

## Two new European geometrid moths: *Xanthorhoe skoui* sp. n. and *Xanthorhoe friedrichi* sp. n. (Geometridae)

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**Abstract.** Two new European larentiine species are described: *Xanthorhoe skoui* Viidalepp & Hausmann sp. n. from eastern part of central Spain, and *Xanthorhoe friedrichi* Viidalepp & Skou sp. n. from Greece. Both are closely related to *Xanthorhoe oxybiata* (Millière, 1877). Habitus, male and female genitalia are illustrated.

**Zusammenfassung.** Zwei neue europäische Larentiinen-Arten werden beschrieben: *Xanthorhoe skoui* Viidalepp & Hausmann sp. n. aus dem östlichen Zentralspanien, und *Xanthorhoe friedrichi* Viidalepp & Skou sp. n. aus Griechenland. Beide sind vergleichsweise nah mit *Xanthorhoe oxybiata* (Millière, 1877) verwandt. Abbildungen der beiden neuen Arten, sowie der männlichen und weiblichen Genitalien werden gegeben.

**Key words.** Lepidoptera, Geometridae, *Xanthorhoe*, new species, new status, Spain, Greece.

### Introduction

After the death of the famous Microlepidoptera specialist Dr. J. Klimesch (1901–1997), his enormous Lepidoptera collection was incorporated into the Zoologische Staatssammlung Munich (ZSM), where it began to be studied by a large number of guest researchers. Among the Geometridae, the junior author discovered a series of Spanish specimens of the genus *Xanthorhoe* Hübner, [1825] that could not be attributed to one of the known European species. The specimens had been collected by R. Wolfschläger (1874–1958) from Austria, whose collection has been acquired by Klimesch. In 1998, the above mentioned specimens were studied by the senior author, who confirmed that they belong to a so far undescribed species. In the same period the Thuringian amateur lepidopterist Egbert Friedrich brought some specimens of *Xanthorhoe* from Greece to the ZSM, asking for their identification. Also these specimens revealed to belong to an undescribed species. Furthermore, at the SEL congress in Malle 1998, specimens of both new species had been shown and given on loan by Peder Skou, Stenstrup, Denmark, to the senior author. As a forerunner to the third volume of the book series ‘Geometrid moths of Europe’ (Viidalepp, in preparation) these discoveries are published here. They raise the number of European *Xanthorhoe* species from 16 (Müller 1996) to 18. Hopefully this will focus attention on the taxa in question, and help to trace additional material which may permit to improve knowledge about their distribution areas.

### Abbreviations

ZSM – Zoologische Staatssammlung München, Germany; ZMUC – Zoological Museum University Copenhagen, Denmark; EMEM – Entomological Museum Eitschberger Marktleuthen.

## Systematic relationships

Currently, the larentiine genus *Xanthorhoe* Hübner, 1825 includes 228 species from all zoogeographical regions (Scoble 1999). Due to the world-wide distribution, it has split into a taxonomically complicated pattern of various phylogenetical lines. No modern revision of the genus is available, and, until now, no analytical study revealed evidence for monophyly of the genus, as presently delimited (Holloway 1997: 190–191).

The type species of the genus *X. montanata* ([Denis & Schiffermüller], 1775) is characterised by extremely long, eversible coremata between segments A7 and A8 in male, in male genitalia by long, free distal projections of costa of valva, by elongate lateral thorns of manica, in female genitalia by broad antrum, heavily sclerotized and longitudinally folded. Apart from the type species, the apical process of the valve costa exceeds the distal margin of the membranous ventral part of valva in five other European *Xanthorhoe* species: *X. annotinata* (Zetterstedt, 1839), *X. incursata* (Hübner, 1813), *X. vidanoi* Parenzan & Hausmann, 1993, *X. spadicearia* ([Denis & Schiffermüller], 1775), and *X. ferrugata* (Clerck, 1759), but also in the south-west Asian *X. inconsiderata* (Staudinger, 1892) and *X. pseudogaliata* (Staudinger, 1898). The costa is shorter than the rest of the valva in the other congeners.

Both the below described species belong to the *oxybiata* species-group, embracing *Xanthorhoe oxybiata* (Millière, 1877) with possible certain relationships to *X. inconsiderata* and *X. pseudogaliata*. The group is characterized by similar habitus with broad, dark median fascia, male antennae shortly bipectinate with additional fasciculate ventral sensilla at distal, ventral part of each flagellomere, in *X. oxybiata* on short branches, thus sub-quadripectinate here. Male genitalia with large aedeagus with large and thick bundles of thin, dark cornuti. Female genitalia with sclerotised ductus bursae, posterior part of corpus bursae sclerotized, a very unusual character in *Xanthorhoe*. Signum distinct in *X. friedrichi* sp. n., very small in *X. skoui* sp. n., absent in *X. oxybiata*, probably due to a secondary loss in the phylogeny of this group.

*Xanthorhoe designata* (Hufnagel, 1767), *Xanthorhoe abrasaria* (Herrich-Schäffer, 1856), and *Xanthorhoe montanata* are characterised by three small patches of cornuti attached to the distal part of vesica in male genitalia, the other European species with some thin cornuti at distal end of aedeagus.

## *Xanthorhoe skoui* Viidalepp & Hausmann sp. n.

**Material.** Holotype ♀, 'Hispania Arag[on], Albarracin, Wolfschläger IX 1954', ZSM. – Paratypes. 3♂, 9♀, 'Hispania, Arag[on], Albarracin', 6.VIII.-26.IX.1954, Wolfschläger leg., ZSM; 1♂, 'Zentralspanien, Provinz Teruel, Albarracin, 7.-17.IX 1998, W. Kraus leg.', coll. Kraus, Kaiserslautern; 1♀, 'Spanien, Aragon, Umg. Albarracin, 22.IX 1962, V. Buddenbrock leg.', EMEM in ZSM; 1♀, 'Hisp. centr. or. Albarracin, 1200 m, 7.-30.IX 1963, J. R. & W. Caron leg.', EMEM in ZSM; 1♀, 'Spanien, Murcia/Moratalla, 21.IX.1989, J. Lenz leg.', ZSM; 1♀, 'Spain, Teruel, Albarracin, 1000m, 29.IX.1987, P. Skou leg.', coll. Skou, Stenstrup; 1♂, 'Spain, Prov. Teruel, Albarracin, Val de Vecar, 1200 m, 18.ix.2002, Peder Skou leg.', coll. Skou; 5♂, 1♀, 'Spain, Prov. Teruel, 7 km W. of Albarracin, 1200 m, 17.-18.ix.2002, Peder Skou leg.', coll. Skou; 1♂, 2♀, 'Spain, Prov. Teruel, 1 km E. of Tramacastilla, 1200 m, 17.ix.2002, Peder Skou leg.', coll. Skou.



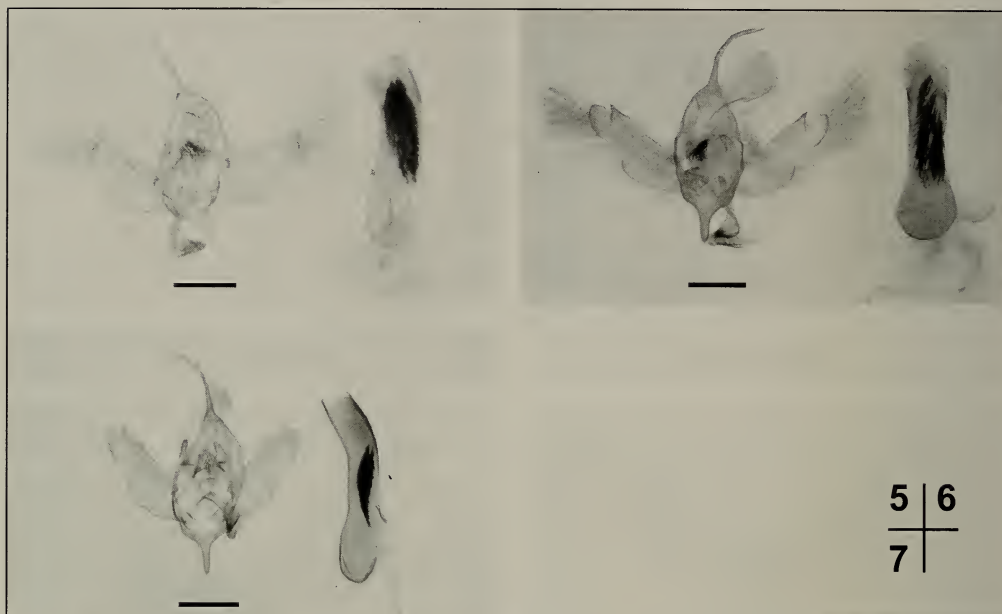
**Figs. 1–4.** *Xanthorhoe skoui* sp. n., and *Xanthorhoe friedrichi* sp. n.: 1. *Xanthorhoe skoui* sp. n., ♂, paratype. 2. *Xanthorhoe skoui* sp. n., ♀, paratype. 3. *Xanthorhoe friedrichi* sp. n., ♂, paratype. 4. *Xanthorhoe friedrichi* sp. n., ♀, paratype (scale bar 1 cm).

**Description.** External characters (Figs. 1, 2). Length of forewing 12–14 mm, females slightly larger than males. Antennae of male bipectinate with comparatively short branches, length of longest branches ca. 0.35 mm, measured at half length of antenna. Ground colour of forewing light grey. Basal and medial area blackish grey with slight brown tinge. Postmedial fascia whitish, divided by a fine, grey line, at veins strongly projecting towards medial area. Cell spots absent on upperside, on underside present but small. Hindwings grey, in the medial area with four or five dark grey transverse lines, which are indistinct or, sometimes, well contrasted. Terminal line consisting of small separate dots. Fringe usually concolorous with ground colour, unchequered.

**Male genitalia** (Fig. 6). Similar to those of *X. oxybiata* (see Fig. 5, and differential diagnosis). Uncus long and slender. Calcar, i.e. ventral projection of juxta, comparatively broad, saccus long. Valva elongate, with distal end of costa tapering, and ventral margin slightly concave or shallowly indented. Aedeagus large, with two large bundles of cornuti of nearly equal length ( $n=2$ ).

**Female genitalia** (Fig. 9). Similar to those of *X. oxybiata* (see Fig. 8, and differential diagnosis). Ductus bursae broad bottle-shaped, smoothly sclerotized. Corpus bursae laterally with ‘rough surface’ (lamina dentata) and a weak bundle of spines.



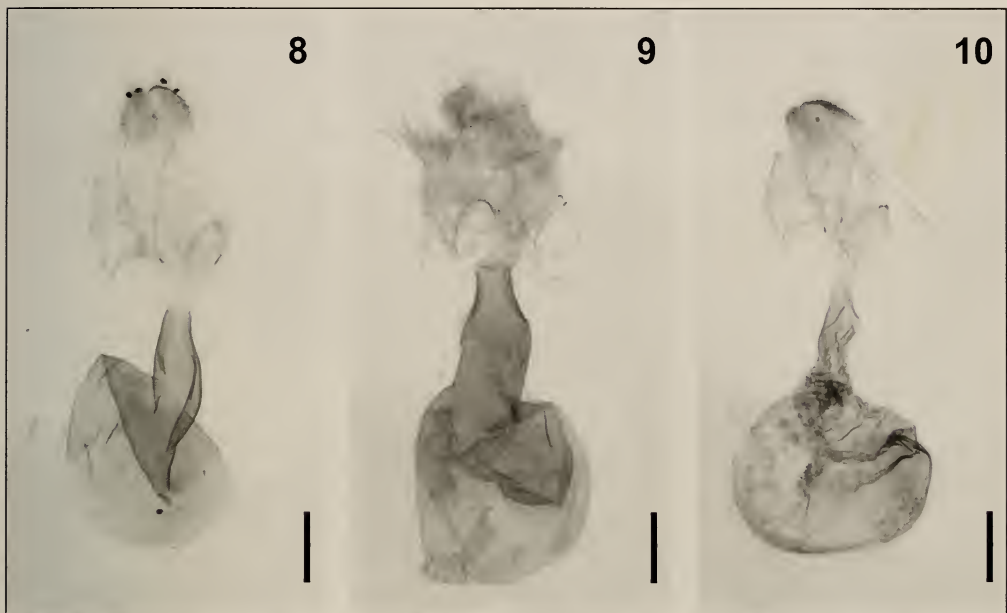


**Figs. 5–7.** Male genitalia of *Xanthorhoe* species: 5. *Xanthorhoe oxybiata* (Millière, 1877), southern France, prep. ZSM G 4416. 6. *Xanthorhoe skoui* sp. n., paratype, prep. ZSM G 10089. 7. *Xanthorhoe friedrichi* sp. n., holotype, prep. ZSM G 12634 (scale bar 1 mm).

Posterior part of corpus bursae well sclerotised, at the right side (ventral view) with V-shaped sclerotisation, at the left side irregularly bordered ( $n=2$ ).

**Diagnosis.** In habitus similar to *X. oxybiata* (Millière, 1877), but the latter with white postmedial border of medial area straighter, without sharp indentations, ground colour of forewing darker, hindwing basad from postmedial line uniformly dark, cell spots distinct on all wings, terminal dots elongate, often contiguous, fringe slightly chequered. Male antennae in *X. oxybiata* sub-quadripectinate with short additional branches from distal, ventral side of each flagellomere. Male genitalia of *X. oxybiata* ( $n=4$  from southern France and Dalmatia; Fig. 5) with calcar on average narrower, valva shorter, ventral margin of valva with deep emargination, costal process of valva broad and rounded at tip. Saccus on average slightly shorter. In aedeagus ventral patch of cornuti shorter than the dorsal. Female genitalia ( $n=4$  from southern France and Dalmatia; Fig. 8) with ductus bursae narrower, corpus bursae smoothly sclerotised, without spinules and lamina dentata. Sclerotised, posterior part of corpus bursae tapered at the right side, straightly and sharply bordered at the left side.

**Distribution.** Eastern Spain, from Aragon to Murcia province. The closest related species, *X. oxybiata*, is recorded from southern France, Italy including Sardinia and Sicily, former Yugoslavia, Greece, Cyprus and Turkey. Spanish records of *X. oxybiata* (e.g. Vives Moreno 1994; Redondo & Gaston 1999) are misidentified and refer to the new species. To date, no sympatric occurrence of both species is known, and they have to be considered allopatric vicariant species.



**Figs. 8–10.** Female genitalia of *Xanthorhoe* species: **8.** *Xanthorhoe oxybiata* (Millière, 1877), Dalmatia, prep. ZSM G 7994. **9.** *Xanthorhoe skoui* sp. n., paratype, prep. ZSM G 10091. **10.** *Xanthorhoe friedrichi* sp. n., paratype, prep. ZSM G 12635 (scale bar 1 mm).

**Biology.** Supposedly univoltine phenology, from early September to late September. No specimens could be collected at the type locality late August (Skou, pers. comm.). On average, *X. oxybiata* flies later, from September to November, exceptionally December. Limited data to vertical distribution indicate occurrence from 500 m to 1200 m above sea-level. Immature stages unknown.

**Derivatio nominis.** The species is dedicated to Peder Skou, Stenstrup, Denmark, who collected the species and pointed it out as a potential new species. With this dedication, his merits in promoting research on European Geometridae, especially by initiating the project ‘The Geometrid Moths of Europe’ are honoured.

### *Xanthorhoe friedrichi* Viidalepp & Skou sp. n.

**Material.** Holotype ♂, ‘Greece, Parnassos-Gebirge, Umg. Arahova, Grotte, 1400 m, 14.09.1997 a.L., E. Friedrich leg.’, ZSM. – Paratypes. 1♂, id., ‘13.09.1997’, coll. Friedrich, Jena; 1♂, 1♀, ‘Greece, Peloponnes, Umg. Kalavrita, Rogi, 950 m, 23.09.1997 a.L., E. Friedrich leg.’, coll. Friedrich; 1♂, id., ZSM; 2♀, ‘Greece, Peloponnes, Parnon-Gebirge, Umg. Kosmas, 850 m, 29.09.1997, E. Friedrich leg.’, ZSM; 1♀, id., coll. Friedrich; 1♂, id., ‘1150 m, 28.09.1997’, coll. Friedrich; 1♂, ‘Greece, Peloponnes, Umg. Kalavrita, Mega Spileon, 900 m, 7.10.1992, E. Friedrich leg.’, coll. Friedrich; 1♂, 2♀ (with gen. prep. JV 6216), ‘Greece, Erythrea, 29.09.1984, M. Fibiger & A. Moberg leg.’, coll. Skou, Stenstrup; 1♀, id., ZMUC; 1♀, ‘Greece, Pierias, mt. Olympus above Litochorion, 950 m, 9.09.1983, M. Fibiger & A. Moberg leg.’, coll. Fibiger, Soro; 1♀, ‘Gricchenland, Thermopilae, 60 m, 18.10.1971, Lukasch leg.’, ZSM; 1♀, ‘M. Gricchenland, Tempí-Tal, Omelio, 50 m, 02.10.1996, Stengel leg.’, ZSM.



**Fig. 11.** Habitat of *Xanthorhoe skoui* sp. n.: Spain, Prov. Teruel, 7 km west of Albarracin, 1200 m, 19th September 2002 (photo P. Skou).

**Description.** External characters (Figs. 3, 4). Length of forewing 13–14 mm. Male antennae bipectinate with longest branches about 0.4 mm. Female antennae filiform. Ground colour light grey in male, slightly darker in female. Medial fascia of forewing blackish grey, with arched proximal and distal border. Broad whitish post-medial fascia with traces of a wavy transverse line, dark grey blotches present at the forewing costa close to apex, and in the terminal area, between veins  $M_1$ – $M_3$ . Terminal area more or less suffused with grey, mainly in females. Vein ends with paired blackish terminal dots. Hindwing slightly darker than ground colour of forewing, postmedial line diffuse, bent between veins  $M_3$ – $CuA_1$ . Underside of forewing greyish, darker than hindwing. Distal border of medial area concave between  $M_1$  and  $M_3$ , distally projecting at  $M_3$ – $CuA_1$ . A dark costal spot at the position of the antemedial line, three costal spots in the distal half of medial area. Underside of forewing apex dark grey with traces of wavy line, reduced to 2–3 whitish spots. Paired terminal dots indistinct on underside of forewing, distinct on hindwing. Fringe chequered white and grey. Wing pattern is variable, but is always characterised by a certain chalk-powdered aspect. One male shows bright orange patches at the main veins along the inner and outer border of the medial field, and one female has the entire forewing suffused with ashen, with a slight bluish tinge.

**Male genitalia** (Fig. 7). Similar to those of *X. oxybiata* (see Fig. 5, and differential diagnosis). Uncus long and slender. Calcar comparatively broad, saccus long. Valva elongate, with distal end of costa tapering, and ventral margin slightly concave or shallowly indented. Aedeagus very long, comparatively slender, with one patch of cornuti, of about 2/5 length of aedeagus ( $n=3$ ).



**Female genitalia** (Fig. 10). Genitalia pyriform with ductus bursae sclerotised, narrow. Anterior part of ductus bursae and posterior part of corpus bursae irregularly folded, with finely granulate surface on the left side. Signum well developed, as an elongate patch of longer needles, length of signum 0.20–0.35 mm ( $n=3$ ).

**Diagnosis.** In habitus slightly reminiscent of *Epirrhoe galiata* ([Denis & Schiffermüller], 1775), but clearly belonging to the genus *Xanthorhoe* according to venation (two accessory cells in forewing), and male antennal structure (bipectinate rather than ciliate). Close relationship to *X. oxybiata* species-group supported e.g. by the size of the aedeagus with large patch of cornuti in male genitalia, or the sclerotised ductus bursae in female genitalia. Antennae of *X. friedrichi* exactly as described for *X. skoui* sp. n., differences from *X. oxybiata* see diagnosis of *X. skoui* sp. n.. In habitus, the chalk-powdered aspect of the wing pattern of *X. friedrichi* sp. n. is unique within Mediterranean species of the genus *Xanthorhoe* Hbn. *X. oxybiata* differing from *X. friedrichi* sp. n. furthermore in darker medial fascia of forewing and uniformly dark coloration of hindwing basad from postmedial line. Male genitalia of *X. oxybiata* ( $n=4$  from southern France and Dalmatia; Fig. 5) with valva shorter, ventral margin of valva with deep emargination, costal process of valva broad and rounded at tip. Saccus on average slightly shorter. Aedeagus shorter and broader, cornuti patches larger, about  $3/5$  length of aedeagus, with two patches of cornuti. Female genitalia ( $n=4$  from southern France and Dalmatia; Fig. 8) with ductus bursae and posterior part of corpus bursae smoothly sclerotised. Corpus bursae without signum.

Consequently *Xanthorhoe friedrichi* shares three derived character states (large aedeagus; vesica with numerous dark cornuti arranged in large and thick bundle; entire ductus bursae sclerotised) with *X. oxybiata* and *X. skoui* sp. n.

**Distribution.** Central and southern Greece, probably endemic.

**Bionomics.** Collected at light from early September to mid-October, mainly on limestone mountains (800–1400 m above sea-level), accompanied by xeromontane species such as *Aplocera dervenaria* Mentzer, 1981, *Nebula senectaria* (Herrich-Schäffer, 1852), *Xanthorhoe oxybiata*, *Scopula vigilata* (Sohn-Rethel, 1929) (E. Friedrich, pers. comm.). Immature stages unknown.

**Derivatio nominis.** The species is dedicated to Egbert Friedrich, Jena, Thuringia, who collected a fine series of it in Greece.

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