes the book, listing both animal and host plant names together, which is better than the frequent practice of separating the two. There is no overall synonymic checklist summarizing all taxa covered. This is provided under each taxon (genus), including generic synonyms and a list of species included.

The book is richly illustrated with photographs showing morphology, larvae, pupae, adult moths, genitalia, larval mines, and habitats. They are generally of high quality and show clearly what is intended or presented in the text. All have been digitally post-processed and cleaned, and offer uniform backgrounds as well as good contrast and sharpness. However, the placement and numbering of the figures is confusing. They are arranged in two ways: scattered throughout the text, or grouped after the main body of text before the references. Figures 1–49 (mostly morphology with one map and one graph) are found in the initial sections of the book from pages 22–42; figs 50–56 showing habitats are on pages 253–257; figs 57–94 showing larvae are distributed throughout the taxonomic section from pages 68–218, close to the species they illustrate; figs 95–438 are the genitalia photos, they are all grouped together, males followed by females, and begin on page 301 after the colour plates; the colour plates on pages 258–300 show adult moths, pupae, and larval mines, and are numbered 1–43, with individual photos numbered 1–x in each plate. It is unclear why photos of larvae were distributed within the main body of the text rather than being grouped together at the end.

Notwithstanding the mild criticism expressed over some organisational details, this is a very well produced book. The binding, cloth cover, and semi-glossy paper are of the same high quality that characterized previous volumes of this series. The book remains naturally flat-open from any page, a truly appreciable quality when one uses the keys.

This book is an outstanding example of the fundamental backbone that understanding and documenting biodiversity requires. It almost goes without saying that it is essential for anyone seriously interested in Elachistinae. But I would also recommend it particularly to any Lepidoptera taxonomist as an excellent model of monograph with a thorough conceptual and analytical footing, such as should be published more often nowadays. It also shows clearly that despite its comprehensiveness, much remains to be discovered before Elachistinae can be regarded as "well known".

Jean-François Landry

References

Kaila, L. 1999. Phylogeny and classification of the Elachistidae s. s. (Lepidoptera: Gelechioidea). – Systematic Entomology **24**: 139–169.

Kaila, L. 2004. Phylogeny of the superfamily Gelechioidea (Lepidoptera: Ditrysia): an exemplar approach. – Cladistics **20**: 303–340.

Sruoga, V. & J. De Prins 2011. New species of Elachistinae (Lepidoptera: Elachistidae) from Cameroon and the Democratic Republic of the Congo. – Zootaxa **3008**: 1–32.

On the taxonomic status of *Cephimallota angusticostella* (Zeller) and *C. crassiflavella* Bruand (Tineidae)

Reinhard Gaedike [1] & Richard Mally [2]

[1] Florusstraße 5, 53225 Bonn, Germany; tinagma@msn.com

[2] Senckenberg Naturhistorische Sammlungen Dresden, Museum für Tierkunde, Königsbrücker Landstraße 159, 01109 Dresden, Germany; richard.mally@senckenberg.de

Abstract. *Cephimallota angusticostella* (Zeller, 1839) and *C. crassiflavella* Bruand, 1851 are two Palaearctic Tineidae species which have been recognised as well differentiated taxa. The observation of variability in the male saccus caused doubt about the status of the two taxa and prompted us to initiate a detailed study of the male genital morphology. In this study we found a distinct variability in the shape of the saccus only in *C. crassiflavella*, and not in *C. angusticostella*. The differences in external and genital morphology are corroborated by molecular analyses (DNA barcoding). The morphological and molecular data are discussed in the context of the determined distribution of the two taxa.

Zusammenfassung. *Cephimallota angusticostella* (Zeller, 1839) und *C. crassiflavella* Bruand, 1851 stellen zwei palaearktische, als gut unterscheidbar angesehene Tineidae-Arten dar. Die Beobachtung von Variabilität im männlichen Saccus ließ Zweifel zum Status der beiden Taxa aufkommen und war Anlass einer detaillierten Untersuchung der morphologischen Strukturen der männlichen Genitalien. Es konnte eine klare Variabilität in der Form des Saccus nur bei *C. crassiflavella* gefunden werden, während *C. angusticostella* in dieser Hinsicht keine Variabilität zeigt. Die äußerlichen und genitalmorphologischen Unterschiede bestätigten sich in molekularen Analysen (DNA-Barcoding). Die morphologischen und molekularen Ergebnisse werden im Kontext der hier ermittelten Verbreitung der zwei Taxa diskutiert.

Introduction

The tineid genus *Cephimallota* Bruand, 1851 comprises 11 described species with a Palaearctic distribution. The genus belongs to the subfamily Myrmecozelinae (Robinson 2009). The wingspan of the specimens varies from 10 mm in *C. tunesiella* (Zagulajev, 1966) to 30 mm in *C. colonella* (Erschoff, 1874). The genus is characterised by having specialised male genitalia with the valvae fused, tegumen and vinculum connected to a ring-shaped sclerotisation, and the uncus reduced or characteristically modified. Superficially, *Cephimallota* moths are more or less unicolourous brown, with some species having yellow dots or short stripes. Their biology is still unknown (Robinson 2009), but there are some indications that the larvae may live in nests of aculeate Hymenoptera or in decomposing grass litter (Petersen 1969, Zagulajev 1975).

Cephimallota angusticostella (Zeller, 1839) and *C. crassiflavella* Bruand, 1851 have been treated as vicariant species in the past, whose distributional areas overlap in the region of the Balkan Peninsula and Italy. They can be easily discriminated from each other in both external characters and in the constitution of the male genitalia. However, routine investigations of male genitalia revealed a particular variability of the saccus in specimens from various locations from within the range of both taxa. This finding stimulated a more comprehensive examination of as many specimens as possible from the entire range of the two taxa. This was done in order to clarify the amount

of variability and the so far reliable discrimination of the two taxa based on external and genital characters. It was a possibility that the variability was restricted only to the overlapping distributional area or that the variability hides the differences between the two taxa. In addition to the investigation of the morphological structures, partial DNA sequences of the *cytochrome c oxidase subunit 1* (*coxI*) gene were obtained from a few specimens of each species and analysed in order to compare these results with the morphological data. Mapping of collected material and literature records of *C. angusticostella* and *C. crassiflavella* resulted in a distribution map, which provides a visualisation of the distribution of the two taxa and the area of their distributional overlap.

Material and Methods

The examined material originates from numerous collections and was provided by museum custodians as well as by private collectors. When no reference is given, the distribution records in the species redescriptions rely on studied material. A list of material examined can be found in the appendix. The specimen origins of the pictured genitalia are given in the legends of the figures.

Morphological methods

Genitalia of both sexes were dissected in order to study morphological variability. Phallus and valvae were removed from the genitalia capsule (uncus-tegumen-vinculum with saccus) during dissection. The ring-shaped connection of tegumen-vinculum was not cut laterally but kept intact. Drawings at the same scale were made from genitalia of the two taxa and compared in terms of variability.

Molecular methods

The method suggested by Knölke et al. (2005) was used for investigation of both molecular and morphological characters in the same specimen. DNA was extracted from the abdomen of dried specimens using the Macherey-Nagel NucleoSpin Tissue kit according to the manufacturer's suggestions. PCR amplification of a 587 bp fragment of the *coxI* barcode sequence was done with the primer pair HybLCO/Nancy or in the case of fragmented DNA with the primer pairs HybLCO/K699 and Ron/Nancy, respectively (Wahlberg & Wheat 2008). The amplified *coxI* fragment corresponds to basepairs 50–636 of the 658 bp barcode sequence of Hebert et al. (2003). The sequences were amplified either with SAWADY *taq* DNA polymerase (PeqLab) or with BIO-X-ACT Short DNA polymerase (Bioline). The following PCR program in case of the SAWADY *taq* DNA polymerase was used: initial denaturation for 5 min at 95°C, 40 cycles with denaturation for 30 s at 94°C, primer annealing for 30 s at 48°C, and strand extension for 90 s at 72°C, terminal strand extension for 10 min at 72°C. The PCR program for BIO-X-ACT Short DNA polymerase corresponds to the manufacturer's guidelines in conjunction with the respective primer annealing temperature of 48°C. The PCR products were then analysed with respect to amplification success via gel electrophoresis on a 1% agarose gel, subsequent staining with GelRed, and final examination un-

Table 1. DNA-barcoding voucher data.

taxon	DNA specimen voucher	origin, collection date, collector	*coxI* GenBank accession no.
C. angusticostella	Lep699	Italy, Tuscany, Province of Florence, surrounding of Dicomano, 17–23.vi.2006, leg. F. Theimer	JN130000
	Lep703	Italy, Piedmont, Capanne di Marcarolo Natural Park, 370 m, 5.vii.2005, leg. G. Baldizzone	JN130001
	Lep720	Greece, West Macedonia, Kastoria prefecture, 5 km NW of Kastoria, 10.vii.2007, leg. W. Schmitz	JN130006
	Lep721	Greece, Epirus, Preveza prefecture, Parga, 13.v.2007, leg. W. Schmitz	JN130007
C. crassiflavella	Lep707	France, Provence-Alpes-Côte d'Azur, Alpes-Maritimes, Mandelieu-la-Napoule, 28.v.2005, leg. H. Hendriksen	JN130002
	Lep715	France, Languedoc-Roussillon, Hérault, St. Pons-de-Thomières, 450 m, 24.vi.2005, leg. E. van Nieukerken	JN130003
	Lep717	Italy, Trentino-Alto Adige, South Tyrol, Prad am Stilfser Joch, 930 m, 27.vii.2005, leg. E. van Nieukerken	JN130004
	Lep718	Switzerland, Valais, Brig, Ried-Brig, 800 m, 17.vii.2007, leg. W. Schmitz	JN130005
C. tunesiella	Lep731	Tunisia, Jendouba Governorate, W of Sidi el Barrak lake, 30 m, 04.x.2007, leg. B. Schacht	JN130008

der UV light. Clean-up of the PCR products was carried out with ExoSAP-IT (USB Corporation). The sequence PCR was performed with BigDye Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems). After final clean-up of the samples, sequencing was carried out on a 3130 Genetic Analyzer (Applied Biosystems). For all PCR amplifications, ExoSAP-IT clean-up and sequence PCRs either a Mastercycler ep gradient S (Eppendorf) or a PCR System 9700 (GeneAmp) were used.

Sequence alignment was carried out manually with PhyDE0995 (Müller et al. 2008). Calculation of the genetic distances as well as of the dendrogram using the Neighbor-Joining (NJ) method (Saitou & Nei 1987, Studier & Keppler 1988) were performed under the Kimura-2 Parameter (K2P) model (Kimura 1980) in PAUP* 4.0b10 (Swofford 2000). *Cephimallota tunesiella* (Zagulajev, 1966) was included in the analysis in order to compare the genetic distances of the two investigated taxa to a more distantly related species. All obtained barcode sequences have been submitted to GenBank (for accession numbers see Tab. 1).

Distribution

In order to examine the distributional pattern of *Cephimallota angusticostella* and *C. crassiflavella*, collection localities were compiled from labels of studied specimens and from literature. Geographical coordinates of these collection localities were obtained

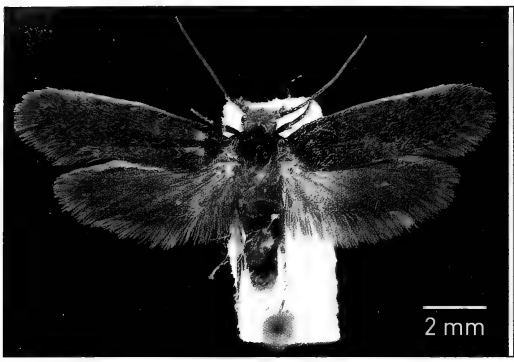


Fig. 1. *Cephimallota crassiflavella*, imago.

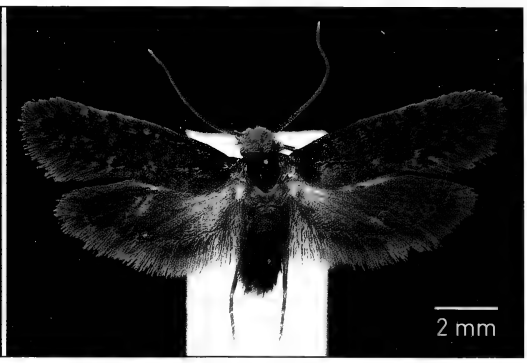


Fig. 2. *Cephimallota angusticostella*, imago.

via Google Earth, Version 5.2.1.1588 and subsequently plotted on a map using DIVA-GIS, Version 7.2.3 (Hijmans et al. 2004).

Results

Morphological results

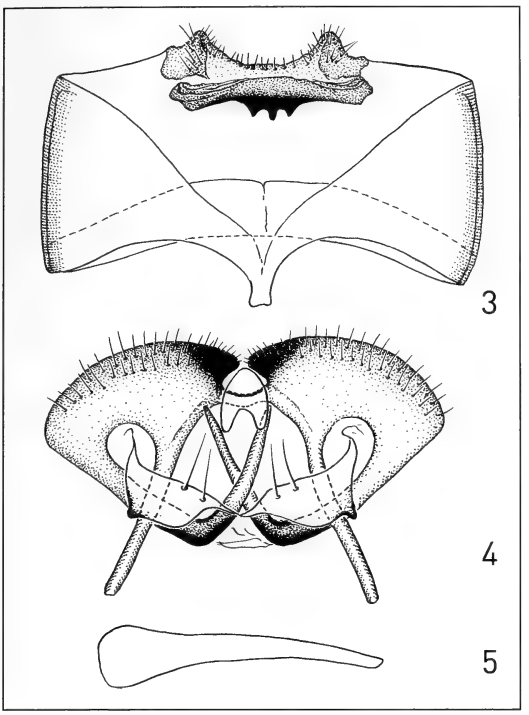
Figures 3–5, 6–27, 28–30 (male genitalia), and 31–34 (female genitalia) are drawn at identical scale in order to illustrate clear differences in size and to be comparable in terms of morphological variation.

Cephimallota crassiflavella **Fig. 1**

Cephimallota crassiflavella Bruand, 1851
[= *Tinea simplicella* Zeller, 1852; = *Tinea simplicella* Herrich-Schäffer, 1854]

Redescription. Wingspan 13–16 mm (n = 219); head brush golden-yellow, antenna filiform, ca. 2/3 of forewing length, brown-grey, labial palps golden-yellow, second segment along the inner side and at outer apex with protruding short bristles; thorax and forewing brown to dark brown, shimmering slightly violet, without any maculation, only costal margin slightly lighter; hindwing a little lighter than forewing.

Male genitalia (Figs 3–27). Uncus with two obtuse setaceous protuberances, firmly attached to the tegumen, below uncus a strongly sclerotised clasp (gnathos?) with three acute small protuberances; tegumen broad, ventrally narrowing, saccus short, variable in shape, either cut straight or stretched out to a more or less short tip (see Figs 6–27); valva compact, broad, semi-circular, with very long and slender transtilla, with strongly sclerotised obtuse tip, below the tip connected to the other valva; lateral side of valva stretched out in a long curved and strongly sclerotised appendix; phallus no longer than width of tegumen, rounded basally, apex narrower, almost straight. The whole genital apparatus in situ compact, valvae fitted into the teguminal invagination, hardly mobile separately.



Female genitalia (Figs 31–32). Anterior apophyses with a very short lateral fork/spine, the inner branch ending in a stronger sclerotised ostium plate with a deep central split, apical part of split acute or rounded, subapical part broader, with rectangular edges, opening of the split more or less constricted.

Distribution. Hitherto known from Morocco, Algeria, Canary Islands, continental Spain, France (incl. Corsica), Belgium, Great Britain, Germany, Switzerland, Austria, Italy (incl. Sardinia), Czech Republic, Poland, Ukraine (Schille 1931), Russia, Hungary, the Balkan peninsula (Slovenia, Croatia, Bosnia and Herzegovina), and Turkey.

Remarks. For Turkey only one male from Isparta is known. More material is needed to verify this record.

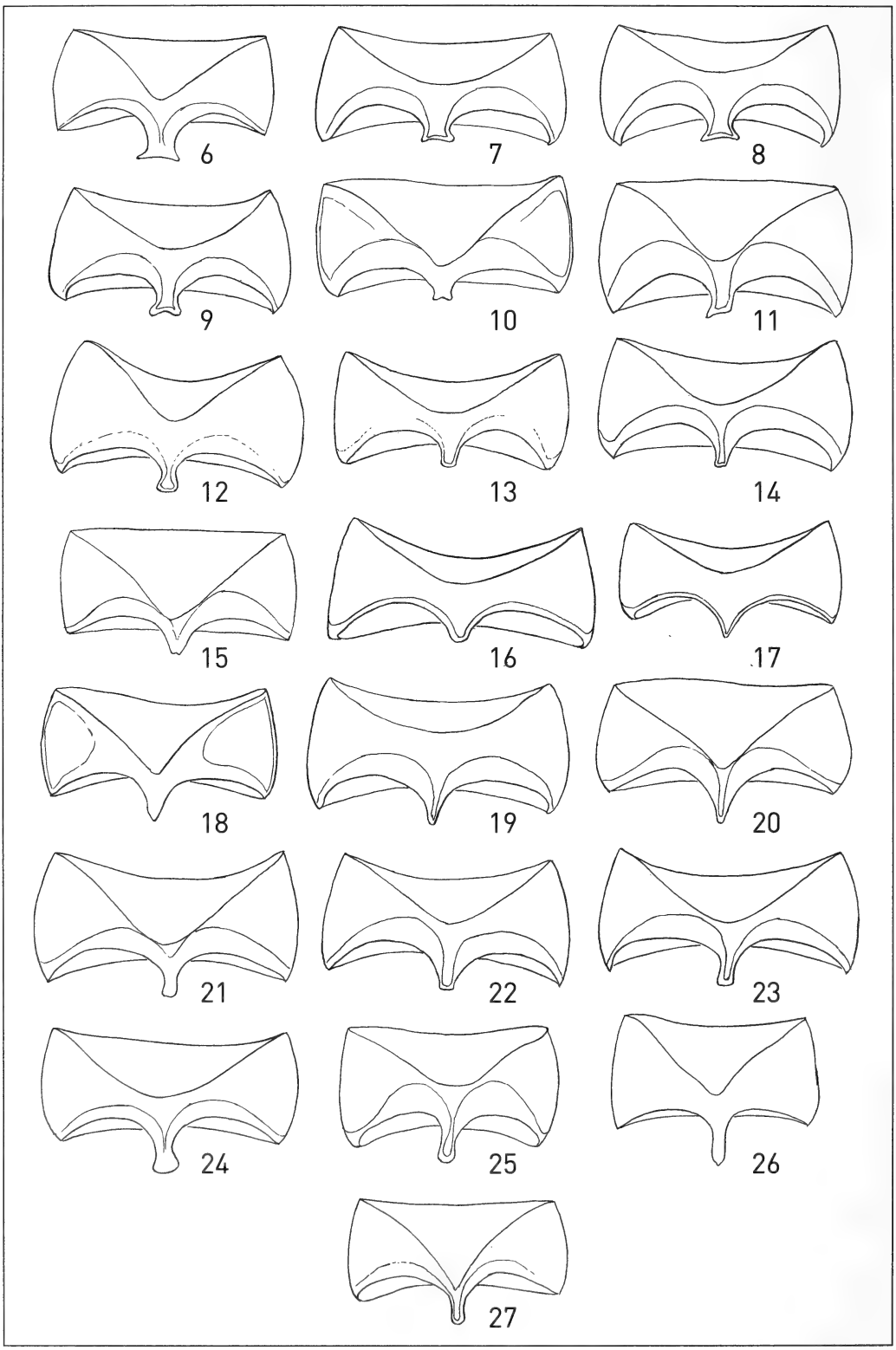
Figs 3–5. *C. crassiflavella*, ♂ genitalia: **3.** uncus-tegumen; **4.** valvae; **5.** phallus (from the same specimen: Dept. Provence, France).

Cephimallota angusticostella (Zeller, 1839) **Fig. 2**

[= *Cephimallota libanotica* Petersen, 1959; = *Tinea angusticostella* Herrich-Schäffer, 1854; = *Cephimallota hasarorum* Zagulajev, 1965]

Redescription. Wingspan 11–16 mm (n = 398); head brush golden-yellow, sometimes more grey-yellow, antenna filiform, ca. 2/3 of forewing length, brown-grey, labial palps golden-yellow, sometimes grey-yellow, second segment at outer apex with protruding short bristles, at the inner side only few bristles; thorax and forewing dark brown, slightly shimmering violet, the whole area covered with small light spots, accumulating along the costal and dorsal margin; hindwing slightly lighter brown-grey.

Male genitalia (Figs 28–30). Uncus with two setaceous oblong protuberances, firmly attached to the tegumen, below uncus a strongly sclerotised clasp (gnathos?) with a slender digitiform appendix; tegumen broad, narrowing ventrally, saccus almost as long as width of tegumen; valva compact, semi-circular, overall more slender then in *C. crassiflavella*, with very long, slender transtilla, with strongly sclerotised obtuse tip, inward-directed, below the tip connected with the other valva; lateral side of valva stretched out in a long curved and strongly sclerotised appendix; phallus as long as tegumen and saccus together, slightly curved over total length. The whole genital apparatus in situ compact, valvae fitted into the teguminal invagination, hardly mobile separately.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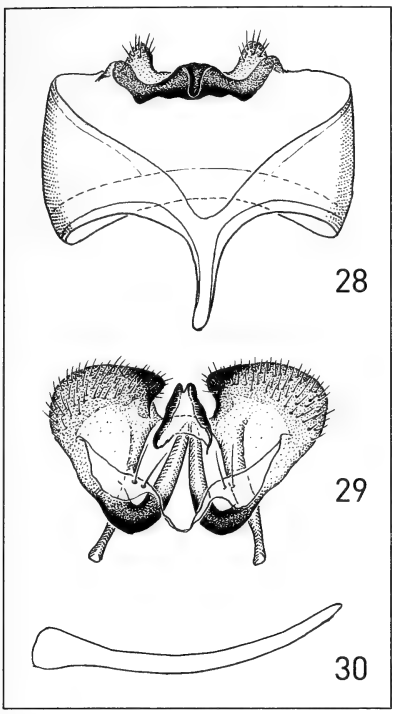


Figs 28–30. *C. angusticostella*, ♂ genitalia: **28.** uncus-tegumen; 29. valvae; **30.** phallus (from the same specimen: Sandanski, Bulgaria).

Female genitalia (Figs 33–34). Anterior apophyses furcated, ventral part ending in a large ostial plate, which is deeply split in the area of the ostium, laterally edged, split with rounded end; in the centre of the split a small, strongly sclerotised appendix.

Distribution. Hitherto known with certainty from Italy (incl. Elba), Balkan Peninsula (Slovenia, Croatia, Serbia, Bosnia and Herzegovina, Macedonia, Albania, Greece, Romania, Bulgaria), Cyprus, Ukraine (Bidzilya & Budashkin 1998), Russia, Austria (Kasy 1987; Wieser 1998, 2003; Wieser & Kofler, 2000; the record from East Tyrol in Deutsch (2003) is erroneous and the specimen belongs to *C. crassiflavella*), Czech Republic (Laštůvka et al. 1994, genitalia dissection by Liška; Vavra 2002), Slovakia, Hungary, Lebanon, Turkey, and Armenia. In addition, one confirmed record from Spain and two confirmed records from Germany are known.

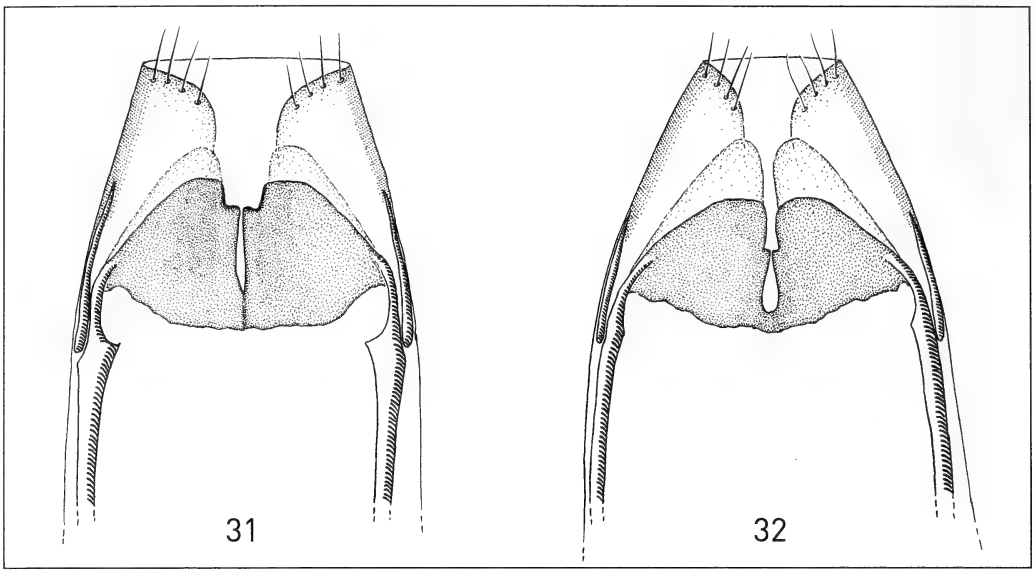
Remarks. No variability was found in the male genitalia. In comparison with *C. crassiflavella*, the genital apparatus is always smaller, even in specimens of the same size. Records from Spain (Sierra Nevada, one specimen) and Germany (Brandenburg, two specimens) are outside the general distribution of this species.

Differential diagnosis

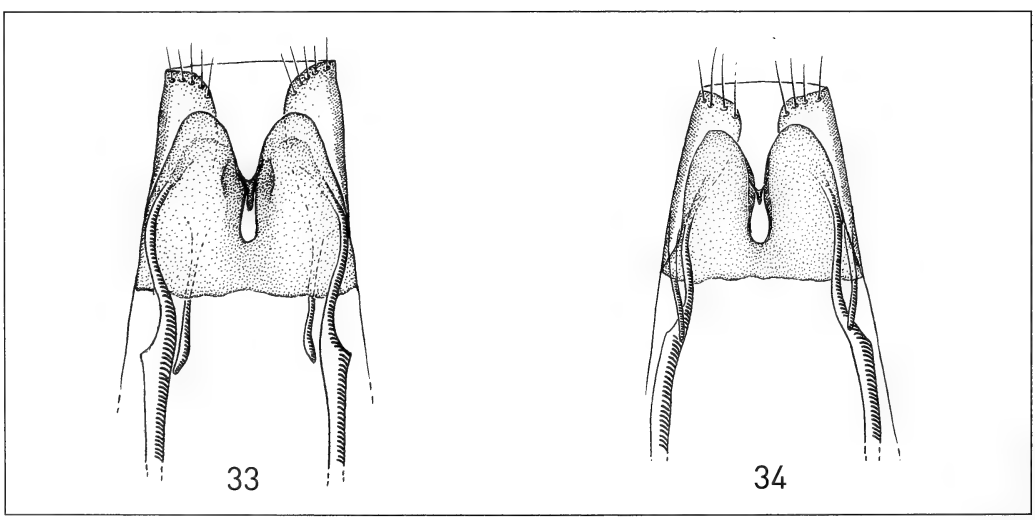
Imago. In contrast to *C. crassiflavella*, *C. angusticostella* bears only a few short bristles at the inner side of second segment of the labial palps. The forewings of *C. crassiflavella* are without maculation and only the costal margin is slightly lighter, whereas forewings of *C. angusticostella* are covered with small light spots, accumulating along the costal and dorsal margin.

Male genitalia. In *C. crassiflavella* the clasp (gnathos?) below the uncus has three acute small protuberances, while in *C. angusticostella* the clasp bears a slender digitiform appendix. The saccus of *C. crassiflavella* is short and variable in shape, being

Figs 6–27. *C. crassiflavella*, ♂ genitalia: variability in saccus shape: **6.** Kaiserstuhl, Germany; **7.** Berlin, Germany; **8.** Grünstadt, Germany; **9.** Port Bou, Spain; **10.** Grünstadt, Germany; **11.** prov. Verona, Italy; **12.** Sardinia, Italy; **13.** Lombardia, Italy; **14.** Dept. Provence, France; **15.** Freiburg, Germany; **16.** Oreison, France; **17.** Trentino, Italy; **18.** Mannheim, Germany; **19.** Lucania, Italy; **20.** Sarajevo, Bosnia and Herzegovina; **21.** Dept. Var, France; 22–23. Piedmont, Italy; **24.** Krasnodarskij kraj, Russia; **25.** Isparta, Turkey; **26.** "Oswitz", Poland; **27.** Russia; type of *C. hasarorum*.



Figs 31–32. *C. crassiflavella*, ♀ genitalia (with variability): **31.** Wroclaw [labelled: Breslau, 1896], Poland; **32.** Bocognano, Corsica, France.



Figs 33–34. *C. angusticostella*, ♀ genitalia (with variability: **33.** Petrina, Macedonia; **34.** Nom. Chania, Crete, Greece.

either cut straight or stretched out to a more or less short tip. In *C. angusticostella* the saccus is almost as long as the width of tegumen and invariable in shape. The valva of *C. angusticostella* is overall more slender then that of *C. crassiflavella*.

Female genitalia. In *C. angusticostella* the ventral part of the anterior apophyses ends in a large ostial plate, which is deeply split in the area of the ostium and laterally edged. The split has a rounded end and bears a small, strongly sclerotised appendix in its centre.

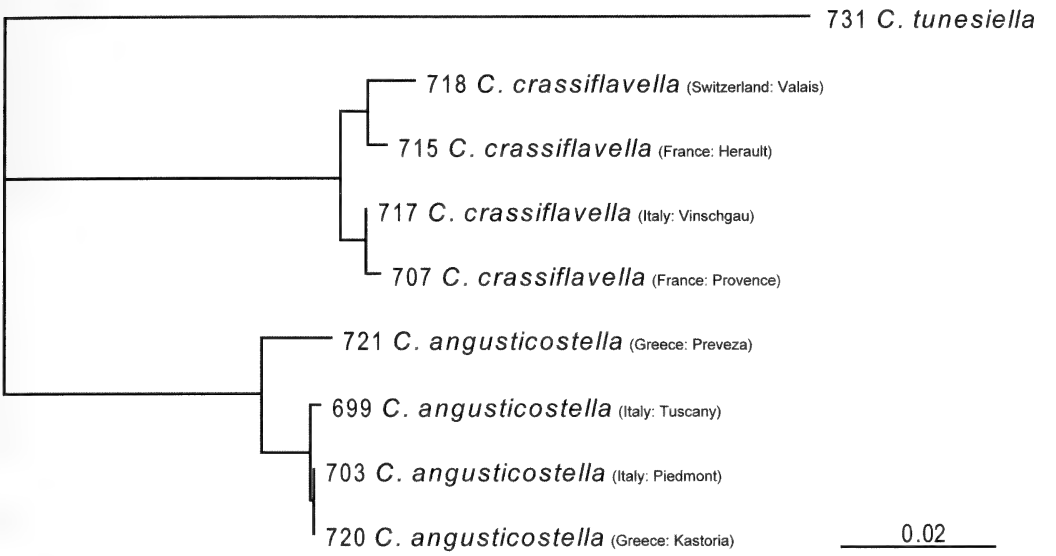


Fig. 35. Neighbor Joining (K2P) dendrogram.

Contrary to *C. angusticostella*, the inner branch of anterior apophyses of *C. crassiflavella* ends in a stronger sclerotised ostial plate, which also has a deep central split. The split is very narrow in its posterior portion and widens to an acute or rounded, broad apex.

Molecular results

All barcode sequences are 587 base pairs (bp) in length. No indels have been observed in any of the sequences. The sequences of *C. angusticostella* and *C. crassiflavella* form two distinct clusters, each comprising only conspecific samples (Fig. 35). According to the K2P distance matrix (Tab. 2), intraspecific genetic distances are low for both taxa: 0%–1.73% (mean 0.865%) for *C. angusticostella*, and 0.17%–1.55% (mean 0.975%) for *C. crassiflavella*. In comparison, the mean interspecific genetic distances between *C. angusticostella* and *C. crassiflavella* are 10-fold higher (8.70%–9.88%; mean 9.15%). A comparison of the maximum intraspecific distances of *C. angusticostella* and *C. crassiflavella* with their minimum interspecific distance leads to a "barcoding gap" ratio of 1 : 5 for *C. angusticostella* and 1 : 5.6 for *C. crassiflavella*. The barcode distance of the two taxa in question to the "outgroup" taxon *C. tunesiella* comes to 14.67%–14.68% (mean 14.68%) for *C. angusticostella*, and to 15.49%–15.71% (mean 15.55%) for *C. crassiflavella*.

Distribution mapping

In the map (Fig. 36) the two taxa show a pattern of vicariance, with *C. angusticostella* being mainly distributed in the eastern half of Europe and *C. crassiflavella* mainly in the western half of Europe. Their distributional areas broadly overlap in Italy, Slovenia,

Table 2. Kimura-2 Parameter (K2P) distance matrix with distances in %. * maximum intraspecific distance; # minimum interspecific distance for species pair C. angusticostella – C. crassiflavella

	angust. 699	*angust.* 703	*angust.* 720	*angust.* 721	*crassifl.* 707	*crassifl.* 715	*crassifl.* 717	*crassifl.* 718
angusticostella 703	0.17	–						
angusticostella 720	0.17	0.00	–					
angusticostella 721	1.73*	1.56	1.56	–				
crassiflavella 707	8.89	8.90	8.90	9.30	–			
crassiflavella 715	9.09	9.10	9.10	9.49	1.03	–		
crassiflavella 717	8.70#	8.71	8.71	9.10	0.17	0.86	–	
crassiflavella 718	9.48	9.49	9.49	9.88	1.55*	0.86	1.38	–
tunesiella 731	14.67	14.68	14.68	14.68	15.71	15.49	15.50	15.50

Austria, and Hungary. Three findings strongly depart from a typical specific distribution: a single *C. angusticostella* specimen was collected in southern Spain; one specimen each of *C. crassiflavella* was collected in western Turkey and in southeastern Russia. Although different explanations for such distributions are possible, the best assumption appear to be that there are simply large gaps in our knowledge of the distribution of both taxa in these regions.

Discussion

The male genitalia of *C. crassiflavella* show significant variability in the shape of the saccus, which is typically very short, broad, and cut straight (see Fig. 3). The saccus shape varies throughout the whole distribution in being more elongate and slender, with the acute apex rounded (see Figs 6–27). No geographic gradient or pattern of degree of saccus slenderness and elongation could be determined (see Figs 6–27), suggesting that genital variation likely depends on factors other than distribution. On the other hand, the male genitalia of *C. angusticostella* show no tendency towards variation.

The mean interspecific K2P distance of 9.145% between *C. angusticostella* and *C. crassiflavella* found in our analysis by far exceeds the 3% mean interspecific barcode distance proposed by Hebert et al. (2003) as threshold for the distinction of Lepidoptera species. Our data also fulfil the "standard screening threshold" of 10x the average intraspecific distance proposed by Hebert et al. (2004). In contrast, if the highest (instead of mean) intraspecific distances are compared with the smallest (instead of mean) interspecific distances as suggested by Meier et al. (2008), the "barcoding gap" is reduced to a 1:5 ratio for *C. angusticostella* and a 1:5.6 ratio for *C. crassiflavella*. We believe that this ratio is much more valuable in describing the real interspecific distances than the mean interspecific barcode distance, which neglects the (sometimes huge) intraspecific variation of the examined taxa.

Our investigations strongly suggest that both taxa are distinct species. They are distributed in the West Palaearctic, with *C. crassiflavella* covering the western part of this area, and *C. angusticostella* being found in the eastern. Their ranges broadly meet in

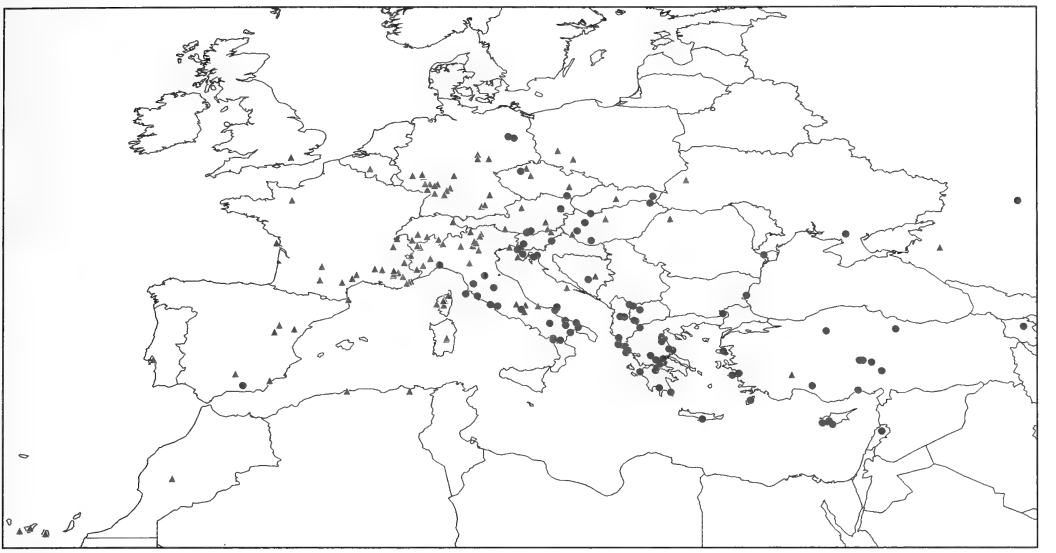


Fig. 36. Distribution map of *Cephimallota angusticostella* (red circles) and *C. crassiflavella* (blue triangles) in the West Palaearctic.

Central Europe, where both species can be found at the same locations. This "contact zone" is located in Italy, Slovenia, Austria, Hungary, Czech Republic, and Russia. In Italy, both species have been found at the same locality (Lucania: Mt. Pollino).

Three confirmed records (one *C. crassiflavella* finding from Turkey and two *C. angusticostella* findings from Spain and Germany) are somewhat inconsistent with the status of vicariant species. Further studies are necessary to solve these contradictions.

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References

Bidzilya, O. V. & Yu. I. Budashkin 1998. Novyje nachodki mikrotscheschujekrylych (Microlepidoptera) v Ukraine. [New records of Microlepidoptera from the Ukraine] – Zhurnal Ukrainskogo entomogitschnogo tovaristva **4** (3/4): 3–16, 11 figs.

Deutsch, H. 2003. Beitrag zur Lepidopterenfauna Osttirols, Österreich – Teil V (Insecta: Lepidoptera). – Beiträge zur Entomofaunistik **4**: 3–26.

Hebert, P. D. N., A. Cywinska, S. L. Ball & J. R. de Waard 2003. Biological identifications through DNA barcodes. – Proceedings of the Royal Society B: Biological Sciences, London **270**: 313–321.

Hebert, P. D. N., M. Y. Stoeckle, T. S. Zemlack & C. M. Francis 2004. Identification of birds through DNA barcodes. – PloS Biology **2 (10)**: e312.

Hijmans, R. J., L. Guarino, C. Bussink, P. Mathur, M. Cruz, I. Barrentes, & E. Rojas 2004. DIVA-GIS. Version 7.2.3. A geographic information system for the analysis of species distribution data. – URL: http://www.diva-gis.org/download/

Kasy, F. 1987. Die Schmetterlingsfauna des Naturschutzgebietes "Glaslauterriegel-Heferlberg" südlich von Wien. – Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen, Suppl. **38**: 1–35, 2 figs.

Kimura, M. 1980. A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences. – Journal of Molecular Evolution **16**: 111–120.

Knölke, S., S. Erlacher, A. Hausmann, M. A. Miller & A. H. Segerer 2005. A procedure for combined genitalia dissection and DNA extraction in Lepidoptera. – Insect Systematics & Evolution **35**: 401–409.

Laštůvka, Z., J. Liška, J. Vávra, V. Elsner, A. Laštůvka, J. Marek, T. Dufek, M. Dvořák, F. Kopeček, M. Petrů, J. Skyva & P. Vítek 1994. Faunistic records from the Czech Republic – 18. Lepidoptera. – Klapalekiana **30** (3/4): 197–206.

Meier, R., G. Zhang & F. Ali 2008. The use of mean instead of smallest interspecific distances exaggerates the size of the "barcoding gap" and leads to misidentification. – Systematic Biology **57**: 809–813.

Müller, K., J. Müller, C. Neinhuis & D. Quandt 2008. PhyDE – Phylogenetic data editor, Version 0.9971. URL: http://www.phyde.de/

Petersen, G. 1969. Beiträge zur Insektenfauna der DDR: Lepidoptera – Tineidae. – Beiträge zur Entomologie **19**: 311–388.

Robinson, G. S. 2009. Biology, distribution and diversity of tineid moths. – Art Printing Works Sdn Bhd Kuala Lumpur: 143 pp., 512 figs.

Saitou, N. & M. Nei 1987. The Neighbor-joining method: A new method for reconstructing phylogenetic trees. – Molecular Biology and Evolution **4**: 406–425.

Schille, F. 1931. Fauna Motyli Polski. II. – Prace monograficzne. Kraków, **7**, 358 pp.

Studier, J. A. & K. J. Keppler 1988. A note on the Neighbor-Joining algorithm of Saitou and Nei. – Molecular Biology and Evolution **5**: 729–731.

Swofford, D. L. 2000. PAUP*. Phylogenetic Analysis Using Parsimony (*and Other Methods). Version 4. – Sinauer Associates, Sunderland, Massachusetts.

Vávra, J. 2002. Motýli fauna přírodní památky Stroupeč v okrese Louny. Lepidopteran fauna of Stroupeč Natural Monument in district of Louny. – Sbornik Okresního muzea v Mostě, Řada přírodovědná: 21–47.

Wahlberg, N. & C. W. Wheat 2008. Genomic outposts serve the phylogenomic pioneers: designing novel nuclear markers for genomic DNA extractions of Lepidoptera. – Systematic Biology **57**: 231–242.

Wieser, C. 1998. Ein Beitrag zur Schmetterlingsfauna Kärntens. Ergebnisse einer Lichtfalle in Lassendorf NE von Klagenfurt (Insecta/Lepidoptera). – Carinthia II, Teil 2 **188** (108): 335–362.

Wieser, C. 2003. Die Südabhänge der Sattnitz zwischen Guntschach und Rottenstein – ein "hot spot" der Biodiversität bei Schmetterlingen (Insecta: Lepidoptera). – Carinthia II, Teil 2 **193** (113): 455–486.

Wieser, C. & A. Kofler 2000. Ergebnisse einer Dauerlichtfalle in Reifnitz 1997 (Kärnten, Insecta: Lepidoptera, Coleoptera). – Carinthia II Teil 2 **190** (110): 441–453.

Zagulajev, A. K. 1975. Nastojaschtschije moli (Tineidae), Podsemejstvo Myrmecozelinae. – *In*: Fauna SSSR, N. S. 108. Nasekomyje, Tscheschujekrylyje. – Leningrad **4** (5): 428 pp., 319 figs.

Appendix

A list of examined specimens of *Cephimallota crassiflavella* Bruand, 1851 and *C. angusticostella* (Zeller, 1839) follows below. All specimens were determined by G. Petersen or R. Gaedike. The list contains material examined from ca. 1955 to 2011. The localities in this list are recorded as they appear on the labels. The current depository of the material (if available) is provided using the abbreviations listed below.

Collection Information and Abbreviations

Aalto	Aanti Aalto, Hyvinkää, Finland
Baldizzone	Giorgio Baldizzone, Asti, Italy
Bassi	Graziano Bassi, Avigliana, Italy
De Lattin	Gustav de Lattin, Zentrum für Biodokumentation des Saarlandes, Landsweiler-Reden, Germany
Deutsch	Helmut Deutsch, Lienz, Austria
FMNH	Finnish Museum of Natural History, Helsinki, Finland
Gerber	Hermann Gerber, Bern, Switzerland
Gerstberger	Manfred Gerstberger, Berlin, Germany
Gomboc	Stanislav Gomboc, Kranj, Slovenia
T. Grünewald	Theo Grünewald, Landshut, Germany
Hollingworth	No information available
Langohr	G. R. Langohr, The Netherlands
Lasan	Mojmir Lasan, Ljubljana, Slovenia
LMAD	Löbbecke Museum und Aquazoo, Düsseldorf, Germany
NMEG	Naturkundemuseum, Erfurt, Germany
NMW	Naturhistorisches Museum, Vienna, Austria
Parenti	Umberto Parenti, Torino, Italy
RMNH	Nationaal Natuurhistorische Museum ("Naturalis"), Leiden, The Netherlands
Roweck	Hartmut Roweck, Kiel, Germany
Schmitz	Willibald Schmitz, Bergisch-Gladbach, Germany
SDEI	Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany
Seliger	Rudi Seliger, Schwalmtal, Germany
SMNK	Staatliches Museum für Naturkunde, Karlsruhe, Germany
Strobl/Admont	Gabriel Strobl, Benedikgtiner-Stift Admont, Austria
Theimer	Franz Theimer, Berlin, Germany
TLMF	Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria
Tokar	Zdenko Tokar, Sal'a, Slovakia
Werno	Andreas Werno, Nunkirchen, Germany
ZMHB	Museum für Naturkunde der Humboldt-Universität, Berlin, Germany
ZMUC	Zoological Museum, Copenhagen, Denmark
ZSM	Zoologische Staatssammlung, Munich, Germany

Cephimallota crassiflavella Bruand, 1851

Algeria: 1♂, 1♀, Alger, Aout 1907 (MNHN); 1♂, Algerié, St. Charles, leg. A. Théry (SDEI).
Morocco: 1♂, Marakesch-Tensift-El Haouz Asguine, 970 m, 4.vi.2010, leg. Werno (coll. Werno).
Spain, Canary Islands: Teneriffe: 1 specimen without abdomen, Las Mercedes, 18.vi.1971, leg. J. Klimesch (ZSM); 1♂, Vilaflar, 1400 m, leg. Pinker; La Gomera: 1♂, Hermigua, El Convento, 600 m, 6–13. iv.2007, leg. W. Losert (coll. Schmitz); 1♀, Alujera, 400 m, 16.iv.1998, leg. K. Larsen (coll. Roweck); Gran Canaria: 1♀, S. Bartolomé d. T., 8.v.1965, leg. J. Klimesch (ZSM).
Spain, mainland: 1♂, Granada, Fuente d. l. Mona, 1350 m, 10.vii.1981, leg. St. Nielsen; 1♀, Sierra Nevada, Camino de la Veleta, 1600 m, 22.vii.1985, leg. G. Baldizzone & E. Traugott-Olsen (coll. Baldizzone); 1♂, same location, 2.viii.1986, leg. E. Traugott-Olsen; 1♂, Lanjaron, Sierra Nevada, 1895, leg. Korb (SDEI); 1♂, Prov. Teruel, Sra. Alta, 1600 m, 14–15.vii.1979, leg. Hahn; 3♂, Teruel, Cosa, 9.vii.1985, leg. C. Gielis (RMNH); 1♂, Teruel, Albarracin, 1000–1200 m, 4–8.viii.1989, leg. C. Gielis (RMNH); 1♂,

Teruel, Albarracin, Val de Vecar, 1250 m, 17–18.vii.1988, leg. M. Fibiger (ZMUC); 1♂, Radio Must, 5 km W of Werja, 5.v.1995, leg. R.T.A. Schouten (RMNH); 1 specimen without abdomen, Cinctores, Castellon, 15.viii.2002, leg. B. Niemeyer (coll. Schmitz); 1♂, 1♀, Cataluna, Port Bou, 13.vi.1971, leg. W. Glaser (SMNK, SDEI).

Portugal: 1♂, Extremadura, Ericeira, 5 km N of Lisboa, 4–8.vii.1986, leg. O. Karsholt (ZMUC).

France: 1♂, Aix-les-Bains, vii.1898, leg. Tutt; 1♀, Basses Alpes, vii.1913, leg. Walsingham; 1♂, Durance-Tal: St. Crepin, 900 m, 24–30.vi.1959, leg. H. G. Amsel (SDEI); 4♂, Basses Alpes, Oraison, vii.1962, leg. K. Burmann (ZMNK, SDEI); 3♂, Digne, La Dourbes, 700 m, 9–11.vii.1962, leg. E. Arenberger (ZMNK); 1 specimen Valbonette near oraison, 25.vii.1973, leg. Groß (LMAD); 1♀, Island Oleron, 7.viii.1920; 1♂, Mougin, env. of Cannes, 30.vi.1922; 1♂, Drôme: St. Restitut, St. Paul Trois Chateaux, 250 m, 2.ix.1984, leg. Fibiger & Moberg (ZMUC); 1♂, Drôme: La Penne-s-l-Ouvèze, 20–22. vii.1986, leg. H. W. van der Wolf; 2♂, Haute Provence: Les Mees, 4.viii.1985, 25.vii.1979, leg. Langohr (coll. Langohr); 3♂, Umgebung Castellaune, 17.vi–3.vii.1999, leg. S. Steegers (coll. Seliger, SDEI); 1♂, Umgebung Sisterone, Orpiere, 10.v.2001, leg. A. Blumberg (coll. Schmitz); 21 ♂, 1♀, Provence: Domaine de Maure Vieille, v–vi 2000–2005, leg. H. Hendriksen (ZMUC, SDEI); 1♂, Haute Garonne: Blagnac, 4.viii.1988, leg. Hollingworth (coll. Hollingworth); 1♂, Gard: Roquedur, Ganges, 28.vi–6. vii.1980, leg. K. Schnack (ZMUC); 6♂, Dept. Var: Frejus, Roquebrune, 12–17.vi.2002, 17–19.vi.2004, leg. H. Hendriksen (ZMUC); 2♂, Dept. Herault: St. Pons de Thornieres, Artenac, 24.vi.2004, leg. E. van Nieukerken (RMNH); 1♂, Dept. Var: Loiras, 25.vi.2009, leg. Z. Lastuvka (SDEI); 1♂, Dept. Lot: Arcambal (Cahors), 6.viii.1981, leg. R. T. A. Schouten (RMNH).

France, Corsica: 1♀, Bocognano, vi.1905, leg. Leonhard (SDEI); 1♂, Castirla, 12 km N Corté, 400 m, 20.vi.1994, leg. Skule & Skou (ZMUC); 1♂, Ascotal, 800 m, Umg. Asco, 6.vi.1993, leg. N. Keil; 1♂, Saint Florent, Marfines du Soleil, 1–12.vi.1993, leg. N. Keil; 1♂, above Lozzi, 1150 m, 18.vii.2004, leg. P. Skou (ZMUC); 1♂, Cargèse, 15–16.v.1999, leg. O. Karsholt (ZMUC).

Italy: 1♂, Friuli: Tagliamento, 4.viii.2002, leg. H. Deutsch (TLMF); 1♂, Abruzzen: Ovindoli, 1400 m, 3–13.vii.1959, leg. Gross (LMAD); 1♀, Abruzzi, Passo di Lanciano, vii.1960, leg. Parenti (coll. Parenti); 1♂, Trentino: Pietramurata, viii.1959, leg. K. Burmann (SDEI); 1♂, Prov. Trient: Pomarolo, 19.vii.1995, leg. P. Huemer (TLMF); 2♂, Süd-Tirol, Praderfeld, 5.viii.1991, leg. P. Huemer (TLMF); 1♂, Südtirol, Vintschgau, Prad am Stilfser Joch, 27.vii.2005, leg. E. van Nieukerken (RMNH); 1♀, Bozen, 19.vi.1911, leg. Lenthe (SDEI); 1♂ Auer [=Ora], 15–16.vi.1958, leg. K. Burmann (ZMNK); 1♂, Monte Baldo, env. of. Spiazzi, 600 m, 22.vii.1983, leg. P. Skou & B. Skule (ZMUC); 1♂, 1♀, Reggio/Emilia, vi.1929; 7♂, 2♀, Piemonte: Monferr. Alfiano N. 300 m, 29.vi., 8.vii.1979; leg. Baldizzone (coll. Baldizzone); Asti-Boschi di Valmanera, 14.vii.1976; leg. Baldizzone (coll. Baldizzone); Asti; fraz. Valmanera, Oasi WWF, 13.vii.2006; leg. Baldizzone (coll. Baldizzone); V. Curone, Poggio di Casasco, 300 m, 11.vii.1981; leg. Baldizzone (coll. Baldizzone); Trinità, Vallone Grande, 1400 m, 15.vii.1996; 13–24.vii.1998; leg. Baldizzone (coll. Baldizzone); Valdieri, Riserva Nat. Spec., 12., 17.vii.1999; leg. Baldizzone (coll. Baldizzone); 6♂, 3♀, Valsusa, Giaglione, 14.viii.1986, 2., 8., 16.vii.1983, 26.vi.1985, 20.vii.1984, leg. Bassi (coll. Bassi); 1♂, Piemonte, S. Carlo Canse, Vanda di Nole, 1.vii.1991, leg. Delmastro, (coll. Baldizzone); 2♂, Valle d'Aosta: Parco Nat. Monte Avic, 17.vii.1993, 25.vii.1994, leg. Baldizzone (coll. Baldizzone); 2♂, Valle d'Aosta, Quart, 700 m, 18–31.vii.1989, leg. M. Bocca; 2♂, Castello d'Annone, Bosco del Lago, 9.vii.2000, leg. Baldizzone (coll. Baldizzone, SDEI); 1♂, Lombardia: Lago d'Iseo, Montisola, 1.viii.1985, leg. M. Gerstberger (coll. M. Gerstberger); 1♂, Lombardia, Brusimpiano, Ardena, 20–22.vii.2002, leg. Aalto & Räsänen (coll. Aalto); 1♂, Molise: Petacciato, Marina CB, vii.1980, leg. Langohr (coll. Langohr); 1♂, Molise, Pizzone, 920 m, 17.vii.1990, leg. Baldizzone (coll. Baldizzone); 1♂, Prov. Verona: Monte, 25.vi.1981, leg. K. Burmann (ZMNK); 2♂, Lucania: Mt. Pollino, sotto Rif. Pasanelli, 13.vii.1991, leg. Baldizzone (coll. Baldizzone).

Italy, Sardinia: 2♂, Mts Gennargentu, Belvi, 700 m, 20., 29.vii.1975, leg. Gozmány (SDEI); 1♂, Gennargentu, 1000 m, Arcu Tascussi, 28.vii.1981, leg. Baldizzone (coll. Baldizzone).

Germany: 1♂, Berlin-Bohnsdorf, 1.vii.2006, leg. Gerstberger (coll. Gerstberger); 1♂, Bremm/Mosel, 8.vii.2002, leg. Schmitz (coll. Schmitz); 1♂, Kyffhäuser, Kosakenstein, vii.1912, leg. Petry, Mus. Erfurt; 1♂, Tilleda, vii.1891, leg. Petry (NMEG); 1♀, Umgebung Naumburg, leg. Bauer (ZSM); 2♂, Grünstadt, 1874, 1879, leg. Eppelsheim (SDEI); 1♀, Mannheim, 30.vii.1948, leg. K. Müller (SDEI); specimens, Speyer, leg. Disque (ZSM, SDEI); Frankfurt/Main, leg. von Heyden; Nollig bei Lorch, leg. Gross; Loreley, leg. Stamm et Jäckh; St. Goarshausen, leg. Tetens; Annweiler; Albersweiler, Falkenstein, leg. Jöst; Weinheim/Bergstraße, leg. Lienig; Durlach bei Karlsruhe, leg. Reutti; Markgröningen, leg. Wörz; Kehlheim/Donau, leg. Osthelder (ZSM); Gröbenzeller Moor bei München, leg. Osthelder (ZSM); Eching bei München, leg. Pfister (ZSM);

Poland: 1♂, 1♀, Breslau-Oswitz, 28.vii., 4.viii.1896.

Czech Republic: 1♀, Suchdol bei Praha, 16.vii.1953, leg. F. Gregor.

Austria: 1♂, Gumpoldskirchen, 4.vii.1939; 1♂, Mödling, leg. Mann (coll. Strobl/Admont); 2♀, Steiermark, bei Klagenfurt, 15.vi.1948, leg. J. Klimesch (ZSM); 1♂, Osttirol: Lavant, 21.vii.1995, leg. Deutsch (coll. Deutsch).

Switzerland: 3 specimens, Wallis: Lenk, 900 m, 20.vii.1973, leg. Groß (LMAD); 6♂, Wallis, Umgebung Lenk, Erschmatt, 1200–1300 m, 8., 11., 13.vii.2010, leg. Seliger (coll. Seliger, SDEI); 2♂, Wallis: Dar-

nona d'en Bas, 9., 14.vii.2010, leg. Gerber (coll. Gerber); 1♂, Wallis, Simplon, Schallberg, 1900 m, 15–17.vii.2007, leg. Schmitz (SDEI); 1♂, Wallis, Brig/Ried, 800 m, 17.vii.2007, leg. Schmitz (SDEI); Genf, leg. Frey, leg. Rehfous; Tessin, leg. Schmidlin; leg. Krüger, leg. Nägeli.**Hungary**: 1♀, Budapest; 1♀, Ofen (ZMHB); 1♂, Budafok, viii.1911; 1♂, 2♀, Hadad, vii.1914, leg. Kleisl; 3♂, Nagykanisza, vi.1961, leg. Karolyi.
Slovenia: 1♂, Podgorski Kras, 21.vi.2003, leg. Gomboc (coll. Gomboc).
Croatia: 1♂, Insel Lesina, leg. Novak; 6 specimens, Istrien/Rovinj, vii.1967, leg. Daniel (ZSM).
Turkey: 1♂, Isparta, Bagkonak, 22.vii.1996, leg. Skovgaard (ZMUC).

Cephimallota angusticostella (Zeller, 1839)

Spain, mainland: 1♂, Sierra Nevada, Ruta de Veleta, 2000 m, 1.vii.1990, leg. Schütze (coll. T. Grünewald).
Italy: 27♂, 1♀, Piemonte: Capanne di Marcarolo, 7., 21., 22., 28.vi., 5., 6., 12.vii.2005; Cirimilla-Capanne, 21.vi.2005; colle d. Eremit, 24.vi.2003; leg. Baldizzone (coll. Baldizzone, SDEI); 1♂, Appenin centr., Mtgna Grande, 1000 m, 1.viii.1928, leg. Dannehl (SDEI); 17♂, 1♀, Toscana: Umg. Dicomano, 17–23.vi.2006; Umg. Voltera, 10–16.vi.2006, leg. Theimer (coll. Theimer, SDEI); 4♂, Monti Uccellina, 12.vi.1977, leg. Baldizzone (coll. Baldizzone, SDEI); 1♂, Umbria: Lago Trasimeno, 18.vii–8.viii.1987, leg. Theimer (coll. Theimer); 1♂, Roma: Ogliata, 6.vii.1965, leg. F. Hartig (SDEI); 1♂, Lazio: Monti di Tolfa, dint. Manziana, 23–28.vi.1989, leg. Baldizzone (coll. Baldizzone); 7♂, Lucania: Mt. Pollino, Versante Lucano, 11–12.vii.1991, leg. Bassi & Baldizzone (coll.Baldizzone); 4♂, Lucania, Mte Pollino, Rotonda, 8.vii.1991, leg. Baldizzone (coll. Baldizzone); 1♂, Lucania, Mte Vulture, Groticelle, 300–500 m, 9.vi.1966, leg. F. Hartig; 3♂, Lucania, Monticchio, Valle dell' Ofanto, 300 m, 15., 17., 21.vi.1970, leg. F. Hartig (SDEI); 1♂, Lucania, Lagho di Monticchio, 750 m, 18.vii.1967, leg. F. Hartig; 1♂, Lucania, F. Bradano, Santa Lucia, 1.vi.1976, leg. F. Hartig; 2♂, 1♀, Basilicata: Trecchina, 320 m, 25.v., 24.vi.1993, leg. Hausmann (ZSM); 1♂, Puglia, San Paolo, Martine Franca (Taranto), 400 m, 13.vi.1969, leg. Parenzan (SDEI); 3♂, 1♀, Puglia, Terlizzi, 20.vi.1978, leg. Parenzan (SDEI); 4 ♂, Puglia, Polignano, 16.vi.1978, leg. Baldizzone (coll. Baldizzone); 1♂, Puglia, 4 km N of Altamura, 27–29.v.2005, leg. P. Skou (ZMUC); 1♂, Calabria, Fiumicella (Tortora), 6.vi.1993, leg. Hausmann (ZSM); 1♂, Gargano, Peschici, 29.vi.1980, leg. Baldizzone (coll. Baldizzone); 1♂, Elba, Porto Azzurro, 15–18.vi.1967, leg. P. Müller (coll. De Lattin).
Germany: 1♂, Brandenburg: Ferbitzer Bruch, 3.vi.2003, 1♀, Berlin-Marienfelde, 30.vi.2010, leg. Theimer (coll. Theimer).
Slovakia: 1♂, 1♀, Vinianska stran, 19.vi.1993, leg. Tokar (coll. Tokar); 1♂, 1♀, Komarno, 15.viii.1984, 14.vii.1992, leg. Pastoralis (coll. Pastoralis); 8 specimens, Vihorlat mts . Senderov, 9., 12.vi.1994; Ladmovce, 2.vii.1993, leg. Tokar (coll. Tokar).
Hungary: 1♂, Vörs, Com. Somogy, vii.1931, leg. Osthelder (SDEI); 1♂, Veszprem county, Bakony mts 47°01'N, 17°53'E, 18.vi.2005, leg. B. Skule et al. (ZMUC).
Slovenia: 1♂, Fruska Gora, 28.vi–12.vii.1935, leg. Daniel (ZSM); 1♂, Portoroz, Secovije, 2.vi.1999, leg. Lasan (SDEI); 6♂, Oresje, Kozja pec, 26.vi.2003, leg. Gomboc (coll. Gomboc, SDEI); 1♂, Slovensko Primorje, Osp, 4.vii.2004, leg. Gomboc (coll. Gomboc, SDEI); 2♂, Piran, Strunjan, 24.v.2000, leg. Lasan (coll. Lasan, SDEI); 1♂, Vipava, 27.vii.2000, leg. Lasan (SDEI); 2♂, SW-Slovenia, below Nanos Mts, near Vipava, 1.vii.2003, leg. B. Skule & C. Hviid (ZMUC); 1♂, Nanos, 3.viii.1999, leg. Lasan (coll. Lasan); 1♂, Lom near Topolscica, 9.vii.2002, leg. Gomboc (coll. Gomboc); 2♂, Vetmik near Podsreda, Kozjanski park, 24.vi.2003, leg. Gomboc (coll. Gomboc, SDEI); 2♂, Slowenien-Karst, Prfesnica, 23.vi.2003, leg. Deutsch (coll. Deutsch); 1♂, Sentilj, Sladki Vrh, 1.viii.2003, leg. Lasan (coll. Lasan); 1♂, Crni Kol, Petrinje, 5.vii.2000, leg. Lasan (coll. Lasan).
Croatia: Krk Island: 1♂, Misucaynica, 3.vii.1978, leg. Baldizzone (coll. Baldizzone); 1♂, Malmasuta, 17.vii.1999, 1♂, Konobe near Punat, 5.vi.1999, 1♂, env. of Punat, 14.vi.1999, leg. Gomboc (coll. Gomboc); 2♂, Mali Hlam, 18.vi.2004, leg. Gomboc (SDEI); 1♂, Stara Baska, 6.vi.2003, leg. M. & E. Arenberger (NMW). 1♂, Plitvice, 17–20.vii.1984, leg. K. Schnack (ZMUC). 1♂, Porec, 26.vii–13.viii.2009, leg. A. Blumberg (coll. Schmitz). 3♂, Vinodolski, 12–14.vi.2004, leg. Theimer (coll. Theimer, SDEI). 1♂, Limski Kanal, 3.vii.2002, leg. Lasan (coll. Lasan). 1♂, Barban, Melnica, 24.vi.2001, leg. Lasan (SDEI).
Serbia: 2♂, Shar Planina, Pena-Fluss bei Brodec, 16–19.vii.1939, leg. Daniel, Forster et. Pfeiffer (ZSM, SDEI).
Bosnia and Herzegovina: 1♂, Konjica, 18.vii.1898, leg. Rebel (NMW).
Macedonia: 3♂, Ochrida, vii.1936–1939, leg. Wolfschläger (ZSM, SDEI); 1♀, Petrina, 3–15.viii.1936, leg. Wolfschläger (SDEI); 2♂, Mt. Asan Djura (Prespa), 5.viii.1979, leg. Baldizzone (coll. Baldizzone, SDEI); 2♂, Mt. Asan Djura (Ochrida), 4., 7.viii.1979, leg. Baldizzone (coll. Baldizzone); 1♂, Treska-Schlucht, 23–27.vi.1955, leg. Klimesch (ZSM).
Albania: 1♀, Bize bei Shengjerghji, 10–15.vii.1961, leg. G. Friese (SDEI); 1♂, Borshi, südl. Vlora, 14–27.v.1961, leg. G. Friese (SDEI); 1♂, Dajti, Shkall Prisk, 850 m, 27.vi–2.vii.1961, leg. G. Friese (SDEI); 1♂, Kula e Lumes, 18–28.v.1918, leg. Predota & Zerny (NMW).

Greece: some specimens, Peloponnisos, 5 km N of kalavrita, 24.vi.1991, leg. Schouten (RMNH, SDEI); 1♂, Peloponnes: Zachlorou bei Kalavryta, 1–14.vii.1959, leg. Noack (LMAD); 1♂, Peloponnisos, Yithion, 14.v.1990, Exp.Mus. Kop. (ZMUC); 21♂, 3♀, Peloponnisos, Ilia, Loutra Kilinis, vi.1981, leg. Grotenfelt (FMNH, SDEI); 2♂, Loutra Kilinis, 22.v.2006, leg. Schmitz (coll. Schmitz, SDEI); 2♂, Desfina Ilea, 29.v.2006, leg. Schmitz (coll. Schmitz); 12♂, Peloponnes, Achaia Diakopto, Kerynia, 11., 13., 16., 20.v.2009, leg. Seliger (coll. Seliger, SDEI); 3♂, Peloponnes, Elis Kastro-Kyllini, Loutra Kyllinis, 14.v.2009, leg. Seliger (coll. Seliger, SDEI); 3♂, Peloponnes, Elis Manolada, Kounoupeli, 21.v.2009, leg. Seliger (coll. Seliger, SDEI); 7♂, Lakonia, Monemvasia, v.1978/1979, leg. Gozmany; leg. Christensen (ZMUC, SDEI); 2♂, 5 km S. Monemvasia, 17.v.1985, leg. Christensen (ZMUC); 12♂, Lakonia, Taygetos, vii.1978, vi.1979, leg. Gozmany; leg. Christensen (ZMUC, SDEI); 4♂, waterfall b. Nomia-Lyra, 17.v.1979, leg. Gozmany & Christensen (ZMUC); 6♂, Lakonia, Mt. Taygetos, 27.vii.1982, leg. Baldizzone (coll. Baldizzone); 1♂, Lakonia, Mt. Taygetos, 8.viii.1979, leg. Christensen (ZMUC); 2 specimen, Taygetos, 1100 m, 20.vii.1977, leg. Groß (LMAD); 4 specimen, Taygetos, Mt. Elias, 1400 m, 21.vii.1977, leg. Groß (LMAD); 1♂, Chalkidiki, Olymbiada, 21.vi.2006, leg. R. Keller (SDEI); 1♂, Mt. Taygetos, Alagonia, 1000 m, 1.viii.1987, leg. van der Wolf; 6♂, Prov. Katerine, Platomon, 7–14. vi.1968, leg. U. Roesler (SMNK); 3♂, Parnassos, N. Arakhova, 22.vii.1984, leg. E. Arenberger (NMW); 1♂, Parnass, Amfiklia, 30.v.2006, leg. Schmitz (SDEI); 4♂, Olymp, Karfia, 12.viii.1973, 15.vii.1974, leg. E. Arenberger (NMW); 2♂, Epiros, Pindos-geb., östl. Konitsa, 17.vii.1985, leg. E. Arenberger (NMW); 2♂, Epiros, Polyneri near Igoumenitsa, 18., 20.vi.2000, leg. Gomboc (coll. Gomboc, SDEI); 7♂, Sivota, 10 km S Igoumanitsa, 30.v.2009, 22.v.2010, leg. Schmitz (coll. Schmitz, SDEI); 2 specimen, Rumelien, Tunfristos, 18–21.vii.1971, leg. Groß (LMAD); 1 specimen, Rumelien, Vardcussia, S. Marmara, 15–18. vii.1971, leg. Groß (LMAD); 1♂, NW-Griechenland, Gomenitsa, 2.vi.1982, leg. Bassi; 1♂, Makedhonia/ Olympos, Litokhoron, 21–26.v.1990, leg. Exp.M.Kop. (ZMUC); 1♂, Parnassos Oros, Paßstraße, 2000 m, 24.viii.2003, leg. Baisch (coll. Baisch); 7♂, Parnaßgebirge, Litea-Polidrosus, 27.v.2006, leg. Schmitz (coll. Schmitz); 5♂, Parga, 12.v.2006, leg. Schmitz (coll. Schmitz, SDEI); specimens, Kastoria, 10.vii.2007, leg. Viehmann (coll. Schmitz, SDEI); 1♂, Fokida, SW Itea, 10–11.v.1999, leg. Ch. Wieser (coll. Ch. Wieser); 1♂, Arta, Strongiti, 9–10.v.1999, leg. Ch. Wieser (coll. Ch. Wieser); 1♂, Magnissia, Afetis, 16–17u.v.1999, leg. Ch. Wieser (coll. Ch. Wieser); 1♂, Olympos, 5 km NW Leptokaris, 5.vii.1990, leg. M. Fibiger (ZMUC); 1♂, Cas Lampi, 21.v.1989, leg. Grotenfelt (FMNH); 3♂, Drama Valas, 19.vii.1985, leg. Grotenfelt (FMNH); 5♂, Pindos Konitsa Pades, 6.vii.1981, leg. Grotenfelt (FMNH); 16♂, 2♀, Florina Vatochorion, vii.1985, viii.1987, leg. Grotenfelt (FMNH, SDEI); 2♂, Kallidromo-Gebirge, Tithroni, 11.v.2010, leg. Schmitz (coll. Schmitz); 1 specimen, Rhodos Island, 2 km NW Lindos, 22.v.1993, leg. R. Sutter (ZMNK); 4♂, Corfu, Benitses, 6–14.vi.1978, leg. Vesa varis (FMNH, SDEI); 1♂, Korfu, Kommeno, 10 km N Kerkira, 17.vii.1984, leg. Arenberger (NMW); 7♂, Lesvos Island: various locations, vi.2009, leg. Kaila & Kullberg (FMNH).

Crete: 1♂, Kreta, 1966, leg. H. Reissser; 5♂, Straße Malia-Neapolis, v.1980, leg. W. Glaser (ZMNK, SDEI); 1♂, Agia Pelagia, 20–26.iv.1995, leg. M. Fibiger (ZMUC); 1♂, 1♀, Nom. Chania, 6.vi.2004, leg. Skule et al. (ZMUC); 1♂, Kristallenia, leg. H. Rebel (NMW); 1♂, Mt. Ida, Goniai, 24.vii.1984, leg. Baldizzone (SDEI).

Bulgaria: 26♂, Pirin-Gebirge: Sandanski, Liljanovo, v–vi.1981–1989, leg. F. Eichler (ZSM, SDEI); 5♂, Pirin, Sandanski, 5 km N, 19.vi–1.vii.2009, 17.31.v.2010, leg. N. Savenkov (coll. Roweck); 1♂, Nessebar, 24.vi–5.vii.1960, leg. Soffner (SDEI).

Cyprus: 1♂, Troodos-Gebirge, Platres, 1200 m, 20.vii–1.viii.1981, leg. M. & E. Arenberger (NMW); 10♂, Umgebung Paphos, 8–20.v.1993, 29.iv–13.v.1994, leg. J. Wimmer (coll. J. Wimmer, SDEI); 7♂, Moniatis, N. Limassol, 23–29.vi.1997, leg. M. Fibiger et al. (ZMUC, SDEI).

Turkey: 4♂, Kusadasi, 65 km S von Izmir, 17–24.v.1968, leg. Roesler (ZMNK); 2♂, Prov. Kayseri, 5 km NW Ercios Dagh, 2000 m, 22.vii.1986, leg. M. Fibiger (ZMUC); 1♂, Prov. Ankara, 20 km nw Kizilcahamam, 1200 m, 24.vii.1986, leg. M. Fibiger (ZMUC); 1♂, Mersin, bei Arsanköy, Bolkar Daglari, 4.vi.1974, leg. Groß (LMAD); 1 specimen, 10 km östl. Nevsehir, 1300 m, 21.vii.1979, leg. Groß (LMAD); 1♀, Prov. Nevsehir, 10 km of ürgüp, 1300 m, 30.vii.1996, leg. Stovgaard (ZMUC); 2♂, Antalya, Akseki, 1500 m, 28.vii.1994, leg. K. Larsen (coll. Roweck, SDEI); 1♂, Adana, Salmbeyli, 1700 m, 6.viii.1997, leg. K. Larsen (SDEI); 1♀, Tokat, Niksar, Kcentes, 13.vii.2000, leg. K. Larsen (coll. Roweck).

Lebanon: 1♂, Libanon (without exact location)[holotype of libanotica], 1897 (ZMHB); 1 specimen, Zedern bei Becharré, 1900–2000 m, 14–16.vi.1969, leg. Groß (LMAD).

Armenia: 1♀, Dilican, 1600–2100 m, 21.vii.1977, leg. Felix (SDEI).

A new species of *Digitivalva* Gaedike, 1970 from Greece (Acrolepiidae)

Reinhard Gaedike

Florusstraße 5, 53225 Bonn, Germany; tinagma@msn.com

Abstract. A new species from the genus *Digitivalva* Gaedike, 1970 is described from Greece, *Digitivalva seligeri* sp. n. This species belongs to the species group *eglanteriella*. Keys, based on the adult characters and male and female genitalia, that allow separation of the new species from the other species of its species group, are provided.

Introduction

My friend Rudi Seliger (Schwalmtal) sent me undetermined material from Greece, which contains a small series of a species from the genus *Digitivalva* Gaedike, 1970. After a careful examination, it became obvious that these specimens belong to a new species. This species is described below.

The genus *Digitivalva* is one of four genera in the family Acrolepiidae. Hitherto 92 species of acrolepiids are known worldwide. According to Dudgale et al. (1998), this family is a member of the putative clade Plutellidae + Acrolepiidae + Glyphipterigidae + (Heliodinidae + Bedellidae + Lyonetiidae). The likely family autapomorphies (Kyrki 1984) include the details of the male genitalia (for example, the reduction of the tegumen, teguminal processes, and gnathos, and the basal widening of the phallus) and the stalking of the hindwing veins $M_1 + M_2$ and $M_3 + CuA_1$. The adults are crepuscular/nocturnal. The larvae are leaf miners or borers in stems, flower buds, and seeds. The larval hosts include Liliaceae, Asteraceae, Lamiaceae, and Solanaceae.

Currently 42 Palaearctic species of *Digitivalva* are known. The genus was described in the framework of a revision of Palaearctic Acrolepiidae (Gaedike 1970). *Digitivalva* is characterised by having the costal arm of the valva with one or more processi. Its larvae feed on various species of Asteraceae. The genus is represented in all faunal regions except Australia and Oceania. In the publication "Lepidopterorum Catalogus (New Series)" a compilation of the knowledge on the whole family was presented (Gaedike 1997).

The new species is a member of a group of species of subgenus *Digitivalva* s. str., which is characterised by the shape of the valva (see Figs 6, 8–10). Budashkin (1995) first recognized that *heringi* (Klimesch, 1956) and *eglanteriella* (Mann, 1855) are different, and this was later confirmed by Sutter & Gaedike (2003). The known distribution of these two species and the third member of this group, *pappella* (Walsingham, 1907), is in the Mediterranean region. *D. pappella* is known from the Canary Islands and from Spain, while *D. heringi* is known from the Balkan Peninsula (Croatia, Macedonia, Bulgaria, and Greece). *D. eglanteriella* is currently known from the Iberian Peninsula, Corsica, Greece, and Libya, while the records from Italy and Cyprus have not been

verified. The larval host plants are known for *pappella* (*Allagopappus dichotomus*), *heringi* (*Inula aschersoniana*) and *eglanteriella* (*Helichrysum angustifolium*).

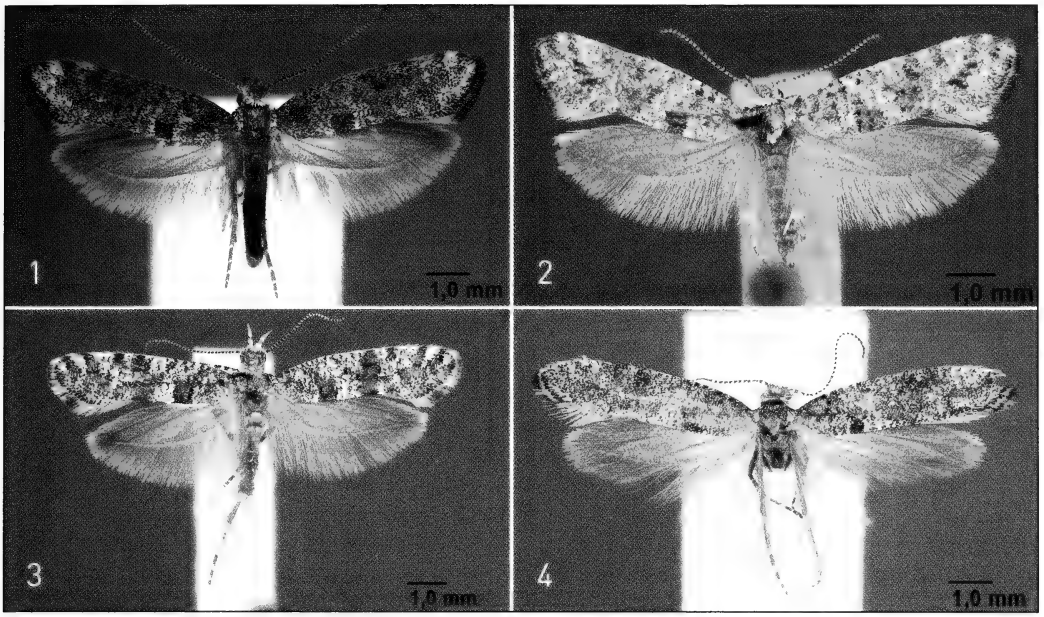
Abbreviations

coll. Schmitz	Personal collection of Willibald Schmitz, Bergisch-Gladbach, Germany
coll. Seliger	Personal collection of Rudi Seliger, Schwalmtal, Germany
SDEI	Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany

Digitivalva seligeri sp. n.

Material. Holotype: ♂, "GR Peloponnes, Achaia Diakopto, Kerynia 320 m, 9.5.2009, leg. Rudi Seliger;" "Holotypus ♂ *Digitivalva seligeri* sp. n. det. R. Gaedike 2011" (SDEI). Paratypes: 1♂, 1♀, same data; genitalia slide R. Gaedike Nr. 7274 (♂), 7485 (♀); 1♂, same data, but 13.5.2009; genitalia slide R. Gaedike Nr. 7447 (coll. Seliger); 1 ♀, Greece, Parnass, Itea, 300 m, 18.5.2007, leg. J. Viehmann (coll. Schmitz).

Description (Fig. 1). Wingspan 11 mm; head with erect scales from neck to base of antennae, with flat scales from antennae to base of palpi, scales light grey, tip somewhat darker, above neck nearly white; labial palpi curved upwards, grey, basally lighter, antennae ringed. Thorax and tegulae grey, mixed with whitish. Forewing with indistinct pattern, background overlaid with bicoloured scales, basally whitish, tip grey; on dorsum to cell at 1/3 and after 1/2 an indistinct light brown stripe, overlaid with grey scales, between these stripes an indistinct whitish area; on costa before apex and basally fringe colouration more white than elsewhere, fringe with dark grey scales. Hindwing light grey.
Male genitalia (Figs 5–6). Vinculum with long saccus, medially narrower, enlarged before rounded tip. Valva rounded basally, costal arm oblique, basally narrow, enlarged to truncated end with short incision. Phallus as long as whole genitalia, basally broad, curved and narrowing to a pointed tip.
Female genitalia (Fig. 7). Cone-shaped sclerotizations between anterior apophyses small, with some bristles. Ostium ring-shaped, with prolonged sclerotization through ductus bursae as narrow stick with a pointed tip; corpus bursae proximally with numerous rows of small spines; area around ostium with somewhat stronger sclerotization as in the distal part of sternite VIII; below this area a stronger sclerotized fold.
Differential diagnosis. The new species belongs to the species-group *eglanteriella*, *heringi*, and *pappella*. Superficially it can be separated by the very indistinct wing pattern, overlaid with greyish scales, while the pattern of the other three species is more distinct, with especially brown stripes on the dorsum being always clearly visible. The shape of the valva with the apical incision is very distinct, as the valva of the other three species has a C-shaped ending. The female genitalia of the new species are quite similar to those of *eglanteriella*, and hence cannot be used in species determination.
Derivatio nominis. Named after the collector, Mr. Rudi Seliger.
Biology. Unknown.
Remarks. As some of the other members of the species group are distributed in the same area, it is possible that the new species occurs also in other areas of the Mediterranean region.



Figs 1–4. Adults of *Digitivalva* spp. **1.** *D. seligeri* sp. n. **2.** *D. eglanteriella* (Mann, 1855). **3.** *D. heringi* (Klimesch, 1956). **4.** *D. pappella* (Walsingham, 1907).

Key for separation of the four species in the species-group *eglanteriella*

Externally:

1 Colouration of forewing more or less greyish, pattern of light brown nearly completely overlaid by greyish scales (Fig. 1) ..... ***seligeri* sp. n.**

– Brown pattern on lighter background **2**

2 Forewing whitish, with light brown stripe on dorsum clearly defined, the whole wing with numerous short darker dots (Fig. 2) ..... ***eglanteriella* (Mann, 1855)**

– Forewing: in addition to light brown stripes on dorsum, with a brown patch before apex **3**

3 Brown pattern clearly visible, with the rest of forewing with many short narrow dark grey stripes, the contrast between these areas of the wing clearly visible (Fig. 3) ..... ***heringi* (Klimesch, 1956)**

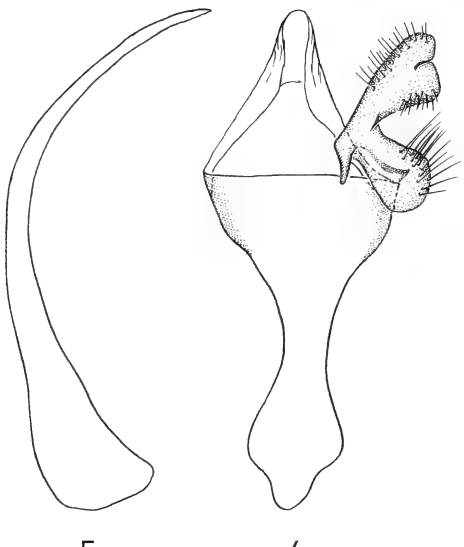
– Brown pattern overlaid with dark grey scales, ground colouration creamy (Fig. 4). ..... ***pappella* (Walsingham, 1907)**

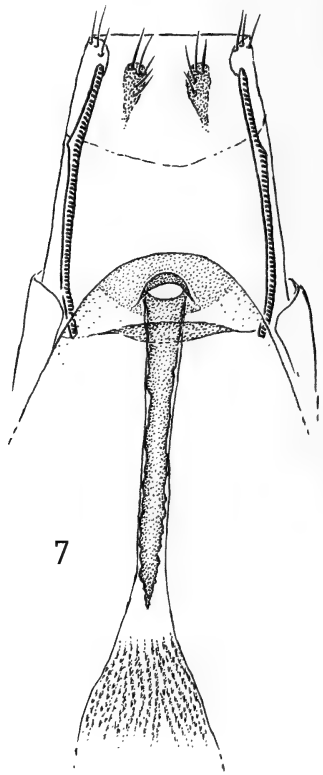
Male genitalia:

1 Valva with apical incision (Fig. 6) ..... ***seligeri* sp. n.**

– Valva apically C-shaped **2**

2 Saccus long, narrow, with rounded tip (Fig. 8) ..... ***pappella* (Walsingham, 1907)**





Figs 5–6. *D. seligeri*: 5. Phallus. 6. Male genitalia, left valva removed.
Fig. 7. *D. seligeri*, female genitalia.

– Saccus shorter, separated into 1/2, enlarged before tip **3**

3 Dorsal part of C-shaped end of valva longer than ventral part, narrower and pointed, ventral part rounded (Fig. 9) ..... ***heringi* (Klimesch, 1956)**

– Dorsal part of C-shaped valva as long as ventral part (Fig. 10) ..... ***eglanteriella* (Mann, 1855)**

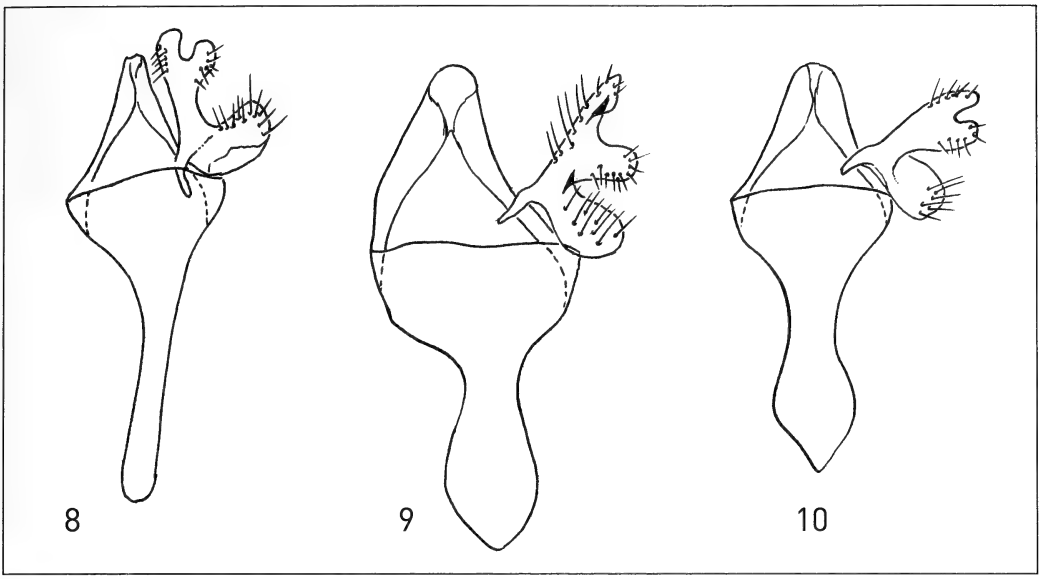
Female genitalia:

1 Ostium sclerotized, ring-shaped, triangular, prolonged into ductus bursae (Fig. 13) ..... ***pappella* (Walsingham, 1907)**

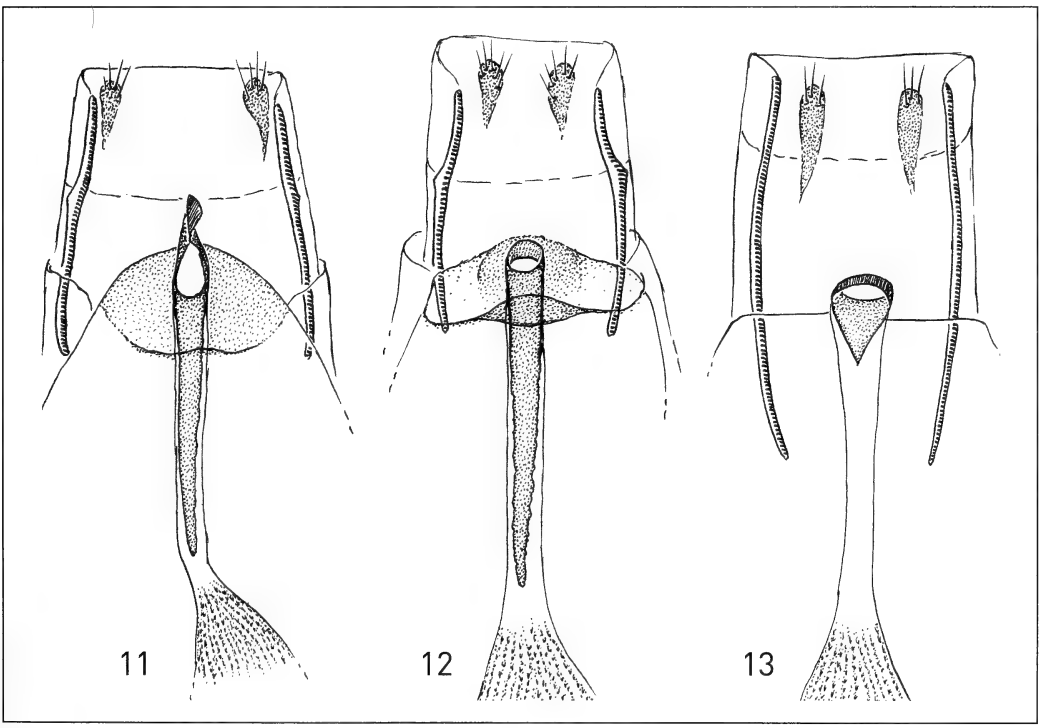
– Sclerotization of ostium prolonged as narrow stick through the whole ductus bursae **2**

2 Sclerotization of ostium apically prolonged, with arrow-shaped tip (Fig. 11) ..... ***heringi* (Klimesch, 1956)**

– Sclerotization of ostium ring-shaped, area around ostium more sclerotized as in the rest of sternite VIII, below this area a sclerotized fold (Figs 12, 7) ..... ***eglanteriella* (Mann, 1855); *seligeri* sp. n.**



Figs 8–10. Male genitalia: 8. *D. pappella*. 9. *D. heringi*. 10. *D. eglanteriella*.



Figs 11–13. Female genitalia: 11. *D. heringi*. 12. *D. eglanteriella*. 13. *D. pappella*.

Acknowledgements

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References

Budashkin, Ju. I. 1995. Novyje materialy po taksonomii, biologii i rasprostraneniju palearktitscheskich molej-akrolepiid (Lepidoptera, Acrolepiidae). – Zhurnal Ukrainskogo Entomologitschnogo Tovaristva [= Journal of the Ukrainian Entomological Society] **2** (2) (1994): 21–32.

Dugdale, J. S., N. P. Kristensen, G. S. Robinson & M. J. Scoble 1998. The Smaller Microlepidoptera-Grade Superfamilies. Pp. 217–232. – *In*: N. P. Kristensen (ed.), Lepidoptera, Moths and Butterflies. Volume 1: Evolution, Systematics, and Biogeography. Handbook of Zoology, vol. IV Arthropoda: Insecta, Part 35. – Berlin, New York, Walter de Gruyter.

Gaedike, R. 1970. Revision der paläarktischen Acrolepiidae (Lepidoptera). – Entomologische Abhandlungen Staatliches Museum für Tierkunde Dresden **38** (1): 1–54.

Gaedike, R. 1997. Yponomeutoidea: Acrolepiidae. Pp. 1–20. – *In*: J. B. Heppner (ed.), Lepidopterorum Catalogus (New Series), Fascicle 55. E. J. Brill, Leiden, New York.

Kyrki, L. 1984. The Yponomeutoidea: a reassessment of the superfamily and its suprageneric groups (Lepidoptera). – Entomologica scandinavica **15**: 71–84.

Sutter, R. & R. Gaedike 2003. *Digitivalva eglanteriella* (Mann, 1855) und *Digitivalva heringi* (Klimesch, 1956), zwei valide Arten. (Lepidoptera: Acrolepiidae). – Entomologische Zeitschrift Stuttgart **113** (7): 214–216.

Contributions to the knowledge of Palaearctic Tineidae

Reinhard Gaedike

Florusstraße 5, 53225 Bonn, Germany; tinagma@msn.com

Abstract. Examination of tineid specimens from the Mediterranean Region has resulted in the discovery of two new taxa, *Eudarcia* (*Abchagleris*) *jaworskii* and *Eudarcia* (*Neomeessia*) *alanyacola*. The previously unknown female genitalia of *Nemapogon somchetiella* Zagulajev, 1961 and *Infurcitinea vanderwolfi* Gaedike, 1997 are described for the first time. A study of *Monopis bisonella* Šumpich, 2011 revealed that this taxon is a junior synonym of *Monopis burmanni*, 1979. New country records are given for six species.

Introduction

Through the courtesy of colleagues, I have been able to examine several interesting tineid specimens from various areas, mainly from the Mediterranean Region. As a result, two new species are described, as well as the previously unknown female genitalia of two other species. From my friend Willibald Schmitz I received several specimens from Jordan, and the identification of these specimens has increased our knowledge of the tineid fauna of this country. The information on the distribution of the taxa, mentioned below, is based on studied material. Additionally it was possible to examine the newly described *Monopis bisonella* Šumpich, 2011 and a comparison with *Monopis burmanni* Petersen, 1979 revealed that *bisonella* is a synonym of *burmanni*.

Abbreviations

The abbreviations of the institutional collections, in which the material studied is deposited, follow the list "Insect and Spider Collections of the World" from the Bishop Museum, Honolulu (http://hbs.bishopmuseum.org/codens).

Coll. Baldizzone	Personal collection of Giorgio Baldizzone, Asti, Italy
Coll. Roweck	Personal collection of Hartmut Roweck, Kiel, Germany
Coll. Schmitz	Personal collection of Willibald Schmitz, Bergisch-Gladbach, Germany
Coll. Šumpich	Personal collection of Jan Šumpich, Česka Bela, Czech Republic
SDEI	Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany
ZMHB	Museum für Naturkunde der Humboldt-Universität, Berlin, Germany
ZMUC	Zoological Museum, University of Copenhagen, Copenhagen, Denmark
ZSM	Zoologische Staatssammlung, Munich, Germany

Rhodobates nodicornellus (Rebel, 1911)

Material. **Jordan:** 3♂, Al Tafila, Dhana Nature reserve, 1050 m, 12–15.v.2010, leg. R. & S. Fiebig, coll. Schmitz.

This represents the first country record. Hitherto the species was known only from Lebanon.

Nemapogon anatolica Gaedike, 1986

Material. **Jordan:** 2♀, Al Tafila, Dhana nature reserve, 1050 m, 12–15.v.2010, leg. R. & S. Fiebig, coll. Schmitz.

This represents the first country record. Hitherto the species was known from Greece and Turkey.

Nemapogon signatella Petersen, 1957

Material. **Jordan:** 2♂, Al Tafila, Dhana Nature reserve, 1050 m, 12–15.v.2010, leg. R. & S. Fiebig, coll. Schmitz.

This represents the first country record. Hitherto the species was known in Europe from Italy through the Balkan Peninsula and from Cyprus, and outside Europe it was known from Turkey and Iran.

Nemapogon somchetiella Zagulajev, 1961 **Fig. 3**

Material. **Italy:** 1♂, 1♀, Piemonte, Asti, fraz. Valmanera, Oasi WWF, 200 m, 3, 22.vii.2009, leg. et coll. Baldizzone.

This is the third locality for this species in Italy, which was hitherto known only from the Caucasus region (Zagulajev 1961, 1964) and from Northern Italy (Gaedike 2009). Females were previously unknown.

Female genitalia (Fig. 3). Dorsal branches of anterior apophyses very short, each ending in somewhat stronger sclerotised plate, curved to middle, apically rounded and edged with strong sclerotisation; ventral branches connected, band-shaped below ostium; ostium lip shield-shaped, rhomboidal, apically rounded, laterally pointed and connected with the band of ventral branches of apophyses; ductus bursae broad, before corpus bursae the characteristic ring of approximately four rows of sclerotised scales.

Eudarcia Clemens

The two new species, described below, are members of the genus *Eudarcia* Clemens, 1860. Robinson & Nielsen (1993) synonymised with *Eudarcia* the previously separate Palaearctic genera *Meessia* Hofmann, 1898, *Obesoceras* Petersen, 1957, *Neomeessia* Petersen, 1968, *Colchiromis* Zagulajev, 1979, *Abchagleris* Zagulajev, 1979, *Haugresis* Zagulajev, 1979, *Zagulyaevella* Kocak, 1981, and *Pseudobesoceras* Gaedike, 1985 (described as subgenus of *Obesoceras*).

The species of *Eudarcia* are small moths with drooping labial palpi showing terminal and lateral bristles. The antenna is sexually dimorphic, with the male antenna appearing swollen. The male genitalia have the vinculum and tegumen undifferentiated, and a more or less developed saccus. The uncus usually has two setose lobes, sometimes rounded, the gnathos is hardly visible, and a pair of small triangular sclerites

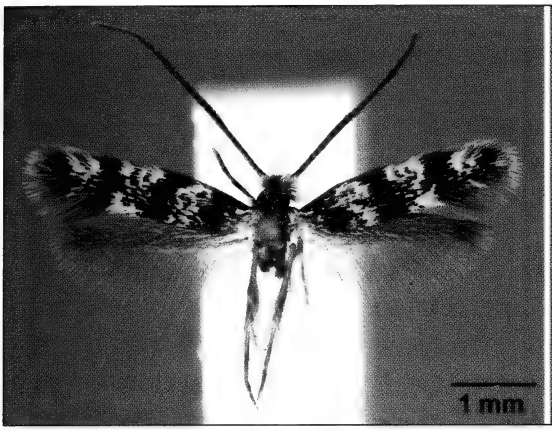


Fig. 1. *Eudarcia* (*Abchagleris*) *jaworskii*.

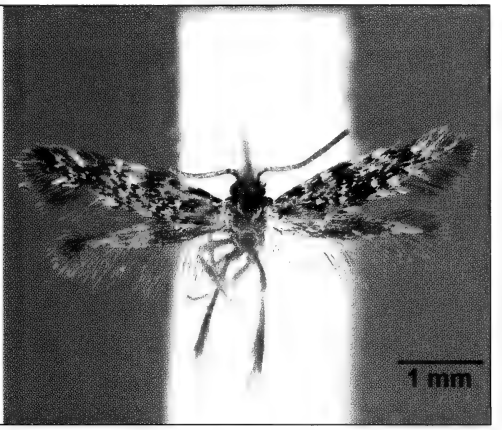


Fig. 2. *Eudarcia* (*Neomeessia*) *alanyacola*.

that are fused with the tegumen. The subscaphium often forms a spinose pad between the arms of the gnathos, and several species have processes. The valva is very variable, the phallus short, sometimes prolonged, and the vesica usually has cornuti. The female genitalia have a weakly sclerotised tergite VIII, divided mediolongitudinally. Sternite VIII is hardly sclerotised and connected laterally to the anterior apophyses. The ductus bursae is sometimes strongly sclerotised. The corpus bursae sometimes has serrate sickle-shaped signa. The larvae, as far as known, are lichenophagous and case-makers. A compilation of the recent knowledge on the biology can be found in Robinson (2009). In the Palaearctic Region 50 species are known. These are divided into several species groups at the subgeneric level, for which the synonymised generic names are used. The monophyly of the genus *Eudarcia* seems to be supported by a number of apomorphies (Robinson & Nielsen 1993).

Subgenus *Abchagleris* Zagulajev, 1979

The sugenus *Abchagleris* is characterised by a mostly prolonged whip-shaped phallus, a more or less simple valva, and a sometimes very complex subscaphium. *Eudarcia sutteri* Gaedike, 1997 shows a reduction in the length of the phallus and a simplification of the subscaphium.

Eudarcia (*Abchagleris*) *jaworskii* sp. n. Figs 1, 4–6

M a t e r i a l . Holotype ♂: 'Turkey, WF97 | Guzeloluk, Mersin prov. | 14.vi.2009 | T. Jaworski leg.', 'Gen. präp. [genitalia slide] Gaedike | Nr. 7484', 'Holotypus ♂ |*Eudarcia* | *jaworskii* sp. n. | det. R. Gaedike 2011', SDEI.

Diagnosis. The genitalia structure is similar to that of *E. sutteri* Gaedike, 1997, but in size is twice as large, and the valva (Fig. 7) and phallus (Fig. 8) are distinctly different in shape.

Description. (Fig. 1). Wingspan 6 mm; head brush yellowish, grey-brown over collar, lighter above palpi to base of antenna; scape yellowish, flagellum dark grey; labial palpi dark brown, second segment apically bristled; maxillary palpi yellowish; thorax and tegulae grey-brown; tegulae apically whitish; forewing dark grey-brown, with whitish pattern: a band at 1/3 from costa to dorsum, a second one at 1/2 from costa to dorsum, narrower in the middle, and one dot on costa before apex; the whitish areas overlaid with some dark scales; hindwing light grey.

Male genitalia (Figs 4–6). Tegumen more or less triangular, apically rounded, without subscaphium, vinculum with two lateral notches, saccus with rounded apex; valva as long as saccus, with long narrow transtilla, narrowest basally, and broadest before rounded apex; costal edge concave, basal edge convex; phallus distinctly longer than valva, slightly curved, with pointed tip and one cornutus, directed from apex to base.

Female genitalia. Unknown.

Etymology. The species is named in honour of the collector, Tomasz Jaworski.

Remarks. The similarity of the shape of uncus-tegumen-saccus, valva, and phallus with *sutteri* place this new species into this subgenus.

Subgenus *Neomeessia* Petersen, 1968

The subgenus *Neomeessia* is characterised by the shape of the uncus and the lateral socii.

Eudarcia (*Neomeessia*) *alanyacola* sp. n. Figs 2, 9–11

Material. Holotype ♂: 'Türkei, Alanya | Mahmutlar, Ruine | 17.vi.2005, LF leg. W. Mey', 'Gen.präp. [genitalia slide] Gaedike | Nr. 7212', 'Holotypus ♂ | Eudarcia | alanyacola sp. n. | det. R. Gaedike 2011', ZMHB.

Diagnosis. This species is similar to *Eudarcia lobata* (Petersen & Gaedike, 1979), but socii are claw-shaped (in *lobata* socii are rounded; Fig. 12), the small subscaphium has thorns (in *lobata* without thorns; Fig. 12), the valva has a notch instead of a long hook as in *lobata* (Fig. 13), and the phallus has only one cornutus (in *lobata* it has three cornuti; Fig. 14).

Description (Fig. 2). Wingspan 5 mm; head brush creamy, on collar and laterally grey-brown; antenna cream; labial palpi light cream, darker laterally, second segment apically bristled, maxillary palpi light cream; thorax and tegulae grey-brown; forewing dark-brown with numerous cream scales, without a clear pattern; hindwing grey.

Male genitalia (Figs 9–11). Uncus oval, basally with claw-shaped socii; tegumen broad, narrower to vinculum, saccus short, pointed; subscaphium short, apically with very small thorns; valva as long as tegumen and saccus, the entire costal edge distinctly convex, basal edge notched at 1/2, the notch with numerous bristles; basal half of valva distinctly broader than apical half; phallus shorter than valva, with one strongly sclerotised, acute cornutus.

Female genitalia. Unknown.
Etymology. The species is named after the locality in which the holotype was collected.

Infurcitinea amseli Petersen, 1957

Material. **Jordan:** Al Tafila: 2♂, 1♀, Dhana Nature reserve, 1050 m, 12–15.v.2010, leg. R. & S. Fiebig, coll. Schmitz; 2♂, 1♀, Wadi al Haza, 3,5 km east of Afra, 290 m, 21.v.2010, leg. R. & S. Fiebig, coll. Schmitz. Ajlun: 4♂, 7♀, Umgebung Ajlun, 920 m, 8–10.v.2010, leg. R. & S. Fiebig, coll. Schmitz.

These are the first records for this country. Hitherto the species was known from Middle Asia (Turkmenistan, Pakistan, Afghanistan, and Iran).

Infurcitinea tauridella Petersen, 1968

Material. **Bulgaria:** Pirin: Sandanski: 2♂, Ploski, 100 m, 17–31.v.2010, leg. N. Savenkov, coll. Roweck; 1♂, Ilindentsi, 500 m, 30.v.2010, leg. N. Savenkov, coll. Roweck.

These are first country records. Hitherto the species was known from Greece and Turkey and from East European Russia.

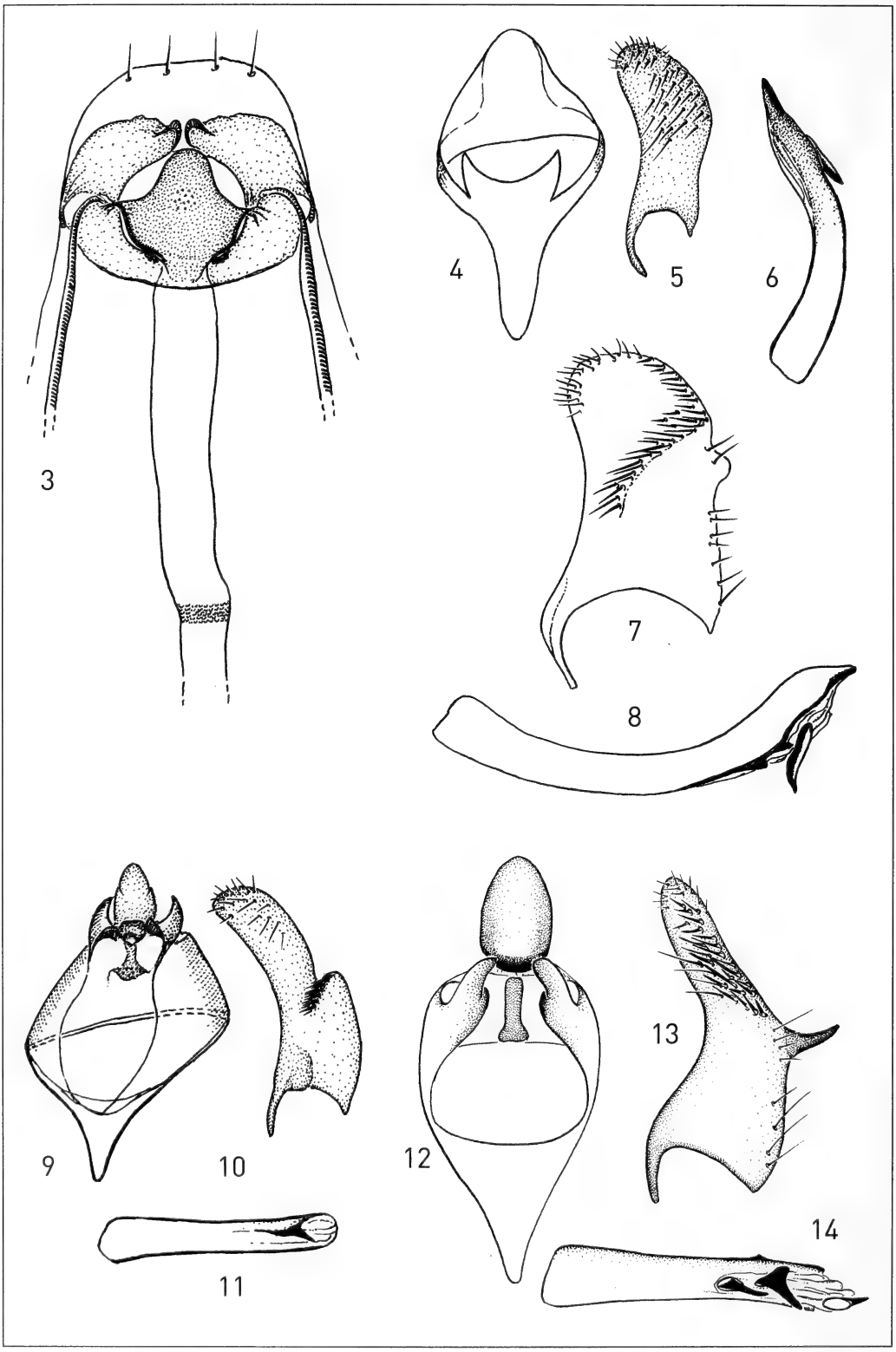
Infurcitinea vanderwolfi Gaedike, 1997 Fig. 15

Material. **Croatia:** Dalmatia: 12♂, 4♀, Murter Is., Tijesno, 43°47'27"N, 15°37'31"E, 15–17.vii.2003, leg. et coll. Šumpich; 2♂, Peljesac, Zuljana, 1–13.vii.2005, leg. et coll. Šumpich. **Bulgaria:** 1♀, Piringebirge, Sandanski, Liljanowo, 27.vi–25.vii.1985, leg. F. Eichler, ZSM.

This represents first record for Bulgaria. The species was previously known only from Greece and Croatia (Gaedike 2011). As this material includes first known females of the species, it is now possible to describe this sex as well.
Female genitalia (Fig. 15). Anterior apophyses short, ventral branches associated with large, strongly sclerotised plate with numerous longitudinal wrinkles; ostium area deeply incised; dorsum of segment VIII with terminal, beak-shaped, curved process.
Remarks. The female morphology is similar to that of *I. albicomella* (Herrich-Schäffer, 1851), but the large, strongly sclerotised plate of sternum VIII distinguishes the female of this species from that of *albicomella*.

A new synonym of *Monopis burmanni* Petersen, 1979

In 2011 Šumpich described *Monopis bisonella* from Bialowieza, Poland as a new species (Šumpich et al. 2011). The author graciously permitted me to compare a photograph of the holotype and its male genitalia with a paratype specimen of *burmanni*. There are no differences in the forewing pattern, which is characteristic and unique in the genus. The shape of the genitalia, especially of the valva, is also without any differences. These findings strongly suggest that *Monopis bisonella* Šumpich, 2011 and *Monopis*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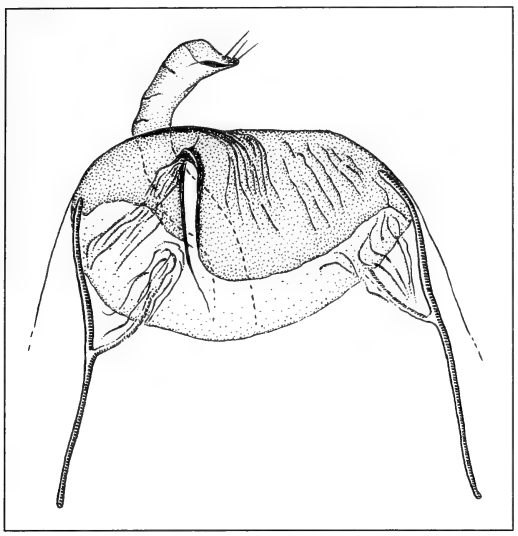


Fig. 15. *Infurcitinea vanderwolfi*, female genitalia.

burmanni Petersen, 1979 refer to the same taxon, and consequently *M. bisonella* is here synonymized with *M. burmanni*.

Monopis burmanni Petersen, 1979

Monopis bisonella Šumpich, 2011; **syn. n.**

The species was hitherto known from Austria (Northern Tirol: type locality; several other localities, see: http://www.salzburg.com/wiki/index.php/Monopis_burmanni), Poland (Bialowieza: type locality of *M. bisonella*), and Russia (Ural: Sverdlovsk; Burjatia).

Acknowledgements

My thanks go to Tomasz Jaworski for his kindness in locating the holotype of *E. jaworskii* in the SDEI collection; Christian Kutzscher for making the photos of the new species; the reviewers for their useful comments; Bernard Landry for editing the manuscript; and Paul Sokoloff for linguistic corrections.

References

Gaedike, R. 2009. *Nemapogon somchetiella* Zagulajev, 1961, a new record for the Italian fauna (Lepidoptera: Tineidae). – Rivista Piemontese di Storia Naturale **30**: 53–56.

Gaedike, R. 2011. New and poorly known Tineidae from Western Palaearctics (Lepidoptera). – Beiträge zur Entomologie **2**: 357–370.

Petersen, G. & R. Gaedike 1979. Beitrag zur Kenntnis der Tineiden-Fauna des Mittelmeerraumes. – Beiträge zu Entomologie **29** (2): 383–412.

Robinson, G. S. 2009. Biology, distribution and diversity of tineid moths. – Art Printing Works Sdn Bhd Kuala Lumpur. 143 pp., 512 figs [34 pages].

Robinson, G. S. & E. S. Nielsen 1993. Tineid Genera of Australia (Lepidoptera). – Monographs on Australian Lepidoptera, Vol. 2, CSIRO Publications, Melbourne. XV+344 pp., 734 figs.

Šumpich, J., J. Liska & I. Dvorák 2011. Contribution to knowledge of the butterflies and moths (Lepidoptera) of north-eastern Poland with a description of a new tineid species from the genus *Monopis* Hübner, 1825. – Polish Journal of Entomology **80**: 83–116.

Figs 3–14. Genitalia of Tineidae. **3.** *Nemapogon somchetiella*, female. **4–6.** *Eudarcia* (*Abchagleris*) *jaworskii*, male; **4.** Uncus + tegumen; **5.** Valva; **6.** Phallus. **7–8.** *Eudarcia* (*Abchagleris*) *sutteri*, male; **7.** Valva; **8.** Phallus. **9–11.** *Eudarcia* (*Neomeessia*) *alanyacola*, male; **9.** Uncus + tegumen; **10.** Valva; **11.** Phallus. **12–14.** *Eudarcia* (*Neomeessia*) *lobata*, male (after Petersen & Gaedike 1979); **12.** Uncus + tegumen; **13.** Valva; **14.** Phallus.

Zagulajev, A. K. 1961. Novyje vidy gribnych molej roda *Nemapogon* Schr. (Lepidoptera, Tineidae). [New species of fungous moths of the genus *Nemapogon* Schr. (Lepidoptera, Tineidae). – Zoologitscheskij Zhurnal **40** (8): 1184–1191.

Zagulajev, A. K. 1964. Nastojaschtschije Moli (Tineidae), Podsemejstvo Nemapogoninae. *In*: Fauna SSSR, N. S. 86: Nasekomyje, Tscheschujekrylyje. – Moskva, Leningrad **4** (2): 1–424.

The winter-flying adelid *Nematopogon stenochlora* (Meyrick, 1912) discovered in Spain (Lepidoptera, Adelidae)

Ole Karsholt[1] & Mikhail V. Kozlov[2]

[1] Zoological Museum, Natural History Museum of Denmark, Universitetsparken 15, DK 2100, København Ø, Denmark; okarsholt@snm.ku.dk

[2] Section of Ecology, University of Turku, FI-20014 Turku, Finland; mikoz@utu.fi

Abstract. *Nematopogon stenochlora* (Meyrick, 1912), described from Algeria, is for the first time reported from Europe. The specimens collected in the province of Malaga, Spain have genitalia indistinguishable from the holotype of *N. stenochlora*, although externally they resemble *N. dorsiguttella* (Erschoff, 1877) in their large size and the presence of two prominent white spots on the dorsal forewing margin. Investigation of additional specimens collected in Algeria demonstrated that the external characters of *N. stenochlora* are variable; we update the description of this species accounting for this variation in external characters and also illustrate female genitalia that have not been figured previously. Appearance of *N. stenochlora* in late winter and early spring is the most likely reason behind the elusiveness of this species.

Introduction

The fairy moth genus *Nematopogon* Zeller contains 14 species confined to Eurasia (Nielsen 1985, Kozlov 2001), nine of which are known to occur in Europe (van Nieukerken & Kozlov 2011). The fauna of Spain includes only three species, *N. adansoniella* (Villers, 1789), *N. schwarziellus* (Zeller, 1839) and *N. robertella* (Clerck, 1759) (Vives Moreno 1994; van Nieukerken & Kozlov 2011). The discovery on the southern coast of Spain of a *Nematopogon* that showed no external affinities to any of the European species was therefore astonishing. An attempt to identify this species by using the keys by Nielsen (1985) provided two alternative solutions: while the male genitalia appeared indistinguishable from *N. stenochlora* (Meyrick, 1912), the external characters were most similar to *N. dorsiguttella* (Erschoff, 1877), an East Palaearctic species distributed from Siberia to China and Japan.

The puzzle had been solved only recently, when we had an opportunity to examine the collections of the Natural History Museum (London). Along with the male lectotype and two male paralectotypes (apparently the only specimens that were available to E. S. Nielsen at the time of his revisionary work), this collection houses ten additional specimens of *N. stenochlora* collected in Algeria during 1887–1908. Significantly, all these specimens differ externally from the types of *N. stenochlora*; they have been accessioned and were identified as *N. stenochlora* only a few years ago by one of the authors (M.K.) following examination of the male genitalia.

Considering both variability of *N. stenochlora* and the scarcity of information about this newly discovered representative of the European fauna, we provide descriptions of external characters and female genitalia to allow recognition of this species.

Abbreviations

BMNH The Natural History Museum, London, U.K.
ZMUC Zoological Museum, University of Copenhagen, Denmark
ZMUH Finnish Museum of Natural History, Helsinki, Finland

Systematics

Nematopogon stenochlora (Meyrick, 1912) (Figs 1, 2)

Nemophora stenochlora Meyrick 1912a: 3. Lectotype, ♂ (designated by Nielsen 1985: 56): Algeria, Skikda (36° 53' N, 6° 54' E); labelled: 8 mm circle with violet border, print 'LECTO- | TYPE'; 8 mm circle with red border, print 'Type'; 4 × 8 mm, black ink 'Philippeville [= Skikda] | Algeria | 13 / 4 / [18]90'; 2.5 × 8.5 mm, print 'Meyrick Coll. | B.M. 1938-290.'; 9 × 14 mm, black frame, black ink + print 'Nemophora | stenochlora | Meyr. | Holo- | TYPE ♂'; 9 × 18 mm, red paper, print + black ink 'LECTOTYPE | Nemophora | stenochlora | Meyr. | design. E. S. Nielsen, 1978'.

Nemophora stenochlora: Meyrick 1912b: 3; Chrétien 1922: 377; Rungs 1979: 27.

Nematopogon stenochlora: Nielsen 1985: 17 (fig. 25, external appearance of a male), 22–24 (keys and phylogeny), 55 (figs 108–111, male genitalia), 56 (description).

Material. **Algeria**. Paralectotypes 2♂♂, collected at same date and place as the holotype; Hammam Righa (36° 23' N, 2° 24' E), 1♂, 21.iii.1905 (Longstaff); Bône [= Annaba] (36° 54' N, 7° 46' E), 4♂♂, 22–23.ii.1886, 2♂♂, 13.iii.1908 (Eaton); El Biar (36° 45' N, 3° 3' E), 20.iii.1893, 1♂ (Eaton); Constantine (36° 22' N, 6° 37' E), 1♂, 1♀, 19.xi.1887 (Staudinger) (all in NHM). **Tunisia**. 5 km E Station de Tamera, 1♀, 21.–25.iii.1986 (Karsholt) (ZMUC). **Spain**. Prov. Malaga, El Mirador, 100 m, 1♂, 1 ♀, 3.ii.1984 (Traugott-Olsen) (ZMUC); Prov. Malaga, Casares (36° 27' N, 5° 17' W), 350 m, 4 ♂♂, 3.ii., 9.ii., 4.iii.2003 (Hale) (ZMUC and MZH); 2 ♂, Prov. Malaga, 1 km E. Casares, 30.i.–3.ii.2009 (Fibiger & Top-Jensen) (ZMUC).

Diagnosis. Due to variability of the external characters, *N. stenochlora* can only be reliably identified by the male genitalia. This species, along with *N. robertella* and *N. caucasica*, has three (or even four – in one exceptional case) stalked pectinifers on the valva, but differs from the other mentioned species by the triangular uncus (Fig. 3). In the female genitalia, *N. stenochlora* is most similar to *N. adansoniella*, from which it differs by the narrow tergite VIII (3.3 × as long as wide) with medially pointed posterior band (Fig. 8). The specimens from Spain differ from all European species of *Nematopogon* by two prominent white marks on the dorsal forewing margin; however, variability of this character in the European population remains unknown (in the specimens from North Africa this character is variable – see below).

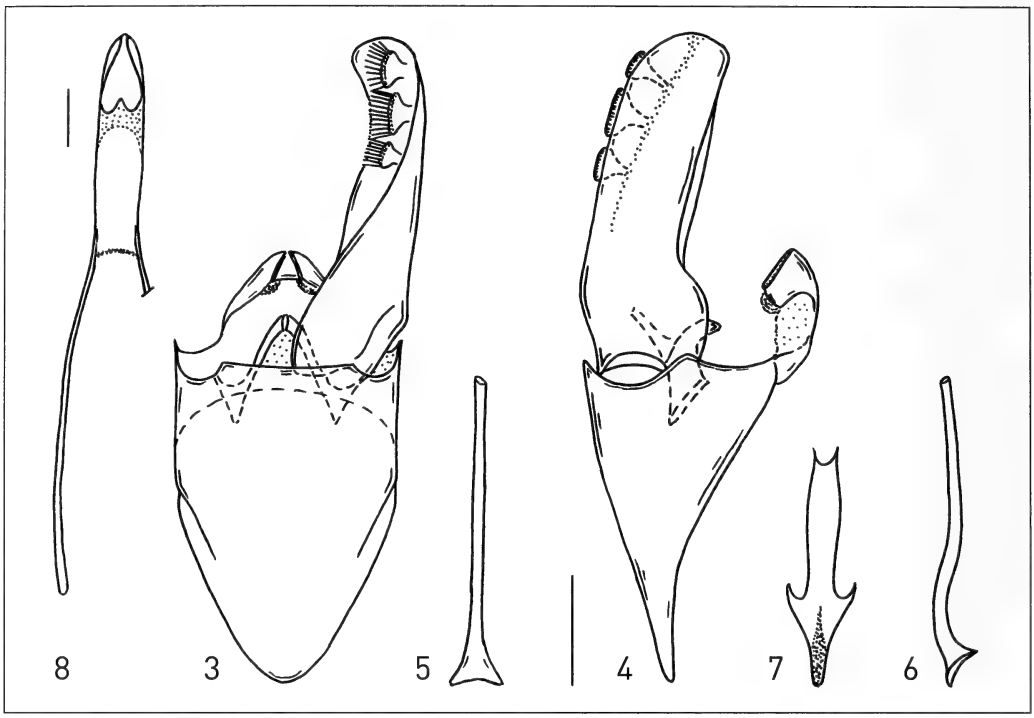
Description. Male (Fig. 1): Forewing length 5.5–9.2 mm, width/length ratio 0.29–0.31. Vertex from entirely pale yellow (in syntypes) to brown occipit, with pale yellow scales restricted to narrow line above antennal sockets only (specimens from Spain). Frons from white to pale yellow; palpi and proboscis pale grey brown to light brown. Compound eyes relatively large; frontal distance between eyes subequal to vertical diameter of the compound eye (i.e. interocular index 1.0). Antenna 2.8–3.7 × forewing length. Scape from pale yellow to greyish brown; flagellum uniformly coloured, whitish to light pale yellow. Tegulae and thorax pale ochreous to greyish brown. Forewing from pale ochre, without reticulate pattern (only in some specimens from Algeria), to brownish grey with prominent reticulate pattern (both in specimens from Algeria

Figs 1, 2. *Nematopogon stenochlora*. **1.** female, Spain, prov. Malaga, Marbella, El Mirador, 3.ii.1984; **2.** male, Spain, prov. Malaga, Casares, 9.ii.2003.

and Spain); discal spot absent in light specimens (e.g. in syntypes) but present in dark specimens (e.g. those collected in Spain). Cilia from pale ochreous, indistinguishable from forewing colour (e.g. in syntypes) to dark brown, clearly contrasting to forewing background (e.g. in specimens collected in Spain). Light marks on dorsal margin of forewing greatly variable. The tornal mark is always present, although minor (a few scales) and almost indistinguishable in light specimens (e.g. in syntypes); however, even in these extreme situations the light colour of cilia marks its occurrence (this can be seen even in the paralectotype, see Nielsen 1985: 17, fig. 25). The proximal mark (located at approx. 1/3 of forewing length) is absent in most specimens from Algeria, although traces of it are present in two specimens from Constantine; in contrast, this mark is very distinct (reaching 0.15 × forewing length and 0.20 × forewing width) in specimens from Spain. Hindwing sparsely scaled, semi-translucent, from pale greyish to light brown. Legs light brown. Epiphysis at 0.3, not reaching apex of tibia. Abdomen greyish brown.

Female (Fig. 2): Similar to male.

Male genitalia (Figs 3–7). Tegumen dome-shaped, without medial ridge; its dorsal surface with triangular plate (termed uncus by Nielsen 1985). Vinculum short, nearly equal to length of valva, with slightly convex lateral margins. Distal 3/4 of valva of about the same width, base slightly wider; apex of valva broadly rounded. Inner surface



Figs 3–8. *Nematopogon stenochlora*, genitalia (drawn from preparations in glycerol, kept in tubes on the pin of the specimens). **3–7.** male, Spain, prov. Malaga, Casares, 4.iii.2003; **3.** Genital complex, ventral view (right valva not shown); **4.** ditto, lateral view; **5.** phallus, ventral view; **6.** phallus, lateral view; **7.** juxta; **8.** female, Spain, prov. Malaga, Marbella, El Mirador, 3.ii.1984; tergite VIII and apophyses posteriores; scales 0.25 mm.

of valva with three stalked pectinifers (exceptionally, one specimen from Spain has four pectinifers on left valva only). Transtilla w-shaped. Phallus nearly equal to length of vinculum, basal half slightly s-shaped in lateral projection; base of phallus swollen; tip membranous, without any sclerotized structures. Juxta 0.7 × length of phallus, arrowhead wide (width/length ratio 0.8), with very narrow apical part (1/3 of total length of arrowhead).

Female genitalia (Fig. 8). Apophyses posteriores 0.95 × length of apophyses anteriores. Tergite VIII relatively narrow (3.3 as long as wide), without medial keel; posterior band with triangular medial protuberance. Vestibulum without sclerotization.

Distribution. Southern Spain, northern Algeria, northern Tunisia; also recorded from Morocco (Chrétien 1922).

Remarks. Investigation of additional material demonstrated that, contrary to the diagnosis given by Nielsen (1985), this is one of the largest *Nematopogon* species; only *N. dorsiguttella* and *N. taiwanella* attain a larger size.

One of the Algerian specimens in BMNH has been determined by Durrant as *N. pilella*; however, it seems that this misidentification had not been published. Another specimen bears the label '*Nemophora panzerella* Hb. f. *algericella*, named by St[audin]g[e]r'; however, no publication has been found in which the latter name is made available.

Phenology. The information summarised by Nielsen (1985) indicates that the adults of all *Nematopogon* species fly during spring and early summer, from April to July. Several species are reported to start flying during April. Additional records suggest that *N. stenochlora* is a winter-flying species: in Algeria and Tunisia it was collected from mid-November to mid-April, and in Southern Spain from early February to early March. The average monthly temperature for the collecting period in all localities where *N. stenochlora* had been sampled ranges from 11.1 to 14.8°C (FAO 2006).

Fig. 9. *Nematopogon stenochlora.* Living specimen in resting position, Spain, prov. Malaga, Casares, photo P. Hale.

Acknowledgements

We are grateful to K. R. Tuck for help with access to the BMNH collections; to P. Hale, Casares, Spain, for taking the photograph of the live specimen; to P. Skou, Stenstrup, Denmark for information; and to G. Brovad, ZMUC for taking photographs of the pinned adults. We also thank E. J. van Nieukerken, NCB Naturalis, Leiden, Netherlands and two anonymous reviewers for helpful comments that improved the manuscript. This research was made possible by the financial support from the SYNTHESIS programme.

References

Chrétien, P. 1922. [Galleriinae – Micropterygidae]. Pp. 324–379. – *In*: C. Oberthür (ed.), Les Lépidoptères du Maroc, Etudes de lépidoptérologie comparée **19(1)**: 1–403, pls. 74–124.

FAO 2006. New_LocClim, Local Climate Estimator Version 1.10. Environment and Natural Resources Service – Agrometeorology Group, FAO/SDRN, Rome, Italy, ftp://ext-ftp.fao.org/SD/SDR/Agromet/New_LocClim/. [Accessed 28.09.2006]

Kozlov, M. V. 2001. *Nematopogon taiwanella* sp. n. from the mountains of Taiwan (Lepidoptera, Adelidae). – Tijdschrift voor Entomologie **144**: 41–44.

Meyrick, E. 1912a. Lepidoptera Heterocera (Tineae). Fam. Adelidae. – *In*: P. Wytsman (ed.), Genera Insectorum **133**: 1–12, 1 pl. – V. Verteneuil & L. Desmet, Bruxelles.

Meyrick, E. 1912b. Adelidae, Micropterygidae, Gracilariadae [sic!]. – *In:* H. Wagner (ed.), Lepidopterorum Catalogus 6: 1–68. – W. Junk, Berlin.

Nieukerken, E. J. van & M. V. Kozlov 2011. Adelidae. *In*: O. Karsholt & E. J. van Nieukerken (eds), Lepidoptera, Moths. – Fauna Europaea, version 2.4, http://www.faunaeur.org. [Accessed 12.1.2011]

Nielsen, E. S. 1985. A taxonomic review of the adelid genus *Nematopogon* Zeller (Lepidoptera: Incurvarioidea). – Entomologica Scandinavica, suppl. **25**: 1–66.

Rungs, C. E. E. 1979. Catalogue Raisonné des Lépidoptères du Maroc. Inventaire faunistique et observations écologiques 1. – Travaux de l'Institut Scientifique, Série Zoologie **39**: i–viii, 1–222, A1–A5, 2 maps.

Vives Moreno, A. 1994. Catálogo sistemático y sinonimico de los Lepidopteros de la Peninsula Iberica y Baleares (Insecta: Lepidoptera) (Segunda parte). – Ministerio de Agricultura, Madrid. x + 775 pp.

New species and taxonomic changes in Sesiini from Asia and Europe (Sesiidae)

Axel Kallies

The Walter and Eliza Hall Institute of Medical Research, 1G Royal Parade, Melbourne/Parkville, Victoria 3052, Australia; kallies@wehi.edu.au

Abstract. Two new clearwing moth species (Sesiidae) of the tribe Sesiini are described, *Cyanosesia ormosiae* sp. n. from Hong Kong, China, and *Lamellisphecia xerampelina* sp. n. from Kullu, Northern India. *C. ormosiae* was reared from larvae collected in the trunks of *Ormosia pachycarpa* (Fabaceae); *L. xerampelina* was collected with the help of pheromone lures. Furthermore, a number of taxonomic changes are introduced for the tribe Sesiini. *Sphecodoptera* Hampson, [1893] (gen. rev.) is resurrected from synonymy with *Sesia* Fabricius, 1775, and *Scasiba* Matsumura, 1931 (syn. n.) is established as its junior synonym. *Vespisesia* Heppner, 2010 (syn. n.) is found to be a junior synonym of *Sphecosesia* Hampson, 1910, and *Clavisphecia* nom. n. is introduced as a replacement name for *Clavigera* Kallies & Arita, 2004 (a homonym of *Clavigera* Hector, 1879 in Brachiopoda). *Synanthedon catalina* Meyrick, 1926 (syn. n.) is considered a junior synonym of *Sphecodoptera repanda* (Walker, 1856) comb. rev. Finally, the western Palaearctic species *Sesia melanocephala* Dalman, 1816 is transferred to the genus *Eusphecia* Le Cerf, 1937 (comb. n.).

Introduction

The members of Sesiini of Palaearctic and Oriental regions were revised relatively recently (Kallies & Arita 2004, Špatenka et al. 1999). Since then only a small number of additional taxa have been described and few taxonomic changes introduced (Fischer 2005, Heppner 2010, Kallies & de Freina 2009, Petersen & Lingenhöle 1998).

Sesiini of the Palaearctic are well known and their diversity at least at the generic level is relatively low. Only three genera with 25 species are recognized, most of which occur in central and eastern Asia. Conversely, the Sesiini fauna of Southeast Asia is only partly known, but with nine genera and 54 named species, it shows a diversity unmatched anywhere in the world. The genus *Cyanosesia* is particularly rich with 13 named species.

Here a new species is described, the larvae of which were collected in the trunks of the economically important tree species *Ormosia pachycarpa* (Fabaceae) at Ma On Chan, Hong Kong. The moths that emerged from these larvae were initially identified as *Chimaerosphecia sinensis* Walker, [1865] (Cissuvorini) (Kendrick 2001, as *Toleria sinensis*). Re-examination of the specimens, however, revealed that they belong to a new species of the genus *Cyanosesia*, *C. ormosiae* sp. n., which is described here. Secondly, a new species of *Lamellisphecia* Kallies & Arita, 2004 is described from northern India. Only five other species of this genus are known, occurring from Thailand via Sumatra to Papua New Guinea (Fischer 2005, Kallies & Arita 2004, Kallies unpublished). Thus, the discovery of a new species, *Lamellishecia xerampelina* sp. n., in northern India close to the limits of the Palaearctic region is of zoogeographic interest.

Interestingly, both new species described in this study are unusual amongst their congeners and do not easily fit the current concept of *Cyanosesia* and *Lamellisphecia*,

respectively. This may be explained by the fact that both species inhabit areas at the very edges of the known distribution ranges of their respective genera, or by the possibility that the characters used to separate Sesiini genera are plesiomorphic. Thus, rather then describing new, ill-defined genera, a conservative approach was adopted here and the species were described in existing genus-group taxa. However, discovery of additional species and further research may reveal the need to erect additional genera. Re-examination of several Sesiini taxa in the course of this study showed that further taxonomic changes are required as outlined below.

Abbreviations

BMNH British Museum of Natural History, London, U.K.
CAK Personal collection of Axel Kallies
AFCD Collection of the Agriculture, Fisheries and Conservation Department of the Government of the Hong Kong Special Administrative Region, China
ZMHB Zoological Museum of the Humboldt University, Berlin, Germany
ETA external transparent area
ATA anterior transparent area

Results

Cyanosesia Gorbunov & Arita 1995

Type species. *Cyanosesia tonkinensis* Gorbunov & Arita, 1995, by original designation.

Cyanosesia was described from Vietnam (Gorbunov & Arita 1995) on the basis of two species. It was further characterized and additional species were described from various parts of Southeast Asia later (Arita & Gorbunov 2002; Gorbunov & Kallies 1998; Kallies 2003; Kallies & Arita 1998, 2004). Only one species of *Cyanosesia*, *C. tonkinensis*, was known from mainland China to date (Kallies 2007); the new species, described below, is the second one.

Little is known about the biology and host plant preferences of *Cyanosesia*. *Litsea umbellata* (Lauraceae) was the only known host plant for the genus with both *C. tonkinensis* and *C. litseavora* Kallies & Arita, 2004 utilizing this tree species in Vietnam (Kallies & Arita 2004).

Cyanosesia ormosiae sp. n. (Figs 1–3, 9, 10)

Material. Holotype ♂: 'Hong Kong: | New Territories, | Ma On Shan | 24. v. 1999 | P.-W. Chan', 'Ex larva in | *Ormosia* | *pachycarpa* tree trunk', 'BMNH(E) | 1999-229' (BMNH). Paratypes: 3♂, 10♀, same data as holotype (genitalia examined by Axel Kallies, slides Nos AK636, ♂, and AK693, ♀) (AFCD, 1♀ BMNH, 1♀ CAK).

Description. Male (Fig. 2). Alar expanse 21 mm, body length 9 mm. Head: antenna ciliate, yellow-brown, labial palp yellow, with some black ventrally; frons light grey, yellowish laterally; pericephalic scales yellow. Thorax: dark brown, tegula black, with

yellow margins; patagia yellow along the base. Forewing: apical area orange, veins black; transparent areas well developed, cells of ETA between R3 and R4/5 lightly covered with orange scales; discal spot orange, black proximally; costal area black with some orange; fringe dark fuscous; scaled parts of the wings bright orange ventrally. Legs: forecoxa yellow, remainder of foreleg orange; mid- and hindcoxae black; midfemur yellow, remainder of midleg orange; hindfemur black, hindtibia orange, with a white patch near the anterior pair of spurs and a black patch dorsally. Abdomen: tergites I–II with base colour black, tergite II covered with blood-red scales and a narrow yellow posterior margin; tergite III black; tergite IV broadly yellow in anterior half, dark fuscous in posterior half; tergite V black; tergites VI–VII dark fuscous, with a narrow yellow-orange band in anterior part; sternites I–III dark fuscous; sternites IV and V yellow, posterior margins dark fuscous; sternites VI–VII dark fuscous with dark orange scales in anterior and lateral parts; anal tuft dirty yellow dorsally, black laterally, dirty orange ventrally. Female (Figs 1, 3) similar to male but significantly larger, alar expanse 32–35 mm, body length 17–18 mm. ETA mostly covered with dirty orange scales; discal spot wider and more extensively black; costal margin orange; all abdominal tergites with black posterior margins, in particular tergite III with wide black margin; tergite I orange-yellow; tergite II deep orange-red; tergites III–IV yellow; tergite V dirty orange; tergite VI orange brown.

Male genitalia (slide #AK636, Fig. 9). Uncus with few simple setae; gnathos consisting of two well-developed arms; valva long, pointed, with broad scale-like setae towards dorsal margin and long simple setae medially, apically and near ventral margin, crista broad triangular, covered with scale-like setae, with a small plate-like process; saccus long; phallus long and simple without plates or distinct cornuti.

Female genitalia (slide #AK693, Fig. 10). Ostium large, distal end of ductus bursae sclerotized; antrum well developed.

Diagnosis. Due to its characteristic wing and abdominal markings and the unique genitalia this species cannot be confused with any congener or any other known Sesiini.

Remarks. *C. ormosiae* sp. n. is an unusual species; the association with the genus *Cyanosesia* is based mainly on the ciliate antennae and the morphology of the valva (tapering and distinctly pointed, with a pronounced crista). While the ciliate antennae as well as the shape of the discal spot (relatively short and pointed towards the base, not oblique) would also allow a placement within *Sphecodoptera*, the morphology of the male genitalia, in particular the pointed valval apex, the absence of a setaceous field near the dorsal margin of the valva, and the absence of an apical plate on the phallus, precludes this.

Lamellisphecia Kallies & Arita, 2004

Type species. *Lamellisphecia haematinea* Kallies & Arita, 2004, by original designation.

This genus was described on the basis of three species from Vietnam and Thailand (Kallies & Arita 2004). Subsequently, another species was described from Sumatra (Fischer 2005), and an additional species is known from Papua New Guinea (unpub-

lished). Species of *Lamellisphecia* are similar to *Cyanosesia* and *Sphecodoptera* but differ by the presence of pronounced antennal rami and details in their genitalia (compare Kallies & Arita 2004).

***Lamellisphecia xerampelina* sp. n.** **(Figs 4, 11)**

Material. Holotype ♂: 'NW India, Himachal Pradesh | Distr. Kullu, Kullu Valley | 4 km S Kullu, Sastri Nagar | 31°56.49'N 77°06.68'E | ca. 1200 m, 26–29. IX. 1999 Ph. | leg. P. Kautt & V. Weisz' 'genitalia examined | by Axel Kallies | slide No AK233' (CAK, will be transferred to ZMHB).

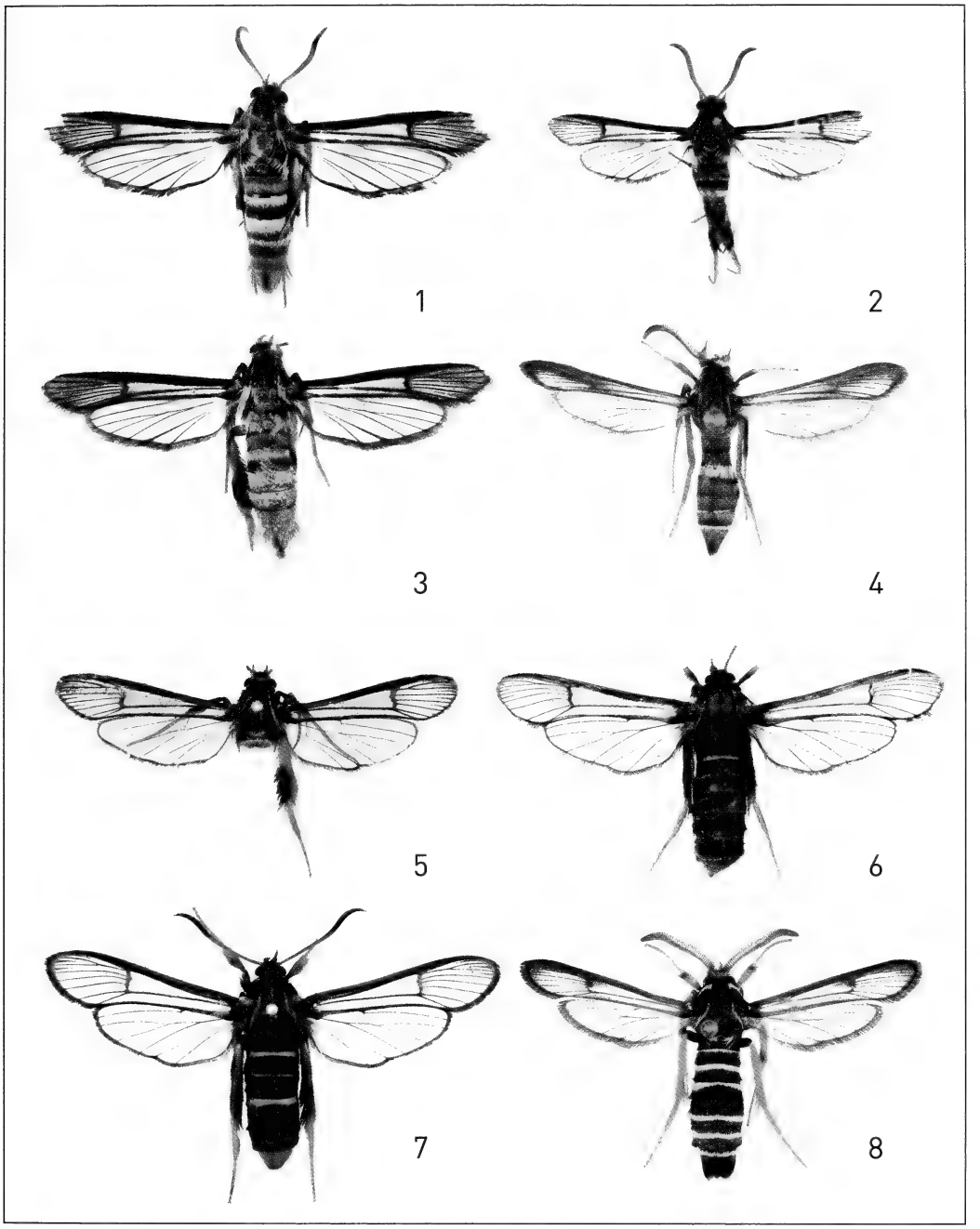
Description. Male (Fig. 4). Alar expanse 23.5 mm, body length 12 mm. Head: antenna unipectinate, ciliate; labial palpus orange yellow with some black scales ventrally; pericephalic scales yellow laterally, black dorsally; frons light grey, white laterally, vertex brown, dirty yellow towards base; pericephalic scales pale yellow. Thorax: black to brown, patagia pale yellow along base; tegula with yellow scapular spot, with some orange distally and basally; mesothorax with dorsal yellow spot. Forewing: veins orange brown; ETA and posterior transparent area partially covered with orange brown scales, cell between M1 and M2 partly transparent, cells between M2/M3 and M3/CuA1 fully transparent; ATA divided by a line of brown scales that runs along rudimentary vein M. Legs: dirty orange, mid- and hindfemora yellow. Abdomen: segments I–III and V–VII dirty orange, segment IV yellow, segments II–IV narrow black posterior margins; segments V–VII with narrow yellow posterior margins; anal tuft black and yellow mixed.

Male genitalia (slide #AK233, Fig. 11). Uncus with simple setae; gnathos reduced; valva short, pointed, with long simple setae and with a simple broad triangular crista; juxta with a well-sclerotized ventral band; saccus short; proximal end of phallus with short lateral extensions, distal end with a narrow well-sclerotized plate, vesica with a group of short cornuti.

Diagnosis. This is the smallest species of the genus (all previously known species are large, with alar expanse 30–41 mm). Due to its characteristic wing and abdominal markings and genitalia morphology it cannot be confused with any congener or any other known Sesiini.

Remarks. This species occupies an isolated position in the genus *Lamellisphecia*; however, both the morphology of the antennae and the simple setae of the valva support the placement in this genus and preclude a close relationship with either *Sphecodoptera* or *Cyanosesia*.

The type locality for *L. xerampelina* lies in the Kullu valley, in the foothills of the Himalaya Mts. The only known specimen was collected with the help of artificial pheromone lures together with several specimens of *Bembecia guesnoni* Špatenka & Toševski, 1994 or a species close to it. This is remarkable as the occurrence of *Bembecia* is typically restricted to the Palaearctic region, whereas *Lamellisphecia* was known only from the Oriental region.



Figs 1–8. Sesiini specimens. **Figs 1–3.** *Cyanosesia ormosiae* sp. n. **1.** ♀, paratype, alar expanse 32–35 mm (AFCD, CAK). **2.** ♂, holotype, alar expanse 21 mm (BMNH). **3.** ♀, paratype, alar expanse 35 mm (CAK). **4.** *Lamellisphecia xerampelina* sp. n., holotype, ♂, alar exanse 23.5 mm (CAK). **Figs 5–7.** *Sphecodoptera repanda* comb. rev. **5.** ♂ (holotype of *Synanthedon catalina*), alar expanse 32 mm (BMNH). **6.** ♀ (holotype of *Sphecia repanda*), alar expanse 51 mm (BMNH). **7.** ♀, alar expanse 47 mm (BMNH). **8.** *Eusphecia melanocephala* comb. n., ♂, alar expanse 30 mm (CAK).

Sphecodoptera Hampson, 1893 gen. rev.

Type species. *Sphecia repanda* Walker, 1856, by original designation.

= *Scasiba* Matsumura, 1931 syn. n.

Type species. *Scasiba taikanensis* Matsumura, 1931, by original designation.

Sphecodoptera was described by Hampson (1893) on the basis of *Sphecia repanda* Walker, 1856. The genus was considered a synonym of *Sesia* Fabricius, 1775 in the recent Sesiidae literature (Heppner & Duckworth 1981, Pühringer & Kallies 2004, Špatenka et al. 1999). Kallies & Arita (2004), however, already suggested that this taxon may be distinct from *Sesia*. Recent examination of material in the BMNH revealed that *Sphecia repanda* does not belong to *Sesia*. The presence of small wedge-like streaks of scales in the ETA, the form and colouration of the discal spot on the forewing, and the details of the venation (veins CuA1 and CuA2 arising from a common point from the posterior end of the discal spot) indicate that this species belongs to a group of species currently considered to belong to the genus *Scasiba*. Consequently, *Scasiba* is here regarded as a synonym of *Sphecodoptera*. The genus is distributed from northeastern Pakistan through northern India, to China, Japan, Taiwan, and Vietnam.

The following species are here considered to belong to *Sphecodoptera*: *S. repanda* (Walker, 1856) comb. rev., *S. okinawana* Matsumura, 1931 comb. rev., *S. rhynchioides* (Butler, 1881) comb. n., *S. scribai* (Bartel, 1912) comb. n., *S. sheni* (Arita & Xu, 1994) comb. n., *S. difficilis* (Kallies & Arita, 2004) comb. n., *S. taikanensis* (Matsumura, 1931) comb. n., and *S. tenuimarginata* (Hampson, [1893]) comb. n.

Sphecodoptera repanda (Walker, 1856) comb. rev. (Figs 5–7)

= *Synanthedon catalina* Meyrick, 1926 syn. n.

Material. 1♀ (holotype of *Sphecia repanda*) '*Sphecia* | *repanda* | Wkr., Type ♀ ', 'Type', '3. *Sphecia repanda.*' (BMNH); 1♀ 'India: | Punjab, | Khyra Gully. | vii. 1881.', 'H. Roberts Coll. | B.M. 1926-395', '*repanda* Walker' (BMNH); 1♂ (holotype of *Synanthedon catalina*) 'Muktesar, 7500' | Kumaon | TBF. 14. 9. 22', '*catalina* Meyr.' (BMNH).

Sphecia repanda, the type species of *Sphecodoptera,* was previously known from only two specimens, the holotype (Fig. 6) and a second female (Fig. 7). Both were collected in former northern 'British India'. While the type locality of *S. repanda* cannot be traced with accuracy, the second female was collected in present northeastern Pakistan.

Synanthedon catalina was described from a single specimen collected in 'Muktesar' in northwestern India (Meyrick 1926). Examination of the holotype (Fig. 5) revealed that this taxon does not belong to the tribe Synanthedonini but to Sesiini. The venation, shape, and colouration of the discal spot and the presence of small wedge-like streaks of scales in the ETA place this taxon in *Sphecodoptera*. Meyrick (1926) stated in his description that the holotype is a female. The specimen has lost its abdomen and antennae (preserved in a capsule with the specimen); however, the image (Fig. 5) suggests that the specimen is a male. Taking into consideration the sexual dimorphism typical for this genus, the similarity of the type specimens of *S. repanda* and *S. catalina*,

and the close proximity of the type localities, it is here concluded that these taxa are synonymous.

S. repanda seems to occur in the southern foothills of the Himalaya Mountains. The type specimen of *S. catalina* was collected in Mukteshwar in the Kumaon Hills in the Nainital district of Uttarakhand, India, in September. The elevation of the type locality (ca. 2300 m) indicates that this taxon should be considered a Palaearctic species.

Sphecosesia Hampson, 1910

Type species. *Specosesia pedunculata* Hampson, 1910, by original designation.
= *Vespisesia* Heppner, 2010: 179 syn. n.
Type species. *Vespisesia vespiformis* Heppner, 2010, by original designation.

The genus *Sphecosesia* was reviewed and characterized extensively, and six species have been named to date, ranging from Sikkim (NE India) to the Philippines and Borneo (Kallies & Arita 2004). The genus *Vespisesia* was described based on a new species from Vietnam (Heppner 2010). The description and figure leave no doubt that this is a junior synonym of *Sphecosesia*, with its type species, *Vespisesia vespiformis*, being very similar or identical to *Sphecosesia ashinaga* Kallies & Arita, 2004.

Clavisphecia nom. n.

Replacement name for *Clavigera* Kallies & Arita, 2004
Type species *Trochilium pugnax* Meyrick, 1926, by original designation [nec *Clavigera* Hector, 1879: 538 (Brachiopoda)]

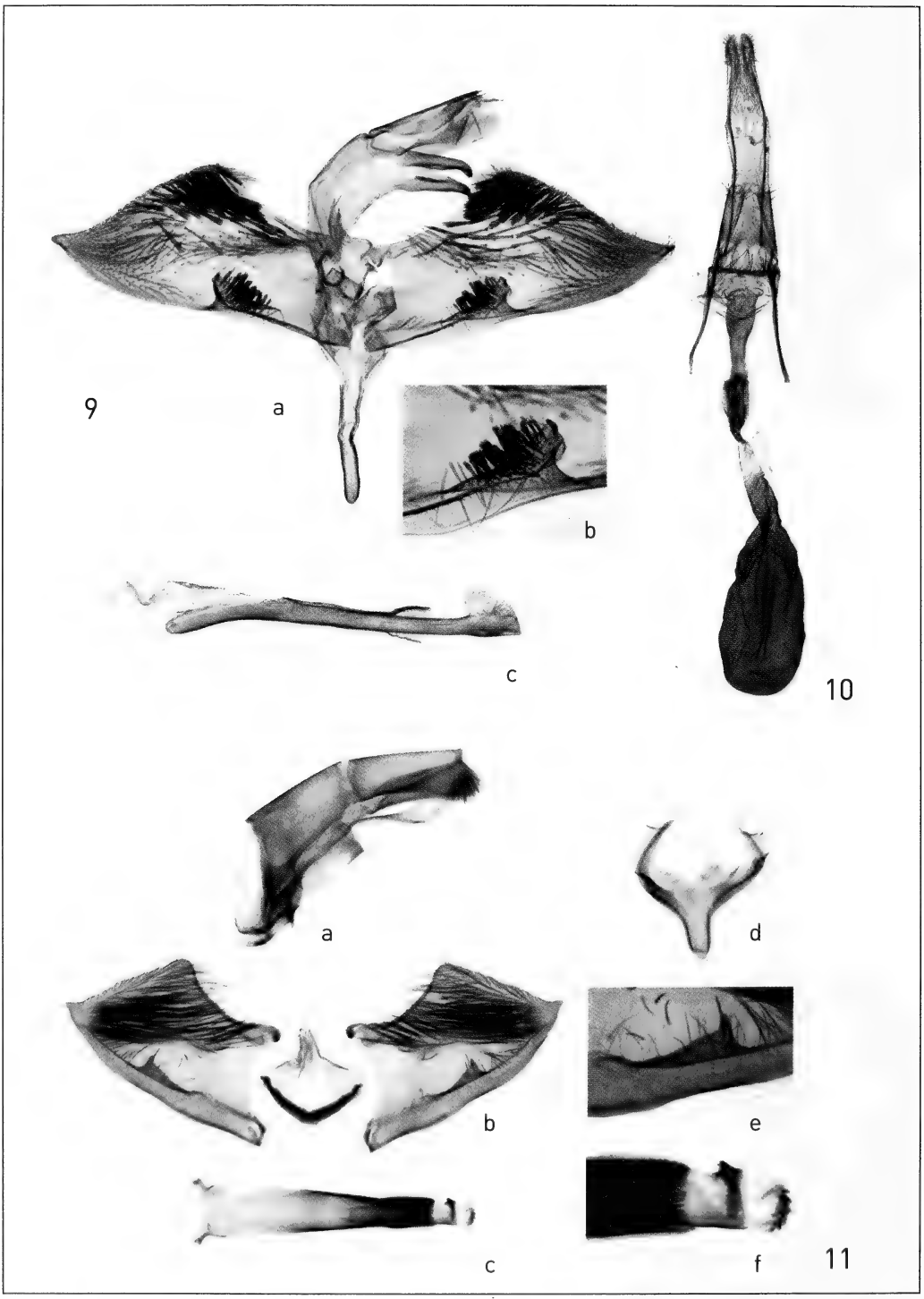
The description of this genus was based on two species, *Trochilium pugnax* from Burma and Vietnam and *Aegeria chrysoptera* Hampson, 1919 from Sri Lanka (Kallies & Arita 2004). Subsequently, the name *Clavigera* was found to be preoccupied by *Clavigera* Hector, 1879 (in Brachiopoda). *Clavisphecia* is here introduced as a replacement name.

Eusphecia Le Cerf, 1937 (Figs 8, 12)

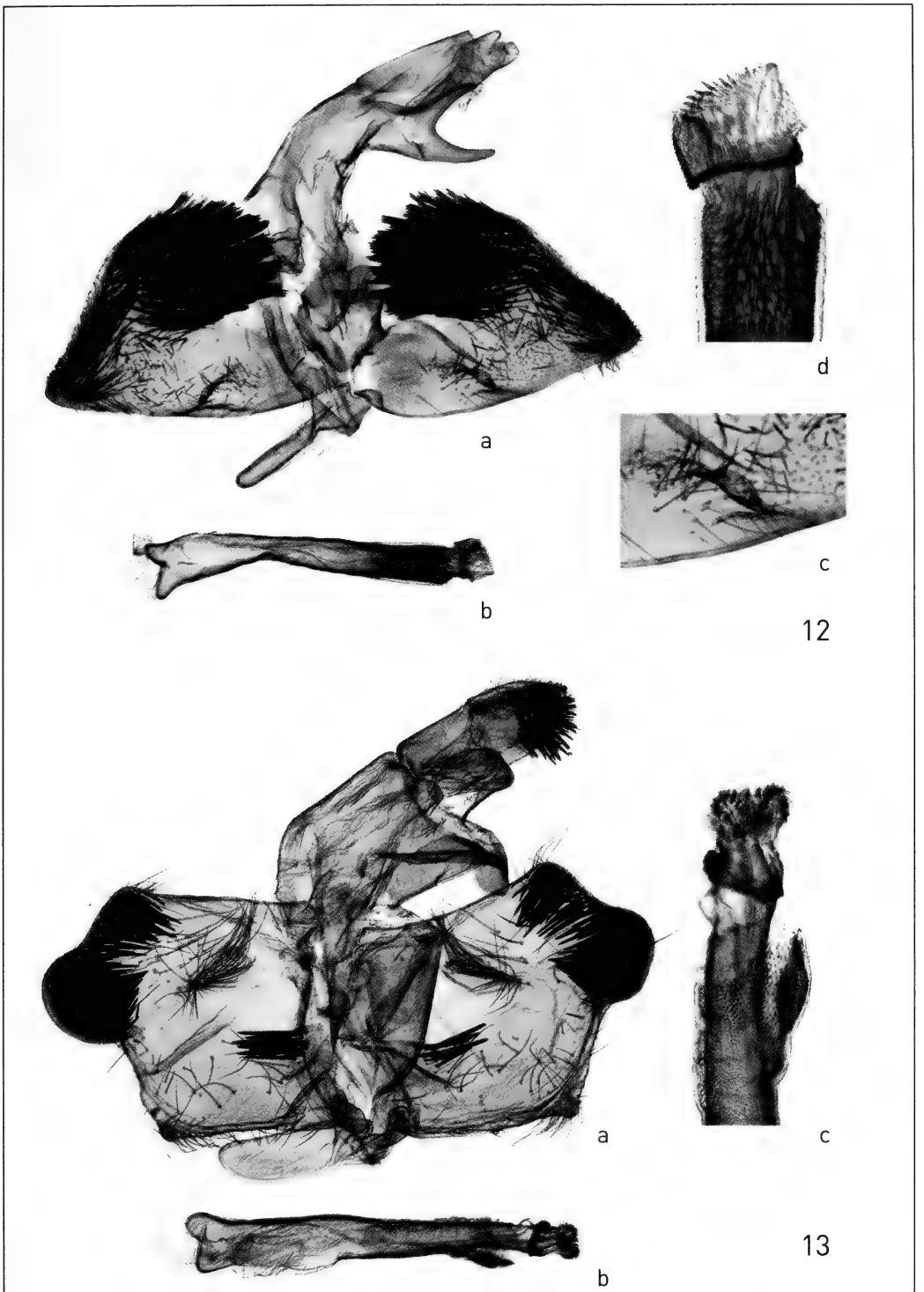
Type species *Sesia pimplaeformis* Oberthür, 1872, by original designation

Material. *E. melanocephala*: 1♂, Germany, Brandenburg, Wernsdorf, 1–16. V. 2000 e.l., leg. F. Rämisch / genitalia examined by A. Kallies, slide No AK700 (CAK, Fig. 12); *Sesia yezoensis* (Hampson, 1919) (Fig. 13): 1♂, Far East Russia, Primorski Krai, Krounowka river, 8–12. VIII. 1994, leg. L. Kühne / genitalia examined by A. Kallies, slide No AK701 (CAK, Fig. 13).

This genus was erected by Le Cerf (1937) to accommodate *Sesia pimplaeformis*, which was followed by Naumann (1971). Subsequently, however, *Eusphecia* was treated as a synonym of *Sesia* by several authors (e.g., Heppner & Duckworth 1981, Špatenka et al. 1999). In contrast, Kallies & Arita (2004) and Pühringer & Kallies (2004) considered it as a distinct genus, although without further explanation.



Figs 9–11. Sesiini, genitalia. **9–10.** *Cyanosesia ormosiae* sp. n. **9.** ♂, paratype. (**a**) ventral view, (**b**) crista of valva, enlarged, (**c**) phallus. **10.** ♀, paratype. **11.** *Lamellisphecia xerampelina* sp. n., ♂, holotype. (**a**) uncus tegumen complex, (**b**) valvae and juxta, (**c**) phallus, (**d**) vinculum and saccus, (**e**) crista of valva, enlarged, (**d**) distal end of phallus, enlarged.



Figs 12–13. Sesiini, male genitalia. **12.** *Eusphecia melanocepala* comb. n. (**a**) ventral view, (**b**) phallus, (**c**) crista of valva, enlarged, (**d**) distal end of phallus, enlarged. **13.** *Sesia yezoensis*. (**a**) ventral view, (**b**) phallus, (**c**) distal end of phallus, enlarged.

Eusphecia (Fig. 12) differs from *Sesia* (Fig. 13) in a number of characters of the male and female genitalia. The ventral part of the valva is extended, apically pointed, with a distinct and strong process near the ventral margin, and covered with multifurcate setae (the dorsal part of the valva is extended, apically rounded, without a process, and covered with strong simple setae in *Sesia*). The gnathos consists of two lateral branches that can be very short as in *E. pimplaeformis* or long and pronounced as in *E. melanocephala* comb. n. (it is typically in the shape of a triangular plate in *Sesia*). The ductus bursae is straight, relatively long and narrow, with a distinct antrum (it is short and angled, without antrum in *Sesia*) (compare Figs 12, 13, as well as figures in Naumann 1971 and Špatenka et al. 1999). According to Naumann (1971) and Špatenka et al. (1999) the male antennae in *Sesia* and *Eusphecia* are bipectinate; however, both genera have clearly unipectinate antennae. The rami are somewhat longer and slightly bent downwards in *Eusphecia*, while they are somewhat shorter and oriented upwards in *Sesia.*

Eusphecia is probably most closely related to *Lamellisphecia*, but it also appears to shows similarities with *Sphecodoptera* and *Cyanosesia*. It differs from *Lamellisphecia* by the presence of scale-like setae on the inner surface of the valva and the absence of an apical plate on the phallus. *Eusphecia* differs from *Sphecodoptera* and *Cyanosesia* by having distinct antennal rami (rami not distinct in the genera compared), the absence of wedge-like extensions of scales from the apical area into the ETA (present in the genera compared) and the absence of a distinct field of scale-like setae near the dorsal margin of the valva (present in *Sphecodoptera*).

Re-examination of Palaearctic Sesiinae revealed that *Sesia melanocephala* Dalman, 1816 (Fig. 8) displays all characteristics of *Eusphecia*. Therefore, the following new combination is introduced, *Eusphecia melanocephala* (Dalman, 1816) comb. n.

Ackowledgements

The author would like to express his gratitude to John K Page (Thomson Zoological Ld) for drawing attention to the homonymy of *Clavigera*, to Kevin Tuck (BMNH) for providing access to the BMNH collection, to Ping Wing Chan (AFCD) for collecting the type material of *C. ormosiae*, to Tony Wong (AFCD) for the loan of material examined here, to Peter Kautt, Frank Rämisch and Lars Kühne for the donation of specimens, and to Daniel Bartsch for providing images of specimens from the BMNH.

References

Arita, Y. & O. Gorbunov 2002. Sesiidae of Taiwan. II. The tribes Osminiini, Melittiini and Sesiini. – The Japanese Journal of Systematic Entomology **8**: 199–241.

Fischer, H. 2005. *Lamellisphecia sumatrana* sp. n., eine neue Glasflüglerart aus Sumatra (Lepidoptera: Sesiidae, Sesiinae). – Entomologische Zeitschrift **115**: 91–93.

Gorbunov, O. & Y. Arita 1995. New and poorly known clearwing moth taxa from Vietnam (Lepidoptera, Sesiidae). – Transactions of the Lepidopterological Society of Japan **46**: 69–90.

Gorbunov, O. & A. Kallies 1998. Two new species of the genus *Cyanosesia* Gorbunov & Arita, 1995 (Lepidoptera, Sesiidae) from the Oriental Region. – Nachrichten des entomologischen Vereins, Frankfurt am Main, Apollo, Suppl. **17**: 457–464.

Hampson, G. F. 1893. Family Sesiidae. – The Fauna of British India, including Ceylon and Burma (Moths) **1** (imprint "1892"), xxiii+527 pp. (187–206)

Hector, J. 1879. On the Fossil Brachiopoda of New Zealand. – New Zealand Institute, Transactions and Proceedings **11**: 537–539.

Heppner, J. B. 2010. Notes on Vietnam Moths, 14. *Vespisesia* a new clearwing moth genus and species from Vietnam (Lepidoptera: Sesiidae: Sesiinae). – Lepidoptera Novae **3**: 179–181.

Heppner, J. B. & W. D. Duckworth 1981. Classification of the Superfamily Sesioidea (Lepidoptera, Ditrysia). – Smithsonian Contributions to Zoology **314**: 1–144.

Kallies, A. 2003. Two new species of Sesiini from the Oriental Region (Lepidoptera: Sesiidae, Sesiinae). – Nachrichten des entomologischen Vereins, Frankfurt am Main, Apollo **23**: 161–166.

Kallies, A. 2007. A revision of the clearwing moth species described by Zukowsky from China with additional notes on Sesiidae species from the Mell collection (Sesiidae). – Nota lepidopterologica **30**: 387–396.

Kallies, A. & Y. Arita 1998. New and little known clearwing moths (Lepidoptera, Sesiidae) from the Philippine Islands. – Transactions of the Lepidopterological Society of Japan **49**: 245–270.

Kallies, A. & Y. Arita 2004. A survey of the clearwing moths of the tribe Sesiini (Lepidoptera, Sesiidae) from Vietnam and adjacent countries with a synopsis of the Oriental Sesiini fauna. – Tinea **18**: 65–95.

Kallies, A. & J. J. de Freina 2009. *Sesia himachalensis* sp. n. and *Sesia ladakhensis* Špatenka 1990 comb. rev. from the Indian Himalaya (Lepidoptera: Sesiidae, Sesiinae). – Nachrichten des entomologischen Vereins, Frankfurt am Main, Apollo **30**: 169–172.

Kendrick, R. C. 2001. New moth species for Hong Kong, part 5: update and further 1999 records. – Porcupine! Newsletter of the Department of Ecology and Biodiversity, The University of Hong Kong **22**: 3–4.

Le Cerf, F. 1937. Aegeriidae nouvelles ou peu connues d'Asie antérieure. – Zeitschrift des Österreichischen Entomologen-Vereines **22**: 81–89, 96–99, 103–109.

Meyrick, E. (1926) Aegeriadae [sic]. – Exotic Microlepidoptera **3**: 266–270.

Naumann, C. M. 1971. Untersuchungen zur Systematik und Phylogenese der holarktischen Sesiiden (Insecta, Lepidoptera). – Bonner Zoologische Monographien **1**, 190 pp.

Petersen, M. & A. Lingenhöle 1998. Zur Kenntnis von *Sesia nirdhoji* sp. n., *Sesia ruficollis* sp. n. und *Bembecia lamai* Kallies 1996 aus dem Dhaulagiri Himal/Nepal (Lepidoptera: Sesiidae). – Esperiana **6**: 41–49, 846–847.

Pühringer, F. & A. Kallies 2004. Provisional checklist of the Sesiidae of the world (Lepidoptera: Ditrysia). – Mitteilungen der Entomologischen Arbeitsgemeinschaft Salzkammergut **4**, 185 pp.

Špatenka, K., O. Gorbunov, Z. Lastuvka, I. Tosevski & Y. Arita 1999. Sesiidae – Clearwing Moths. *In*: C. Naumann (ed.), Handbook of Palaearctic Macrolepidoptera, Vol. 1, 569 pp. – Gem Publishing Company, Wallingford, England.

SwissLepTeam* 2010. Die Schmetterlinge (Lepidoptera) der Schweiz . Eine kommentierte, systematisch-faunistische Liste. – Centre suisse de cartographie de la faune & Schweizerische Entomologische Gesellschaft. – Fauna Helvetica, Neuchâtel 25. 350 pp. – ISBN 978-2-88414-037-9. In German.

Switzerland can be once more mentioned for its high-quality products: The new checklist of the Lepidoptera of Switzerland is printed on high-quality paper (not disturbingly glossy), contains numerous high-quality colour photographs, as well as stitched binding in hardcover. The publication is authored by 25 lepidopterists*, who name themselves "SwissLepTeam", under which the book is officially authored.

The book starts with an historical overview of the faunistics of Swiss Lepidoptera, which dates back to the 17th century. Among others, outstanding lepidopterists are mentioned and reference is made to two bibliographies covering the periods 1634–1900 and 1900–1982. The introductory part closes with an outline of the importance of faunistic research for the conservation of species and points to the serious decline of experts, as well as the currently hardly existing teaching of students at universities in fields related to faunistics and natural history.

The systematic-faunistic list starts with short statements about the degree of the faunistic exploration of every family group and provides the names of responsible authors per family. Occurrence of species within Switzerland is given for the six sub-regions: Jura (JU), Central Country (ML), northern Alps (NA), Wallis (WA), Graubünden (GR) and southern Switzerland (SS). Records within these regions are distinguished by symbols for verified records, literature or database records and doubtful records. Species are listed with the respective numbers used in the European checklist by Karsholt & Razowski (1996). For many species, comments are given on important occurrences or systematics and nomenclature in an appendix.

The book is well illustrated by numerous colour photographs, starting with examples of the scenery of the six sub-regions of Switzerland. Living adults are illustrated for every lepidopteran family, thus providing useful images for recognising the main groups of butterflies and moths in nature. For some groups, the immatures and typical frass are also shown.

The book is completed with a list of references and an index to scientific names referring to page numbers for family group names and to Karsholt & Razowski's (1996) numbers for genus and species group names. Altogether, 3668 species are now recorded for Switzerland, not counting the 183 disproved species records.

The book is easy to use, even for non-German speaking lepidopterists, and a must-have for anybody interested in the faunistics of Central European butterflies and moths. It is highly recommend for beginners due to its didactic value for recognising lepidopteran families.

Matthias Nuss

References

Karsholt, O. & J. Razowski 1996. The Lepidoptera of Europe. A distributional checklist. – Apollo Books, Stenstrup, Denmark. 1–380, 1 CD-ROM.

* Aistleitner, U., M. Albrecht, F. Altermatt, G. Artmann, D. Bolt, R. Bryner, M. Fluri, D. Fritsch, K. Grimm, R. Guenin, M. Hächler, P. Hättenschwiler, R. Joos, T. Kaltenbach, W. Keller, A. Kopp, B. Landry, B. Merz, L. Reser, W. Sauter, J. Schmid, P. Schmitz, P. Sonderegger, S. Whitebread & H.-P. Wymann

The protected Transylvanian Blue (*Pseudophilotes bavius hungarica*): new information on the morphology and biology

Andrei Crișan [1], Cristian Sitar [2], Cristina Craioveanu [3] & László Rákosy [4]

Department of Taxonomy and Ecology, Babeș-Bolyai University, str. Clinicilor 5–7, Cluj-Napoca, Romania

[1] andrei.crel@gmail.com
[2] cristian_sitaru2007@yahoo.com
[3] christii_99@yahoo.com
[4] corresponding author; laszlorakosy@hasdeu.ubbcluj.ro

Abstract. *Pseudophilotes bavius hungarica* (Diószeghy, 1913) is an endemic subspecies from Transylvania with a distribution restricted to steppe-like habitats. It is included as a protected entity in Romanian and European legislation. The present study reveals new data on the morphology and biology, host plants, and behaviour of this taxon and tries to provide a basis for developing conservation measures in the future.

Introduction

The Transylvanian Blue, *Pseudophilotes bavius hungarica* (Diószeghy, 1913), is mentioned in the annexes II and IV of the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, the European Red List of Butterflies (van Swaay et al. 2010), in the Romanian legislation (OUG 57/2007 approved with amendments by Law 49/2011 on the protected nature reserves, natural habitats, wild flora and fauna), and the Red List of Romania (EN) (Rákosy 2002).

The conservation status of this taxon is due to the restricted distribution of its populations in Romania. The Transylvanian Blue can only be found in areas with steppe-like vegetation and presence of the larval host plant *Salvia nutans* L. (Lamiaceae) (Kovács et al. 2001). One of the known populations in Transylvania, considered to be the healthiest, is located in Suatu (Cluj County), in and around the botanical nature reserve (Fig. 1).

As conservation efforts need to be based on a good knowledge of the characteristics and behaviour of the taxon in question, and as previous data (Jutzeler et al. 1997, König 1992) were incomplete, we provide new information about the morphology of the egg, larva, and adult and the biology of this protected taxon.

Materials and methods

The study was conducted at two sites (each 9500 m^2) with high densities of *S. nutans* in and around the Suatu botanical nature reserve. In these locations we systematically collected and observed all stages in the development of *P. bavius hungarica*.

The pre-adult developmental stages and the adults were observed and studied both in the laboratory and in the field between April 15 and June 15, 2010 and 2011. During the same period, larval host plants, flight pattern, oviposition preferences, host plant

phenology, and meteorological parameters were recorded daily for 60 minutes with time being randomised to avoid systematic effects of the time of day.

Twenty-seven larvae, together with their host plant (in pots) and the respective closest ant colony were transferred and reared in the laboratory. These larvae were fed and observed daily for 120 minutes to analyse their mobility, myrmecophily, and parasitism. The ants and parasites were sent to specialists for identification.

For a more accurate description of the taxon, detailed photographs (macro and scanning electron micrographs) of the eggs, larvae, and pupae were taken.

Results and Discussion

Taxonomy

The name *Pseudophilotes bavius hungaricus* was often erroneously used in the literature, as for example in all editions of "A field guide to the Butterflies of Britain and Europe" (Higgins & Riley 1970, 1978; Tolman & Lewington 1997, 2008) and in "Verzeichnis der Schmetterlinge Rumäniens" (Rákosy et al. 2003). We wish to emphasize that the correct name of this taxon is *Pseudophilotes bavius hungarica* as it was originally described by Diószeghy in 1913 under this name.

P. bavius hungarica is completely isolated, both ecologically and geographically, from other subspecies of *P. bavius*, the closest being *P. bavius egea* present at a distance of about 200 km southeast of the Carpathian arch (Dincă et al. 2011a). Due to this isolation, the question arose whether it would be appropriate to change the taxonomic status from subspecies to species. However, the hypothesis that these taxa are conspecific was rejected by molecular studies comparing *P. bavius hungarica* and *P. bavius egea*, which revealed a rather weak genetic differentiation between them (Dincă et al. 2011b).

Morphology

E g g . The eggs are laid between the unopened hairy flower whorls of the host plant. The colour of fresh eggs is whitish. They are in the shape of a flattened sphere with a slightly deepened micropylar area, a diameter of 0.50–0.62 mm and a height of 0.25–0.28 mm. The chorion shows a characteristic reticulate structure (Fig. 2). The micropylar rosette is made up of more or less regular polygonal cells (Fig. 3). The size and the shape of the egg were first described by König (1992) and Jutzeler et al. (1997).

L a r v a . After a short period of embryonic development (7–12 days), whitish, very mobile, 2.5 mm long larvae emerge and climb into the growing flower spikes. Our observations confirm those of König (1992) about the duration of the larval stage, which extends over 25–30 days. After the first moult, the larva changes its shape and colour; on the flattened and, at both ends, rounded body a horizontal line and many diagonal lateral lines appear, and the colour becomes very similar to that of the host plant (König 1992) (Figs 4–5). On the larval body several lateral rows of long hairs can be observed (Fig. 6), as well as two rows of subdorsal hair pairs and a double row of dorsal hairs,

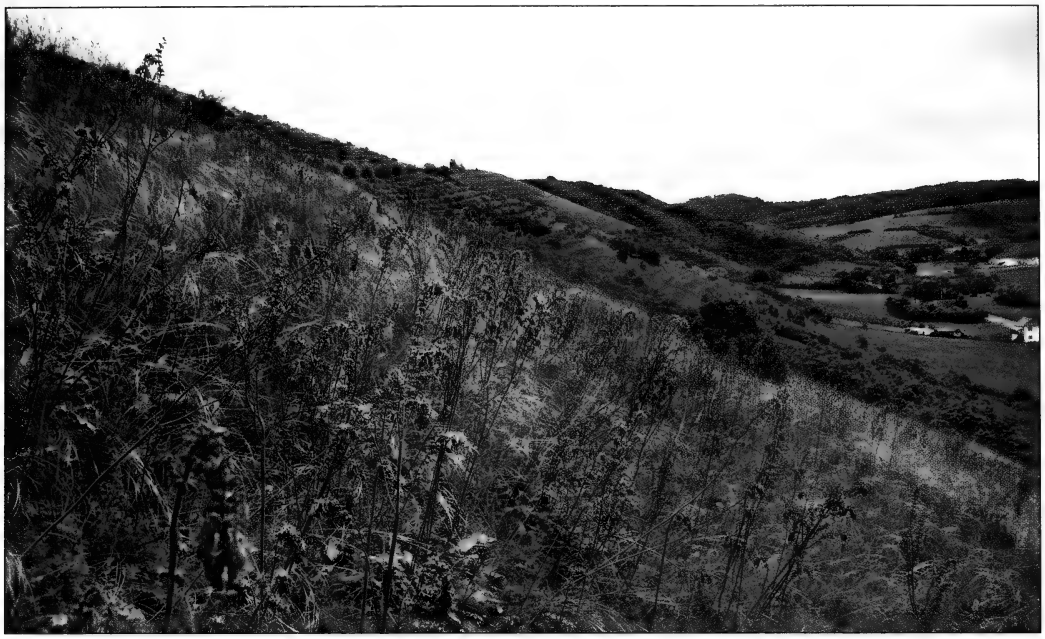
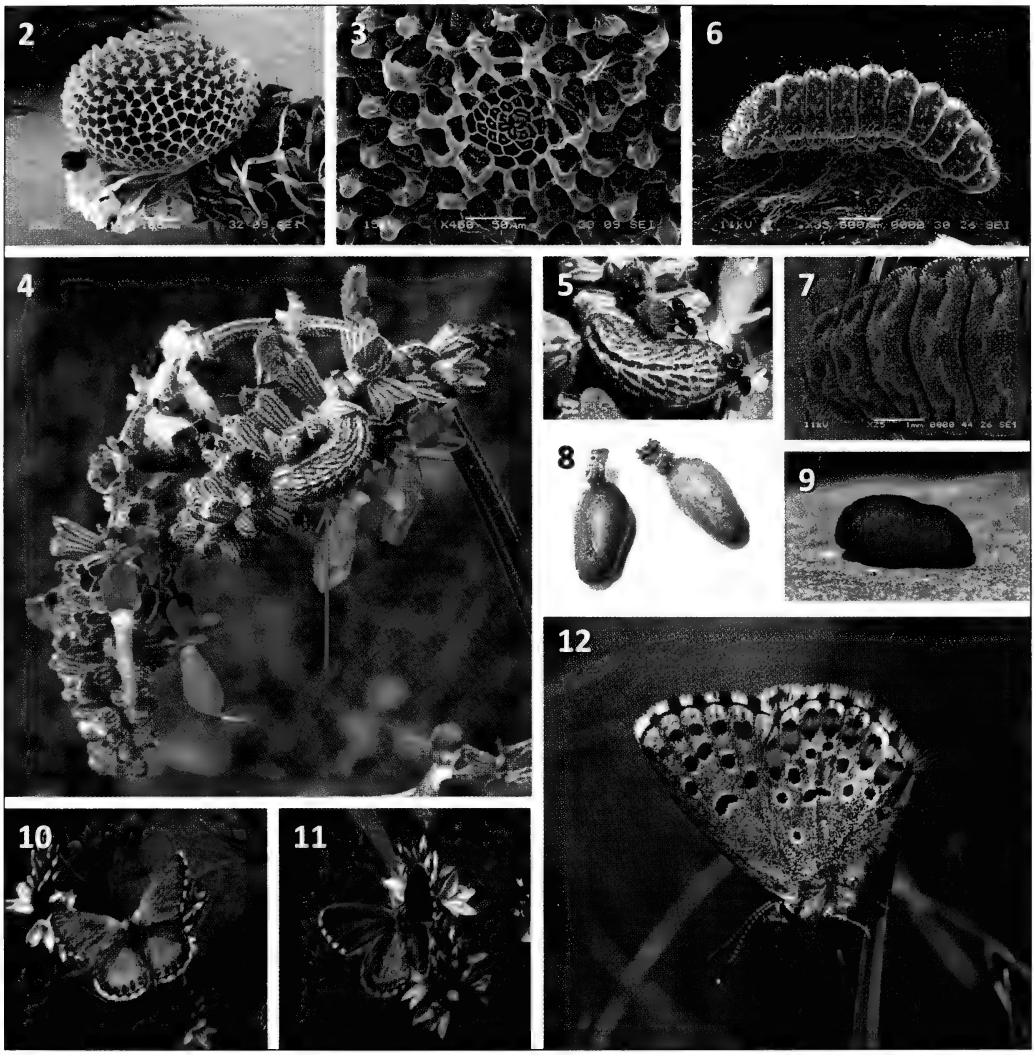


Fig. 1. Terraces with flowering *Salvia nutans* at Suatu – suitable habitat for *P. bavius hungarica*.

which are shorter and more visible in later larval developmental stages (Fig. 7). Both field and laboratory observations showed that the last instar larvae have a lower mobility, but they still move from one floret to another without leaving the host plant.

P u p a . The mature larva climbs down the host plant onto the ground in order to pupate and prepares a pupation site by binding together sand, fine gravel and plant material with a silken thread (König 1992). The pupal colour varies from a light brownish-green in the beginning of this stage (Fig. 8), to a dark brown colour by the end of the pupal stage (Fig. 9). The pupa is barrel shaped with a length of 7–9 mm (7–8 mm was indicated previously by Jutzeler 1997) and a width of 4–5 mm (König 1992). Pupation takes place on the ground next to the host plant (König 1992). The pupae were kept in the laboratory for 280–290 days and the butterflies emerged in the first ten days of April.

A d u l t . The average wingspan resulting from measuring 20 males and 24 females was 22.24 mm ± 1.29 SD for the males and 22.35 mm ± 2.35 SD for the females. The smallest individual had a wingspan of 17.2 mm (female) and the largest of 25.1 mm (also a female). The upperside of the wings in males has a more pronounced blue colour with a metallic iridescence and a row of orange spots narrower than in females (Fig. 10). The dorsal area of the forewing in females is darker and has less of a blue metallic iridescence and the row of orange spots on the hindwing is more intensly marked (Fig. 11). The row of orange spots on the hindwing is more intensly marked on the ventral side of the wings in both sexes (Fig. 12). There is individual variability, especially in the size and the number of the orange spots on the upper- and underside of the hindwing, and in the size of the black spots on the underside of both wings.



Figs 2–3. Scanning electron micrographs (SEM) of the *P. bavius hungarica* egg (photos by Mihali): **2.** General view. **3.** Detail of micropylar rosette. **Figs 4–5.** *P. bavius hungarica* larvae: **4.** Larva before pupation perfectly camouflaged in the *Salvia nu-tans* flowers. **5.** *P. bavius hungarica* larvae visited by *C. atricolor* ants. **Figs 6–7.** *P. bavius hungarica* larva (SEMs by Mihali): **6.** Second larval instar. **7.** Detail of dorsal view. **8.** Fresh pupae of *P. bavius hungarica*. **9.** Mature pupa of *P. bavius hungarica* (photo by Gascoigne-Pees). **Figs 10–12.** Imago of *P. bavius hungarica*: **10.** Male. **11.** Female feeding on *Veronica prostrata.* **12.** Ventral view.

Biology

Pseudophilotes bavius hungarica larvae are monophagous, feeding exclusively on *Salvia nutans*. In laboratory conditions they also accept *S. pratensis* L. (Jutzeler et al. 1997).

P. bavius hungarica is a monovoltine species; the flight period of the adult starts at the end of April, but depending on the particular climatic conditions each year, it can vary significantly. In the time interval 1910–2010 the earliest observed beginning of the flight period was reported by Diószeghy (1913) on the 20th of April in Vițe. In 100

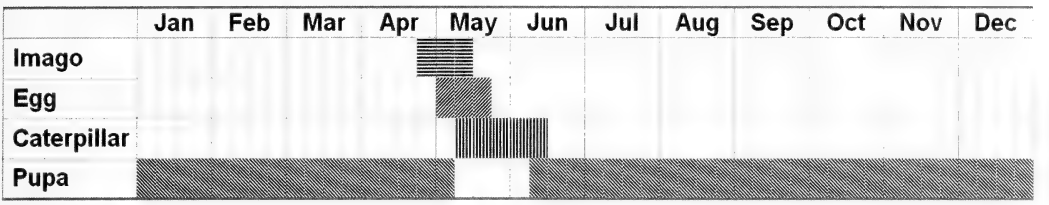


Fig. 13. Developmental stages of *P. bavius hungarica.*

years of observations of the populations of *P. bavius hungarica* from the Transylvanian Basin no earlier beginning of its flight period has been recorded. In 2011, when the month of April was extremely dry and warm, the first individuals were observed on the 18th of April. Usually, the flight period lasts for 15–17 days. However, climatic disturbances can break or derange the flight period, leading to its extension of up to four weeks. The last individuals were observed on the 17th of May. Twenty-seven larvae, together with their host plant (in pots) and the respective closest ant colony were transferred and reared in the laboratory. These larvae were fed and observed daily for 120 minutes to analyse their mobility, myrmecophily, and parasitism. The ants and parasites were sent to specialists for identification. For a more accurate description of the taxon, detailed photographs (macro and scanning electron micrographs) of the eggs, larvae, and pupae were taken.

During our field observations we noticed that the flowers of *S. nutans* appeared later and in fewer numbers in 2011 compared to 2010. This change might explain the observed oviposition preferences of the adults in 2011. Thus, on the flower whorls we found 10–11 eggs in 2011, compared to 3–5 eggs in 2010. As a consequence, the number of larvae observed on a single flower whorl was also higher in 2011 (maximum of five) compared to 2010 (maximum of two). In this context, it has to be noted that the number of observed *P. bavius hungarica* individuals was low in Suatu during the 2011 flight season, just about 10% of the 2010 season. The life cycle of *P. bavius hungarica* is summarized in Fig. 13.

Our field observations confirmed the following plants to be nectar sources for the adults: *Veronica prostrata* L. (Scrophulariaceae), *Fragaria viridis* Duchesne (Rosaceae), *Thymus marschallianus* Willd. (Lamiaceae), and *Euphorbia seguieriana* Neck. (Euphorbiaceae).

Parasites. From the 27 larvae that we studied in the laboratory, six pupated (22%), five were infested with the braconid wasp *Apanteles* sp. and the tachinid fly *Aplomya confinis* (Fallén, 1820), and the rest died of unknown causes.

Myrmecophily. We observed larvae often being visited by ants of the species *Camponotus atricolor* (Nylander, 1849) (det. Marko) (Fig. 5), in contrast to Jutzeler et al. (1997), who found ants of the species *Crematogaster sordidula* (Nylander, 1849) visiting the larvae of *P. bavius hungarica.* Our field and laboratory observations confirm a facultative myrmecophily with the ant *C. atricolor.* Thus, our findings support and

complement the data given by König (1992) and Jutzeler et al. (1997). No *P. bavius hungarica* larva was found on florets infested by aphids.

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References

Dincă, V., S. Cuvelier & M. S. Mølgaard 2011a. Distribution and conservation status of *Pseudophilotes bavius* (Lepidoptera: Lycaenidae) in Dobrogea (south-eastern Romania). – Phegea **39** (2): 59–67.

Dincă, V., E. V. Zakharov, P. D. N. Hebert & R. Vila 2011b. Complete DNA barcode reference library for a country's butterfly fauna reveals high performance for temperate Europe (Annex 2 – Neighbour-joining tree of 1387 barcoded specimens of Romanian butterflies). – Proceedings of the Royal Society B **278** (1704): 347–355.

Diószeghy, L. 1913. Adatok a *Lycaena bavius* Ev. életmódjához. – Rovartani Lapok, Budapest **20**: 105–109.

Higgins, L. G. & N. D. Riley 1970. A field Guide to the Butterflies of Britain and Europe. Collins Publishers, London. 380 pp.

Jutzeler, D., L. Rákosy & E. Bros 1997. Observation et élevage de *Pseudophilotes bavius* (Eversmann, 1832) des environs de Cluj; distribution de cette espèce en Roumanie. Une nouvelle plante nouricière de *Colias alfacariensis* (Ribbe, 1905). – Bulletin de la Société Entomologique de Mulhouse: Avril-juin: 23–30.

König, F. 1992. Morphologische, biologische une ökologische Daten über *Philotes bavius hungarica* Diószeghy 1913. Lepidoptera. Lycaenidae. – Entomologische Zeitschrift, Jhg. 102, Nr. **9–10**: 168–172, 188–191.

Kovács, S., L. Rákosy, Z. Kovács, C. Cremene & M. Goia 2001. Lepidoptera (Fluturi). Pp. 81–114. – *In*: L. Rákosy & S. Kovács (eds) Rezervația Naturală „Dealul cu fluturi" de la Viișoara. – Societatea Lepidopterologică Română.

Rákosy, L. 2002. Lista roșie pentru fluturii diurni din România. – Buletinul informativ al Societății Lepidopterologice Române **13** (1–4): 9–26.

Rákosy, L., M. Goia & Z. Kovács 2003. Catalogul Lepidopterelor României / Verzeichnis der Schmetterlinge Rumäniens. – Societatea Lepidopterologică Română, Cluj-Napoca. 446 pp.

Tolman, T. & R. Lewington 2008. Collins Field Guide to the Butterflies of Britain and Europe. 3rd ed. – Harper Collins, London. 400 pp.

van Swaay, C., A. Cuttelod, S. Collins, D. Maes, M. López Munguira, M. Šašić, J. Settele, R. Verovnik, T. Verstrael, M. Warren, M. Wiemers & I. Wynhoff 2010. European Red List of Butterflies. – International Union for Conservation of Nature. 1–10 + 1–47 pp.

*** Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

*** OUG 57/2007 approved with amendments by Law 49/2011 on the protected nature reserves, natural habitats, wild flora and fauna (in Romanian).

Catocala afghana Swinhoe, 1885, a new species for the Kyrgyzian fauna (Lepidoptera: Erebidae: Catocalinae)

Stanislav K. Korb

a/ya 2, Knyaghinino, Nizhny Novgorod Province, 606340 Russia; stanislavkorb@rhopalocera.com

Abstract. *Catocala afghana* Swinhoe, 1885 is recorded for the first time from North Kyrghyzstan, in the Bishkek area.

Резюме. *Catocala afghana* Swinhoe, 1885 впервые приводится для Северного Кыргызстана (окрестности Бишкека).

Introduction

On June 24, 2004 during a moth-collecting session with a 250-Watt mercury vapour light in the Bishkek area (Kyrgyzstan), at the specific location of Kok-Dzhar (in local letters: Кок-Жар), a large underwing moth was trapped. At first determination it resembled *Catocala nupta* (Linnaeus, 1767) but the form of red fields, colouration of forewing upperside and red spotting along the external border of hindwing were atypical (Figs 1, 2). Further investigation made it clear that it was *Catocala afghana* Swinhoe, 1885 described from "Gwal" and "Quetta" localities in Southern Afghanistan (Swinhoe 1885: 352). This identification was confirmed by Dr. A. V. Sviridov. It is the first record of this species in Kyrgyzstan and in the northeastern part of Middle Asia.

Catocala afghana occurs in Afghanistan and Pakistan (Sviridov 2008) and the distribution is extremely fragmented. This record is about 1000 km from the known distribution area of the species. The biology of this little-known moth is unknown. The specimen was collected in a small river valley in the zone of foothill semideserts (Fig. 3).

Identification details. This species belongs to the *C. elocata* (Esper, 1787) species group with which it shares all the specific features: almost the same pattern of gray lines on the forewing upperside, a red spot in the marginal border on the upperside of the hindwing and the apex of the valve in male genitalia not rounded. Species closely related to *C. afghana* are *C. locata* Staudinger, [1892] and *C. deducta* Eversmann, 1843. *C. afghana* differs from them in the following characters: from *C. locata* by the shorter black band in the middle of the hindwing (not reaching the anal edge of the wing) and by the red w-shaped post-discal band connected with the red basal band in the anal part of the wing; from *C. deducta* by the darker wing coloration (especially in the forewing) and by the red w-shaped post-discal band connected with the red basal band in the anal part of the wing.

Figs 1–2. *Catocala afghana* Swinhoe, 1885. **1.** Male upperside, 24.06.2004, Bishkek area, 800 m, leg. S. Korb. **2.** Male underside, 24.06.2004, Bishkek area, 800 m, leg. S. Korb.

Fig. 3. Biotope where *C. afghana* Swinhoe, 1885 was caught: Bishkek area, locality Kok-Dzhar, 800 m, semidesert.

Acknowledgements

I would like to thank Dr. A. V. Sviridov (Zoological Museum of Moscow University) for valuable help with identification.

References

Sviridov, A. V. 2008. A catalogue of the underwing moths (Lepidoptera, Erebidae, *Catocala*) of the Palaearctic. – Trudy Zoologicheskogo Museya Moskovskogo Universiteta **49**: 70–100.

Swinhoe, C. 1885. List of Lepidoptera collected in Southern Afghanistan. – Transactions of the Royal Entomological Society of London **1885**: 337–355.

Lebensweise und Beschreibung der Entwicklungsstadien von *Pachythelia villosella quadratica* de Freina, 1983 (Psychidae: Oiketicinae: Acanthopsychini)

Peter Hättenschwiler

Seeblickstraße 4, CH-8610 Uster, Schweiz; peter.haettenschwiler@dative.ch

Abstract. The original description of *Pachythelia villosella quadratica* De Freina, 1983 is based on two males and their bags from Turkey. New material of this taxon became known only recently. During 2007, a bag with eggs was found in the same region from which two generations were reared. Based on the specimens obtained, all developmental stages are described and the status of the taxon is discussed.

Zusammenfassung. Die Originalbeschreibung von *Pachythelia villosella quadratica* De Freina, 1983 basiert auf zwei Männchen und deren Säcke aus der Türkei. Bis vor kurzem sind keine weiteren Belege dieses Taxons bekannt geworden. 2007 wurde in der gleichen Region ein Sack mit Eiern gefunden, die über zwei Generationen weiter gezüchtet wurden. Basierend auf diesen Nachkommen werden alle Entwicklungsstadien beschrieben sowie der Status des Taxons diskutiert.

Einleitung

Vom 22. bis 24. Mai 1981 wurden durch eine Entomologen-Gruppe im Gebiet der östlichen Türkei Bombyces und Sphinges gesammelt. Dabei fand Herr Josef de Freina in der Nähe von Antalya in Termessos auf einer Höhe von 900–1000 m einen Psychidensack, der zwischen Steinen angesponnen war. Aus diesem Sack schlüpfte am 8.7.1981 ein männlicher Falter. In der Zoologischen Staatssammlung München befindet sich ein weiteres Männchen mit Sack (leg. Heuberger), ebenfalls aus der Nähe von Antalya, in der Umgebung Alanya (e.l. 30.5.1978). Aufgrund dieser beiden Männchen und ihrer Säcke wurde 1983 *Pachythelia villosella quadratica* De Freina, 1983 beschrieben.

Am 9.6.2007 wartete der Spinnen-Spezialist Siegfried Huber in der Provinz Adana, ca. 30 km nördlich Kozan in der östlichen Türkei auf den Bus zur Weiterreise. Vor der Weiterfahrt inspizierte er das Bushäuschen auf der Suche nach Spinnen und fand dabei auf der Rückseite zwei etwa 28 mm lange Psychidensäcke. Diese Säcke wurden mit einigen Blättern aus der Umgebung in einer Schachtel im Gepäck verstaut. Am 14.6.2007, noch auf der Weiterreise in der Türkei, schlüpften aus dem einen Sack junge Räupchen die an den Blättern, die als Feuchtigkeitsspender und Polsterung mit den Säcken zusammen in der Schachtel lagen, nagten und aus Pflanzenfragmenten kleine Säckchen bauten.

Durch unseren gemeinsamen Freund Dr. Jakob Walter kamen die beiden Psychidensäcke und die jungen Raupen zu uns. Die Weiterzucht wurde in Zuchtkästen durchgeführt, in denen ein der Natur im Fundgebiet nachgebildeter Biotop eingerichtet war und die Raupen gut gediehen.

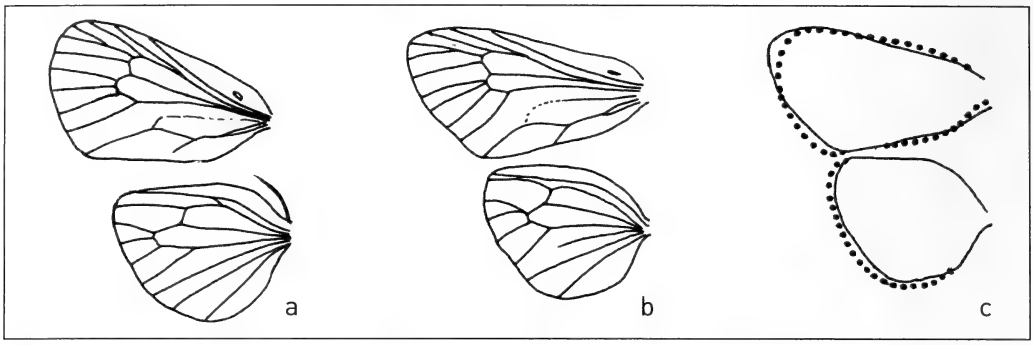

Abb. 1. Darstellung der Flügeladerung und -form. **a.** *P. villosella quadratica*, **b.** *P. villosella villosella*, **c.** die beiden übereinander gezeichnet, dünner Strich *P. v. villosella*, Punktlinie *P. v. quadratica*. Die Skizze zeigt ein Beispiel; die Unterschiede können ausgeprägter oder weniger auffallend sein.

Pachythelia villosella quadratica de Freina, 1983

Material. Türkei, Adana, ca. 30 km N Kozan (37°27'N 35°49'E). Das gesamte Material stammt vom gleichen Weibchen ab, das zur Beobachtung in zwei ex ovo Zuchten kultiviert wurde. Belege sind in den folgenden Sammlungen deponiert: National Museum of Natural History Washington DC, USA; INRA Orleans Forerstry Unit, Olivet, France; Naturhistorisches Museum Wien, Österreich; Museum Witt, München; Natural History Museum, London; Schmalhausen Institut of Zoology, National Academy of Science, Kiev, Ukraine; Nationaal Naturhistorisch Museum, Leiden, Niederlande sowie in einigen Sammlungen von Freunden und Kollegen.

Beschreibung. Männchen (Abb. 2a, 3, 4b). Flügel Spannweite 21–26 mm (Mittel 24 mm, n = 41), alle Flügel braun, dicht beschuppt mit langen Schuppen der Klassen 1–2 (Sauter 1956), Flügelfransen um den Apex der Vorderflügel (Vfl.) meist breit, oft mehrspitzig. Vfl. mit neun Adern aus der Discoidalzelle (DZ), r3+r4 und m2+m3 gestielt oder aus einen Punkt (selten nur acht Adern aus DZ, dann sind m2+m3 verschmolzen). Hinterflügel (Hfl.) Farbe und Beschuppung wie Vfl. Fünf Adern aus DZ, Radialramus (rr) mit Subcosta (sc) im basalen Drittel der DZ durch Querader verbunden. Der vordere Teil der DZ, zwischen dem Radialramus und der trennenden Ader der DZ in m1 mündend, ist deutlich kürzer als der hintere Teil. Antennen dunkelbraun, total 27–34 Glieder (Abb. 3) lange beschuppte Kammzähne, die feine Setae tragen. Ocellen fehlen, Augen klein, leicht hochoval im Abstand von 2–2.5facher Augenhöhe. Labialpalpen eingliedrig mit Haarbusch. Kopf, Körper dorsal und Flügel dunkelbraun, Thorax mit silbergrauen Haaren durchmischt, Abdomen ventral hell behaart. Vorderbeine mit langer Epiphyse, Mittel- und Hinterbeine ohne Sporne. Das Genital (Abb. 4b) ist breit, Phallus fast so lang wie das ganze Genital, distal kopfförmig. Saccus schmal, nur etwa ein Fünftel der ganzen Genitallänge.

Weibchen (Abb. 5). Ungeflügelt, Brustbeine reduziert, Bauchbeine, Flügel und Antennen fehlen, weichhäutig blass gelblich, Eier durch die dünne Haut erkennbar, Kopfpartie in hellbraun übergehend. Augen auf einen kleinen dunklen Punkt reduziert. Körper zylindrisch, etwa 16–22 mm lang bei 3.5–4.5 mm Durchmesser, Kopf und Brustsegmente nach vorn unten gebogen. Das Genital weichhäutig, die Legeöffnung wenig vorstehend. Ein Kranz von Afterwolle ist nicht erkennbar, jedoch sind über den ganzen Körper feine, weiße Haare verteilt, die beim Legen der Eier abgerieben werden.

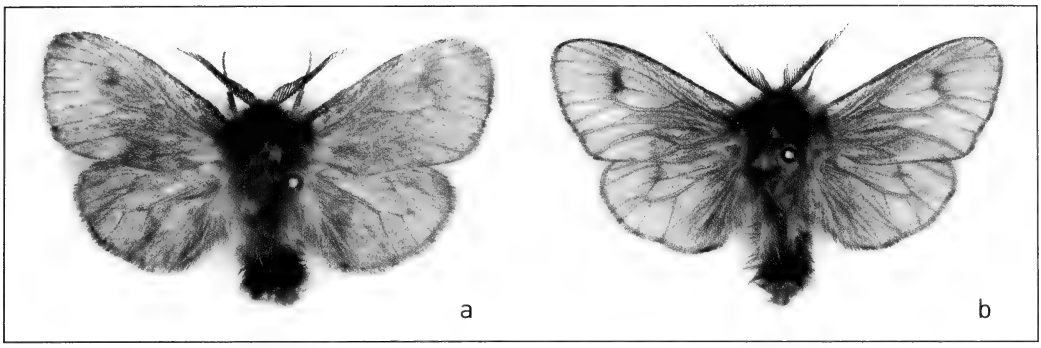

Abb. 2. Männchen von *Pachythelia villosella*. **a.** ssp. *quadratica*; **b.** ssp. *villosella* (Fotos: Erwin Hauser).

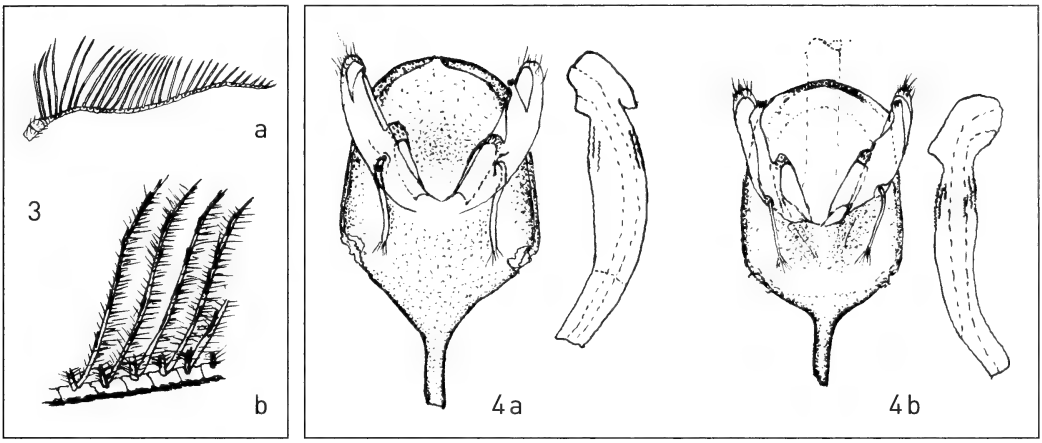

Abb. 3. Antennen der Männchen von *Pachythelia villosella quadratica*. **a.** Kammzahnpaare einseitig; **b.** vergrößerter Ausschnitt aus der Fühlermitte zeigt die beschuppten und schwach bewimperten Kammzähne.**Abb. 4.** Männliche Genitalien von *Pachythelia villosella*. **a.** *P. v. villosella* (aus Griechenland), **b.** *P. v. quadratica* (aus der Türkei).

E i . Frisch abgelegte Eier sind blassgelblich, leicht oval (0.8–1.2 mm) ohne Strukturen. Während der etwa dreiwöchigen Entwicklung verfärben sich die Eier grau, denn die sich entwickelnden Räupchen im Inneren der Eier scheinen mehr und mehr durch die dünne Eischale.

R a u p e (Abb. 6a, b). Ausgewachsene Raupen sind 16–21 mm lang, rundlich mit 4–4.5 mm Durchmesser. Die Abdominalsegmente sind „schmutzig" gelblich, Kopf und Brustsegmente dunkel, fast schwarz mit breiten, hellen Längsstreifen lateral und dorsal. Das Labrum der Raupe mit vier Dornenpaaren, die symmetrisch angeordnet sind.

S a c k (Abb. 7a–c). Die Säcke erwachsener Raupen sind dreieckig im Querschnitt, 23–37 mm lang, die Bauch- oder Schleifseite 7–12 mm breit. Der Sack besteht aus einer seidenen Röhre, an die auf der unteren Seite und seitlich, links und rechts rundliche Blattstücke angesponnen werden. Diese Blattstücke werden von der Raupe aus harten, dürren Blättern herausgebissen. Die Größe der Stücke ist durch die Größe der Raupe gegeben, sie sind so groß wie die Raupe reichen kann, ohne den Sack zu verlassen. Die

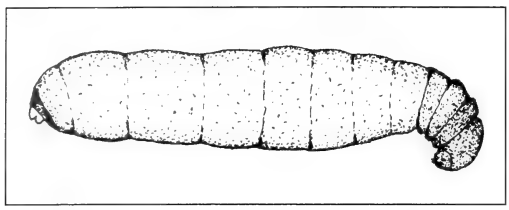

Abb. 5. Weibchen von *Pachythelia villosella quadratica* in Seitenansicht; der Kopf (rechts) ist stark nach vorn unten gebogen, die Brustbeine sind auf kleine Stummel reduziert, Bauchbeine und Flügel fehlen.

dachziegelartig angeordneten Blattstücke werden mit dem Wachstum der Raupe größer, sodass die hinten am Sack angesponnenen Stücke kleiner und die gegen die vordere Öffnung des Sackes größer sind.

Puppe. Die Puppenhülle der Männchen ist hellbraun, sie erscheint jedoch vor dem Schlüpfen dunkelbraun, fast schwarz, wenn der entwickelte Falter durchscheint. Die Kopf-Brustplatte mit 4 Borstenpaaren, eines davon am Hinterkopf. Die Abdominalsegmente 4–7 tragen dorsal nach hinten gerichtete Dornenreihen sowie auf den Intersegmentalmembranen nach vorn gerichtete Dornenreihen. Die weibliche Puppe ist hellbraun, alle Segmente sind vorhanden jedoch fehlen die Flügel-, Bein- und Fühlerscheiden und die Rückendornen. Die Kopf-Brustplatte ist so stark reduziert, dass die einzelnen Teile kaum unterscheidbar sind.

Lebensweise. Die Flugzeit dauert etwa von Ende Mai bis Ende Juli, abhängig von Höhenlage und Klima. Männchen schlüpfen am späteren Nachmittag bis frühen Abend. Dazu winden und stossen sich die Puppen etwa zur Hälfte aus dem Sack, schlüpfen aus der Puppenhülle, die in der Sacköffnung stecken bleibt und strecken die Flügel. Sie bleiben meistens am Sack oder dessen Nähe und warten bis zu den ersten Strahlen des neuen Tages. Die Weibchen schlüpfen in den frühen Morgenstunden im Sack aus der Puppe und winden sich zur Sacköffnung, bis der Kopf aus dem Sackende ragt und lässt ihr Pheromon durch die Luft wegtragen. Sobald der Duft ein Männchen erreicht, fliegt es zum Weibchen und paart sich durch die hintere Sacköffnung, die durch das Weibchen geöffnet wurde. Die Männchen könnten 2–3 Weibchen begatten, sterben aber meistens noch am gleichen Tag. Die Weibchen legen nach der Kopula sogleich die etwa 100–150 Eier in die Puppenhülle im Sack und sterben. Ohne Paarung kann das Weibchen an 6–8 weiteren Morgen erneut mit ihrem Duft Männchen anlocken. Wenn in dieser Zeit keine Kopula erfolgen konnte, verlässt das ermattete Weibchen den Sack und fällt zu Boden oder es bleibt im Sack in ihrer Puppenhülle und stirbt dort.

Abhängig von Jahr und Klima kann eine Generation 1 bis 2 Jahre dauern. In einer Nachzucht in Uster schlüpften die Räupchen am 14. Mai 2007. Anfang Oktober 2007 waren die Säckchen 10–12 mm lang und hatten sich zur Überwinterung an festen Pflanzen und oben an den Kästen festgesponnen. Schon im Februar des nächsten Jahres erwachten die Räupchen und begannen an Spitzwegerich, *Plantago lanceolata* der im Zuchtkasten wuchs, zu fressen. Anfang April waren die Säcke etwa 20 mm lang und Ende Mai begannen einige Raupen ihre nun 23–36 mm langen Säcke oben in den Kästen fest zu spinnen Aus diesen angesponnenen Säcken schlüpften nach nur einer Überwinterung vom 5.7. bis zum 4.8.2008 sieben Männchen und 21 Weibchen. Der grössere Teil der Raupen war träge, frass ab und zu oder sie arbeiteten an ihren, nun etwa 20–30 mm langen Säcken und begannen im Herbst eine zweite Überwinterung. Im März 2009 begannen sie wieder zu fressen und an den Säcken nötige Reparaturen

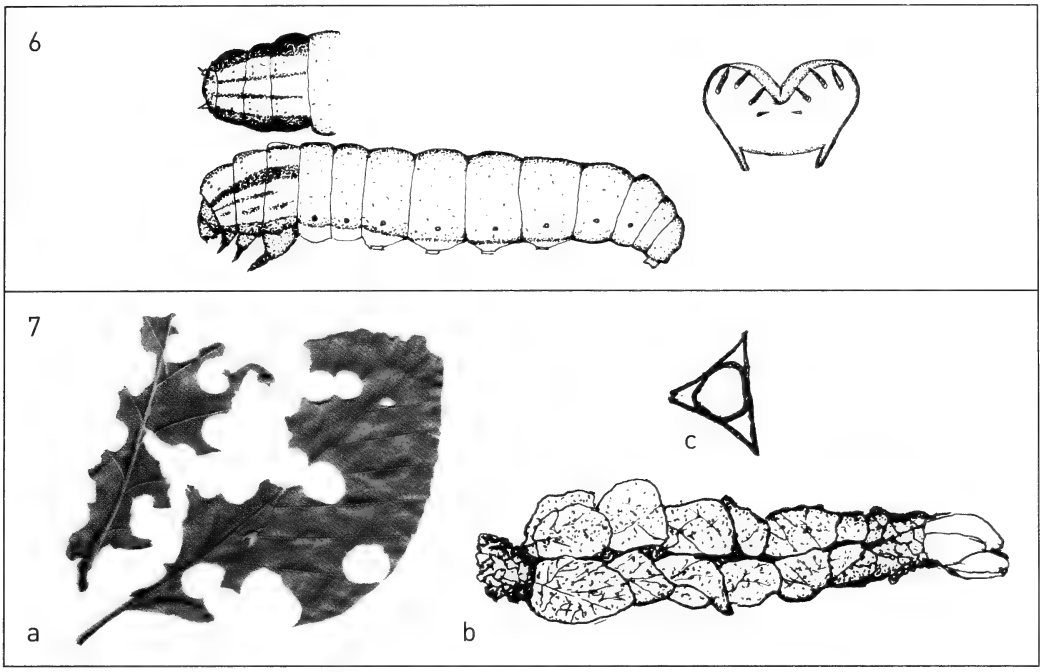

Abb. 6–7. Raupe von *Pachythelia villosella quadratica*. **6a.** Seitenansicht; **b.** Kopf- und Brustteil dorsal; **c.** Labrum (Psychidae tragen hier jeweils 4 Dornenreihen); **7a.** zum Sackbau Beißen die Raupen rundliche Scheiben aus festen, dürren Blättern und anderen Materialien; **b.** die rundlichen Stücke werden dachziegelartig in Dreiecksform außen an den röhrenförmigen Seidensack angesponnen; **c.** Querschnitt durch den Sack.

auszuführen. Anfang Mai waren alle Tiere oben in den Zuchtkästen angesponnen und verpuppten sich. Ab dem 28.5.2009 begann das Schlüpfen der Weibchen bei Tagesanbruch, der Männchen in der Abenddämmerung oder in der frühen Nacht. Die Paarungen finden am frühen Morgen statt. Nun schlüpften bis etwa Ende Juni 45 Männchen und 12 Weibchen. In weiteren etwa 20 Säcken verschiedener Stadien hatten die Raupen bzw. Puppen nicht überlebt.

Von uns unbeobachtet fanden in den Zuchtkästen Paarungen der geschlüpften Imagines statt, denn aus vier Säcken schlüpfte eine grosse Zahl von Nachkommen, die wir als Zucht F2 weiter züchteten. Alle Zuchten fanden in einem sicheren, geschützten, frostfreien Raum statt und trotzdem hatten wir bei der F2 Zucht durch die sprunghaften Änderungen der Wintertemperaturen grosse Verluste. Auch die Raupen der F2 Zucht überwinteren zwei Mal und ergaben Ende Juni 2010 fünf Männchen und drei Weibchen. Auf eine weitere Zucht haben wir verzichtet.

Verbreitung. Die Unterart ist ausschließlich von den folgenden Fundorten bekannt:

- Türkei, Antalya, Termessos, 900–1000 m, leg. De Freina (1♂ + Sack).
- Türkei, Antalya, Umgebung Alanya, e.l. 30.5.1978 leg. Heuberger (1♂ + Sack).
- Türkei, Adana, ca. 30 km nördlich Kozan (37°27'N 35°49'E), 142 m, leg. Siegfried Huber (ex ovo Zucht).
- Israel, Mt. Hermon, 1600 m, 16.5.2000, leg. R. Dor (ein Sack), Museum Tel Aviv.

Tab. 1. Vergleich einiger Merkmale der drei Arten/Unterarten, die leicht verwechselt werden.

	Pachythelia villosella		*Canephora unicolor*
	villosella	*quadratica*	
Männchen			
Flügelspannweite (in mm)	22–28, Mittelwert 25 (n = 30)	21–26, Mittelwert 24 (n = 48)	16–28, Mittelwert 24 (n = 181)
Vorderflügeladerung Hinterflügel: Adern aus DZ	N=9; r3+r4 gestielt N=5; m2+m3 gestielt	N=9 (8); r3+r4 gestielt N=5; m2, m3 meist getrennt	N=9; r3 +r4 gestielt N=5; m2, m3 getrennt
Schuppenklasse nach Sauter (1956) Länge / Aussehen	1–2 einspitzig kurz / durchscheinend	1–2 einspitzig lang / dicht	5–6 breit oft mehrspitzig schwarz, dicht deckend
Antennengliederzahl Kammzahn Beschuppung	35–39 unbeschuppt	27–34 dicht beschuppt	30–36 schwach beschuppt
Augenform Augenabstand	klein, hochoval 1,8–2,0 × Augenhöhe	klein, hochoval 2,0–2,5 × Augenhöhe	klein, hochoval ca. 2,0 × Augenhöhe
Sacklänge / Endröhrenlänge (in mm)	30–45 / 3,5–4 (n = 25) Querschnitt rund	23–34 / 7–12 (n = 49) Querschnitt dreieckig	25–37 / 3,5–4,5 (n = 80) Querschnitt rund
Weibchen			
Länge / Durchmesser (in mm)	16–18 / 4,0–8,0	18–22 / 3,5–4,8	13–20 / 3,5–5,0
Sacklänge / Breite (in mm)	30–45 / 4–8 (n = 33) Querschnitt rund	24–37 / 8–13 (n = 40) Querschnitt dreieckig	25–37 / 4–8 (n = 60) Querschnitt rund

Diagnose

Ein Teilstück des mitochondrialen Gens CoxI (jeweils 658 Basenpaare) wurde im Rahmen des Barcode of Life Data Systems (BOLD www.boldsystems.org) der University of Guelph, Kanada für *Pachythelia villosella quadratica* und ihre Nominatunterart *P. v. villosella* (Ochsenheimer, 1810) ermittelt. Danach weisen *P. v. villosella* von Griechenland, Spata (Barcode ID: BCREB087-09; Sample ID: BC-EH-V87) und *P. v. quadratica* aus der Türkei, Kozan (Barcode ID: BCREB088-09; Sample ID: BC-EH-V88) einen genetischen Abstand (= Unterschied in den Basenpaaren) von 6,67% auf, was eher auf unterschiedliche Arten als auf Unterarten hindeutet. Da aber bisher nur wenige Exemplare der Gattung *Pachythelia* betreffend ihrer DNA-Barcode Sequenze untersucht wurden, sollen an dieser Stelle noch keine Schlussfolgerungen gezogen werden. Unterschiede zwischen adulten Tieren, selbst aus einem Gelege, können recht gross sein (Hättenschwiler 2007).

Die an vielen Exemplaren beobachteten morphologischen Unterschiede liegen, wie der Name beschreibt, in der mehr quadratischen Form der Vorderflügel, in unterschiedlicher Länge ihrer Deckschuppen und dadurch bedingt unterschiedlicher Deckung und Transparenz sowie in der Fühlerbeschuppung, der Fühlergliederanzahl und deutlich unterschiedlicher Bauweise der Raupensäcke (Tab. 1).

Alle diese Unterschiede sind aber auch Streuungen unterworfen und so möchten wir hier den nomenklatorischen Status von *P. v. quadratica* als Unterart bestehen lassen.

Die Gattung *Pachythelia* Westwood, 1848 enthält neben *P. villosella* nur noch *P. robusta* Krüger, 1939 (Sobczyk 2011), deren taxonomischer Status noch der eingehenden Untersuchung bedarf. Hier erscheint zunächst ein Vergleich mit grossen, äußerlich ähnlichen Arten der Tribus Acanthopsychini sinnvoll. Die drei Taxa sind mit einigen Merkmalen in Tab. 8 gegenübergestellt. Die beiden Unterarten *P. villosella* und *quadratica* sind äusserlich und durch den DNA-Barcode unterscheidbar. *C. unicolor* hat breite Flügelschuppen, ist dicht beschuppt und dadurch nicht durchscheinend. Gegenüber *quadratica* unterscheidet sie sich außerdem deutlich durch die Säcke. Für einen Vergleich mit *P. v. villosella* und *C. unicolor* soll an dieser Stelle auch auf Hättenschwiler (1997) verwiesen werden.

Aus den Ländern um das Mittelmeer, sowie Ost- und Südosteuropa sind viele Arten beschrieben, die in der Gattung *Oiketicoides* Heylaerts, 1981 zusammengefasst sind. Hier soll nicht auf die etwa vierzig Arten eingegangen werden, doch verbinden die grossen, stark bis schwach hochovalen Augen und der kleine Augenabstand, der meist unter 1 × Augenhöhe liegt, alle Arten der Gattung *Oiketicoides* und trennt sie deutlich von den in Tab. 8 betrachteten Arten. Zudem sind die meisten Männchen der *Oiketicoides*-Arten hell gelb bis braun gelb gefärbt und dadurch auch farblich unterscheidbar.

Danksagung

Mein bester Dank geht an Herr Siegfried Huber, Oberuhldingen (D). Er fand den Sack mit den Eiern und hat ihn Herrn Dr. Jakob Walter, Schaffhausen (CH) übergeben, der das Geschenk zur Weiterzucht an uns weitergab. Meine liebe Frau Ruth betreute erfolgreich die Zuchten wie immer mit viel Liebe und Sorgfalt. Prof. Dr. Willi Sauter, Illnau (CH) danke ich für Beratung und das Lesen des Manuskriptes. Nicht zuletzt geht mein Dank an Herrn Dr. Erwin Hauser, Wolfern (A) für die Fotos der beiden Männchen sowie zusammen mit Rodolphe Rougerie, Mont Saint Aignan (F) und dem Canadian Centre for DNA Barcoding (Biodiversity Institute of Ontario, Guelph, Canada) für die Abwicklung der DNA Untersuchungen und Bereitstellung der DNA-Barcode Sequenzen.

Literatur

De Freina, J. 1983. 4. Beitrag zur systematischen Erfassung der Bombyces- und Sphinges Fauna Kleinasiens. Neue Kenntnisse über Artenspektrum, Systematik und Nomenklatur sowie Beschreibungen neuer Taxa. – Mitteilungen der Münchner Entomologischen Gesellschaft **72**: 57 – 127.

Hättenschwiler, P. 1997. Psychidae. S. 165 – 308. – *In*: Pro Natura – Schweizerischer Bund für Naturschutz (Hrsg.), Schmetterlinge und ihre Lebensräume, Band 2. – Basel.

Hättenschwiler, P. 2007. Wie unterschiedlich kann die Grösse der erwachsenen Tiere innerhalb einer Art sein? Beispiele von Sackträgern (Lepidoptera, Psychidae). – Mitteilungen der Basler Entomologischen Gesellschaft Basel **57** (1):10 – 15.

Sauter, W. 1956. Morphologie und Systematik der schweizerischen Solenobia-Arten, – Revue Suisse de Zoologie **63** (27), Fasicule 3(22): 451 – 550.

Sobczyk, T. 2011: Psychidae (Lepidoptera). – *In*: M. Nuss (ed.), World Catalogue of Insects 10: 1 – 467.

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Publication dates

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Bengtsson, B. Å. & N. Ryrholm 2011 (21.x.). Obituary to Ingvar Svensson. **34** (1): 7–9.

Blackstein, H. 2011 (21.x.). Tortricinae aus der Sammlung Shchetkin des Museums für Naturkunde Berlin. **34** (1): 39–47.

Budashkin, Yu. I. & B. Zlatkov 2011 (21.x.). A new species of *Epinotia* Hübner, 1825 ("1816") from south-western Bulgaria (Tortricidae: Olethreutinae). **34** (1): 33–37.

Crişan, A., Sitar, C., Craioveanu, C. & L. Rákosy 2011 (22.xii.). The Protected Transylvanian Blue (*Pseudophilotes bavius hungarica*): new information on the morphology and biology. **34** (2): 163–168.

Dolinskaya, I. V. 2011 (21.x.). Larval head microsculpture in Palaearctic Notodontidae (Noctuoidea) and its significance for the systematics of the family. **34** (1): 11–28.

Đurić, M. & M. Popović 2011 (21.x.). A note on the status of the rare species *Kirinia climene* (Esper, 1783) (Nymphalidae) in Serbia. **34** (1): 79–82.

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Hättenschwiler, P. 2011 (22.xii.). Lebensweise und Beschreibung der Entwicklungsstadien von *Pachythelia villosella quadratica* de Freina, 1983 (Psychidae: Oiketicinae: Acanthopsychini). **34** (2): 171–177.

Kallies, A. 2011 (22.xii.). New species and taxonomic changes in Sesiini from Asia and Europe (Sesiidae). **34** (2): 151–161.

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