

***Dorsispina furcornaria*, a new geometrid species and new genus from Kazakhstan (Lepidoptera: Geometridae: Ennominae)**

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Abstract. A new geometrid genus, *Dorsispina*, with the type species *Dorsispina furcornaria* sp. n. (Lepidoptera: Geometridae: Ennominae), is described and illustrated from the River Emba, western Kazakhstan. A single adult male was found in late September, flying rapidly in sunshine about two hours before sunset in a sandy riverside dune surrounded by chalk steppes. The species has several unique, diagnostic features not seen in other Palaearctic Geometridae, for instance a thorax with a Y-shaped sclerotised extension and abdominal tergites 3–8 that are densely covered with sclerotised spines. Systematic position of *Dorsispina* within the Ennominae is uncertain; it is tentatively classified in the Ennominae tribe Boarmiini. Various abdominal sclerotisations across Ennominae taxa from the tribes Boarmiini (*Biston* Leach, [1815] 1830 and related genera), Wilemanini and Desertobini, are illustrated and their potential relationships are discussed.

Introduction

The first author has collected Lepidoptera very extensively in Russia, particularly in the Ural area, western Kazakhstan and southern Siberia. Since 1996, altogether about 45 field trips have been carried out, comprising 22 months in the field. During a field trip in Kazakhstan in September 2012, an unknown, diurnal Geometridae species was discovered (Fig. 1). The encounter was unusual: while taking a bath in the middle of a shallow river, the moth flew rapidly like a bullet towards the senior author and landed in the water. The long-haired moth became wet immediately and sunk into the water within a few seconds. The specimen was captured by hands and put in a soap box for carrying to the base camp, where it was dried and set.

Examination of its morphology revealed it to have unique structures, for instance a Y-shaped sclerotised extension on its thorax, which has not been described for any Geometridae taxa in the Palaearctic region. The purpose of this paper is to describe the above mentioned taxon as a new species, to classify it into a new genus, and to assess its systematic position within the Ennominae.

Methods

To minimize the risk of creating a new synonym, we examined all pertinent literature (e.g., Mironov et al. 2008; Prout 1912–16; Viidalepp 1996; Wehrli 1939–1954; Zoological Record Plus 2013), studied all the relevant taxa listed in *The Geometrid Moths of the World* (Parsons et al. 1999), and examined specimens at major entomological collections. The latter include for instance The Natural History Museum, London,

United Kingdom (BMNH), the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia (ZRAS) and Zoological Museum of the Finnish Museum of Natural History, Helsinki, Finland (ZMH). We also consulted numerous lepidopterists, particularly in Russia, who are experts in the local fauna and who have access to local museum collections and who know the holdings extensively.

Genitalia were prepared following methods described by Hardwick (1950). Terminology for the male genitalia follows Klots (1970) and Kristensen (2003) and for the wing venation McGuffin (1977). Nomenclature follows Parsons et al. (1999).

A comparative morphological method was used, i.e. the morphology of the new taxon was compared against other potentially related taxa, to infer the systematic position of the taxon in question. The approach relies on similarities only, homologies of the structures were not tested in a phylogenetic context.

***Dorsispina* gen. n.**

Type species: *Dorsispina furcicornaria* sp. n.

Diagnosis. Brown and beige wings, combined with brown line in the middle of forewing, which is parallel with costa (Fig. 1). Thorax with a Y-shaped sclerotised extension (Fig. 7). Abdominal tergites 3–8 densely covered with sclerotised spines (Fig. 14). The male genitalia with asymmetric uncus and no gnathos. Phallus is narrow, curved, and vesica is without sclerotisations.

Description. See below the description of *Dorsispina furcicornaria* sp. n.

Systematic position. The position within Ennominae is supported by the wing venation, particularly by the hindwing vein M_2 , which is vestigial, yet weakly tubular. The genus is tentatively classified in the tribe Boarmiini (*sensu* Holloway 1994), due to similarities with a few Palaearctic taxa in habitus, male genitalia and abdominal sclerites. See Figs 1–6 and Discussion.

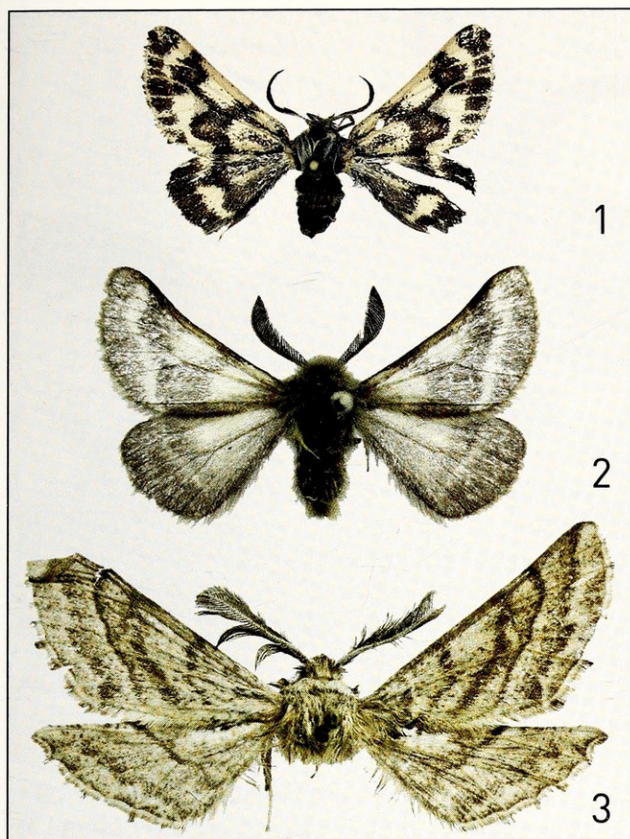
Etymology. The genus name *Dorsispina* refers to the abdominal tergites 3–8, which are densely covered with stout sclerotised spines. The name is derived from Latin: *dorsi* = genitive form of dorsal, *spina* = thorn.

***Dorsispina furcicornaria* sp. n.**

Figs 1, 4, 7, 14

Material. Holotype ♂, labeled: 'HOLOTYPE | *Dorsispina furcicornaria* | Nupponen & Sihvonon [red rectangle label]', 'KAZAKHSTAN | 47°12'25" N 55°28'49" E | Emba river, 47 m [a.s.l.], | Besbai village 2 km E | 25.9.2012, K. Nupponen leg.', 'Prep. number 1877 | Pasi Sihvonon', 'DNA sample | No. 175 | Pasi Sihvonon' (coll. Kari & Timo Nupponen, Espoo, Finland). Holotype can be borrowed via Zoological Museum of the Finnish Museum of Natural History, Helsinki, Finland.

Diagnosis. *Dorsispina furcicornaria* does not externally resemble any other Geometridae species in the Palaearctic region. The colour and pattern of wing markings, brown and beige, remotely resemble *Chondrosoma fiduciaria* Anker, 1854 (Fig. 2) and *Narraga* Walker, 1861 species (Macariini) but the patterns are different. The stout abdomen and short, triangular forewings are found in numerous Boarmiini taxa (e.g., *C. fiduciaria*



Figs 1–3. Adult males of *Dorsispina furcicornaria* and morphologically similar species. **1.** *D. furcicornaria*, holotype. **2.** *Chondrosoma fiduciaria*, Austria: Münchendorf, 23.x.1910 (wingspan 25 mm, coll. ZMH). **3.** *Apochima flabellaria*, Italy: Sardinia, 22.i.1987 (wingspan 37 mm, coll. ZMH).

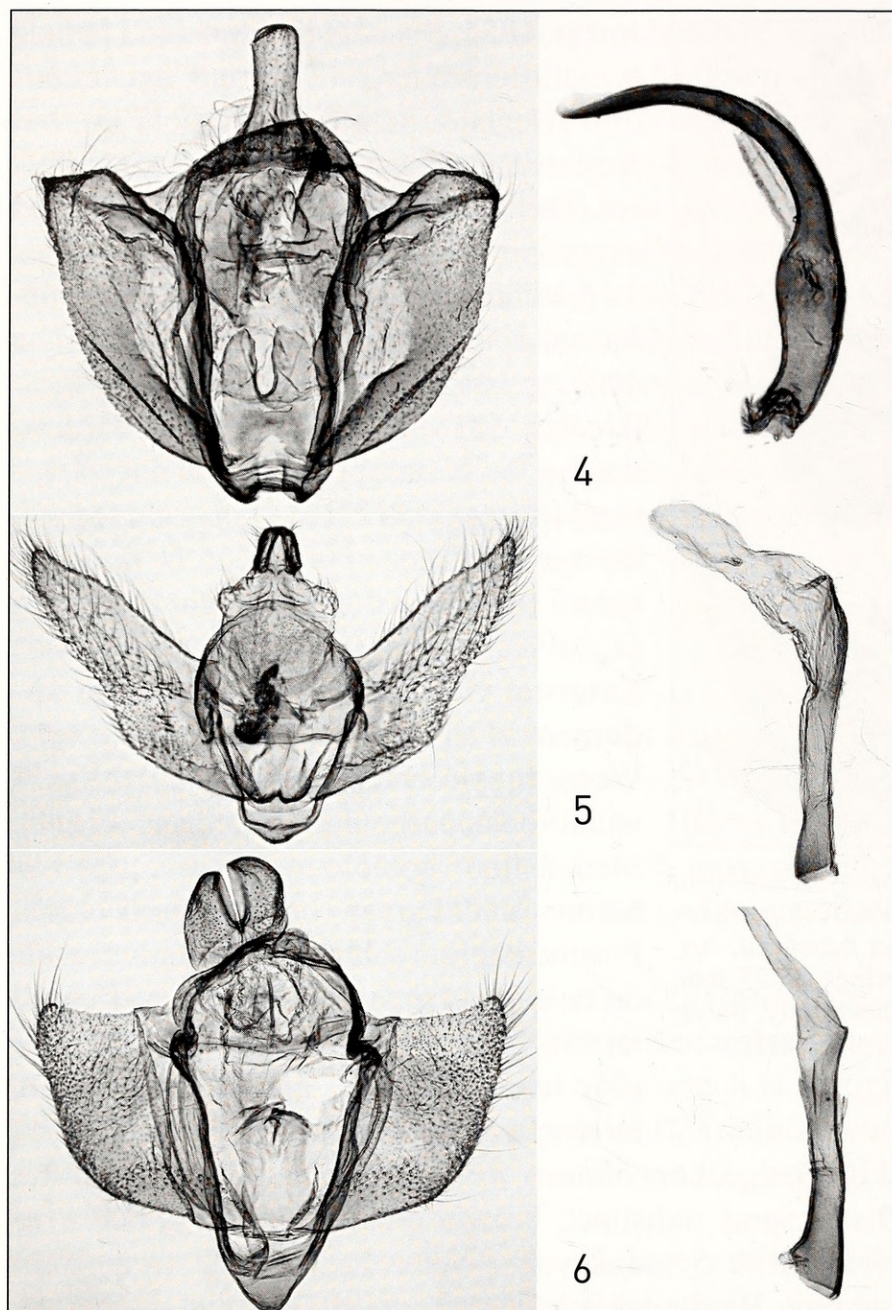
Anker, 1854, *Apocheima hispidaria* [Denis & Schiffermüller], 1775, and *Lycia zonaria* [Denis & Schiffermüller], 1775), but the external appearance of those are different. The thorax with a Y-shaped sclerotised extension (Fig. 7) and abdominal tergites 3–8, which are densely covered with sclerotised spines (Fig. 14), are unique. The male genitalia of *Apochima flabellaria* (Heeger, 1838) (Fig. 6) are somewhat similar but the costa of the valva is not sclerotised (it is sclerotised in *D. furcicornaria*), the uncus is bilobed (single in *D. furcicornaria*) and the phallus is straight (curved in *D. furcicornaria*).

External characters and pregenital abdomen. Male. Wingspan 20 mm ($n = 1$). Wings brown and beige, weakly suffused with brown, particularly near base (Fig. 1). Medial line (homology tentative) brown, narrow and curved inwards near costa. Postmedial line (homology tentative) wide on costa, narrow in the middle and parallel with costa, partly fused with medial line near inner margin. Terminal area brown, interrupted by beige veins. Forewing apex

with beige wedge. Terminal line beige, concolorous with wings. Fringes brown. Lines continued on hindwings. Discal spots indistinct, brown, elongated. Wings below as above, slightly paler. Forewing with 5 radial veins, veins R_{3-5} arising from common stalk. Accessory cells absent. Hindwing veins $Sc+R_1$ and R_s parallel, not fused. Hindwing vein M_2 vestigial, weakly tubular. Eyes small. Frons, collar and thorax mixed brown and beige. Thorax with prominent, Y-shaped sclerotised extension, with smaller lateral lobes at base (Fig. 7). Antennae bipectinate, pectinations long. Foreleg tibia with flat epiphysis, about same length as tibia. Hindleg tibia not swollen, with two minute apical spurs. Abdomen blackish. Tympanal organs large, sclerotised, almost meeting medially. Ansa bottle-shaped, very wide at base. Sternite 2 sclerotised, other sternites undifferentiated. Tergite 2 with narrow, long setae. Tergites 3–8 densely covered with sclerotised spines, base beige, apex dark (Fig. 14). Head, thorax and abdomen covered with long hair, majority of these were detached during immersion in water and the consequent drying process.

Variation. Unknown, only one male is known. See Remarks.

Genitalia. Male genitalia (Fig. 4). Uncus wide, spatulate, weakly setose. Socii small, membranous, covered with setae. Gnathos absent. Tegumen narrow, sclerotised. Juxta large, U-shaped, posterior margin deeply invaginated. Valva wide, short, mem-



Figs 4–6. Male genitalia and phallus of *Dorsispina furcicornaria* and morphologically similar species (figures not to scale). **4.** *D. furcicornaria*, holotype (coll. Nupponen, slide 1877/Pasi Sihvonen). **5.** *Chondrosoma fiduciaria*, Hungary: Budapest, 28.x.1945 (coll. ZMH, slide 1390/Pasi Sihvonen). **6.** *Apochima flabellaria*, Italy: Sardinia, 22.i.1987 (coll. ZMH, slide 1405/Pasi Sihvonen).

branous. Ventral margin slightly concave below apex. Dorsal margin (costa) sclerotised, weakly triangular. Apex weakly setose, with minute hook. Saccus concave. Phallus curved, widest in the middle, tapering towards acute apex. Caecum absent. Vesica not everted, presumably narrow tube, without sclerotisations. Female genitalia. Female is unknown.

Distribution. Only the holotype male is known from western Kazakhstan.

Biology. The flight period of the *D. furcicornaria* is presumably restricted to late autumn. The moth was observed in late September, and during the same period the flight of some other late autumn species started in the region, such as *Dasypolia timoi* Fibiger & Nupponen, 2006, *Ulochlaena hirta* (Hübner, [1813]) and *Deuterotinea casanella* Eversmann, 1844. *D. furcicornaria* seems to be diurnal: the specimen was in active flight about two hours before sunset (i.e. at 6 p.m.) in sunshine. The temperature was $> 25^{\circ}\text{C}$, there was a clear sky and no wind. The collecting site is a riverside sand dune,



Fig. 7. Dorsal Y-shaped sclerotisation on the thorax of *Dorsispina furcicornaria*, holotype; a: ventral view; b: lateral view.

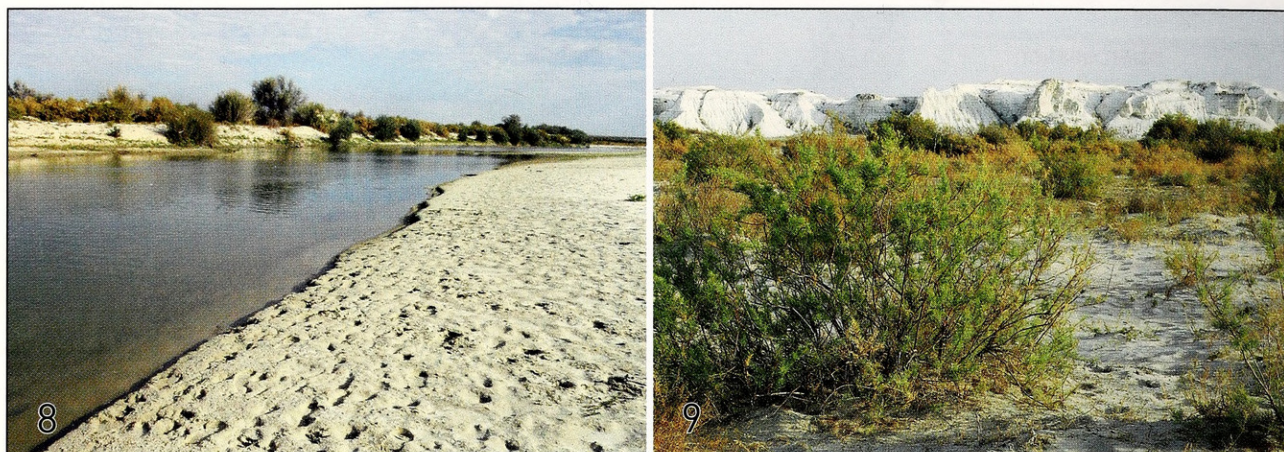
surrounded by a large chalk steppe (Fig. 8). The potential habitats of *D. furcicornaria* are riverside sand dunes and chalk steppes (Fig. 9). The immature stages remain unknown.

Etymology. The species name *furcicornaria* refers to the fork-shaped, horn-like dorsal sclerotisation on the thorax. The name is derived from Latin: *furca* = fork, *cornu* = horn and the ending *-aria* refers to the pectinate antennae.

Remarks. Only a single male of this new taxon is known. Potentially one additional specimen exists in the Falcovitsch collection in the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia (Jaan Viidalepp, pers. comm.). Despite efforts, the specimen has not been located (Vladimir Mironov, pers. comm.). A foreleg of the holotype has been submitted to the DNA analysis (barcode region of the mitochondrial cytochrome oxidase I (COI) gene, 658 base pairs) to be carried out in the Canadian Centre for DNA Barcoding, Ontario, Canada. The holotype has been under water, thus potentially diminishing the probability of recovering the DNA. At the time of manuscript preparation, the BOLD database (www.boldsystems.org) did not contain DNA barcodes of the taxa that are morphologically similar to *D. furcicornaria*.

Discussion

The systematic position of *Dorsispina furcicornaria* within the Ennominae is uncertain. We place it tentatively in the tribe Boarmiini *sensu* Holloway (1994; see also Sihvonen et al. 2011, who provided molecular support for Holloway's broad concept of Boarmiini), in the group of taxa that were classified earlier in Bistonini. Lack of phylo-



Figs 8, 9. Collecting site of *Dorsispina furcicornaria*. **8.** Kazakhstan: Aktyubinskaya Oblast, Emba river, 2 km East of Besbai village, 25.ix.2012. Photo: Kari Nupponen. **9.** The edge of riverside sand dunes and chalk steppe, habitat of *Dorsispina furcicornaria*. Photo: Pavel Gorbunov.

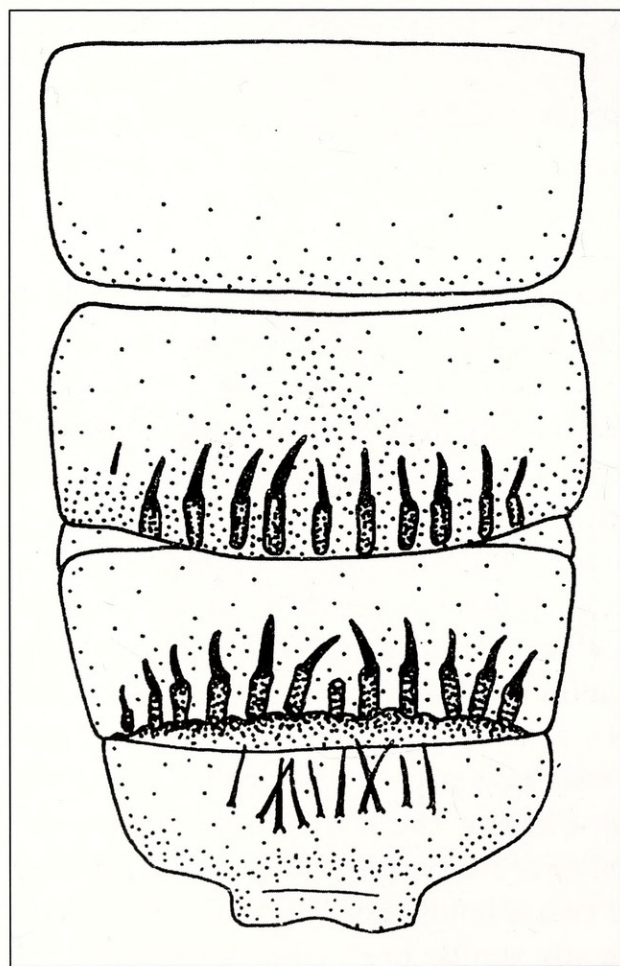
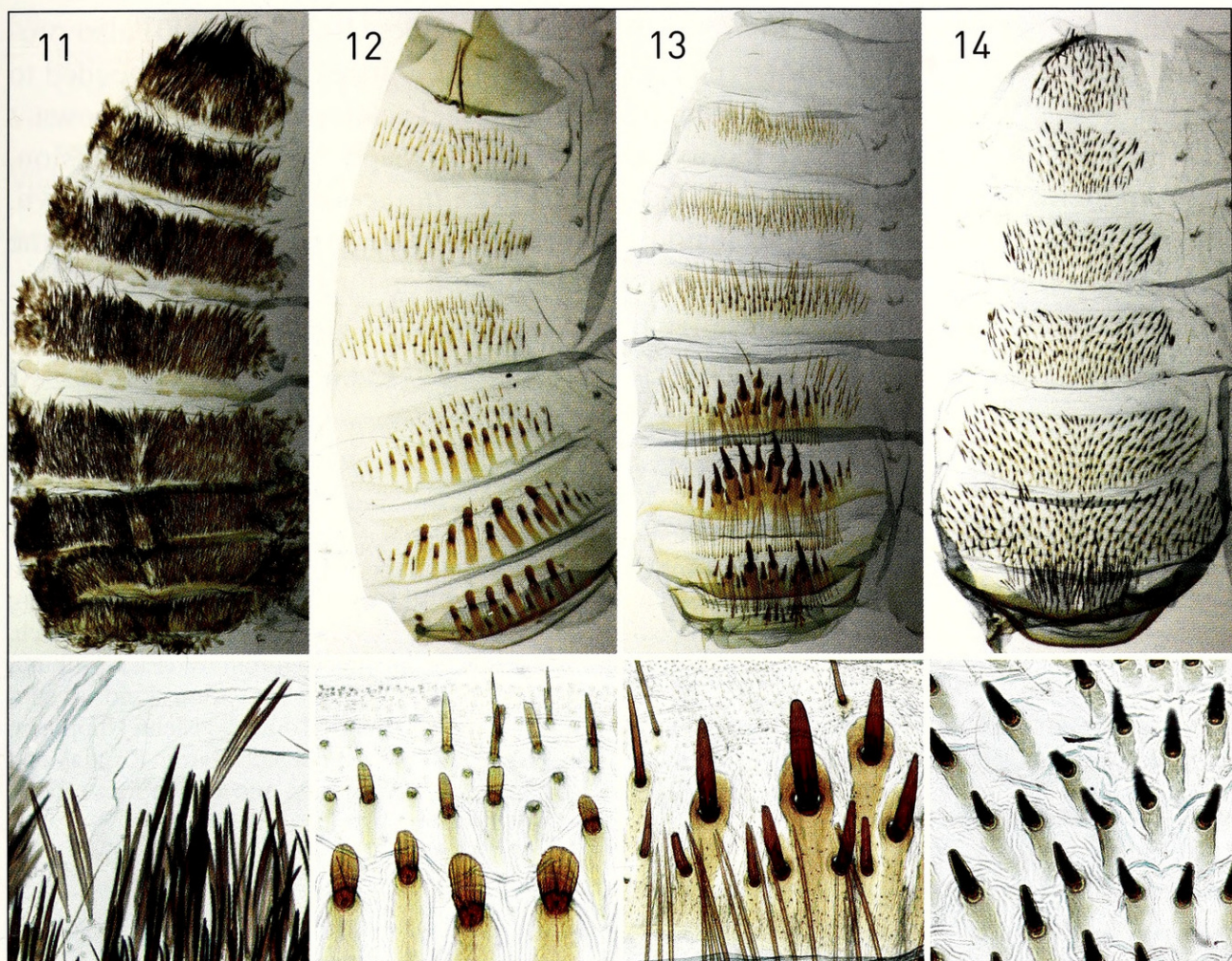


Fig. 10. Male abdominal tergites 1–5 of *Desertobia nocturna* Viidalepp, 1989 (after Viidalepp 1989).

genetic framework and absence of critical, modern generic revision of Boarmiini make the assessment of a more exact systematic position difficult. The Boarmiini relationship is supported by external habitus with several taxa, for instance *Chondrosoma fiduciaria* Anker, 1854 (Fig. 2), *Apocheima hispidaria* and several *Lycia* Hübner, [1825] 1816 species. The wing venation of *D. furcicornaria* is of characteristic Ennominae type, being essentially the same as in *Desertobia* Viidalepp, 1989 (see Viidalepp 1989) and *Chondrosoma fiduciaria* (our observation). The male genitalia of *D. furcicornaria* do not fit with any generic concepts of Boarmiini, but they are similar to *Apocheima flabellaria* (Heeger, 1838) (Fig. 6), sharing with it for instance the asymmetric uncus, short, stout valvae, and the absence of gnathos (Figs 4–6). *A. flabellaria* does not have, however, any sclerotised structures in the abdominal tergites that are characteristic for *D. furcicornaria* (Fig. 14). The male genitalia of those taxa that have sclerotisations in the abdominal tergites (see Figs 10–14) are structurally different from

that of *D. furcicornaria* sp. n. When a combination of several characters is evaluated, *D. furcicornaria*, *C. fiduciaria* and *A. flabellaria* appear morphologically the most similar (Figs 1–6). Viidalepp (1989) has applied the names Zamacrini and Apochimini to the genus *Apocheima* Agassiz, 1847, but potentially these are introduced in a way that



Figs 11–14. Male abdominal tergites, with details enlarged (figures not to scale). **11.** *Lycia lapponaria* (Boisduval), Finland: Vähäkyrö, 26.iv.1946 (coll. ZMH, slide PS1361/Pasi Sihvonen). **12.** *Chondrosoma fiduciaria* Anker, Hungary: Budapest, 28.x.1945 (coll. ZMH, slide PS1390/Pasi Sihvonen). **13.** *Wilemania nitobei* (Nitobe), Japan: Bushi, Iruma, 24.xi.1973 (coll. BMNH, slide PS1867/Pasi Sihvonen). **14.** *Dorsispina furcicornaria* (coll. Nupponen, slide PS1877/Pasi Sihvonen).

does not fulfill the requirements of Article 13 of the International Code on Zoological Nomenclature (ICZN 2012; see also Beljaev 2008).

Abdominal tergites 3–8 of *D. furcicornaria* are densely covered with sclerotised spines (Fig. 14). We have not found similar structures elsewhere in the Palaearctic Ennominae, but various sclerotised structures on abdominal tergites are found in several Ennominae taxa (Figs 10–13). Unfortunately there is no phylogenetic framework available that would allow evaluating whether these structures are homoplastic or not. Tergites are densely covered with elongated scales in several *Lycia* (our observation) (Fig. 11) and *Biston* Leach, 1815 species (Boarmiini); in a few species in the latter these are partly developed to spines (Jiang et al. 2011). Wide, blunt-ending sclerotisations are found in *Chondrosoma fiduciaria* Anker, 1854 (Boarmiini), those are the most developed in tergites 2–4 (Fig. 12). In the East Palaearctic *Wilemania nitobei* (Nitobe, 1907) (Wilemanini), the sclerotisations are wide, with acute apex (Fig. 13). Those are structurally similar to the structures found in *Desertobia* Viidalepp, 1989 (Fig. 10), classified in the Desertobiini (Viidalepp 1989). According to Beljaev (2000), *Semidesertobia* Beljaev, 2000 is potentially related. The latter lacks abdominal sclerotisations,

but tergites are covered with numerous firm fork-like scales. Beljaev (2000) also proposed *Desertobiini* to be a junior synonym of *Boarmiini*. Further research is needed to clarify these relationships. The function of the abdominal sclerotisations is unknown.

The function of the peculiar thorax structure, the Y-shaped sclerotised extension, with smaller lateral extensions at the base (Fig. 7) in *D. furcicornaria* is also unknown. Potentially it may play a role in eclosion during the emergence of the imago from the pupal case. *Apochima flabellaria*, which might be related on the basis of the male genitalia structures, does not have dorsal sclerotisations on the thorax but it does have a small sclerotised, triangular structure on the dorsal margin of the frons.

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