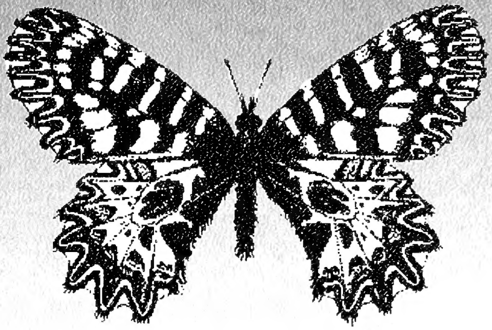
NOTA LEPIDOPTEROLOGICA

A journal devoted to the study of Lepidoptera
Published by Societas Europaea Lepidopterologica (SEL)



Vol. 27 No. 4 2004

SOCIETAS EUROPAEA LEPIDOPTEROLOGICA e.V.

http://www.soceurlep.org

HONORARY MEMBERS

Pamela Gilbert (GB), Barry Goater (GB), Prof. Dr László Gozmány (H), Prof. Dr Vladimir Kuznetzov (RU)

COUNCIL

President:	Prof. Dr Niels P. Kristensen (DK)
Vice-President:	Dr David Agassiz (UK)
General Secretary:	Dr Christoph Häuser (D)
Treasurer:	Manfred Sommerer (D)
Membership Secretary:	Will O. de Prins (B)
Ordinary Council Members:	Dr Bernard Landry (CH), Dr Elisenda Olivella (E), Dr László Ronkay (H), Dr Gerhard Tarmann (A), Dr Alberto Zilli (I),
Editor:	Dr Matthias Nuss (D)

ISSN 0342-7536

Type setting: blattwerk dd | · Markward Fischer

Printed by Lausitzer Druck- und Verlagshaus GmbH, Bautzen

Nota lepidopterologica

A journal devoted to the study of Lepidoptera
Published by the Societas Europaea Lepidopterologica e.V.

Volume 27 No. 4 Dresden, 07.06.2005 ISSN 0342-7536

Contents

Revision of the *Turanana endymion* species-group (Lycaenidae)

John G. Coutsis

4 Glykonos Street, GR-10675 Athens, Greece; e-mail: kouts@otenet.gr

Abstract. The separation of *Turanana taygetica* (Rebel, 1902) stat. n. from *Turanana endymion* (Freyer, 1850) is effected on the basis of small, but constant differences in their male genitalia, the absence of genitalia intermediates, as well as on the basis of syntopism and synchronism of these two species-group taxa in south-central Asiatic Turkey. *Turanana taygetica endymionoides* ssp. n. is described on the basis of constant and rather pronounced external differences. A male neotype is designated for nominotypical *endymion*, as well as for nominotypical *T. taygetica*. A male lectotype is designated for *T. endymion ahasveros* (Bytinski-Salz & Brandt, 1937).

Key words. Lycaenidae, *Turanana endymion*, taxonomy, typification, new subspecies, Greece, Turkey, Iran.

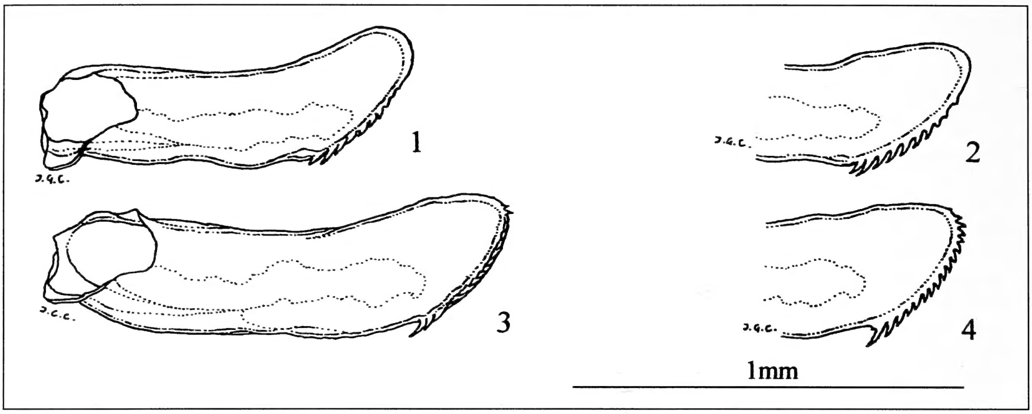
Introduction

A comparison between the valvae of *Turanana endymion endymion* (Freyer, 1850) (= *T. panagaea panagaea* (Herrich-Schäffer, 1851)) from central and eastern Asiatic Turkey (Figs. 1, 2, 5, 7–26, 27–33, 39–50), as well as from Lebanon (Fig. 34), and between the valvae of what is generally accepted as being *Turanana endymion ahasveros* (Bytinski-Salz & Brandt, 1937) from Iran (Fig. 38), and those of *Turanana endymion taygetica* (Rebel, 1902) from Mt. Helmós (Figs. 3, 4, 6, 52) and Mt. Taíyetos (Fig. 51), both situated in Pelopónnisos, Greece, revealed small, but constant differences in the average number and especially in the arrangement of their terminal spikes (Coutsis 1986). It was then suggested that possibly two separate species were involved here, but due to allopatry and the small degree of differentiation between them, it was deemed more appropriate to retain them as separate subspecies only.

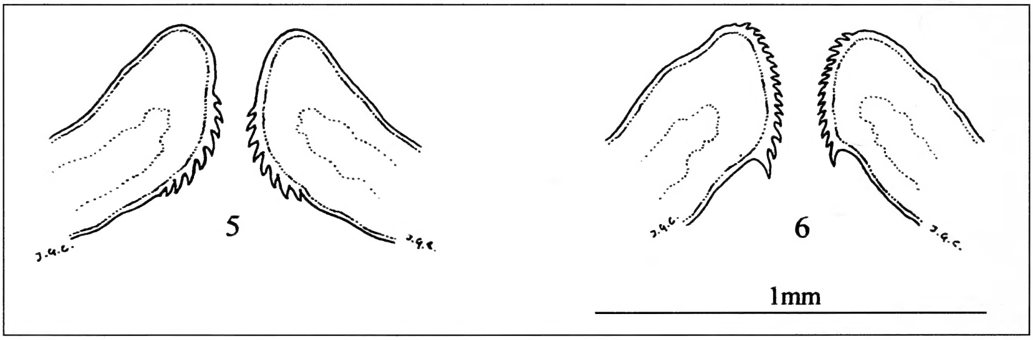
Recent material of *T. endymion* from western Asiatic Turkey, however, demonstrated that their valvae were identical to those of subspecies *T. taygetica* (Figs. 53–65, 66–87), while specimens collected as syntopic and synchronous on Bolkardağları, Niğde province, south-central Asiatic Turkey, were found to possess either one or the other valval type (Figs. 7, 64), without the presence of intermediates.

These conditions seemed important enough to necessitate a reassessment of the hitherto accepted taxonomic relationship between *endymion* and *taygetica*, as well as to warrant a revision, albeit tentative (due to lack of sufficiently extensive material), of the *T. endymion* species-group as a whole.

The name *Turanana endymion endymion* is now provisionally being applied to all specimens that possess valvae that are identical to those of specimens recorded from the type locality of *endymion*, i.e.: Turkey, Amasya province (Figs. 9, 10), the name *Turanana endymion ahasveros* to all specimens that possess valvae that are identical to those of specimens recorded from the type locality of *ahasveros*, i.e.: Iran, Elburs Mts., Keredj (Figs. 35–37), and the name *Turanana endymion taygetica*, to all specimens whose valvae are identical to those of specimens recorded from the type locality of



Figs. 1–4. *Turanana endymion* and *Turanana taygetica*, aspects of right valva for specimens of near equal forewing length. **1.** *T. endymion endymion*, Turkey, Sivas province, Gökpınar, 1600 m (forewing length 11.7 mm), side view of inner face. **2.** Same specimen, view on mesal side, showing distal end. **3.** *T. taygetica endymionoides* (formerly *T. endymion taygetica*), Greece, Pelopónnisos, Mt. Helmós, 1800 m (forewing length 11.2 mm); side view of inner face. **4.** Same specimen, view on mesal side, showing distal end.

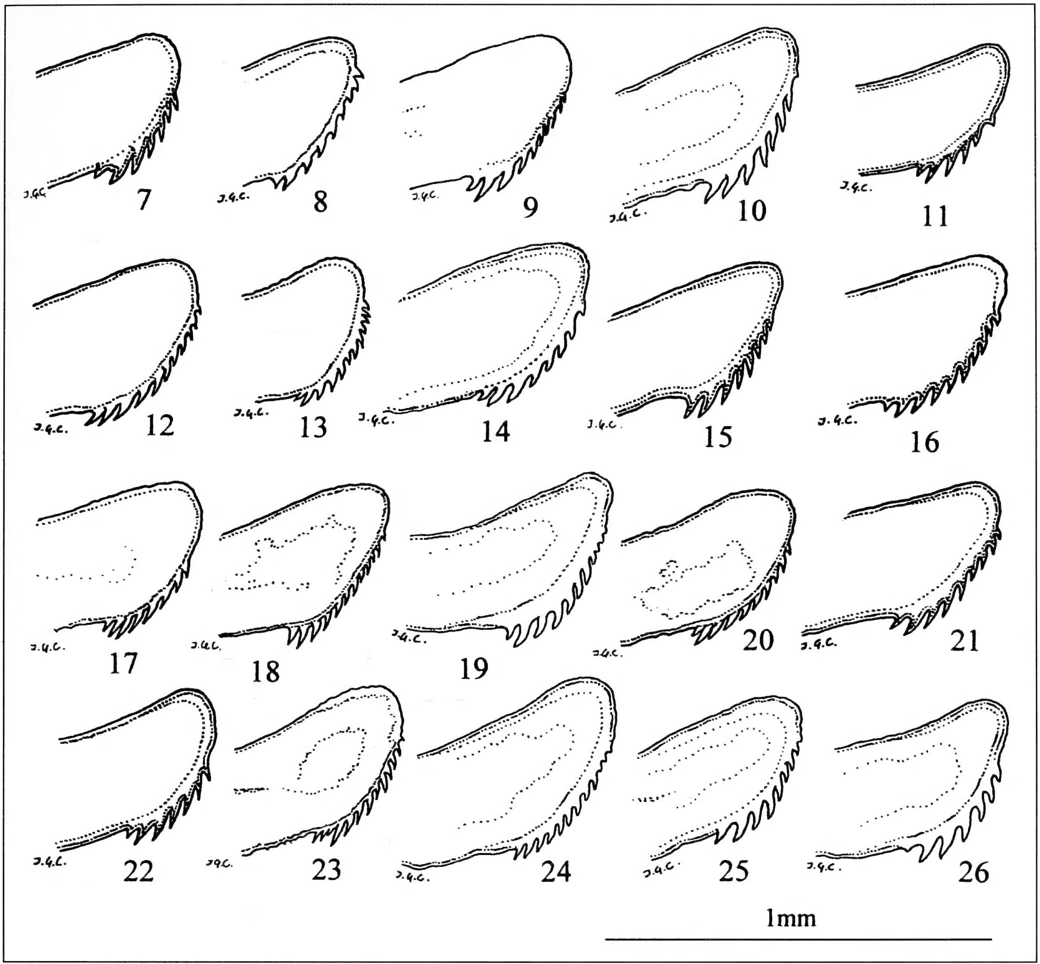


Figs. 5–6. *Turanana endymion* and *Turanana taygetica*, view on distal end of mesal wall of right and left valva, showing the near symmetry of the appendages. **5.** *T. endymion endymion*. Turkey, Sivas province, S of Gürün, Gökpınar, 1500–1650 m. **6.** *Turanana taygetica endymionoides* (formerly *T. endymion taygetica*), Greece, Pelopónnisos, Mt. Helmós, 1800 m.

taygetica, i.e.: Greece, Pelopónnisos, Mt. Taíyetos (Fig. 51). Two specimens from Mazanderan, Iran (the valva of one is shown on Fig. 38), which externally agree with *ahasveros*, but whose genitalia are identical to those of nominotypical *endymion* and differ from those of the subspecies *ahasveros*, are provisionally being referred to as *Turanana endymion ?-ahasveros*.

Abbreviations

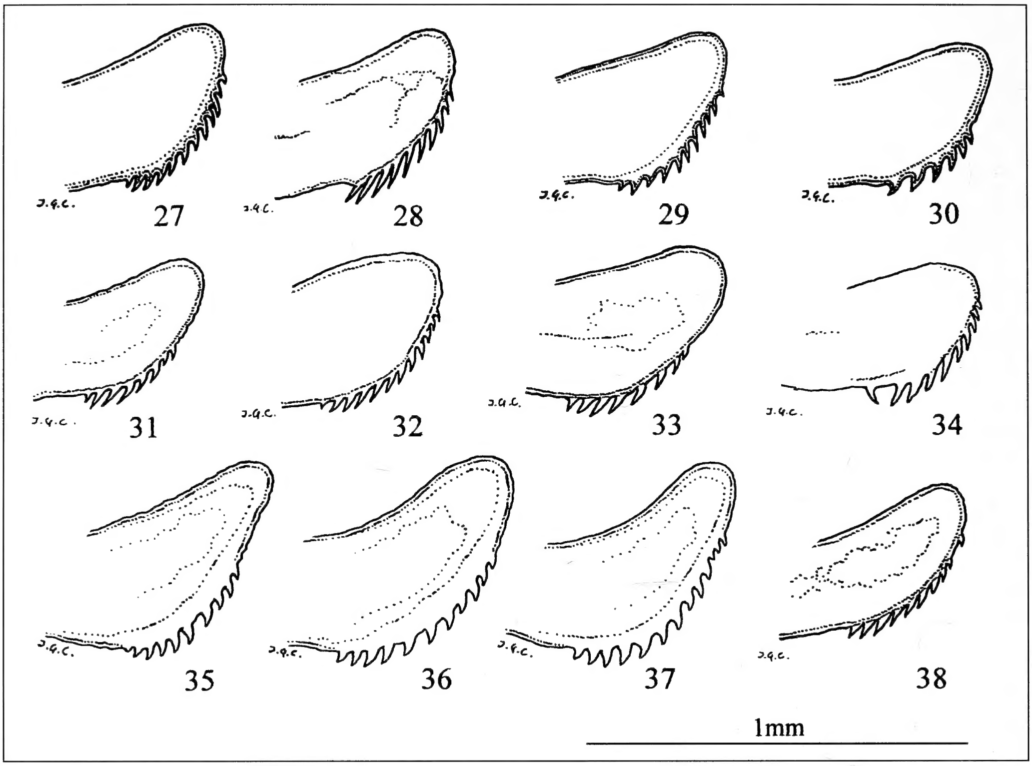
BMNH	The Natural History Museum, London
CMNH	Carnegie Museum of Natural History, Pittsburgh, Pennsylvania
NHRS	Naturhistoriska Riksmuseet, Stockholm
ZMAN	Zoölogisch Museum, Universiteit van Amsterdam



Figs. 7–26. *Turanana endymion endymion* from Turkey, view of distal end of mesal wall of right valva. **7.** Niğde province, Bolkardağları N side, SW of Maden, 1600–1800 m. **8.** Niğde province, Aladağları W side, 15 km SE of Çamardı, Elmalı Boğazı, 1600–1800 m. **9.** Amasya province. **10.** Amasya province, 10 km SW of Ladik, 900 m. **11.** Kayseri province, Hisarcık, road between Develi and Kayseri town, 1800 m. **12.** Kayseri province, Ercıyes Dağ, road between Develi and Kayseri town, 2200 m. **13.** Kayseri province, Aladağları E side, 48 km S of Yahyalı, 2800–2900 m. **14.** Tokat province, near Çamıçı, 1200 m. **15.** Ordu province, 20 km NNW of Mesudıye, 900 m. **16.** Maraş province, hills NW of Maraş town, 5–10 km along road to Ağabeylı, 800–900 m. **17.** Sivas province, near Gökpınar, 10 km S of Gürün, 1500 m. **18.** Sivas province Çamlıbel Geçidi, 1450 m. **19.** Malatya province, 3 km SE of Kubbe Geçidi, 1700 m. **20.** Malatya province, 3–6 km NW of Darende, 1500 m. **21.** Erzincan province, Dumanlı, 10–13 km SW of Erzincan town, along road to Kemah, 1100 m. **22.** Gümüşhane province, Demirkaynak, 2–5 km along road to Şırnak, 1100 m. **23.** Erzincan province, 5 km S of Çağlayan, Munzurdağları. **24.** Erzincan province, Sakaltutan Geçidi, 25 km E of Refahiye, 2000 m. **25.** Tunceli province, 1200 m. **26.** Elazığ province, near Harput, N of Elazığ town, 1200 m.

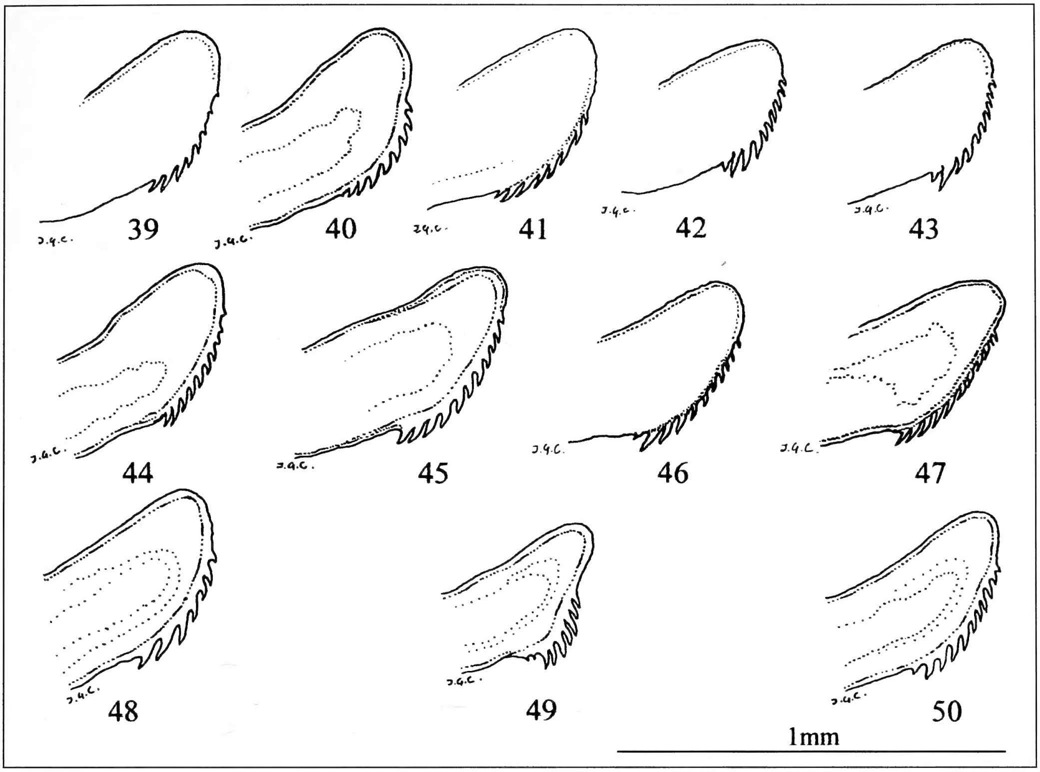
Proposed new nomenclatural arrangement

The constant differences between the valvae of nominotypical *endymion* and those of the subspecies *taygetica*, the syntopism and synchronism of their respective populations in south-central Asiatic Turkey and the absence of intermediate valval forms suggest that it would be better to consider them as representing two distinct species, rather than



Figs. 27–38. *Turanana endymion*, view of distal end of mesal wall of right valva. **27–34.** *T. endymion endymion*. **27.** Turkey, Gümüşhane province, Kopdağı Geçidi W side, 1900 m. **28.** Turkey, Erzurum province, Ovit Geçidi, 10–15 km NW of İspir, 1500–1800 m. **29.** Turkey, Erzurum province, Palandöken, 5 km S of Erzurum town, 2200 m. **30.** Turkey, Artvin province,Sarıbudak, 800 m. **31.** Turkey, Van province, near Edremit, 17 km SW of Van town. **32.** Turkey, Van province, Çatak. **33.** Turkey, Hakkâri province, 10–12 km SW of Hakkâri town, Zap valley, 1500 m. **34.** Lebanon, Mt. Lebanon. **35–37.** *T. endymion ahasveros*. **35.** Iran, Fars, road from Ardekan to Talochosroe, Comèe, ca. 3600 m. **36.** Iran, Fars, road from Chiraz to Kazeroun, Fort Sine-Sefid, ca. 2200 m. **37.** Iran, Elburs Mts., Keredj, 1700 m. **38.** *T. endymion ?-ahasveros*, Iran, Mazanderan, Khosh-Yeylaq, 2000–2500 m.

two subspecies of the same species. The taxon *ahasveros*, differing from nominotypical *endymion* by its extended valval apex, may very well represent yet another species, but it is at present best to consider it as a subspecies of *endymion* on account of the fact that there was no material available for study from geographically intermediate areas (perhaps *ahasveros* might prove to be the end expression of a cline) and also because certain individuals of nominotypical *endymion* likewise show a tendency towards an extension of the valval apex (Figs. 19, 26). The taxon *?-ahasveros* from Mazanderan, Iran, requires the study of presently unavailable further material from other localities in Iran, in order for one to be able to draw sound conclusions about its true taxonomic status. Mt. Helmós *taygetica*, clearly differing externally from the nominotypical form from Mt. Taíyetos (to be dealt with in detail in the ensuing description of the type-material), rightfully deserves separation from it at the subspecies level. Macroscopic comparison of Turkish *taygetica* with nominotypical *endymion* did not reveal constant external differences, but the material at hand was probably not sufficient enough in

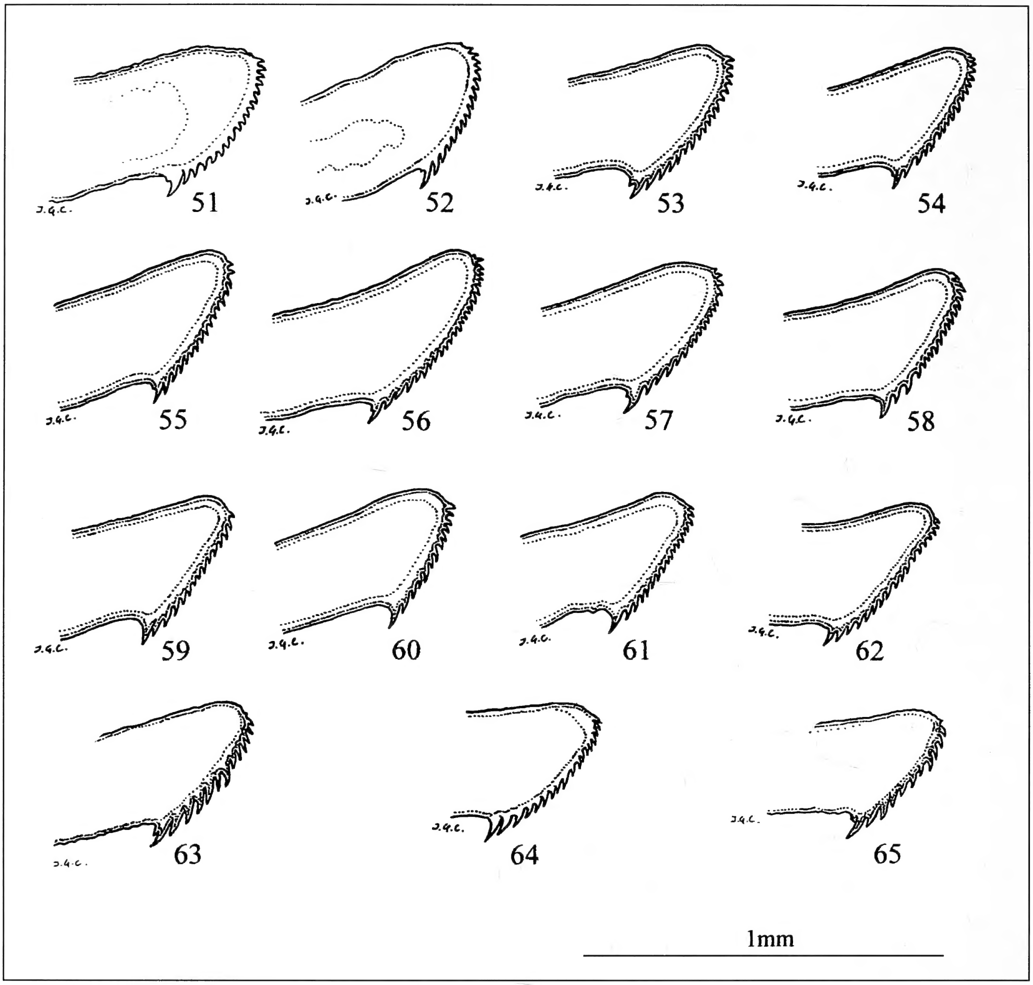


Figs. 39–50. *Turanana endymion endymion*, view of distal end of mesal wall of right valva, demonstrating individual variation within single localities in Turkey. **39–47.** Sivas province, Gökpınar. **48–50.** Erzincan province, Çağlayan.

numbers to allow definitive conclusions. Mt. Helmós *taygetica* on the whole differs externally to some extent from its Turkish counterpart, but as certain individuals are very difficult to set apart and as specimens from geographically intermediate areas (i.e. western extremity of Asiatic Turkey) were not available for study, it seems presently prudent to lump them together under a single subspecies, albeit on a tentative basis. On account of the above, it is proposed that the following taxonomic arrangement be put to effect.

Available type material and type designations

The syntypes of *T. endymion endymion* have been lost and therefore a male specimen from the type locality has been chosen to be designated as the neotype. A number of syntypes of *T. endymion ahasveros* have been made available from the Naturhistoriska Riksmuseet, Stockholm, Sweden and a male specimen has been chosen to be designated as the lectotype, while the rest of the syntypes (4 males and 1 female from the above museum and 5 males and 5 females deposited in the Carnegie Museum, Pittsburgh, Pennsylvania, USA) are designated as paralectotypes. A thorough personal search for the syntypes (one male and two females) of *T. taygetica taygetica* at their depository in the Naturhistorischen Hofmuseum, Wien, Austria, brought about negative results and it is assumed that they too have been lost, thus making it necessary that a male specimen from the type locality be designated as the neotype. Lastly, a male holotype and paratypes of both sexes, all from the author's collection, are designated for *T. taygetica endymionoides*, and the necessary descriptions given below.

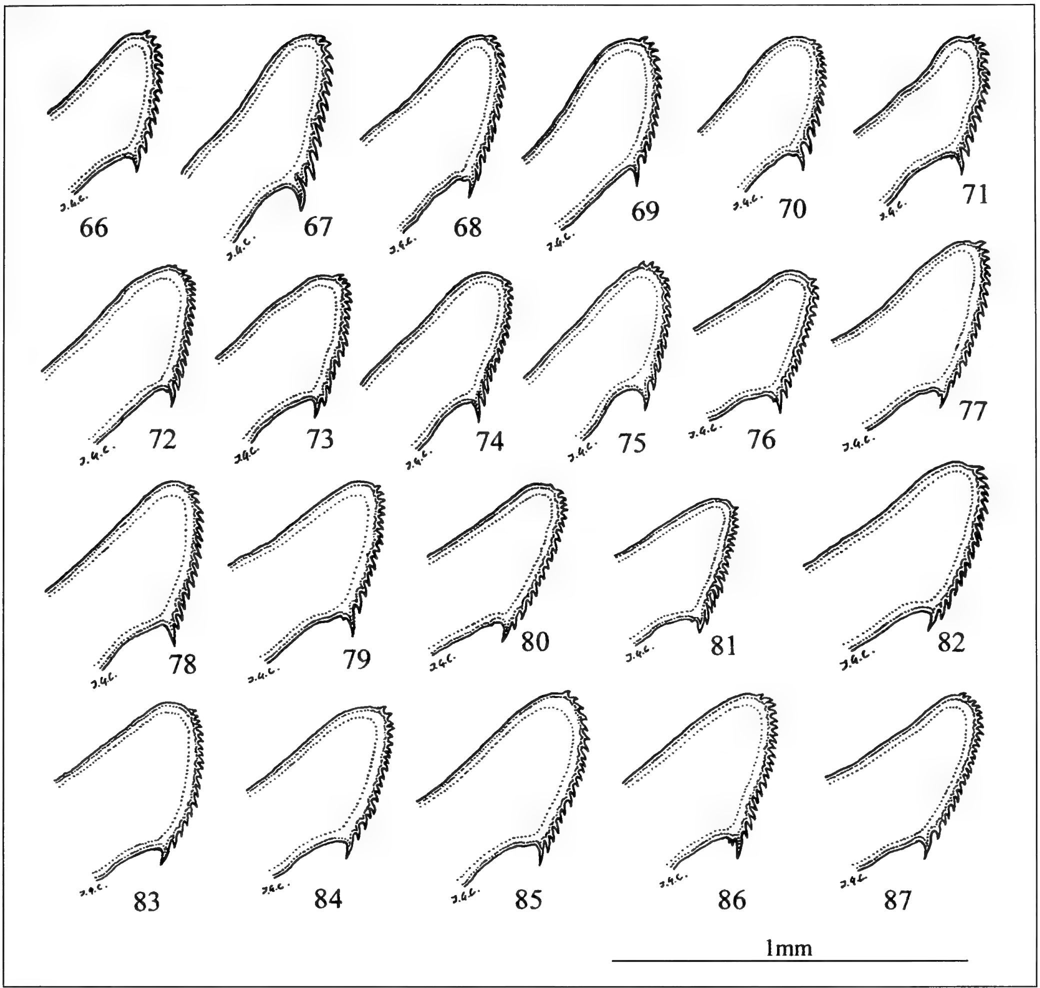


Figs. 51–65. *Turanana taygetica* (formerly *Turanana endymion taygetica*), view of distal end of mesal wall of right valva. **51.** *Turanana taygetica taygetica*. Greece, Pelopónnisos, Mt. Taíyetos, 1150–1200 m. **52–65.** *Turanana taygetica endymionoides*. **52.** Greece, Pelopónnisos, Mt. Helmós, 1800 m. **53.** Turkey, Konya province, Sultandağları, 15 km S of Akşehir, 1500 m. **54.** Turkey, Konya province, 12 km SW of Engilli, 1300–1600 m. **55.** Turkey, Konya province, 10 km NE of Gelendost, 1000 m. **56.** Turkey, Afyon province, Sultandağları, 10 km S of Çay, 1300 m. **57.** Turkey, Afyon province, Sultandağları, 8 km SW of Dereçine, 1700–2200 m. **58.** Turkey, Konya province, Sultandağları, 6km S of Çankaturan, 23km SSE of Akşehir, 1700m. **59.** Turkey, Konya province, Sultandağları, Akşehir, 1100 m. **60.** Turkey, Konya province, Derebucak, 1100 m. **61.** Turkey, Karaman province, Sertavul Geçidi, 1500 m. **62.** Turkey, Konya province, Akşehir, 1900 m. **63.** Turkey, Niğde province, Aladağları E side, 10 km S of Yahyalı, 1800–1900 m. **64.** Turkey, Niğde province, Bolkardağları N side, near Maden, 1500–1650 m. **65.** Turkey, Kayseri province, Aladağları E side, 2800–2900 m, 18 km S of Yahyalı.

Turanana endymion endymion (Freyer, 1850)

Pap.[*ilio*] *Endymion* Freyer, 1850: 145–146, pl. 572 figs. 2, 3. Type locality: Turkey, Amasia. (original description: see Figs. 89–91). Syntypes: lost.

Material. Neotype. ♂ designated here (Figs. 92–96), **Turkey**, Amasya province, 10 km SW of Ladik, 900 m, 2.vi.1988 (gen. prep. no. 3740), H. & Th. v. Oorschot, H. v. d. Brink & H. Wiering leg., coll. ZMAN. – 1♂ Turkey, Amasya province, coll. BMNH; 1♂ Amasya province, 10 km SW of Ladik, 900 m,



Figs. 66–87. *Turanana taygetica endymionoides* (formerly *Turanana endymion taygetica*), view of distal end of mesal wall of right valva, demonstrating individual variation within the single locality in Turkey, Sultandağları mountain range, provinces of Konya and Afyon.

2.vi.1988, coll. ZMAN; 1♂ Artvin province,Sarıbudak, 800 m, 19.vii.1993, coll. De Prins, Olivier & v. d. Poorten; 1♂ Elazığ province, near Harput, N of Elazığ town, 1200 m, 8.vii.1987, coll. ZMAN; 1♂ Erzincan province, Dumanlı, 10–13 km SW of Erzincan town, along road to Kemah, 1100 m, 12.vi.1988, coll. De Prins, Olivier & v. d. Poorten; 3♂ Erzincan province, 5 km SE of Çağlayan, 1500 m, 5.vii.1999, coll. Wiemers; 1♂ Erzincan province, 5 km S of Çağlayan, Munzurdağları, 15–18.vii.1987, coll. De Prins, Olivier & v. d. Poorten; 1♂ Erzincan province, Sakaltutan Geçidi, 25 km E of Refahiye, 2000 m, 13.vii.1986, coll. ZMAN; 1♂ Erzurum province, Ovit Geçidi, 10–15 km NW of İspir, 1500–1800 m, coll. De Prins, Olivier & v. d. Poorten; 1♂ Erzurum province, Palandöken, 5 km S of Erzurum town, 2200 m, 5.vii.1993, coll. De Prins, Olivier & v. d. Poorten; 1♂ Gümüşhane province, Demirkaynak, 2–5 km along road to Şırnak, 1100 m, 25.vii.1992, coll. De Prins, Olivier & v. d. Poorten; 1♂ Gümüşhane province, Kopdağı Geçidi W side, 1900 m, 28.vii.1987, coll. De Prins, Olivier & v. d. Poorten; 1♂ Hakkâri province, 10–12 km SW of Hakkâri town, Zap valley, 1500 m, 16–25.vii.1990, coll. De Prins, Olivier & v. d. Poorten; 1♂ Kayseri province, Hisarcık, road between Develi and Kayseri town, 1800 m, 6.vii.1982, coll. De Prins, Olivier & v. d. Poorten; 1♂ Kayseri province, Ercıyes Dağ, road between Develi and Kayseri town, 2200 m, 22.vii.1995, coll. De Prins, Olivier & v. d. Poorten; 1♂ Kayseri province, Aladağları E side, 48 km S of Yahyalı, 2800–2900 m, 28.vii–2.viii.1995, coll. De Prins, Olivier & v. d. Poorten; 1♂ Malatya province,

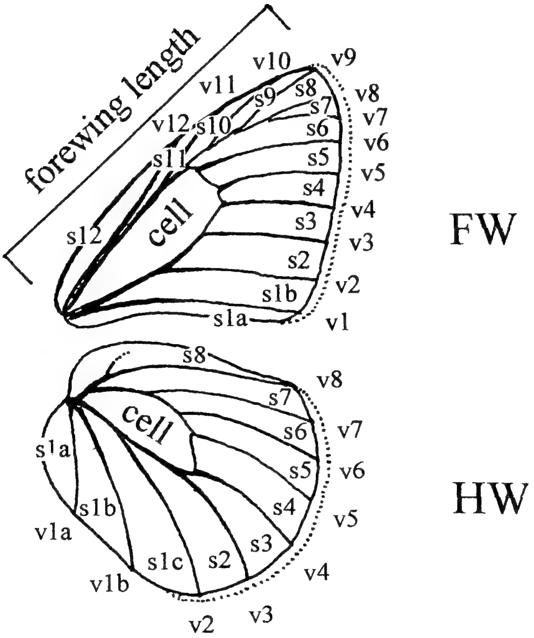
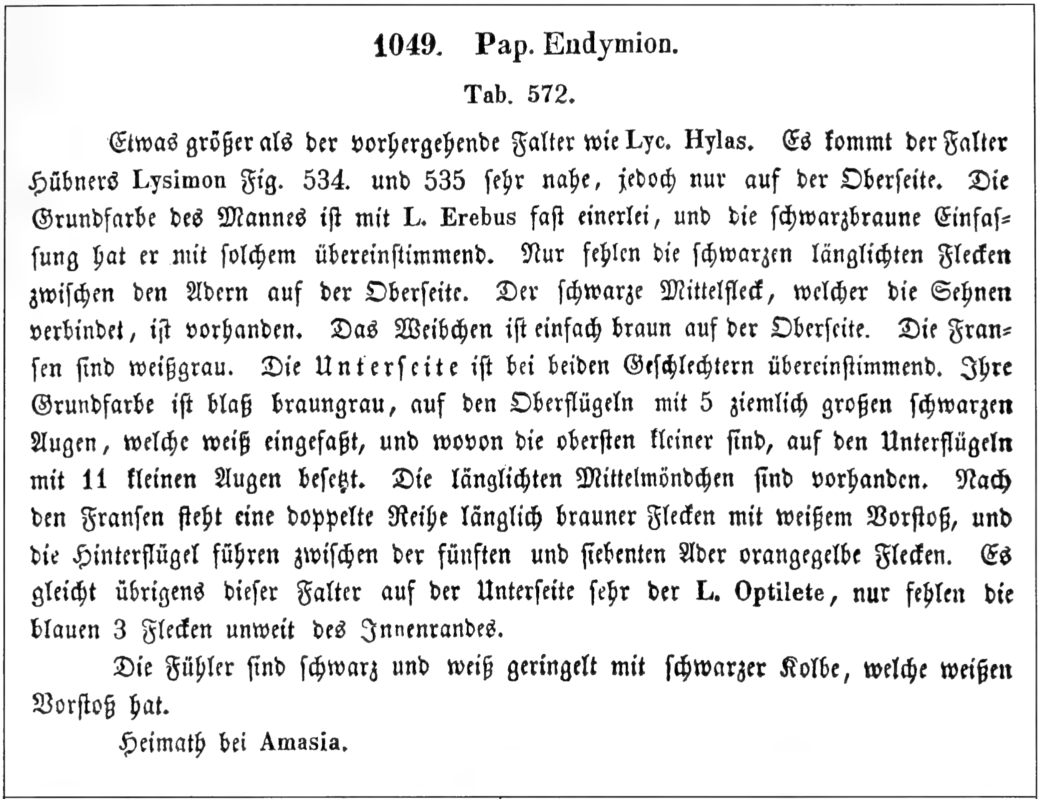


Fig. 88. Scheme of the butterfly wings, defining "forewing length", and showing the cell, the veins and the inter-venal spaces of the fore- and hindwing.

3 km SE of Kubbe Geçidi, 1700 m, 12.vi.1999, coll. ZMAN; 1♂ Malatya province, 3–6 km NW of Darende, 1500 m, 30.vii–3.viii.1983, coll. De Prins, Olivier & v. d. Poorten; 1♂ Maraş province, hills NW of Maraş town, 5–10 km along road to Ağabeylı, 800–900 m, 29.v.1985, coll. De Prins, Olivier & v. d. Poorten; 1♂ Niğde province, Bolkardağları N side, SW of Maden, 1600–1800 m, 24.vii.1994, coll. De Prins, Olivier & v. d. Poorten; 1♂ Niğde province, Aladağları W side, 15 km SE of Çamardı, Elmalı Boğazı, 1600–1800 m, 19.vii.1995, coll. De Prins, Olivier & v. d. Poorten; 1♂ Ordu province, 20 km NNW of Mesudıye, 900 m, 6.vi.1988, coll. De Prins, Olivier & v. d. Poorten; 1♂ Sivas province, Gökpınar, 1600 m, 9–11.vii.1987, coll. Coutsis; 3♂ Sivas province, Gökpınar, 1600m, 10.vii.1982, coll. Coutsis; 1♂ Sivas province, near Gökpınar, 10 km S of Gürün, 1500 m, 10–11.vii.1985, coll. De Prins, Olivier & v. d. Poorten; 4♂ Sivas province, S of Gürün, Gökpınar, 1500–1650 m, 9–11.vii.1982, coll. Coutsis; 1♂ Sivas province, 15 km S of Gökpınar, 1800 m, 2.vi.1999, coll. ZMAN; 1♂ Sivas province Çamlıbel Geçidi, 1450 m, 4.vii.1987, coll. De Prins, Olivier & v. d. Poorten; 1♂ Tokat province, near Çamıçı, 1200 m, 4.vi.1988, coll. ZMAN; 1♂ Tunceli province, 1200 m, 13–14.vii.1987, coll. ZMAN; 1♂ Van province, near Edremit, 17 km SW of Van town, 1–6.vii.1990, coll. Wiemers; 1♂ Van province, Çatak, 2.vii.1991, coll. Coutsis; 1♂ **Lebanon**, Mt. Lebanon, coll. BMNH.

Description. Neotype (Figs. 92, 93). Forewing length 11.1 mm. Upperside ground-colour blue; blackish marginal borders averaging about 1.7 mm wide; blackish border on forewing tending to invade the post-distal area basad of apex; weakly defined pure black spots present in borders in s1c, s2, s3, s4 and s5 of hindwing; apex of cell on forewing marked by a fine, weakly-defined black stria shaped like shallow crescent; fringes pure white. Underside ground-colour light gray-brown, giving impression of "dirty and rough" texture; basal area of hindwing with faint, shiny, whitish-blue dusting; post-discal black spots on forewing large and surrounded by off-white rings; post-discal spot in s3 conspicuously displaced distad; apex of cell on forewing with fine, well-



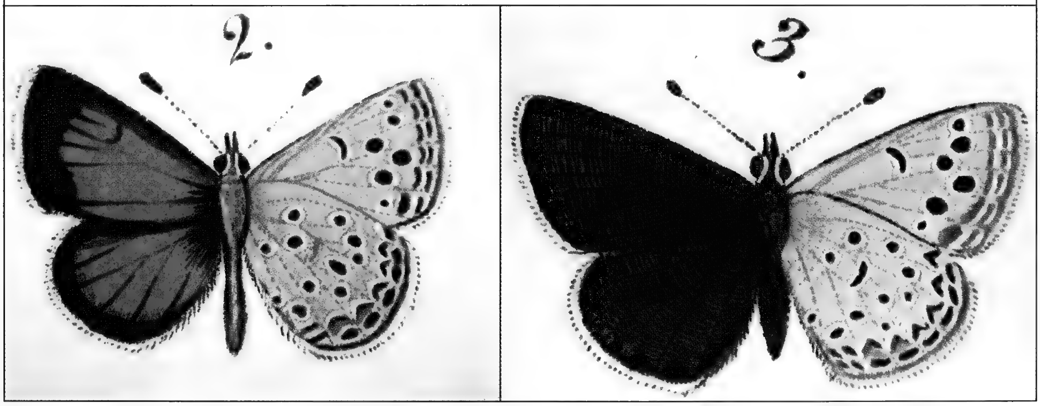
1049. Pap. Endymion.

Tab. 572.

Etwas größer als der vorhergehende Falter wie Lyc. Hylas. Es kommt der Falter Hübners Lysimon Fig. 534. und 535 ſehr nahe, jedoch nur auf der Oberſeite. Die Grundfarbe des Mannes iſt mit L. Erebus faſt einerlei, und die ſchwarzbraune Einfaſſung hat er mit ſolchem übereinſtimmend. Nur fehlen die ſchwarzen länglichten Flecken zwiſchen den Adern auf der Oberſeite. Der ſchwarze Mittelfleck, welcher die Sehnen verbindet, iſt vorhanden. Das Weibchen iſt einfach braun auf der Oberſeite. Die Franſen ſind weißgrau. Die Unterſeite iſt bei beiden Geſchlechtern übereinſtimmend. Ihre Grundfarbe iſt blaß braungrau, auf den Oberflügeln mit 5 ziemlich großen ſchwarzen Augen, welche weiß eingefaßt, und wovon die oberſten kleiner ſind, auf den Unterflügeln mit 11 kleinen Augen beſetzt. Die länglichten Mittelmöndchen ſind vorhanden. Nach den Franſen ſteht eine doppelte Reihe länglich brauner Flecken mit weißem Vorſtoß, und die Hinterflügel führen zwiſchen der fünften und ſiebenten Ader orangegelbe Flecken. Es gleicht übrigens dieſer Falter auf der Unterſeite ſehr der L. Optilete, nur fehlen die blauen 3 Flecken unweit des Innenrandes.

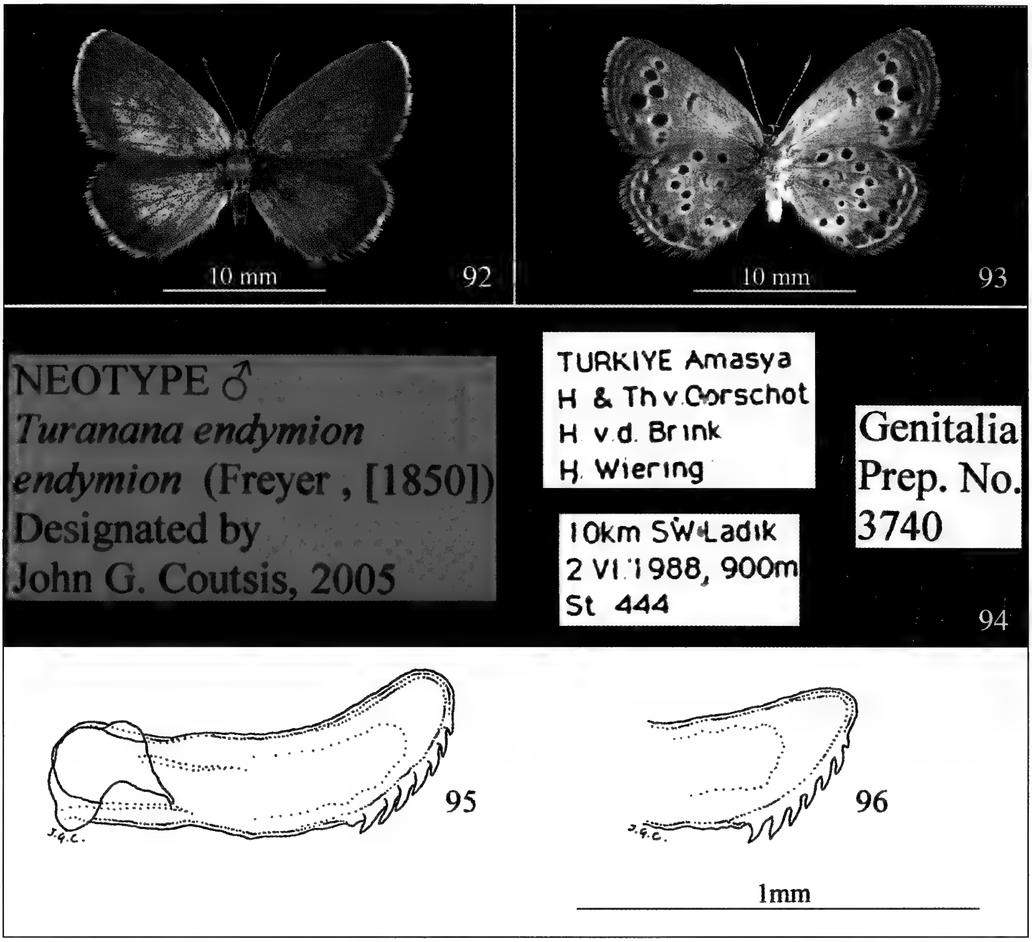
Die Fühler ſind ſchwarz und weiß geringelt mit ſchwarzer Kolbe, welche weißen Vorſtoß hat.

Heimath bei Amasia.



Figs. 89–91. Original description of "Pap.[ilio] Endymion" by Freyer, 1850. **89.** Text on page 145. **90.** Figure of ♂ on pl. 572 fig. 2. **91.** Figure of ♀ on pl. 572 fig. 3.

defined black-brown stria shaped like shallow crescent; both wings with double row of well-defined black-brown sub-marginal markings, the darkest (almost black) and most conspicuous being situated nearest wing margin in s2 of hindwing; space between outer and inner row of dark sub-marginal markings filled with macroscopically conspicuous orange scaling in s1c, s2 and s3 and microscopically discernible orange dusting in s1b, s4 and s5; post-discal black spots on hindwing likewise surrounded by off-white rings,



NEOTYPE ♂
Turanana endymion endymion (Freyer , [1850])
Designated by
John G. Coutsis, 2005

TURKIYE Amasya
H & Th v.Oorschot
H v.d. Brink
H. Wiering

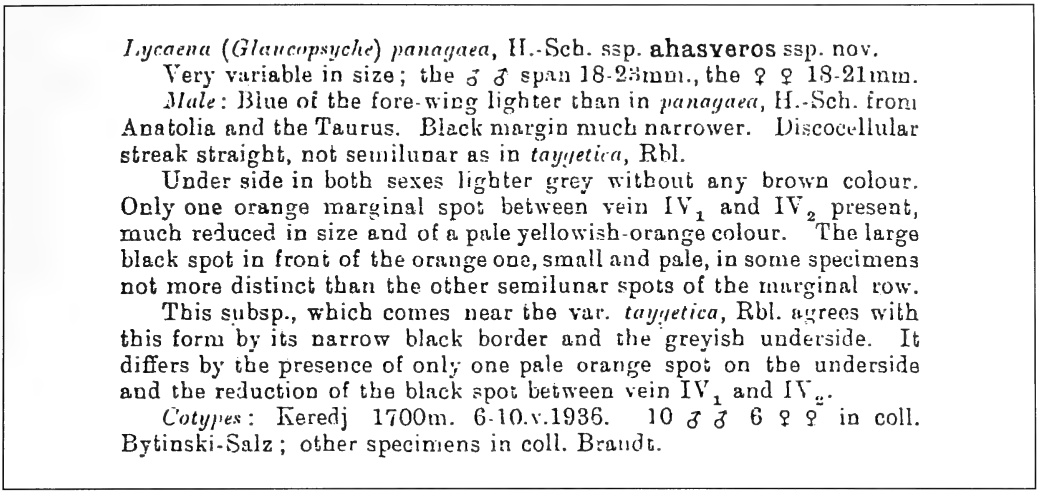
10km SW Ladik
2 VI 1988, 900m
St 444

Genitalia
Prep. No.
3740

Figs. 92–96. *Turanana endymion endymion* (Freyer, 1850), neotype ♂. **92.** Upperside. **93.** Underside. **94.** Data labels. **95.** Male genitalia, view on mesal wall of right valva. **96.** Male genitalia, view on mesal wall of distal end of right valva.

but smaller than their forewing counterparts; apex of cell on hindwing underside with black-brown stria shaped like shallow crescent as in forewing, but about half as long as its forewing counterpart; single black spot enclosed by off-white ring also present in cell of hindwing, just distad of and slightly diagonally to dark stria of cellular apex; fringes pure white. Valva (Figs. 95, 96) 1.26 mm in length, with 7 terminal spikes, most proximal equal in size to next one and most distal situated below apex of valva at distance equal to about ¼ total length of valval distal margin.

Variation. This is expressed in both males and females by their overall size (forewing length from slightly under 10 mm to slightly over 12 mm). In the males in particular it is expressed on their upperside by the width of the blackish marginal borders, the number and intensity of black spots within these borders on the hindwing, the degree of invasion of these borders into the post-distal area of the forewing just basad of wing apex, and the presence, or total absence of the black stria on the hindwing's cell apically.


Lycaena (*Glaucopsyche*) *panagaea*, H.-Sch. ssp. **ahasveros** ssp. nov.

Very variable in size; the ♂ ♂ span 18-23mm., the ♀ ♀ 18-21mm.

Male: Blue of the fore-wing lighter than in *panagaea*, H.-Sch. from Anatolia and the Taurus. Black margin much narrower. Discocellular streak straight, not semilunar as in *taygetica*, Rbl.

Under side in both sexes lighter grey without any brown colour. Only one orange marginal spot between vein IV_1 and IV_2 present, much reduced in size and of a pale yellowish-orange colour. The large black spot in front of the orange one, small and pale, in some specimens not more distinct than the other semilunar spots of the marginal row.

This subsp., which comes near the var. *taygetica*, Rbl. agrees with this form by its narrow black border and the greyish underside. It differs by the presence of only one pale orange spot on the underside and the reduction of the black spot between vein IV_1 and IV_2.

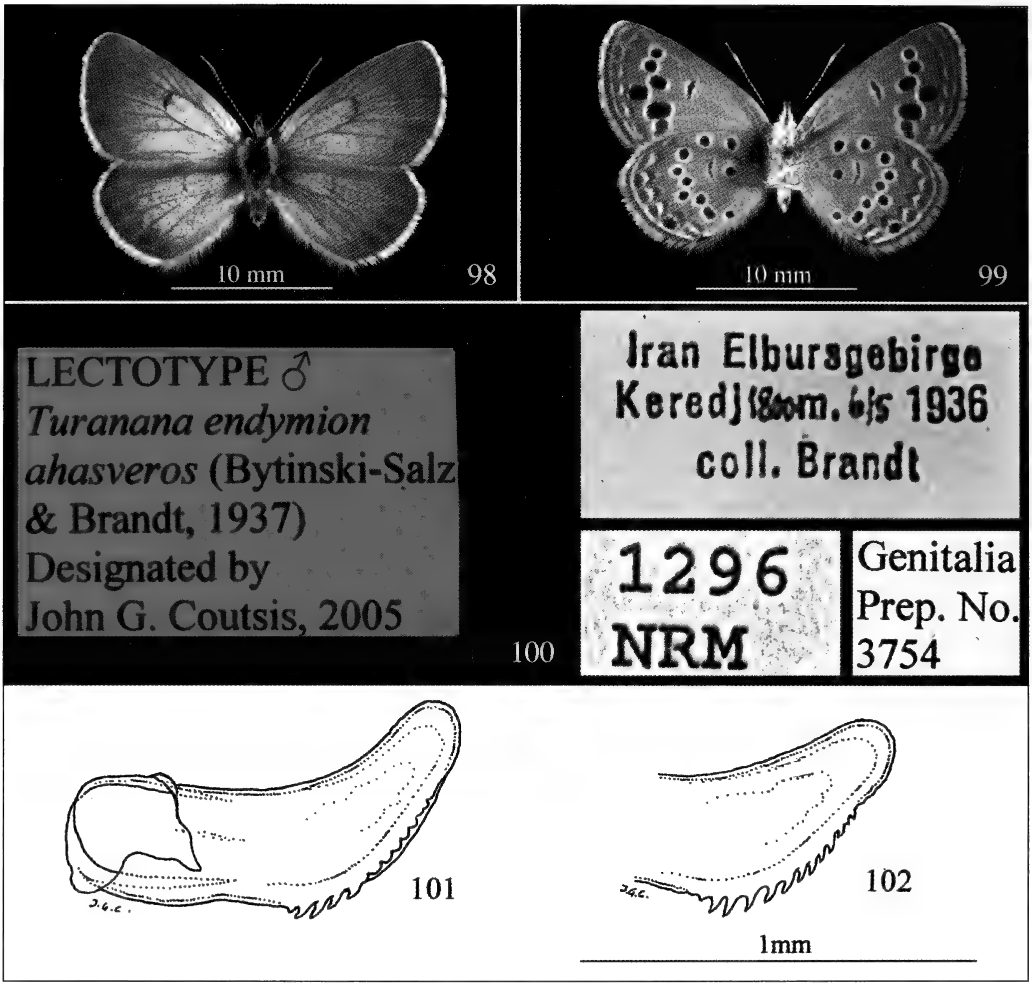
Cotypes: Keredj 1700m. 6-10.v.1936. 10 ♂ ♂ 6 ♀ ♀ in coll. Bytinski-Salz; other specimens in coll. Brandt.

Fig. 97. Original description of "*Lycaena* (*Glaucopsyche*) *panagaea*, H.-Sch. Ssp. *ahasveros* ssp. nov.", by Bytinski-Salz & Brandt, 1937: (1).

On the underside it is expressed by the spread and intensity of the sub-marginal orange scaling of the hindwing and the degree of shiny, whitish-blue dusting at the base of the hindwing. In the females which are overall dark brown on the upperside and are similar to the males on the underside, exhibiting at the same time similar variation, it is expressed on the upperside by the degree of basal blue scaling (often macroscopically invisible), the presence (in various numbers and different intensities), or total absence, of sub-marginal black spots on the hindwing and the occasional presence of a sub-marginal off-orange spot in s2 (and very rarely in s3) on the hindwing. In the male genitalia it is expressed by the number, spread, and positioning of the valval terminal spikes and by the degree of the valval apex extension.

Male genitalia. Right and left valvae (Fig. 5) roughly symmetrical, as in *endymion taygetica* (Figs. 6), but shorter (Fig. 1) than those of *endymion taygetica* (Fig. 3) for specimens of equal, or near-equal forewing length. Number and placement of terminal spikes very variable (6–13 in number and extending distad from about one half (Fig. 49) to more than two thirds (Fig. 34) length of distal margin of valva). In specimens from within two separate localities spikes varying in number from 7 to 11 (Figs. 39–47 and 48–50 respectively). The three characters that stand out as being constant are the short length of the valva, the fact that the most proximal of its terminal spikes is as a rule shorter than, rarely equal in length to and never longer than the one immediately distad and that the terminal spikes, though extending at times towards the valval apex, never quite reach it. Valvae with the above-described configuration are also illustrated in Higgins (1975), from Lebanon, and in Mattoni (1979), without locality data.

Distribution. *Turanana endymion endymion* (Freyer, 1850) applies to specimens from the eastern half of Asiatic Turkey and Lebanon that possess valvae that are similar to those of topotypical *endymion*. Syntopic and synchronous with *taygetica* in south-central Asiatic Turkey.



LECTOTYPE ♂
Turanana endymion
ahasveros (Bytinski-Salz
& Brandt, 1937)
Designated by
John G. Coutsis, 2005

Iran Elbursgebirge
Keredj 1700m. 6/5 1936
coll. Brandt

1296
NRM

Genitalia
Prep. No.
3754

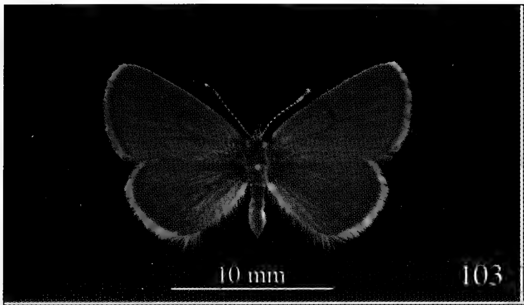
Figs. 98–102. *Turanana endymion ahasveros* (Bytinski-Salz & Brandt, 1937), lectotype ♂. **98.** Upperside. **99.** Underside. **100.** Data labels. **101.** Male genitalia, view on mesal wall of right valva. **102.** Male genitalia, view of distal end of mesal wall of right valva.

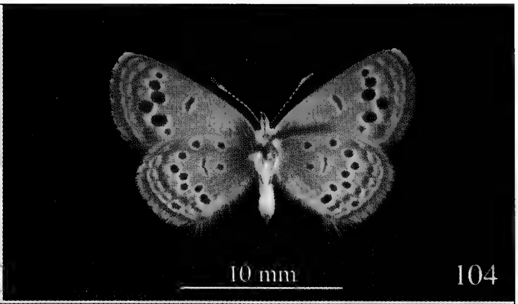
Turanana endymion ahasveros (Bytinski-Salz & Brandt, 1937)

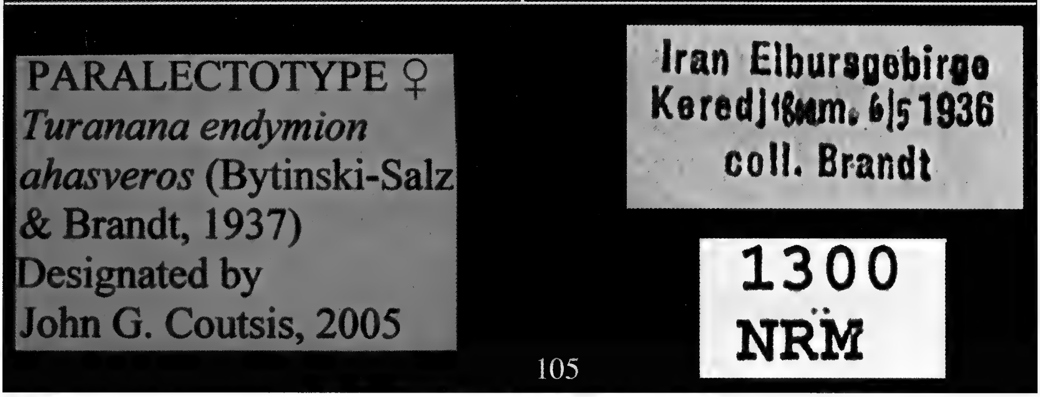
Lycaena (*Glaucopsyche*) *panagaea ahasveros* Bytinski-Salz & Brandt, 1937: (1). Type locality: Iran, Elburs Mts., Keredj (see Fig. 97 for original description).

Material. Lectotype ♂ designated here (Figs. 98–102), Iran, Elburs Mts., Keredj, 1700 m, 6.v.1936 (gen. prep. no. 3754), coll. NHRS. – Paralectotypes: 1♀ (Figs.103–105), same data; 4♂, same locality, 6.–10.v.1936, coll. NHRS; 5♂, 4♀, same locality, 6.–10.v.1936, coll. CMNH. – 1♂ **Iran**, Fars, road from Ardekan to Talochosroe, Comèe, ca. 3600 m, 4.vii. 1937, coll. NHRS; 1♂ Fars, road from Chiraz to Kazeroun, Fort Sine-Sefid, ca. 2200 m, 15.v.1937, coll. NHRS; 1♂ Elburs Mts., Keredj, 1700 m, 6.–10.v.1936, coll. NHRS; – *T. endymion* ?-*ahasveros*: 1♂ Iran, Mazanderan, Khosh-Yeylaq, 2000–2500 m, 15.–21.vii.1973, coll. De Prins, Olivier & v. d. Poorten.

Description. Lectotype (Figs. 98, 99). Forewing length 11.7 mm. Upperside as in nominotypical *endymion*, but blue ground-colour of a “chalkier” lighter hue; blackish marginal borders averaging 2 mm in width, hindwing black spots within borders and







PARALECTOTYPE ♀
Turanana endymion
ahasveros (Bytinski-Salz
& Brandt, 1937)
Designated by
John G. Coutsis, 2005

Iran Elbursgebirge
Keredj 1800m. 6|5 1936
coll. Brandt

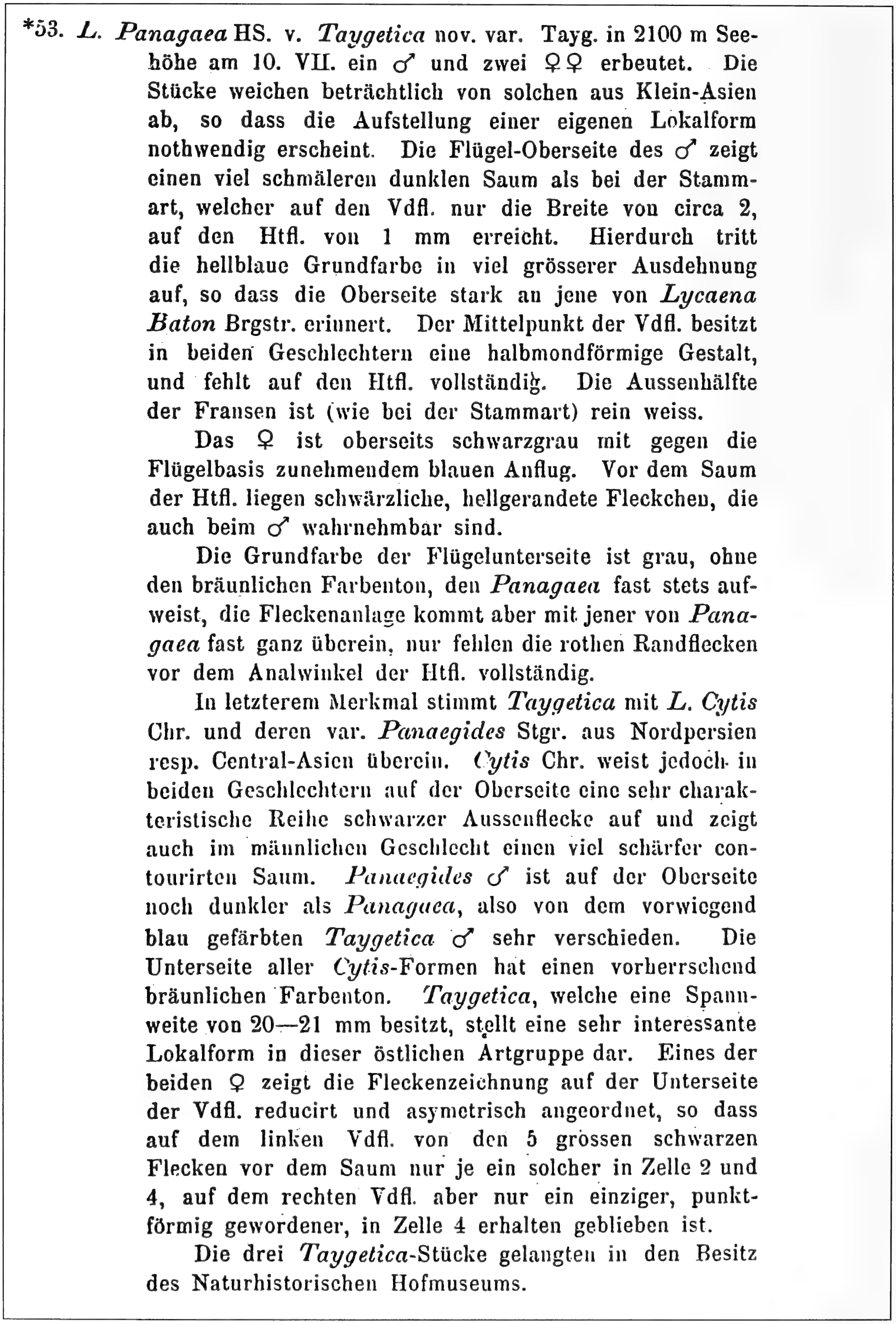
1300
NRM

Figs. 103–105. *Turanana endymion ahasveros* (Bytinski-Salz & Brandt, 1937), paralectotype ♀. **103.** Upperside. **104.** Underside. **105.** Data labels.

forewing black stria in apex of cell better defined, and hindwing black stria in apex of cell present. Underside as in nominotypical *endymion*, but ground-colour slightly browner in tone and giving impression of having "clean and smooth" texture; double row of sub-marginal markings (with exception of one closest to wing margin in s2 of hindwing) lighter-coloured and not in sharp contrast to ground-colour; base of hindwing with better-defined shiny, whitish-blue dusting; usual orange scaling of hindwing substituted by light orange-beige and restricted macroscopically to s2; some light orange-beige dusting also evident microscopically in s1c and s3 of hindwing. Valva (Figs. 101, 102) 1.27 mm in length, with strongly extended apex, and possessing 12 terminal spikes, with most proximal shorter than next one and most distal situated at a distance from valval apex equal to a little under 1/3 total length of valval distal margin.

♀ paralectotype (Figs. 103, 104). Forewing length 9.7 mm. Upperside with ground-colour dark brown, wing outer-margins thinly lined black-brown, stria at apex of cell on forewing black-brown, fringes off-white on hindwing and off-white to light brown on forewing; base of wings with microscopically discernible light-blue dusting; traces of black-brown sub-marginal spots present on hindwing, especially in s2. Underside as in male, but fringes off-white to light-brown.

Variation. Expressed in males as in nominotypical *endymion*, but all specimens observed always with a well-defined black stria at the apex of the cell on the hindwing upperside, with the hindwing underside sub-marginal light orange-beige scaling



*53. *L. Panagaea* HS. v. *Taygetica* nov. var. Tayg. in 2100 m Seehöhe am 10. VII. ein ♂ und zwei ♀♀ erbeutet. Die Stücke weichen beträchtlich von solchen aus Klein-Asien ab, so dass die Aufstellung einer eigenen Lokalform nothwendig erscheint. Die Flügel-Oberseite des ♂ zeigt einen viel schmäleren dunklen Saum als bei der Stammart, welcher auf den Vdfl. nur die Breite von circa 2, auf den Htfl. von 1 mm erreicht. Hierdurch tritt die hellblaue Grundfarbe in viel grösserer Ausdehnung auf, so dass die Oberseite stark an jene von *Lycaena Baton* Brgstr. erinnert. Der Mittelpunkt der Vdfl. besitzt in beiden Geschlechtern eine halbmondförmige Gestalt, und fehlt auf den Htfl. vollständig. Die Aussenhälfte der Fransen ist (wie bei der Stammart) rein weiss.

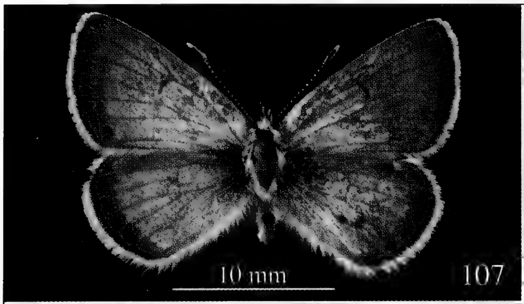
Das ♀ ist oberseits schwarzgrau mit gegen die Flügelbasis zunehmendem blauen Anflug. Vor dem Saum der Htfl. liegen schwärzliche, hellgerandete Fleckchen, die auch beim ♂ wahrnehmbar sind.

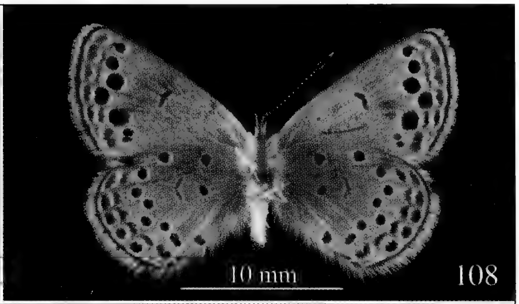
Die Grundfarbe der Flügelunterseite ist grau, ohne den bräunlichen Farbenton, den *Panagaea* fast stets aufweist, die Fleckenanlage kommt aber mit jener von *Panagaea* fast ganz überein, nur fehlen die rothen Randflecken vor dem Analwinkel der Htfl. vollständig.

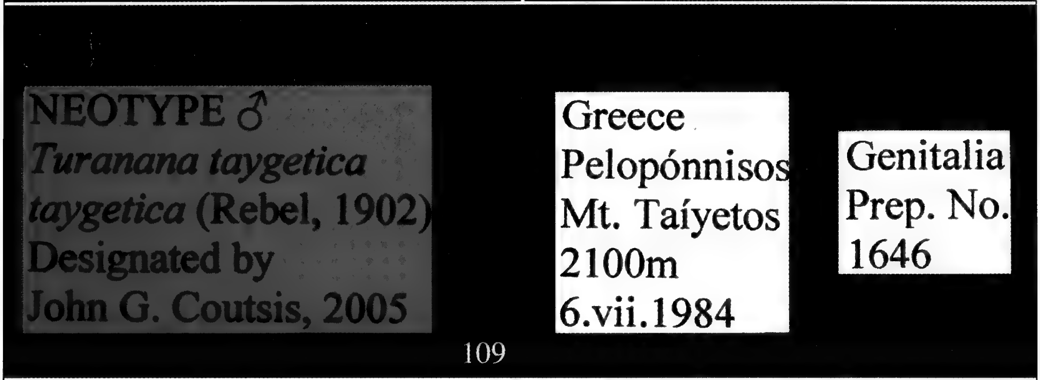
In letzterem Merkmal stimmt *Taygetica* mit *L. Cytis* Chr. und deren var. *Panaegides* Stgr. aus Nordpersien resp. Central-Asien überein. *Cytis* Chr. weist jedoch in beiden Geschlechtern auf der Oberseite eine sehr charakteristische Reihe schwarzer Aussenflecke auf und zeigt auch im männlichen Geschlecht einen viel schärfer contourirten Saum. *Panaegides* ♂ ist auf der Oberseite noch dunkler als *Panaguea*, also von dem vorwiegend blau gefärbten *Taygetica* ♂ sehr verschieden. Die Unterseite aller *Cytis*-Formen hat einen vorherrschend bräunlichen Farbenton. *Taygetica*, welche eine Spannweite von 20—21 mm besitzt, stellt eine sehr interessante Lokalform in dieser östlichen Artgruppe dar. Eines der beiden ♀ zeigt die Fleckenzeichnung auf der Unterseite der Vdfl. reducirt und asymetrisch angeordnet, so dass auf dem linken Vdfl. von den 5 grossen schwarzen Flecken vor dem Saum nur je ein solcher in Zelle 2 und 4, auf dem rechten Vdfl. aber nur ein einziger, punktförmig gewordener, in Zelle 4 erhalten geblieben ist.

Die drei *Taygetica*-Stücke gelangten in den Besitz des Naturhistorischen Hofmuseums.

Figs. 106. Original description of "*L*[*ycaena*]. *Panagaea* HS. V. *Taygetica* nov. var." by Rebel, 1902: 90–91.

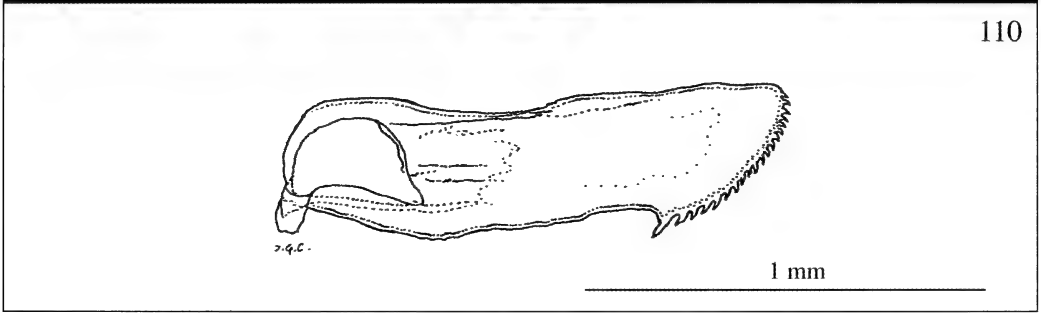





NEOTYPE ♂
Turanana taygetica taygetica (Rebel, 1902)
Designated by
John G. Coutsis, 2005

Greece
Pelopónnisos
Mt. Taíyetos
2100m
6.vii.1984

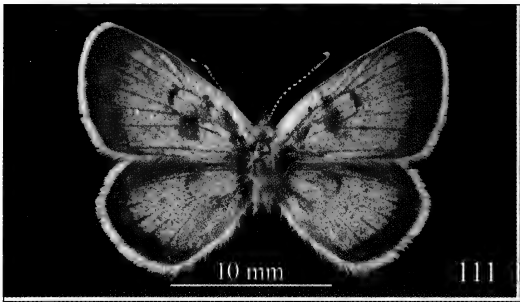
Genitalia
Prep. No.
1646



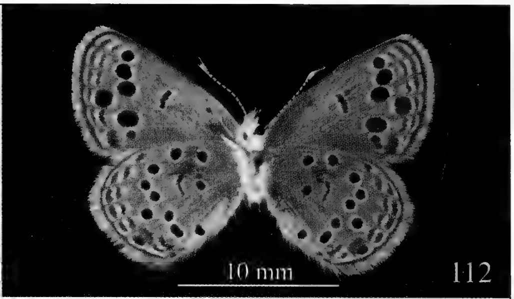
Figs. 107–110. *Turanana taygetica taygetica* (Rebel, 1902) stat. n., neotype ♂. **107.** Upperside. **108.** Underside. (Antennae inadvertently broken off during photographing; one antenna later restored). **109.** Data labels. **110.** Male genitalia, view on mesal wall of right valva.

restricted to s1c and s2 and never extending beyond s3, and with more evident basal, shiny, whitish-blue dusting on the hindwing underside. The variation in the females cannot be defined, due to lack of material.

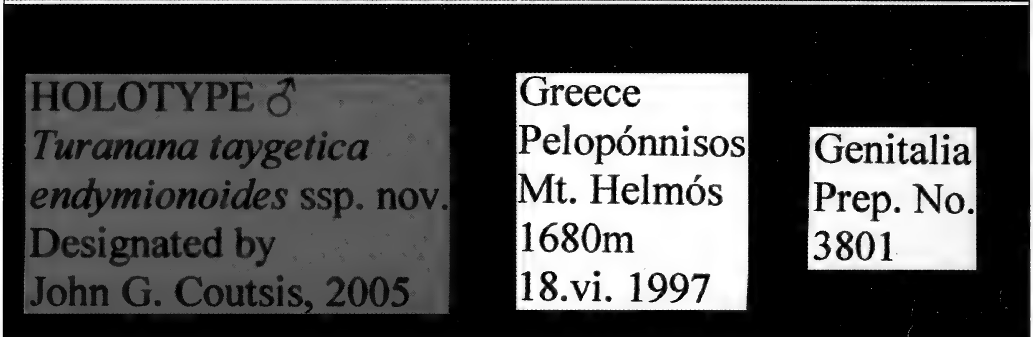
Male genitalia. Recent material obtained for study and representing the syntypes of *ahasveros*, as well as coming from places in Iran situated outside the type-locality of *ahasveros*, though following the nominotypical *endymion* general valval pattern, demonstrate a strong extension of the valval terminal apex (Figs. 35–37). Valvae with the above-described configuration are also illustrated in Tshikolovets (1998), from Turkmenistan, in Tuzov et al. (2000), from the Armenian highland, and in Zhdanko (1984), without locality data. Two specimens of *T. endymion* ?-*ahasveros* – one of which is shown on Fig. 38 – from Mazanderan, Iran, are externally attributable to *ahasveros*, but were found to have valvae that are identical to those of nominotypical *endymion*.



111



112

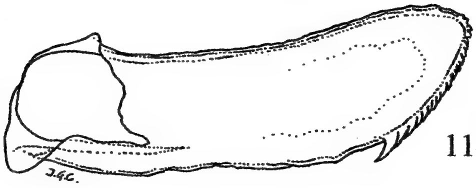


HOLOTYPE ♂
Turanana taygetica
endymionoides ssp. nov.
Designated by
John G. Coutsis, 2005

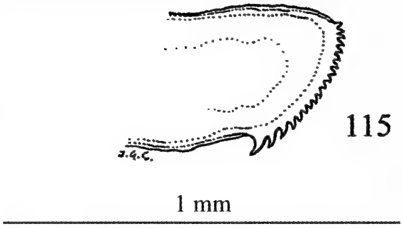
Greece
Pelopónnisos
Mt. Helmós
1680m
18.vi. 1997

Genitalia
Prep. No.
3801

113



114



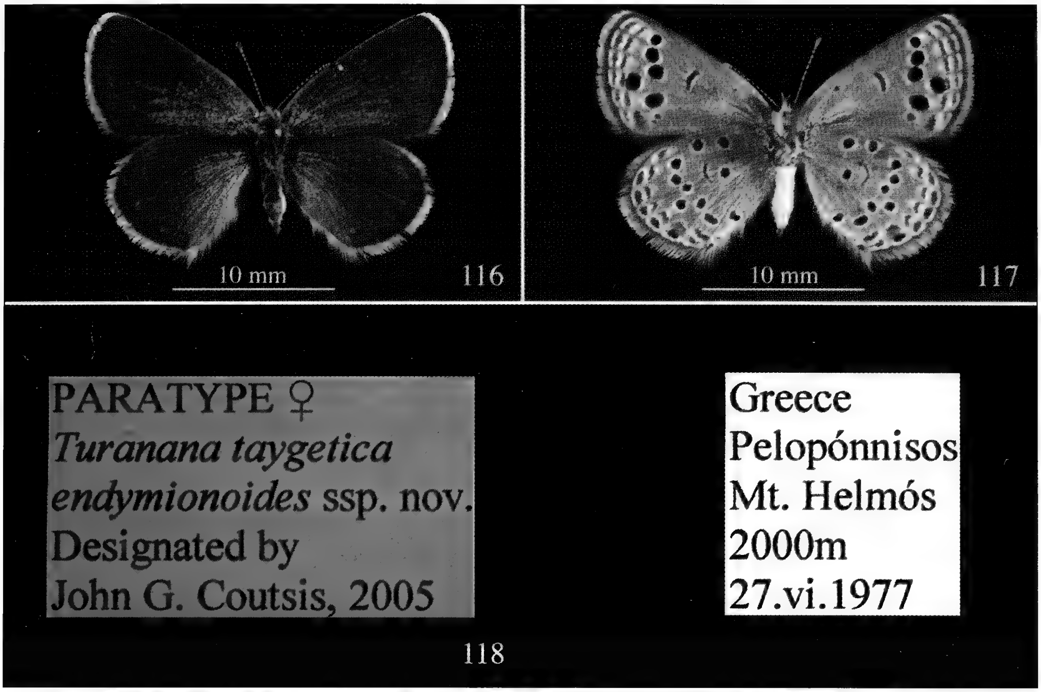
115

Figs. 111–115. *Turanana taygetica endymionoides* ssp. n., holotype ♂. **111.** Upperside. **112.** Underside. **113.** Data labels. **114.** Male genitalia, view on mesal wall of right valva. **115.** Male genitalia, view on distal end of mesal wall of right valva.

Distribution. *Turanana endymion ahasveros* (Bytinski-Salz & Brandt, 1937) applies to specimens from the Elburs range in Iran and from mountains in the province of Fars that possess valvae that are similar to those of *topotypical ahasveros*. *Turanana endymion ?-ahasveros* applies to specimens from mountains in the province of Mazanderan, Iran, whose valvae are found to be similar to those of nominotypical *endymion*.

Turanana taygetica taygetica (Rebel, 1902) stat. n.

L[*ycaena*] *Panagaea* v. *Taygetica* Rebel, 1902: 90–91. Type locality: Greece, Morea (= Pelopónnisos), Taygetos Gebirge (= Mt. Taíyetos). (see Fig. 106 for original description). Syntypes (1♂, 2♀) presumably lost.



PARATYPE ♀
Turanana taygetica
endymionoides ssp. nov.
Designated by
John G. Coutsis, 2005

Greece
Pelopónnisos
Mt. Helmós
2000m
27.vi.1977

Figs. 116–118. *Turanana taygetica endymionoides* ssp. n., paratype ♀. **116.** Upperside. **117.** Underside. **118.** Data labels.

Material. Neotype ♂, designated here (Figs. 107–110), **Greece**, Pelopónnisos, Mt. Taíyetos, 2000 m, 6.vii.1984 (gen. prep. no. 1646), Coutsis leg., coll. ZMAN. – 1♂ Greece, Pelopónnisos, Mt. Taíyetos, 1150–1200 m, 16.vi.2003, Coutsis leg., coll. Coutsis.

Description. Neotype (Figs. 107, 108). Forewing length 12.5 mm. Upperside as in nominotypical *endymion*, but blue ground-colour slightly lighter than in nominotypical *endymion* and slightly darker and brighter than in ssp. *ahasveros*; blackish marginal borders averaging about 1.3 mm in width and having a poorly defined inner margin, especially on hindwing; black spots contained inside blackish borders standing out rather sharply; black stria at apex of cell evident on forewing, but imperceptible on hindwing. Underside as in nominotypical *endymion*, but ground-colour whitish-gray, post-discal black spots placed closer to wing outer-margins, and usual hindwing submarginal orange spots substituted by single macroscopically-evident yellowish-beige spot in s2 only; yellowish-beige dusting also evident microscopically on hindwing in s1c and s3; base of hindwing with faint, shiny, whitish-blue dusting. Valva (Fig. 110) 1.59 mm in length; terminal spikes 20 in number and extending along whole length of valval distal margin, reaching its apex; most proximal spike decidedly longest.

Variation. This is expressed in the males by their overall size (forewing length from just under 10 mm to about 12.5 mm), by the extent, width and definition of the blackish marginal borders on the upperside (in some specimens these are being clearly invaded by blue scaling especially on the hindwing), by the number and definition of

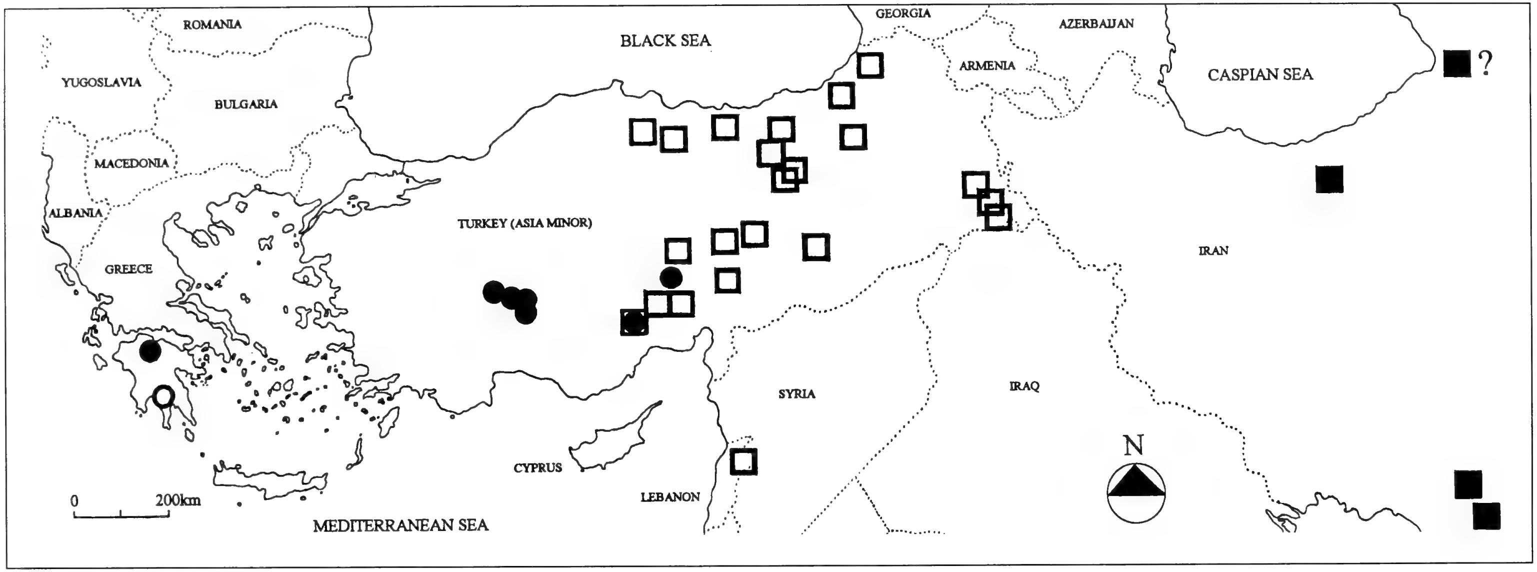


Fig. 119. Map indicating sampling localities of *Turanana endymion* and *T. taygetica*.

□ = *T. endymion endymion*
■ = *T. endymion ahasveros*
○ = *T. taygetica taygetica*
● = *T. taygetica endymionoides*

black spots within these borders on the hindwing upperside, and by the occasional presence of blue rings surrounding the black spots located within the blackish marginal borders. On the underside there is some variation in the extent and definition of the sub-marginal yellow-beige dusting on the hindwing, which occasionally may also be seen microscopically in s1b and s4. The single dark brown female at hand has a forewing length 12.5 mm and is characterised on the upperside by the extended basal blue dusting, by the presence of a narrow sub-marginal light brown area – in the form of a poorly defined band – enclosing black-brown spots (most evident on hindwing in s2 through s5), by a well-defined black-brown stria at the apex of the cell, and by the presence of weekly-defined black-brown post-discal spots on the forewing. Underside, as in males, but the variation is unknown, due to lack of material.

Male genitalia. Right and left valvae roughly symmetrical to one another, as in nominotypical *endymion*, but longer than those of nominotypical *endymion* for specimens of equal, or near equal forewing length (these conditions are figured below under *T. taygetica endymionoides*, which has similar male genitalia to nominotypical *taygetica*) The degree of variation in the number of terminal spikes cannot at present be calculated due to lack of sufficient material. The three characters, however, that stand out as being constant are the long valva, the fact that the most proximal terminal spike (occasionally also bearing a single, or bifid minute extension just basad to it) is always decidedly the longest of the lot, and that the terminal spikes extend all along the distal margin of the valva, clearly reaching its apex.

Distribution. *Turanana taygetica taygetica* (Rebel, 1902) stat. n. applies to specimens derived from the type locality only.

Life history. A low-flying species with males often found watering at altitudes of as low as 1100–1200 m, inside the forest zone and outside the vicinity of *Acantholimon* bushes, the presumed host-plant.

Turanana taygetica endymionoides ssp. n.

Material. Holotype ♂ (Figs. 111–115), **Greece**, Pelopónnisos, Mt. Helmós, 2000 m, 27.vi.1977 (gen. prep. no. 3801), Coutsis leg. coll. ZMAN. – Paratypes (all with same locality data): 1♀ (Figs. 116–118), 2000 m, 27.vi.1977, Coutsis leg., coll. ZMAN; 7♂, 2♀, 1800–1900 m, 4.vi.1997; 3♂, 1♀, 1800 m, 20.vi.1998; 1♂, 2100 m, 23.vi.1981; 1♂, 1700–1800 m, 12.vi.2001; 1♀, 2000 m, 27.vi.1977; 1♀, 2100 m, 23.vi.1981; 1♀, 1650 m, 18.vi.1997, all Coutsis leg. et coll. – 2♂ Greece, Pelopónnisos, Mt. Helmós, 1800 m, 12.vi.2001, leg. et coll. Coutsis; 4♂ **Turkey**, Afyon province, Sultandağları, 10 km S of Çay, 1300 m, 18.–25.vii.1980, coll. De Prins, Olivier & v. d. Poorten; 1♂ Afyon province, Sultandağları, 15 km SE of Çay, 1400–1800 m, 14–18.vii.1981, coll. De Prins, Olivier & v. d. Poorten; 3♂ Afyon province, Sultandağları, 8 km SW of Dereçine, 1700–2200 m, 19.–20.vii.1981, coll. De Prins, Olivier & v. d. Poorten; 1♂ Karaman province, Sertavul Geçidi, 1500 m, 1.viii.1995, coll. De Prins, Olivier & v. d. Poorten; 1♂ Kayseri province, Aladağları E side, 2800–2900 m, 18 km S of Yahyalı, 26.vii.–2.viii.1995, coll. De Prins, Olivier & v. d. Poorten; 1♂ Konya province, Sultandağları, 15 km S of Akşehir, 1500 m, 16.–19.vii.1981, coll. De Prins, Olivier & v. d. Poorten; 12♂ Konya province, Sultandağları, 15 km S of Akşehir, 1500 m, 12.–21.vii.1981, coll. De Prins, Olivier & v. d. Poorten; 1♂ Konya province, Sultandağları, 6km S of Çankaturan, 23km SSE of Akşehir, 1700 m, 12.–21.vii.1995, coll. De Prins, Olivier & v. d. Poorten; 3♂ Konya province, Sultandağları, Akşehir, 1100 m, 17.–26.vii.1980, coll. De Prins, Olivier & v. d. Poorten; 2♂ Konya province, Sultandağları, 22 km SE of Akşehir, 1600–1900 m, 29.vii.1995, coll. De Prins, Olivier & v. d. Poorten; 1♂ Konya province, 12 km SW of Engilli, 1300–1600 m, 12.vii.1981, coll. De Prins, Olivier & v. d. Poorten; 1♂ Konya province, 10 km NE of Gelendost, 1000 m, 16.vii.1980, coll. De Prins, Olivier & v. d. Poorten; 1♂ Konya province, Derebucak, 1100 m, 11.vii.1981, coll. De Prins, Olivier & v. d. Poorten; 1♂ Konya province, Akşehir, 1900 m, coll. De Prins, Olivier & v. d. Poorten; 1♂ Niğde province, Aladağları E side, 10 km S of Yahyalı, 1800–1900 m, 26.vii–2.viii.1994, coll. De Prins, Olivier & v. d. Poorten; 1♂ Niğde province, Bolkardağları N side, near Maden, 1500–1650 m, 18.vii.1995, coll. De Prins, Olivier & v. d. Poorten.

Description. Holotype (Figs. 111, 112). Forewing length 12.0 mm. Upperside ground-colour slightly lighter and shinier blue than in nominotypical *endymion* (due to the relative freshness of the specimen; specimens that have been kept longer in collections have the same ground-colour as do nominotypical *endymion* of same age); blackish marginal borders averaging 1.5 mm in width and with sharply defined proximal edge; black spots evident within these borders on hindwing in s2 through s6; black stria of apex of cell well-defined on both forewing and hindwing, but half as wide on the hindwing than on the forewing; fringe pure white. Underside ground-colour, fringes, and spot arrangement as in nominotypical *endymion*, but sub-marginal orange scaling on hindwing fully developed in s2 only, macroscopically appearing as narrow dusting in s1c and s3 and microscopically also in s4; base of hindwing with faint, shiny, whitish-blue dusting. Valva (Figs. 114, 115) 1.48 mm in length and bearing 20 terminal spikes in same arrangement as in nominotypical *taygetica*.

♀ paratype (Figs. 116, 117). Forewing length 11.9 mm. Upperside ground-colour dark brown, as in nominotypical *endymion*; base of wings with blue scaling extending on forewing into post-discal area; outer margins of wings thinly lined black-brown; sub-marginal black-brown spots present on both forewing and hindwing; black-brown stria at apex of cell clearly evident on forewing, less so on hindwing; some post-discal black-brown spots also in evidence on forewing; fringes white. Underside as in male, but fringes off-white.

Variation. This is expressed in both males and females by their overall size (forewing length from a little under 10 mm to about 12 mm), and on the upperside of the males in particular by the width and definition of the blackish marginal border, the extent of black spotting and occasional blue dusting within this border, the degree of definition of the black stria at the apex of the cell on the hindwing, and the extension of the blackish marginal border into the post-discal area of forewing, just basad of its apex. On the underside it is expressed primarily by the extent of sub-marginal orange scaling and of the basal, shiny, whitish-blue dusting on the hindwing. In the females variation is expressed on the upperside by the amount of basal blue scaling, by the degree of definition and number of black-brown sub-marginal and post-discal spots, and by the occasional presence of a light brown sub-marginal area on the hindwing. Underside variation as in male.

Male genitalia. Identical to those of nominotypical *taygetica*; right and left valvae (Fig. 6) roughly symmetrical to one another, as in nominotypical *endymion* (Fig. 5), but longer (Fig. 3) than those of nominotypical *endymion* (Fig. 1) for specimens of equal, or near equal forewing length. Number of terminal spikes very variable (12–25). In specimens from a single locality the number of spikes was found to vary from 14–23 (Figs. 66–87).

Distribution. *Turanana taygetica endymionoides* ssp. n. applies to specimens that have the same valvae as those of nominotypical *taygetica*, but differ externally from it, and that are found in Greece on Mt. Helmós only (where it was first recorded by Thurner 1967, who listed it as *Vaccinii*[*n*]*a panagaea taygetica* Rebel) and in the western half of Asiatic Turkey (specimens figured in Hesselbarth et al. 1995, pl. 97 figs. 52, 56, 58, 59, 63, 65, 70, are within all probability referable to *taygetica*, as all material checked from the Turkish provinces of Konya and Afyon invariably turned out to be *taygetica*). Syntopic and synchronous with *endymion* in south-central Asiatic Turkey.

Life history. Tolman (1993) discovered on Mt. Helmós the larvae feeding on *Acantholimon androsaceum* ([Jaub & Spach]. Bois, 1846) (Plumbaginaceae). The adults are low-flying and restricted to within the vicinity of the host-plant; found above the tree line and at altitudes ranging from about 1800–2000 m. So far never seen watering despite the fact that a water spring is situated at about 250 m away from its host-plants.

Derivatio nominis. The name *endymionoides*, meaning in Greek "looking like *endymion*", was chosen because of the butterfly's greater external resemblance to nominotypical *endymion* than to nominotypical *taygetica*.

External differentiation

Male specimens of nominotypical *endymion* may be told apart from ssp. *ahasveros* by the darker blue and somewhat shinier ground-colour of the wings upperside and by the – on average – wider marginal blackish borders. On the underside they differ from *ahasveros* by the greyer, less brown and "rough-looking" ground colour, by the better-defined sub-marginal double row of black-brown spots, and by the greater spreading and more intense colour of the sub-marginal orange scaling on the hindwing. Female nominotypical *endymion* differ from those of *ahasveros* on the underside as do the males.

Both male and female *ahasveros* differ from all other members of the species-group on the underside by the brownish tinge and "smooth" texture of the ground-colour, by the less contrasting sub-marginal double row of black-brown markings, and by the light orange-beige colour of the hindwing sub-marginal dusting. Males on the upperside differ by their "chalkier" and lighter blue ground-colour.

Male specimens of nominotypical *taygetica* differ from all other members of the species-group on the upperside by the narrower and poorly defined blackish marginal borders and on the underside by the light grey ground-colour, by the position of the post-discal black spots, these being closer to the wing outer margins, and by the substitution of the usual sub-marginal orange dusting on the hindwing by one of yellow-beige tint; they differ from the males of *endymionoides* on the upperside by the slightly lighter blue ground-colour. The single available female specimen of the nominotypical *taygetica* differs on the underside from all other members of the species-group as do the males.

Male specimens of topotypical ssp. *endymionoides* as a rule differ from all other members of the species-group on the upperside by the sharper blackish marginal borders, and from nominotypical *endymion* in particular, on the upperside by the narrower blackish marginal borders, and on the underside by the more restricted spread of the hindwing sub-marginal orange scaling. Female *edymionoides* differ on the underside from nominotypical *endymion* as do the males and from nominotypical *taygetica* by the darker, grey-brown (instead of light grey) ground-colour and the orange (instead of yellow-beige) sub-marginal hindwing dusting.

Specimens of *endymionoides* from Asiatic Turkey cannot be told apart from nominotypical *endymion* (at least macroscopically and on the basis of the rather limited available material), and they differ from topotypical *endymionoides* in the same way as does nominotypical *endymion* differ from topotypical *endymionoides*. As previously said, however, I have tentatively included them under ssp. *endymionoides* because of occasional character overlap with topotypical *endymionoides* and because of the unavailability of geographically intermediate material from the western extremity of Asiatic Turkey, that might conceivably reveal the existence of a cline in external characters.

The need for further validation

The taxonomic arrangements that have now been adopted for the *endymion* species-group, should eventually be further validated – or perhaps even disputed – by a future study of the DNA-sequences of the various taxa in this species-group. It is hoped that this task will not take long to materialize.

Acknowledgements

I would like to extend my sincerest thanks and express my gratitude to all those people whose assistance made it possible for me to carry out this endeavour. I am particularly indebted to Bert Gustafsson of the Naturhistoriska Riksmuseet, Stockholm, Sweden, for providing me with the syntypes of *ahasveros*; to Willy De Prins, Alain Olivier and Dirk van der Poorten, from Antwerpen, Belgium for providing me with a good many of the Asiatic Turkey specimens used in dissections; to Martin Lödl and Sabine Gaal-Haszler of the Naturhistorischen Hofmuseum, Wien, Austria, for patiently assisting me in my vain endeavour to trace down the *taygetica* syntypes; to Harry van Oorschot of the Zoölogisch Museum, Amsterdam, Netherlands, for providing me with material from Turkey that included specimens derived from the type locality of *endymion*; and last but not least to Konrad Fiedler, Matthias Nuss, Martin Wiemers, all from Germany, for their invaluable advice and much-needed criticism.

References

Bytinski-Salz, H. & Brandt, W. 1937. New Lepidoptera from Iran. – Entomologist's Record & Journal of Variation **49** (Supplement): (1)–(15).

Coutsis, J. G. 1986. Notes concerning the taxonomic status of *Turanana panagaea taygetica* Rebel (Lep: Lycaenidae). – Nota lepidopterologica **9** (1–2): 35–38.

Freyer, C. F. 1846–1852 [imprint "1852"]. Neuere Beiträge zur Schmetterlingskunde mit Abbildungen nach der Natur 6: [i[–[ii], 1–195, pls. 481–600. Augsburg, beim Verfasser.

Hesselbarth, G., van Oorschot, H. & Wagener, S. 1995. Die Tagfalter der Türkei, 3 vols. pp. 1–1354, 1–847, pls. 1–141, maps I–IV, 1–342. – Bocholt (Germany).

Higgins, L. G. 1975. The Classification of European Butterflies. – Collins, London, 320 pp.

Mattoni, R. H. T. 1981. The Scolitantidini II. The World's Smallest Butterfly? Notes on *Turanana*, and a new Genus and Species from Afghanistan (Lycaenidae). – Journal of Research on the Lepidoptera **18** (1979) 4: 256–264.

Rebel, H. 1902. Lepidopteren aus Morea gesammelt von Herrn Martin Holtz im Jahre 1901. – Berliner entomologischer Zeitschrift **47**: 83–110.

Thurner, J. 1967. Lepidopteren aus Morea. Ein weiterer Beitrag zur Fauna des Peloponnes (Griechenland). – Zeitschrift der Wiener Entomologischen Gesellschaft **52**: 5–23.

Tolman, T. G. 1993. The natural history, ecology and distribution of *Turanana panagaea* (Herrich-Schäffer, 1851) and *Lycaena thetis* (Klug, 1834) in Greece (Lepidoptera: Lycaenidae). – Phegea **21**: 81–92.

Tshikolovets, V. V. 1998. The butterflies of Turkmenistan. – Konvoj Ltd., Czech Republic, 237 pp.

Tuzov, V. K. et al. 2000. Guide to the butterflies of Russia and adjacent territories, vol. 2. 580 pp. – Pensoft, Sofia.

Zhdanko, A. B. 1984. Review of the genus *Turanana* Beth.-Bak. With descriptions of *T. tatjana* and *Otaria* subgen. nov. (Lepidoptera, Lycaenidae) from Kazakhstan. – Trudy Zoologicheskogo Instsituta AN SSSR, Leningrad **122**: 98–105 (in Russian).

A review of the genus *Metanarsia* Staudinger, 1871 (Gelechiidae)

Oleksiy Bidzilya

Zoological Museum, Kiev National Taras Shevchenko University, Volodymyrs'ka str., 60, UA-01033 Kyiv, Ukraine; e-mail: bidzilya@univ.kiev.ua

Abstract. All known species of the Palaearctic genus *Metanarsia* Staudinger, 1871 are reviewed. Ten species are recognized, of which two are described as new: *M. piskunovi* **sp. n.** and *M. dahurica* **sp. n.** Four synonymies are established: *Parametanarsia* Gerasimov, 1930 **syn. n.** and *Epiparasia* Rebel, 1914 **syn. rev.** are synonymised with *Metanarsia* Staudinger, 1871; *Metanarsia gobica* Lvovsky & Piskunov, 1989 **syn. n.** with *M. alphitodes* (Meyrick, 1891), and *Epidola halmyropis* Meyrick, 1926 **syn. n.** with *M. incertella* (Herrich-Schäffer, 1861). Descriptions and a key to all species are supplied with illustrations of the adults, male and female genitalia (when known), and their relationships within the genus are briefly discussed. An improved diagnosis of the genus is given and its relationships with allied gelechiid genera are discussed.

Key words. Lepidoptera, Gelechiidae, *Metanarsia*, taxonomic review, Palaearctic region.

Introduction

The genus *Metanarsia* comprises ten species which all occur in the Palaearctic region. The most valuable contributions to the systematics of this genus were made by Piskunov and co-authors (Emelyanov & Piskunov 1982; Piskunov 1988, 1990; Lvovsky & Piskunov 1989). These authors refined the definition of the genus, reviewed all species, illustrated their male genitalia, and described new taxa. More recently, the identity of *Metanarsia* and *Epiparasia* Rebel, 1914 was discussed, further new species were described, and new generic- and species-group name synonymies proposed (Huemer et al. 1996; Ponomarenko 2000).

Notwithstanding a relatively large number of publications, our knowledge of *Metanarsia* is in many respects far from complete. For example, the larval host-plant relationships are unknown. Also, the females of many species remain undescribed, which leads to problems in establishing a clear generic diagnosis and in the generic assignment of some species.

In the course of my studies, two undescribed species and two hitherto unknown females were discovered as well as a first host-plant record for *Metanarsia*. These new data encouraged me to carry out a review of the genus with the aim to describe the new taxa and to provide detailed descriptions and a key for all species, accompanied by illustrations of the adults and genitalia of both sexes (when known). This review is also intended to provide an improved diagnosis of the genus *Metanarsia* based on morphological characters of the adults.

Abbreviations

BMNH	The Natural History Museum, London, U. K.
DEI	Deutsches Entomologisches Institut, Müncheberg, Germany
MHNG	Muséum d'histoire naturelle, Geneva, Switzerland
MTD	Museum für Tierkunde, Dresden, Germany

SIZK	Schmalhausen Institute of Zoology, Ukrainian Academy of Sciences, Kiev, Ukraine
TLMF	Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria
ZIN	Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia
ZMHB	Zoologisches Museum der Humboldt-Universität, Berlin, Germany
ZMKU	Zoological Museum, Kiev National Taras Shevchenko University, Kiev, Ukraine
ZMUC	Zoological Museum, University of Copenhagen, Denmark
ZMUH	Zoological Museum, University of Helsinki, Finland

Metanarsia Staudinger, 1871

Metanarsia Staudinger, 1871: 314. Type-species: *Metanarsia modesta* Staudinger, 1871: 314, by monotypy.

Calyptrotis Meyrick, 1891: 56. Type-species: *Calyptrotis alphitodes* Meyrick, 1891: 56, by monotypy. Synonymized by Ponomarenko 2000: 222.

Epiparasia Rebel, 1914: 276. Type-species: *Epiparasia longivitella* Rebel, 1914: 276, pl. 4 fig. 12, by monotypy. **Syn. rev.** Piskunov 1990: 95 (syn.). Huemer et al. 1996: 341 (gen.).

Parametanarsia Gerasimov, 1930: 33 (as subgenus of *Metanarsia*). Type-species: *Metanarsia (Parametanarsia) junctivittella* Christoph, 1885: 161, pl. 8 fig. 11, by original designation and monotypy. **Syn. n.**

Diagnosis. Adults small to medium sized with forewing length of 5.0–13.0 mm.

Head smooth-scaled. Labial palpus variable in shape: segments 2 and 3 usually straight, but recurved in *M. incertella* (Herrich-Schäffer, 1861) and *M. alphitodes* (Meyrick, 1891); segment 2 broad, densely covered with long scales usually exceeding length and width of segment 3; segment 3 normally very short, covered partially or almost entirely with long scales of segment 2. Scape with pecten of numerous long hair-like scales or with dense brush of short scales (*M. partilella* (Christoph, 1887)), other antennal segments simple. Haustellum reduced or very short, covered by labial palpus, but sometimes well developed (*M. alphitodes*, *M. piskunovi* sp. n.).

Thorax. Forewing usually relatively broad or elongated (*M. junctivittella*), sometimes slightly concave before apex (*M. partilella*), but mostly gradually tapered towards apex; unicolorous greyish-cream, reddish-brown, yellow, etc., or with more or less developed fasciae or longitudinal patches and spots; fringe very long; venation (Fig. 1) with Sc to about middle of costa; R_1 from one-third of cell, R_2 from three-quarters of cell, R_3 and R_4 from corner of cell, R_4 and R_5 on common stalk or R_4 reduced whereas R_3 and R_5 arise from corner of cell (*M. junctivittella*), R_5 to costa before apex; cell narrow; CuP absent; 1A+2A forked at base. Hindwing grey, normally with distinctly excavated termen; venation with R_1 anastamosed with M_1 near base, Rs and M_1 with long common stalk, R_5 to costa near apex, M_1–M_3 to termen, M_3 free, not connate CuA_1, 1A–2A indistinct. Frenulum of male simple, retinaculum a membranous hook under Sc near base. Frenulum of female consisting mainly of two acanthae which may be fused (*M. dahurica* sp. n., *M. junctivittella*), divided only at base (*M. modesta)*, or completely separated (*M. alphitodes*, *M. piskunovi* sp. n.); frenulum of *M. incertella* with three fused acanthae, and that of *M. partilella* consisting of four to five acanthae slightly divided at base. Retinaculum a row of raised scales at base of Sc and along R. Foretibia with epiphysis, midtibia with two spurs, and hindtibia with four spurs.

Abdomen. Sternite VIII normally weakly sclerotized, usually as long as wide or longer than wide (Fig. 28), but in *M. partilella* more than three times wider than long. Female segment VII about twice length of other abdominal segments, weakly narrowed posteriorly. Sternite II of both sexes with pair of venulae with distinct apodemes (Fig. 29).

Male genitalia. Uncus broad, lateral margins usually densely covered with hair-like setae, apex sometimes with deep medial depression. Gnathos weakly sclerotized, membranous, flattened dorsoventrally, usually long and slender, often spoon-like distally, weakly curved; sometimes broad, sucker-like (*M. partilella*), or reduced and indistinct (*M. alphitodes*). Tegumen broad and short, trapezoid. Valva divided at base into cucullus and sacculus. Cucullus slender, slightly longer or as long as uncus, finger-like, often narrowed at base, apex weakly broadened and rounded, densely covered with short setae. Sacculus normally broad, distinctly shorter than cucullus, with one lateral and three or four apical teeth, sometimes covered with short dense setae (*M. alphitodes*) or simple, slender, without modifications (*M. partilella*); inner margin of sacculus with emargination near base. Valvae connected at base by well developed broad medial processes. Vinculum narrow, band-like, posterior margin with paired sub-oval lobes or with narrow triangular processes with delicate membranous connection to apex of aedeagus. Saccus short, broadly rounded, triangular or sub-rectangular (*M. partilella*). Aedeagus normally short, about as long as sacculus, usually bifurcated at base, apex rounded with one or two (*M. junctivittella*) small teeth on one side whereas opposite side is membranous; aedeagus of *M. partilella* very long, not bifurcated basally.

Female genitalia. Papillae anales broad, apically narrowed, sub-triangular, sparsely covered with short setae, except those of *M. partilella* densely covered with very long, hair-like setae. Apophyses posteriores relatively short, slightly curved; apophyses anteriores about three-quarters length of apophyses posteriores, shorter than segment VIII. Segment VIII mainly membranous, sclerotized only laterally and anteriorly, its anterior margin narrow, band-shaped. Ostium bursae on ventral membranous surface of sternite VIII. Ductus bursae short, membranous, evenly broadened towards corpus bursae. Corpus bursae very long, semioval, indistinctly separated from ductus bursae. Ductus and corpus bursae of *M. partilella* extremely short. Signum absent.

Relationships. *Metanarsia* is considered a member of Gelechiinae on the basis of the presence of a pair of venulae, terminating in distinct apodemes on abdominal sternum II. Within Gelechiinae *Metanarsia* resembles *Chrysoesthia* Hübner, 1825 in the male genitalia (shape of aedeagus, shape of valva, membranous gnathos), and *Chrysoesthia* and *Coloptilia* Fletcher, 1940 in the female genitalia (segment VIII sclerotized anterolaterally, papilla anales sub-triangular). *Metanarsia* differs reliably from the above genera in the absence of a signum on the bursae in the female genitalia. These three genera are traditionally considered members of Apatetrini–Anomologini (Karsholt & Riedl 1996: 104), although the classification of these two tribes needs special revision.

Metanarsia is a diverse gelechiid genus for which the external and genital characters vary extensively. The monophyly of *Metanarsia* is not very clear and was previously established by such presumed autapomorphies as a very short ductus bursae in combination with an extremely long corpus bursae without signum. Other diagnostic characters of *Metanarsia* are present in related genera also (see above). The most isolated position within the genus is occupied by *M. partilella* which is characterized by a dense brush of short scales on the scape, a sucker-like gnathos, hairy papillae anales, and an extremely short ductus and corpus bursae in the female genitalia. The male genitalia of this species are characterized by a unique valva which is not entirely divided into a cucullus and sacculus, as well as by a long and basally simple (not bifurcated) aedeagus. *M. incertella* is another species for which the assignment to *Metanarsia* is disputable. Piskunov (1990: 95) synonymized *Epiparasia* with *Metanarsia*, but his opinion was not accepted by subsequent authors (Huemer et al. 1996: 341), who considered *Epiparasia* as a separate genus on the basis of the strongly recurved labial palpus and the clearly separated ductus bursae in the female genitalia. Ponomarenko (2000: 222) followed Piskunov's view and treated *Epiparasia* as a junior synonym of *Metanarsia* mentioning that the shape of the labial palpus is quite variable within the genus. Gerasimov (1930: 33) established the new subgenus *Parametanarsia* for *M. junctivittella* on the basis of the female frenulum which is represented by fused acanthae, in contrast to those of *M. modesta* which are basally separated. It was also mentioned that *Parametanarsia* is characterized by the elongated forewing and its special venation (R_3 and R_5 from end of cell, R_4 reduced). As follows from a review of the external and genital characters of *Metanarsia* the female frenulum, wing venation, and shape of labial palpus are quite variable within the genus and probably reflect individual adaptations of species. So using such characters for establishing new taxa seems to me quite dubious and I treat *Parametanarsia* **syn. n.** and *Epiparasia* **syn. rev.** as junior subjective synonyms of *Metanarsia* Staudinger, 1871. All other *Metanarsia* species are homogeneous both in exterior and in genital characters, except for *M. alphitodes*, which is characterized by its setose apex of the sacculus.

In general the establishment of new taxa of the genus group within such a small genus as *Metanarsia* for some species (*M. incertella* or *M. partilella)* which differ only in some characters seems to be inappropriate at least at the present stage, while a global revision of Apatetrini–Anomologini is still in need. For preliminary definitions of relationships within the genus the most sensible solution seems to call for the grouping of the species in the following species groups:

***Metanarsia modesta*-group**
modesta Staudinger, 1871
    modesta kurdistanella Amsel, 1959
onzella Christoph, 1887
kosakewitshi Piskunov, 1990
dahurica **sp. n.**
scythiella Ponomarenko, 2000
piskunovi **sp. n.**
***Metanarsia junctivittella*-group**
junctivittella Christoph, 1885

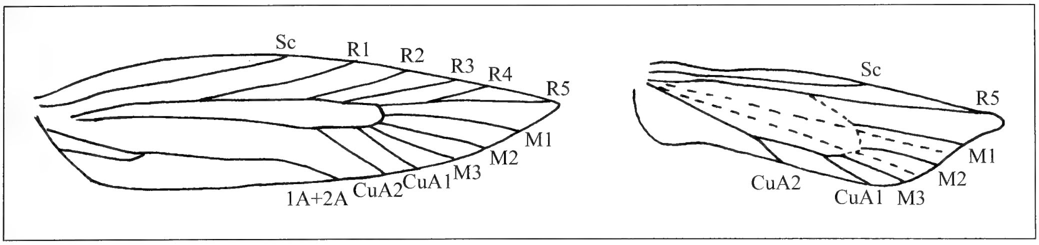


Fig. 1. *Metanarsia modesta*, ♂, wing venation.

***Metanarsia alphitodes*-group**
alphitodes (Meyrick, 1891)
    gobica Lvovsky & Piskunov, 1989, **syn. n.**
***Metanarsia incertella*-group**
incertella (Herrich-Schäffer, 1861)
    longivitella Rebel, 1914
    halmyropis Meyrick, 1926, **syn. n.**
***Metanarsia partilella*-group**
partilella (Christoph, 1887)

Life history. *Nitraria* sp. (Nitrariaceae) was recorded as a host plant for *M. alphitodes,* but the host plant relationships of other species of *Metanarsia* remain unknown. Adults fly from April to September and most species are probably univoltine. Many species are nocturnal and easily attracted to light.

Distribution. The majority of the species inhabit steppes, deserts, and semideserts of the Palaearctic region. The largest number of species occurs in the arid regions of Central Asia. Most of the species are considered localised (*M. scythiella, M. kosakewitshi, M. piskunovi* sp. n.), whereas such species as *M. modesta, M. alphitodes*, and *M. incertella* are widely distributed.

Key to the species of *Metanarsia* based on external characters

1\. Labial palpus recurved, segment 2 slender 2

– Labial palpus straight, segment 2 broad 3

2\. Labial palpus long, strongly curved; forewing uniformly yellowish-cream or with brown longitudinal lines; haustellum reduced; forewing length 8.0–13.0 mm .... *M. incertella*

– Labial palpus slightly recurved; forewing with brown transversal fascia; haustellum well developed; forewing length 5.0–7.0 mm .... *M. alphitodes*

3\. Labial palpus very long, straight, segment 2 covered with very long setae; forewing dark yellow with brown longitudinal line or uniformly yellowish-cream .... *M. junctivittella*

– Labial palpus short, segment 2 covered with relatively short setae 4

4\. Forewing primarily yellow, without lines 5

– Forewing cream, grey, or reddish-brown 6

5\. Forewing bright yellow, with reddish-pink costal margin, without spots; haustellum reduced; forewing length 11.5 mm .... *M. scythiella*

– Forewing uniformly yellowish-cream, pale, with two small brown spot in middle and at two-thirds length; haustellum well developed; forewing length 10.0–11.0 mm .... *M. piskunovi* sp. n.

6\. Forewing reddish-brown 7

– Forewing grey or cream 8

7\. Forewing uniformly reddish-brown .... *M. kosakewitshi*

– Forewing reddish-brown, more contrasting, with distinct brown oblique transversal fascia from one-third of posterior margin to half width .... *M. dahurica* sp. n.

8\. Forewing primarily grey without yellow patches 9

– Forewing cream with yellow patches and diffuse yellowish-brown spots .... *M. onzella*

9\. Forewing whitish-grey, without white fasciae; forewing length 6.0–10.0 mm; scape with pecten .... *M. modesta*

– Forewing grey with distinct white fasciae; forewing length 10.0–11.0 mm; scape with dense brush of short scales .... *M. partilella*

Key to the species of *Metanarsia* based on male genitalia

1\. Sacculus without apical teeth 2

– Sacculus with apical teeth 3

2\. Sacculus apically densely covered with short setae .... *M. alphitodes*

– Sacculus without apical setae; aedeagus very long, gnathos sucker-like .... *M. partilella*

3\. Aedeagus with one teeth before apex, shorter than cucullus 4

– Aedeagus with two teeth before apex, about as long or slightly longer than cucullus .... *M. junctivittella*

4\. Saccus relatively long; uncus with small apical depression; gnathos long and slender 5

– Saccus very short, broadly rounded; uncus with deep apical depression; gnathos short, triangular .... *M. incertella*

5\. Vinculum lobes long and narrow .... *M. onzella*

– Vinculum lobes short and broad, rounded apically 6

6\. Aedeagus longer than sacculus, distal part about as wide as basal part 7

– Aedeagus about length of sacculus, basal part twice width of distal part 8

7\. Sacculus with deep depression at outer margin, apical teeth large .... *M. kosakewitshi*

– Sacculus without deep depression at outer margin, apical teeth small .... *M. dahurica* sp. n.

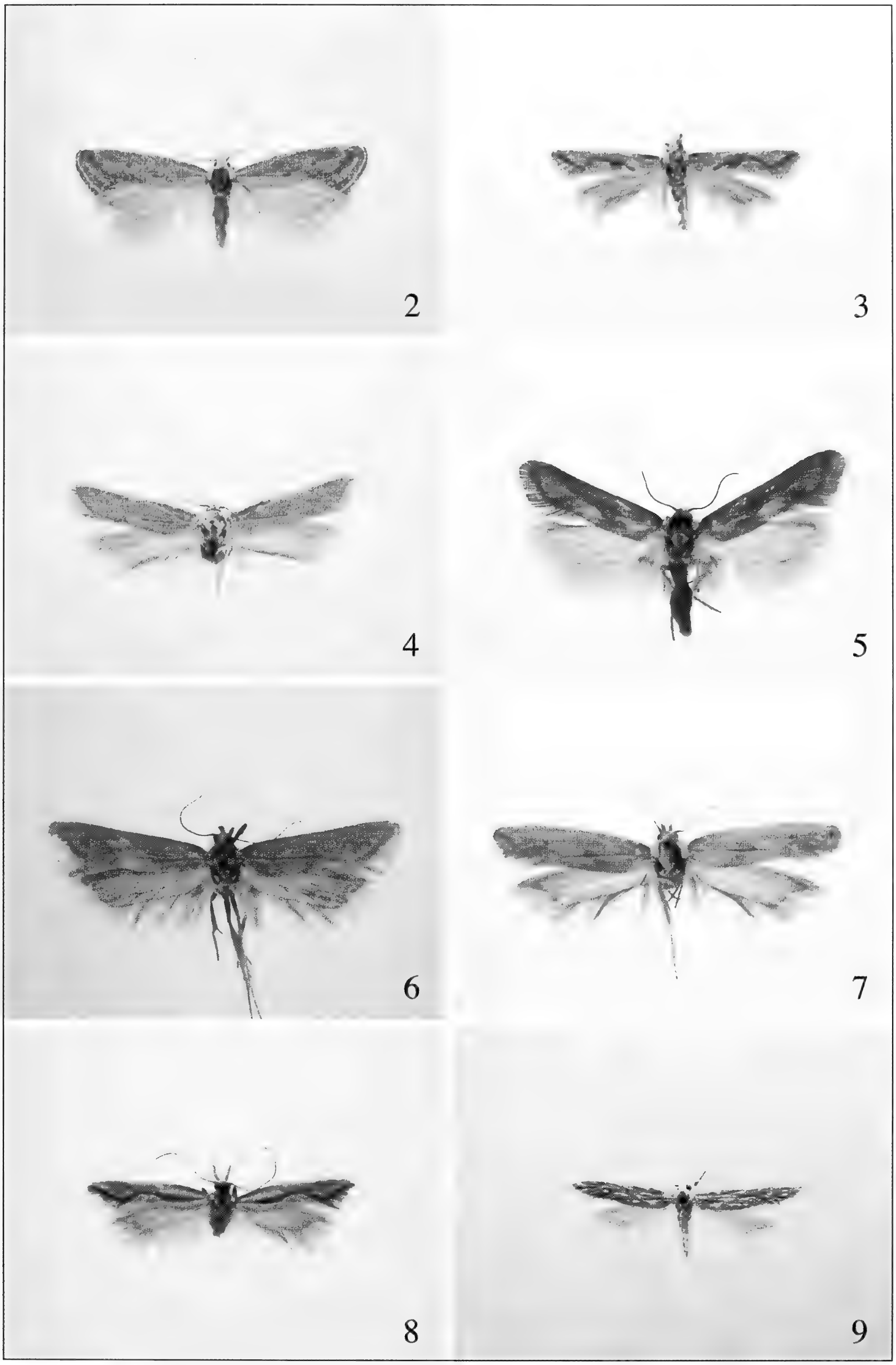
8\. Saccus short; cucullus distinctly narrowed at base 9

– Saccus long; cucullus not narrowed at base .... *M. modesta*

9\. Cucullus very short and broad; sacculus with two large apical teeth .... *M. piskunovi* sp. n.

– Cucullus longer, slender; sacculus with four small apical teeth .... *M. scythiella*

A key to the female genitalia is not provided because females are only known in seven out of ten species.



Figs. 2–9. Adults of *Metanarsia*. **2.** *M. modesta* ♂, Turkmenistan, wingspan 18 mm. **3.** *M. onzella* ♂, Turkmenistan, wingspan 16 mm. **4.** *M. kosakewitshi* ♂, holotype, Kazakhstan, wingspan 23 mm. **5.** *M. dahurica* sp. n., holotype ♂, Russia: Chitinskaja obl., wingspan 21 mm. **6.** *M. scythiella* ♂, paratype, Russia: Tuva, wingspan 25.5 mm. **7.** *M. piskunovi* sp. n., holotype ♀, Mongolia, wingspan 24.5 mm. **8.** *M. junctivittella* ♂, Turkmenistan, wingspan 16 mm. **9.** *M. junctivittella* ♂, Uzbekistan, wingspan 17 mm.

Species review

The *Metanarsia modesta*-group

Labial palpus relatively short, segment 2 much longer and broader than segment 3; aedeagus not exceeding length of cucullus; sacculus with apical teeth; gnathos long, slender.

Metanarsia modesta Staudinger, 1871 Figs. 2, 18, 30, 48

Metanarsia modesta Staudinger, 1871: 315. – Christoph 1885: 161, pl. 8 fig. 10.
Metanarsia (*M.*) *modesta kurdistanella* Amsel, 1959: 66, pl. 10 fig. 12, pl. 7 fig. 5 – Piskunov 1990: 96.

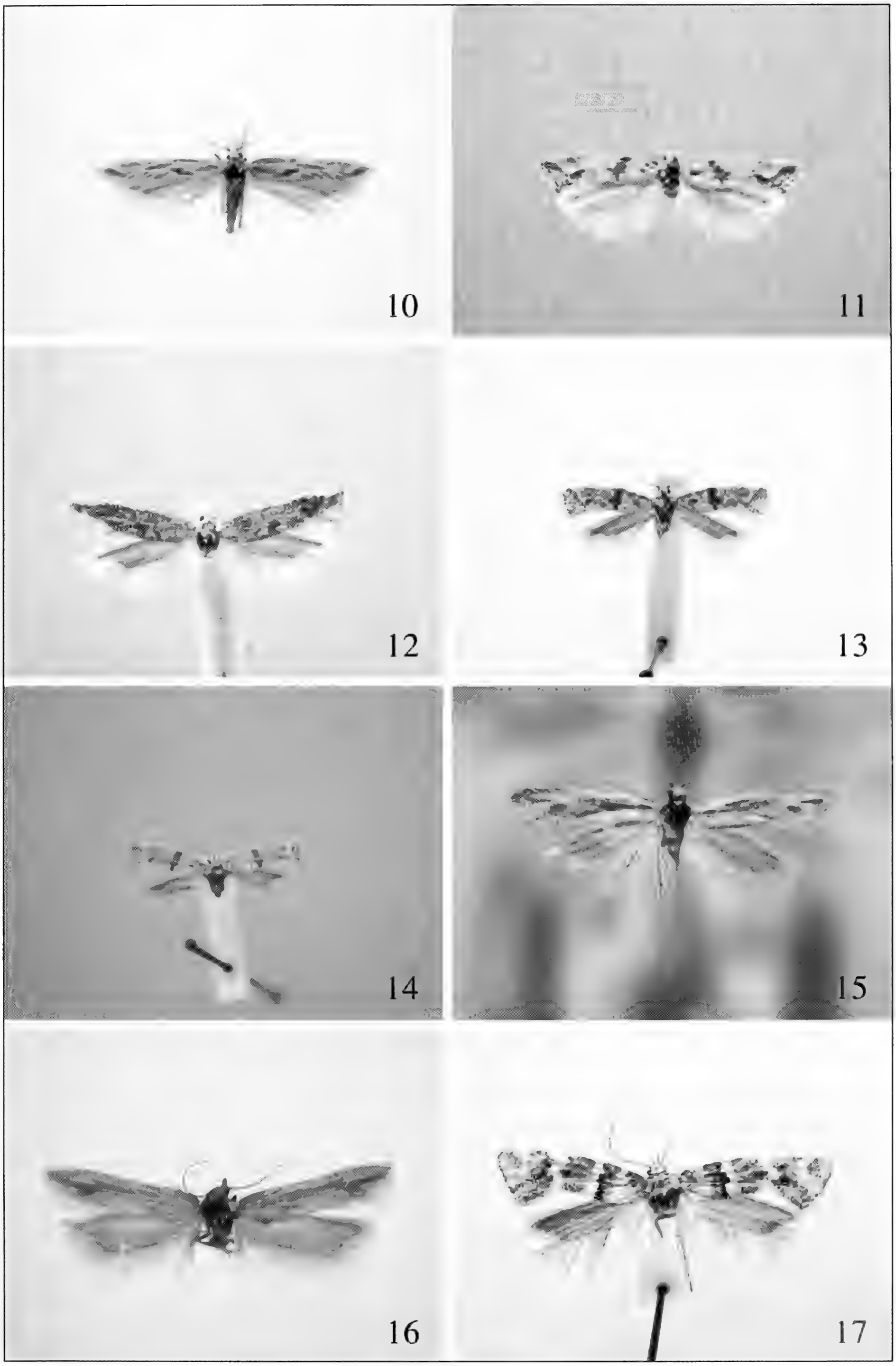
Material. Lectotype ♂ (designated here) with labels: handwritten "Sarepta Ch." (black ink on green paper), printed "LECTOTYPE" (round, blue-edged BMNH label), printed "Origin." (on pink paper), printed "Lectotype ♂, *Metanarsia modesta*, Stgr., teste K. Sattler, 1986", printed "ex coll. STAUIDINGER" (on white paper) (ZMHB). – **Ukraine:** 6♂, 2♀, zap-k Kamennye Mogily, 30.vi–5.vii.1999, Bidzilya leg. (gen. prep. 46/03, 47/03); 2♂, zap-k Khomutovskaja step', 15, 19.v.1996, Bidzilya leg.; 2♂, Prov. Kherson, Vessjolaja Bokovenjka (prope stat. Dolinskaja), 15.vi.1930, lum., Obraztsov leg.; 2♂, Khersonskaja obl., Askania Nova, step', 19.vii.1981, Nesterov leg. (gen. prep. 7/03); 3♂, Nikolaev, 13.vi, 7.vii.1934, Obraztsov leg.; ♂, okr. Zaporozhija, Rybkhoz, 27.vi.1991, svet, Zhakov leg.; 2♂, Krim, Karadag, 23.vii.1924, light, Djakonov leg. (all ZMKU). **Russia:** 2♂, Rostov a/Don, 1, 2.vii.1929, Shtshegolev leg., coll. L. Sheljuzhko; 5♂, Saratoff, 29.vi.1896, coll. Krulikovsky; ♂, Casan, vi.[19]04, coll. Krulikovsky (all ZMKU). **Armenia**: 3♂, mts. Daralagez (Armenia), pag. Azizbekov (Pashalu), ca. 1650 m alt., (lum.), 19, 25.vii.1938, L. Sheljuzhko et N. Pavlitzkaja leg. Mus. Zool. Univers. Kijev (ZMKU). **Kazakhstan:** ♂, Uigursky r-n, 15 km NW Tchundzha, k.[ordon] Jasenevaja roshcha, na svet, 21.v.1991, Ustjuzhanin leg. (ZMKU). **Turkmenistan:** ♂, Aidere, 850 m, W Kopetdag, 1.vi.1986, Falkovitsh leg. (ZIN).

Redescription. Length of forewing 6.0–10.0 mm. Head, thorax, and tegulae with light grey, brown-tipped scales. Segment 2 of labial palpus very broad, densely covered with grey, brown-tipped scales, with dorsal surface and apex cream; segment 3 about one-fifth length of segment 2, almost entirely covered with scales of segment 2, at angle of about 120 degrees from segment 2. Scape dark brown with dense pecten of long hair-like scales, other antennal segments brown with white rings. Forewing light grey mottled with brown scales, with two-four indistinct spots along longitudinal axis of wing. Hindwing light grey.

Male genitalia. Uncus broad, with distinct apical depression. Cucullus finger-like, expanded apically, apex rounded, covered with short setae. Sacculus broad, with three or four small apical teeth and with deep emargination at inner margin, about half length of cucullus. Vinculum lobes broad, rounded. Saccus long, pointed apically. Aedeagus short, about length of sacculus, basal part bifurcated, strongly sclerotized, about twice width of distal part.

Female genitalia. Papillae anales sparsely covered with long setae. Apophyses posteriores about twice length of apophyses anteriores. Sternite VIII laterally broadly sclerotized, anterior margin narrow. Ductus bursae short. Corpus bursae long, evenly expanded proximally.

Variation. The forewing colour varies extensively from cream to grey brown and dark spots may merge to form short dashes; the male genitalia vary in the number of apical teeth of the sacculus and in the shape of the cucullus; there is some slight variation in the degree of sclerotization of sternite VIII in the female genitalia.



Figs. 10–17. Adults of *Metanarsia*: **10.** *M. junctivittella* ♂, Uzbekistan, wingspan 19 mm. **11.** *M. alphitodes* ♂ Algeria, wingspan 15 mm. **12.** *M. alphitodes* ♂, Turkmenistan, wingspan 14 mm. **13.** *M. alphitodes* ♀, Uzbekistan, wingspan 12 mm. **14.** *M. alphitodes* ♂, Mongolia, wingspan 11.5 mm. **15.** *Epidola halmyropis* ♂, holotype, W Kazakhstan (Indersky), wingspan 12 mm. **16.** *M. incertella* ♂, Mongolia, wingspan 23 mm. **17.** *M. partilella* ♂, Turkmenistan, wingspan 22 mm.

Remarks. *M. modesta* is easily recognizable externally by the cream forewing without prominent fasciae. The male genitalia resemble those of *M. dahurica* sp. n. but differ reliably in the shorter aedeagus, pointed saccus, and the shape of the sacculus; they differ from those of *M. schytiella* in the sacculus not being narrowed at base and the longer saccus. The female genitalia resemble those of *M. piskunovi* sp. n. and *M. alphitodes* but differ in the shape and the smaller size of the ductus and corpus bursae. Subspecies *M. m. kurdistanella* differs in the lighter fringe of the forewing as well as longer and narrower cucullus in the male genitalia. This subspecies should probably be considered a junior subjective synonym of *M. modesta,* but to clearly establish this presumed synonymy the type specimens of *M. m. kurdistanella* would have to be checked.

Life history. Adults fly from early May to late July; there is also a record (♂, 50 km NE Erzerum, 1600 m, 17.ix.1993, leg. Fibiger, ZMUC; Karsholt, pers. comm.) in September. Moths inhabit steppes up to about 1650 m in mountains (Turkey, Armenia).

Distribution. Ukraine; Armenia; Turkmenistan; Russia: South and East of European part; SE Kazakhstan. This species was also recorded from South Italy (Karsholt & Huemer 1995: 2), Romania, North Kazakhstan, South of Krasnojarskiy kray of Russia (Caradja 1920: 116), Uzbekistan (Gerasimov 1930: 33), Turkey, NE Iran (O. Karsholt, pers. comm.), Iraq (Amsel 1959: 66). A record from Mongolia (Emeljanov & Piskunov, 1982: 389, figs. 45, 46) must be referred to *M. piskunovi* sp. n.

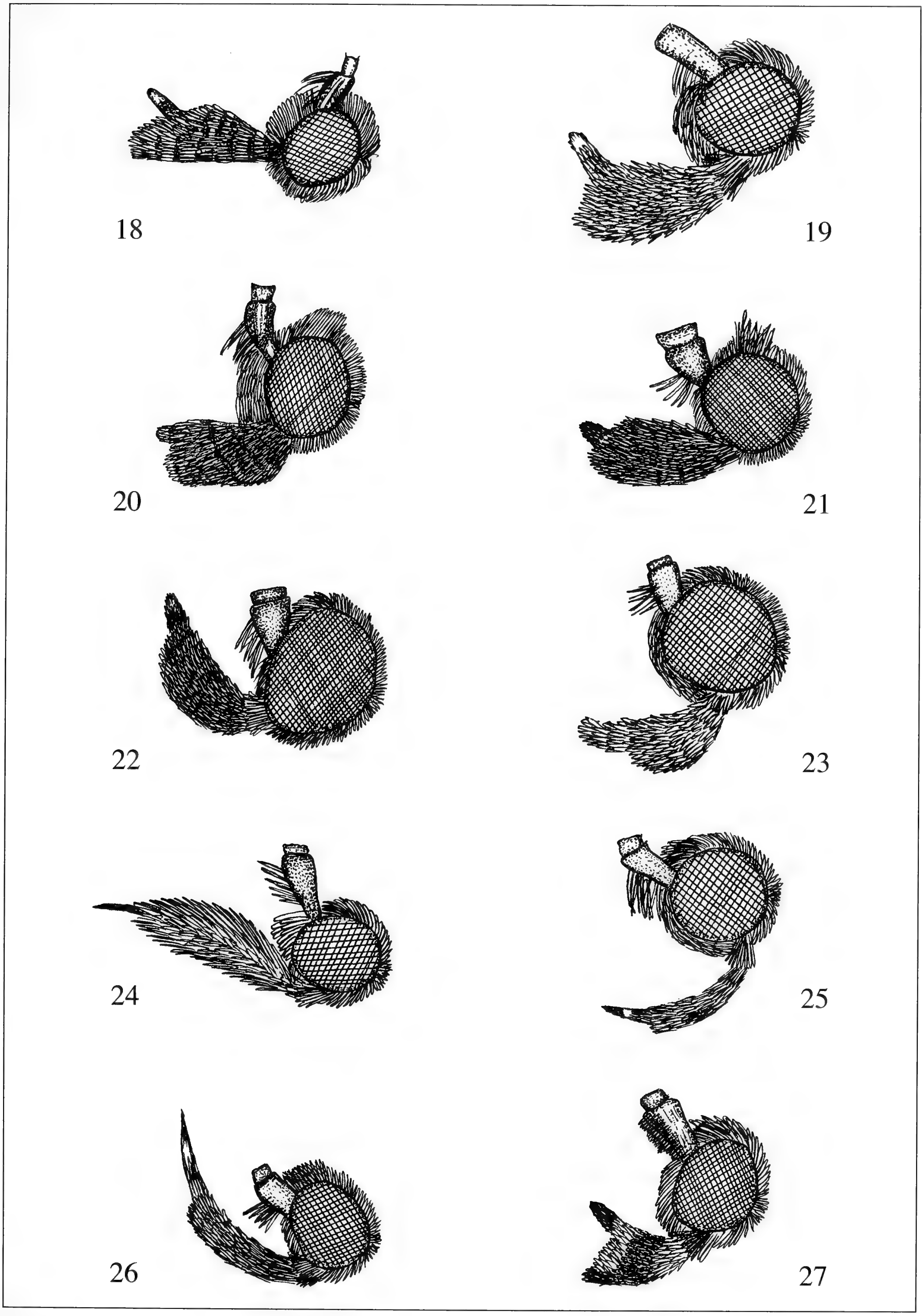
Metanarsia onzella Christoph, 1887 Figs. 3, 19, 31

Metanarsia onzella Christoph, 1887b: 120, pl. 5 fig. 13 [adult].
Metanarsia (*Metanarsia*) *onzella* Christoph, 1887 – Piskunov 1988: 365, figs. 10–12 [male genitalia].

Material. Holotype ♂ (by monotypy) with labels: handwritten "Nuchur, ♂ (recto) 11.6.[18]82 Chr. 305 *Onzella* Orig. (verso)", green paper circle, printed "39" (on white paper), printed "Coll. Vel.[ikogo] Kn.[jazja] Nikolaja Mikhailovicha" (on white paper in Cyrillic characters), printed "Holotype ♂, *Metanarsia onzella* Christoph, teste K. Sattler, 1978" (on white paper), handwritten (Piskunov) "♂, *Metanarsia onzella* Christoph, 1887, Piskunov det., 1981" (on white paper), handwritten (Piskunov) "Holotypus" (on red paper) (ZIN). **Kazakhstan:** 3♂, YuV Kazakhstan, dolina reki Tcharyn, 15 km Z Tchundzha, Jasenevaja roshcha, 24.vi.1990, light, I. Kostjuk leg. (gen. prep. 29/03) (ZMKU). **Uzbekistan:** ♂, Ajakguzhumdy, 40 km O Dzhingil'dy, Kyzylkum, 4.vi.1969, M. Falkovitsh (ZIN). **Turkmenistan:** 3♂, Aidere, 850 m, W Kopetdag, 1, 2, 4.vi.1986, M. Falkovitsh (ZIN).

Redescription. Length of forewing 7.5–8.0 mm. Head, thorax, and tegulae covered with yellowish-grey, brown-tipped scales. Segment 2 of labial palpus straight, broad, expanded towards apex, densely covered with long brown scales, apex cream, about four times length of segment 3; segment 3 short, brown, with white apex, at angle of about 120 degrees from segment 3. Scape yellowish-brown with pecten of numerous long hair-like scales, other antennal segments brown with white rings. Forewing costal, posterior, and subapical areas with yellow patches, middle near posterior margin with diffuse yellowish-brown spot, outer margin dark grey. Hindwing grey.

Male genitalia. Uncus long and slender, with small apical depression. Cucullus relatively broad, finger-like, apex covered with short setae. Sacculus about two-thirds length of cucullus, with one lateral and three large apical teeth. Vinculum lobes long



Figs. 18–27. Labial palpi of *Metanarsia* spp.: **18.** *M. modesta*. **19.** *M. onzella*. **20.** *M. kosakewitshi*. **21.** *M. dahurica* sp. n. **22.** *M. scythiella*. **23.** *M. piskunovi* sp. n. **24.** *M. junctivittella*. **25.** *M. alphitodes*. **26.** *M. incertella*. **27.** *M. partilella*.

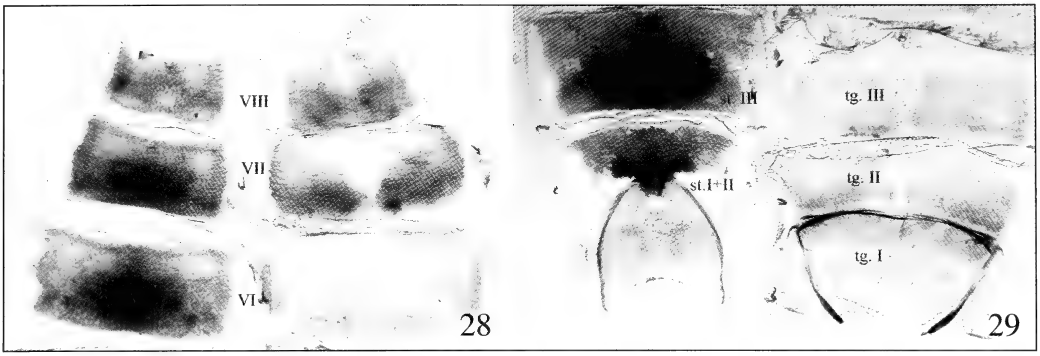
and narrow. Saccus triangular. Aedeagus about as long as sacculus, basal part bifurcated and strongly sclerotized, apex with distinct teeth.
Female. Unknown.
Variation. There is variation in the expression of yellow patches of the forewing and in the shape of the sacculus and vinculum lobes in the male genitalia.
Remarks. *M. onzella* is more similar externally to *M. junctivittella*, but differs reliably in the wing pattern and the shorter labial palpus. The male genitalia are clearly distinguished by long and narrow vinculum lobes.
Life history. Adults fly in June and August.
Distribution. SE Kazakhstan, Uzbekistan, Turkmenistan. Russia: South of European part (Sarepta) (K. Sattler, pers. comm.).

Metanarsia kosakewitshi Piskunov, 1990 Figs. 4, 20, 32

Metanarsia (*Metanarsia*) *kosakewitshi* Piskunov, 1990: 95, figs. 1–3 [male genitalia].

Material. Holotype ♂ with labels: handwritten "Sary-Tau-Kumy, nizovija r.[eki] Ili, 12.vi.1977, I. S. Kumalev" (recto) "Alma-Atinskaja obl." (verso) (on white paper in Cyrillic characters), handwritten (Piskunov) on printed form "Holotypus *Metanarsia (Metanarsia) kosakewitshi Piskunov, sp. n.,* ♂" (recto) "Coll. Inst. Zool. AN Ukrainian SSR, Kiev, gen. prep. № 293, ♂, V. Piskunov" (verso) (on red paper), handwritten (Piskunov) on printed form "MIKR. PREP. № *293,* ♂, *holotypus*" (recto) "*Metanarsia (Metanarsia) kosakewitshi* Piskunov, sp. n., Kazakhstan, Piskunov" (verso) (on white paper) (SIZK).

Redescription. Length of forewing 11.0 mm. Head, thorax, and tegulae covered with yellowish-white scales. Segment 2 of labial palpus straight, slightly broadened towards apex, densely covered with long setae; inner surface yellowish-white, outer surface reddish-brown. Segment 3 of labial palpus straight, very short, entirely covered with long setae of segment 2. Scape reddish-brown with pecten of few, long hair-like scales, other antennal segments brown. Forewing uniformly reddish-brown. Hindwing grey.
Male genitalia. Uncus relatively broad, slightly narrowed apically with very small apical depression. Gnathos weakly curved near middle, distal part slightly expanded, spoon-like. Cucullus finger-like, slightly curved at base, some exceeding length of uncus. Sacculus about two-thirds length of cucullus with deep depression at outer margin, apex with four distinct teeth. Vinculum lobes about one-third length of sacculus, rounded apically. Saccus narrow, triangular. Aedeagus bifurcated at base with distinct teeth before apex, sclerotized basally.
Female. Unknown.
Remarks. *M. kosakewitshi* Pisk. is more similar both externally and in the male genitalia to *M. dahurica* sp. n., but clearly differs in the uniformly reddish-brown forewing without fascia, slightly curved cucullus, smaller apical depression of uncus and the distinct deep depression at the outer margin of the sacculus; differences from *M. scythiella* are mentioned below.
Life history. Adults fly in June.
Distribution. SE Kazakhstan.



Figs. 28–29. Male abdominal segments: **28.** *M. scythiella*, segments VI–VIII. **29.** *M. scythiella*, segments II-III.

Metanarsia dahurica sp. n. Figs. 5, 21, 33–34, 49

Material. Holotype ♂, with labels: handwritten (Kostjuk) [**Russia:** Chitinskaya oblast'] "Daurskie stepi, vostochnyi bereg oz.[era] Barun-Torei, mys Mergen [Dahurian steppes, east bank of Barun-Torei Lake, Cape Mergen], 21.vi.1988, na svet, [on light] I. Kostjuk" (on white paper in Cyrillic characters), handwritten on printed form "Holotypus *Metanarsia dahurica Bidzilya*" (on red paper) (ZMKU). – Paratypes: 15♂, 2♀, labelled as holotype (gen. prep. 24/03, 42/03) (ZMKU). ♂, "**Mongolia**, Vostochnyi Aimak, Tamsag-Bulak, 21.vi.[1]976, Kerzhner" (gen. prep. 23/03) (ZIN).

Description. Length of forewing 9.0–11.0 mm. Head and thorax whitish-cream, tegulae cream with reddish-brown base. Labial palpus straight, segment 2 very broad, about five times length of segment 3, broadened towards apex, reddish-brown, dorsal surface cream; segment 3 very short, almost entirely covered with scales of segment 2. Scape reddish-brown with pecten of numerous long hair-like scales, other antennal segment brown with white rings. Forewing reddish-brown, bright, with distinct brown oblique transversal fascia from one-third posterior margin to half width of wing. Cilia reddish-brown. Hindwing light grey.

Male genitalia. Uncus relatively broad, with deep apical depression, densely covered with long setae. Gnathos broadened and slightly sclerotized at base, curved near apex. Cucullus straight with slightly broadened and rounded apex. Sacculus about two-thirds length of cucullus, with four small apical teeth. Vinculum lobes relatively broad, rounded apically. Saccus triangular. Aedeagus relatively long, distinctly bifurcated at base, with small teeth before apex.

Female genitalia. Papilla anales rounded apically, sparsely covered with long setae. Apophyses posteriores about 1.5 times length of apophyses anteriores. Segment VIII relatively broadly sclerotized laterally whereas anterior margin narrowly sclerotized. Ductus bursae short. Corpus bursae extremely long, evenly broadened proximally.

Variation. The forewing colour varies from bright reddish-brown to pale greyish-brown; the male from Mongolia is characterized by a broader cucullus and reduced apical teeth on the sacculus; two examined females showed no variation.

Remarks. In previous papers (Budashkin & Kostjuk 1994: 19; Kostjuk et al. 1994: 10;

Bidzilya et al. 1998: 48) *Metanarsia dahurica* was recorded as *M. kosakewitshi* Pisk., but my examination of the holotype of *M. kosakewitshi* showed that specimens from Transbaikalia reliably differ in forewing pattern, which has one distinct brown fascia. The male genitalia differ from those of *M. kosakewitshi* Pisk. in the straight cucullus, the sacculus with an indistinct depression on the outer margin and with smaller apical teeth, and the uncus with a deeper apical depression. The female genitalia of *M. dahurica* are clearly distinguished from those of all other known *Metanarsia* females by the very long and thin corpus bursae.

Life history. Inhabits steppe biotopes; adults fly in June.

Distribution. Russia: SE of Chitinskaja oblast'; Mongolia: East Aimak.

Derivatio nominis. Named after the type region.

Metanarsia scythiella Ponomarenko, 2000 Figs. 6, 22, 35

Metanarsia scythiella Ponomarenko, 2000: 223, fig. 1 [adult], figs. 2–5 [male genitalia].

Material. Paratype, ♂, **Russia,** Tuva rep. 50°40' N 92°58' E, 750 m, L. Ubsa-Noor, shore mead./ Nanophyton-steppe, 15.6.1995, Jalava & Kullberg leg. (gen. prep. 54/03) (ZMUH). Holotype not seen.

Redescription. Length of forewing 11.5 mm. Head, thorax, and tegulae yellow; base of tegulae and lateral sides of head mottled with pink. Labial palpus reddish-brown, inner surface lighter; segment 2 about twice width and four times length of segment 3, covered with long scales; segment 3 short, straight. Haustellum very short. Scape reddish-brown with pecten of few long hair-like scales, other antennal segments yellow. Forewing bright yellow, costal margin and termen reddish-pink, cilia yellow with some pink scales. Hindwing grey, cilia yellow.

Male genitalia. Uncus broad, with apical depression. Gnathos relatively short, weakly expanded distally. Cucullus distinctly narrowed at base, weakly curved, with slightly broadened and rounded apex. Sacculus broad, about two-thirds length of cucullus, with one lateral and four small apical teeth, inner surface with triangular depression. Vinculum lobes relatively long, rounded, apically covered with short setae. Saccus triangular. Aedeagus about as long as sacculus, distinctly bifurcated at base, with small teeth before apex, proximal half about twice width of distal half.

Female. Unknown.

Remarks. *M. scythiella* is easily recognizable externally by its bright yellow forewing with reddish-pink costal margin. The male genitalia resemble those of *M. kosakewitshi* Pisk. and *M. dahurica* sp. n. but differ in the shorter and broader aedeagus, the sacculus without deep depression on the outer margin, the longer vinculum lobes, the distinctly narrowed base of the cucullus, and the shorter saccus. In genitalia, *M. scythiella* is also similar to *M. modesta* and *M. incertella* but differs from *M. modesta* in the basally narrowed sacculus and the shorter saccus; differences from *M. incertella* are mentioned below.

Life history. Inhabits arid habitats, adults fly just before sunrise (Ponomarenko 2000: 224).

Distribution. Russia: Tuva, Ubsa-Noor Lake.

Figs. 30–37. Male genitalia of *Metanarsia* spp.: **30.** *M. modesta*, Ukraine (gen. prep. 7/03) **31.** *M. onzella*, Kazakhstan (gen. prep. 29/03). **32.** *M. kosakewitshi*, holotype, Kazakhstan (gen. prep. 293). **33.** *M. dahurica* sp. n., paratype, Russia: Chitinskaja obl. (gen. prep. 24/03). **34.** *M. dahurica* sp. n., paratype, Mongolia (gen. prep. 23/03). **35.** *M. scythiella*, paratype, Russia: Tuva (gen. prep. 54/03). **36.** *M. piskunovi* sp. n., paratype, Mongolia (gen. prep. 6/04). **37.** *M. junctivittella*, Kazakhstan (gen. prep. 30/03).

Metanarsia piskunovi sp. n. Figs. 7, 23, 36, 50

Material. Holotype ♀ with labels: printed "**Mongolia**, Uver-Khangaiskiy Aimak, bliz vost.[ochnogo] ber.[ega] oz.[era] Tatsyn-Tsagan-Nur [Mongolia, Uver-Khangaiskiy Aimak, near east bank of Tatsyn-Tsagan-Nur Lake] 2.–4.viii.[1]969, M. Kozlov" (on white paper in Cyrillic characters), handwritten on printed form "Holotypus *Metanarsia piskunovi Bidzilya*" (on red paper), printed "gen. prep. 33/03" (on white paper) (ZIN) – Paratypes: 2♀, labelled as holotype (ZIN); ♂, Mongolia, Vost.[ochno]-Gob.[iiskiy] Aimak, 45 km S.[evero]-V.[ostochnee] Bajan-Munkha, na svet, 3.vii.[1]971, Kerzhner (gen. prep. 6/04); ♂, Mongolia, Vost.[ochno]-Gob.[iiskiy] Aimak, 50 km S.[evernee] Sain-Shanda, na svet, 31.vii.[1]971, Kerzhner (all ZIN).

Description. Length of forewing 10.0–11.0 mm. Head, thorax, and tegulae light yellow. Labial palpus weakly recurved; segment 2 broad, about twice length of segment 3, outer surface light brown, inner surface and apex cream; segment 3 short, densely covered with cream scales. Haustellum long. Scapus cream with pecten of few hair-like scales, other antennal segments dark grey with white rings. Forewing light yellow, termen with some brown scales; with small brown spot in middle and second spot at two-thirds length; indistinct diffuse dark oblique fascia from one-quarter of posterior margin to half width of forewing. Hindwing light grey.

Male genitalia. Uncus relatively narrow, with apical depression. Gnathos long, broadened distally. Cucullus very short and broad, constricted basally, apex rounded. Sacculus relatively narrow, with one triangular lateral and two large apical teeth. Vinculum lobes broad, rounded apically. Saccus triangular, pointed apically. Aedeagus short, about as long as sacculus, basal half about as long and twice as wide as distal half, base bifurcated, apex with small teeth.

Female genitalia. Papillae anales rounded apically, covered with long setae. Apophyses posteriores about 1.5 times length of apophyses anteriores. Segment VIII relatively narrowly sclerotized anterolaterally. Ductus bursae short. Corpus bursae broad and long.

Variation. The specimens from the type series show no variation both in habitus and in genitalia.

Remarks. This new species is more similar externally to *M. scythiella* but differs in the colour of the forewing which in *M. scythiella* is bright yellow with a pink costal margin and without dark spots. The male genitalia are similar to those of *M. scythiella*, but differ reliably in the broader and shorter cucullus and narrower sacculus with two large apical teeth. The female genitalia of *M. piskunovi* sp. n. resemble those of *M. alphitodes* but differ in the shorter and broader ductus bursae, the shape of the corpus bursae, and the much larger size.

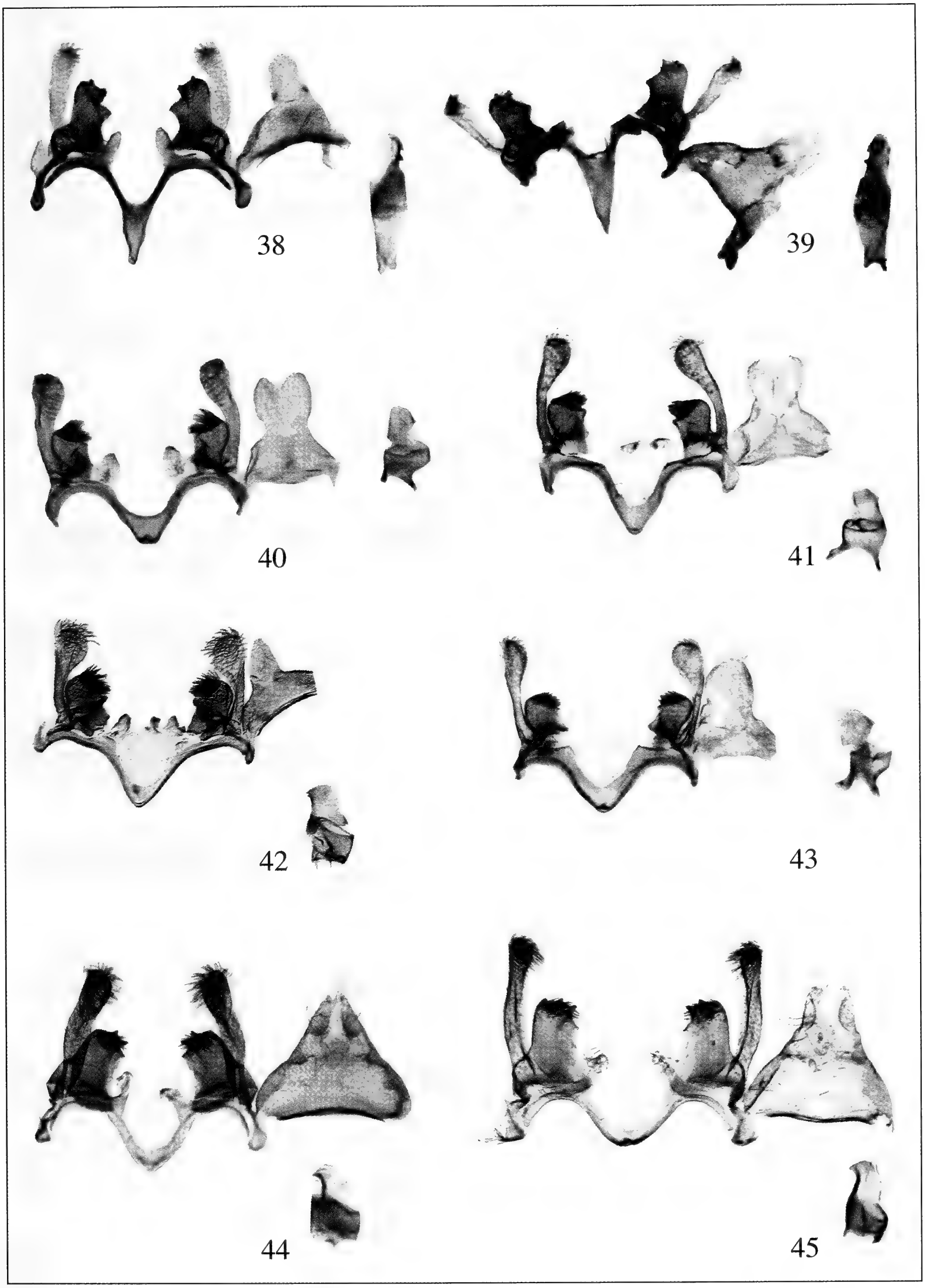
Life history. Adults fly from July to early August.

Distribution. Mongolia: Uver-Khangaiskiy Aimak, East Gobiiskiy Aimak.

Derivatio nominis. Named in honour of Dr. Vladimir I. Piskunov (Vitebsk, Byelorussia), who made an important contribution to the study of the gelechiid moths of the Palaearctic region, in particular with genus *Metanarsia*.

The *Metanarsia junctivittella*-group

Segment 2 of labial palpus very long, straight, covered with very long setae; aedeagus with two teeth before apex; saccus long; gnathos very long; R_4 reduced, R_3 and R_5 arising from corner of cell.



Figs. 38–45. Male genitalia of *Metanarsia* spp. **38.** *M. junctivittella*, Uzbekistan (gen. prep. 31/03). **39.** *M. junctivittella*, Tadzhikistan (gen. prep. 68/02). **40.** *M. alphitodes*, Algeria (gen. prep. 19/03). **41.** *M. alphitodes*, Uzbekistan (gen. prep. 26/03). **42.** *M. alphitodes*, Turkmenistan (gen. prep. 27/03). **43.** *M. alphitodes*, Mongolia (gen. prep. 20/03). **44.** *M. incertella*, Kazakhstan (gen. prep. 15/03). **45.** *M. incertella*, Uzbekistan (gen. prep. 52/03).

Metanarsia junctivittella Christoph, 1885 **Figs. 8–10, 24, 37–39**

Metanarsia junctivittella Christoph, 1885: 161, pl. 8 fig. 11.
Metanarsia (*Parametanarsia*) *junctivittella* Christoph, 1885. – Gerasimov 1930: 33, pl. 10 figs. 6–8.

Material. Lectotype ♂ (designated here) with labels: printed "TRANSCASPIA, Askhabad, 19.v.1882, H. Christoph" (on white paper), printed "LECTO-TYPE" (round, purple-edged BMNH label), handwritten (Christoph), "♂ ♀. Askhabad" (recto) (on white paper, in black box), "19 5 82" (verso), printed "*Metanarsia junctivittella* Christoph, H. Christoph det." (on white paper), printed "Christoph Coll., Walsingham Collection, 1910-427" (on white paper – BMNH registration label), handwritten (Christoph) "*Junctivittella* Chr." (on white paper, in black box). **Kazakhstan:** 8♂, Karatau Chr.[ebet], 10 km N Kentau, 600 m, svet, 19–21.v.1994, Pljushtch, Nesterov (gen. prep. 30/03) (ZMKU). **Uzbekistan:** 4♂, 70 km S Tamdy-Bulaka, Kyzylkum, 30.iv, 8.v.1965, Pastukhov; 3♂, Ajakguzhumdy, 40 km O Dzhingil'dy, Kyzylkum, 7.v.1966, 17.v.1969, Falkovitsh (all ZIN). **Turkmenistan:** 2♂, Badkhyz, kord.[on] Kyzyldzhar, svet, 21.iv.1981, 3.v.1980, V. Pechen'; ♂, Kushka, dolina reki, 21.iv.1981, Nesterov (ZMKU). **Tadzhikistan:** ♂, Staraja Pristan', 12 km Yu Dzhilykul' na reke Vahsh, svet, 20.v.1949, Yu. Shchetkin; ♂, Dzhilykul' na reke Vahsh, 16.iv.1949, Yu. Shchetkin (gen. prep. 28/03); ♂, Vahshskaja dolina, Molotovobadskiy r-n, 6-oi posiolok, 20.iv.1953, V. Degtjariova; ♂, Kondara, 1100 m, 29.vi.1956, Yu. Shchetkin (all ZMHB).

Redescription. Length of forewing 6.0–9.0 mm. Head, thorax, and tegulae yellow. Labial palpus straight, outer surface mottled with brown; segment 2 four times length of segment 3; segment 3 short, slender, covered with scales of segment 2. Scape yellowish-brown with dense pecten of numerous long hair-like scales, other antennal segments brown. Forewing dark yellow with brown longitudinal line from one-quarter of posterior margin to three-quarters length; subapical area and cilia mottled with brown. Hindwing light grey.

Male genitalia. Uncus relatively broad, densely covered with long setae. Gnathos weakly expanded distally, apex spoon-like. Cucullus slender, expanded towards apex. Sacculus about two-thirds length of cucullus, with one lateral and three apical teeth. Vinculum lobes relatively broad, triangular, pointed apically. Saccus long and slender, pointed apically. Aedeagus about as long or slightly longer than cucullus, basally bifurcated, with one small and one large teeth before apex, caecum long.

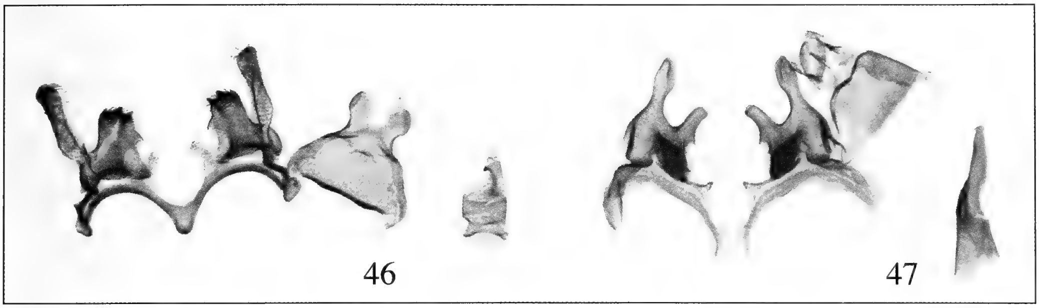
Female genitalia (after Gerasimov 1930: pl. 10 fig. 7). Papilla anales covered with setae. Apophyses posteriores about 1.5 times length of apophyses anteriores. Anterior margin of segment VIII narrowly sclerotized. Ductus bursae thin. Corpus bursae very long and relatively thin.

Variation. Externally very variable: specimens from Uzbekistan grey, with dark brown longitudinal line and numerous brown scales mainly along the veins; occasional specimens from Tadzhikistan light, uniformly yellowish-cream, without markings. The male genitalia vary in the width of the saccus, and the apical teeth of the sacculus may be reduced.

Remarks. *M. junctivittella* is clearly recognizable in the wing pattern, the very long labial palpus, the long saccus, the aedeagus with two teeth before apex, and the extremely long and thin corpus bursae.

Life history. Adults fly from the end of April to late June and readily attracted to light.

Distribution. South and SE Kazakhstan, Uzbekistan, Turkmenistan, Tadzhikistan; Afghanistan and Pakistan (K. Sattler, pers. comm.).



Figs. 46–47. Male genitalia of *Metanarsia* spp.: **46.** *M. incertella*, Mongolia (gen. prep. 21/03). **47.** *M. partilella*, Uzbekistan (gen. prep. 32/03).

The *Metanarsia alphitodes*-group

Labial palpus slender, weakly recurved; sacculus densely covered apically with short setae; gnathos very membranous, indistinct.

Metanarsia alphitodes (Meyrick, 1891) Figs. 11–14, 25, 40–43, 51

Calyptrotis alphitodes Meyrick, 1891: 56–57 – "Biskra [Algeria]; a series obtained one evening from some sheltered shrubs near the river bank".

Calyptrotis alphitodes Meyrick, 1891. – Clarke 1969: 393, pl. 195, figs. 1–1d – "Type: The male so marked in the British Museum, "Biskra, Algeria. 21.4.[18]90." – This action may be considered as an effective lectotype designation (ICZN Art. 74.5), not seen.

Metanarsia gobica Lvovsky & Piskunov, 1989: 554, figs. 43–45, **syn. n.** Holotype ♂ with labels: printed "MNR, Bajan-Khong.[orskiy] aimak, 140 km Yu. Shine-Dzhinsta, oaz.[is] Ehin-Gol, na svet, 26.vi.1981, L'vovskiy" (on white paper in Cyrillic characters), handwritten "26.vi" (recto) "svet" (verso) (on white paper), handwritten on printed form "Holotypus, ♂, *13872*" (recto) "*Metanarsia gobica* Lvovsky et Piskunov." (verso) (on red paper) (ZIN).

Metanarsia alphitodes (Meyrick, 1891). – Ponomarenko 2000: 222.

Material. **Algeria:** 2♂, Biskra, [18]87. Stdg. (gen. prep. 19/03) (ZMHB). **Kazakhstan:** ♂, Uigurskiy r-n, 15 km NW Tchundzha, Jasenevaja roshcha, 20.v.1991, P. Ustjuzhanin (ZMKU). **Uzbekistan:** 5♂, 2♀, Ajakguzhumdy, 40 km O Dzhingil'dy, Kyzylkum, 31.v.1975, 19.v.1970, 13, 15.v.1976, Falkovitsh (gen. prep. 27/03, 39/03) (ZIN). **Turkmenistan:** 2♂, ♀, Krasnovodsk (gen. prep. 27/03) (ZMHB); ♂, W Kopetdag, g.[ora] Sjunt, 19.v.1998, na svet, Z. Kljuchko, O. Torgonja (ZMKU). **Mongolia:** ♂, Mongolskiy Altai, 30 km N Biger, polupustynja, H–1350, 23.vi.1999, P. Ustjuzhanin; ♂, Mongolia, [Uver-Khangaiskiy Aimak] Tugrek, *Nitraria*, 21.vii.[19]70, l.[arva] zimuet, e. l. iii.[19]71, M. Kandybina (gen. prep. 20/03) (ZIN).

Redescription. Length of forewing 5.0–7.0 mm. Head, thorax, and tegulae covered with cream brown-tipped scales. Inner surface of labial palpus cream, outer surface brownish-cream; segment 2 about twice length of segment 3. Haustellum long, well developed. Scape brownish-cream with pecten of numerous hair-like setae, each antennal segment grey with white ring at base. Forewing cream mottled with brown; with two small indistinct spots near base, one brown spot of raised scales near posterior margin at half length, a brown, transversal, distally broadened fascia from half of costa to half width of wing, and greyish-brown scales in subapical area forming diffuse patches or one narrow streak along outer margin and near tornus. Hindwing light grey.

Male genitalia. Uncus long and broad, with small apical depression. Tegumen very short. Cucullus longer than uncus, weakly curved in middle, expanded distally. Sacculus about half length of cucullus. Vinculum lobes membranous, often indistinct, about one-third length of sacculus, broadened apically. Saccus triangular. Aedeagus short, about as long as sacculus, bifurcated and strongly sclerotized basally with distinct teeth before apex.

Female genitalia. Papillae anales sparsely covered with long setae. Apophyses posteriores about twice length of apophyses anteriores. Sternite VIII broadly sclerotized laterally, its anterior margin narrowly sclerotized. Ductus bursae broad, about as long as corpus bursae. Corpus bursae sub-oval.

Variation. The number of brown scales and their distribution can vary extensively and the brown subapical streak is often absent; males from Mongolia have the cucullus more slender medially and the vinculum broader; the three examined females showed no variation.

Remarks. *M. alphitodes* is easily recognizable externally by the slender, weakly recurved labial palpus, the unique wing pattern, and the small size. The male genitalia are clearly distinguished by the apically setose sacculus. The differences of the female genitalia from those of *M. piskunovi* sp. n. are mentioned above.

Life history. In Mongolia an adult was reared from *Nitraria* sp. (Nitrariaceae) in July. The larva hibernates. Adults fly from mid-May to the end of June.

Distribution. Algeria, SE Kazakhstan, Turkmenistan, Uzbekistan, Mongolia.

The *Metanarsia incertella*-group

Labial palpus long, strongly curved; gnathos short, triangular; ductus bursae thin, weakly sclerotized, clearly separated from corpus bursae.

Metanarsia incertella (Herrich-Schäffer, 1861) Figs. 15–16, 26, 44–46, 52

Anacampsis incertella Herrich-Schäffer, 1861: 31, pl. [23], fig. 156.

Epiparasia longivitella Rebel, 1914: 276, Taf. IV, fig. 12 – Caradja 1920: 94.

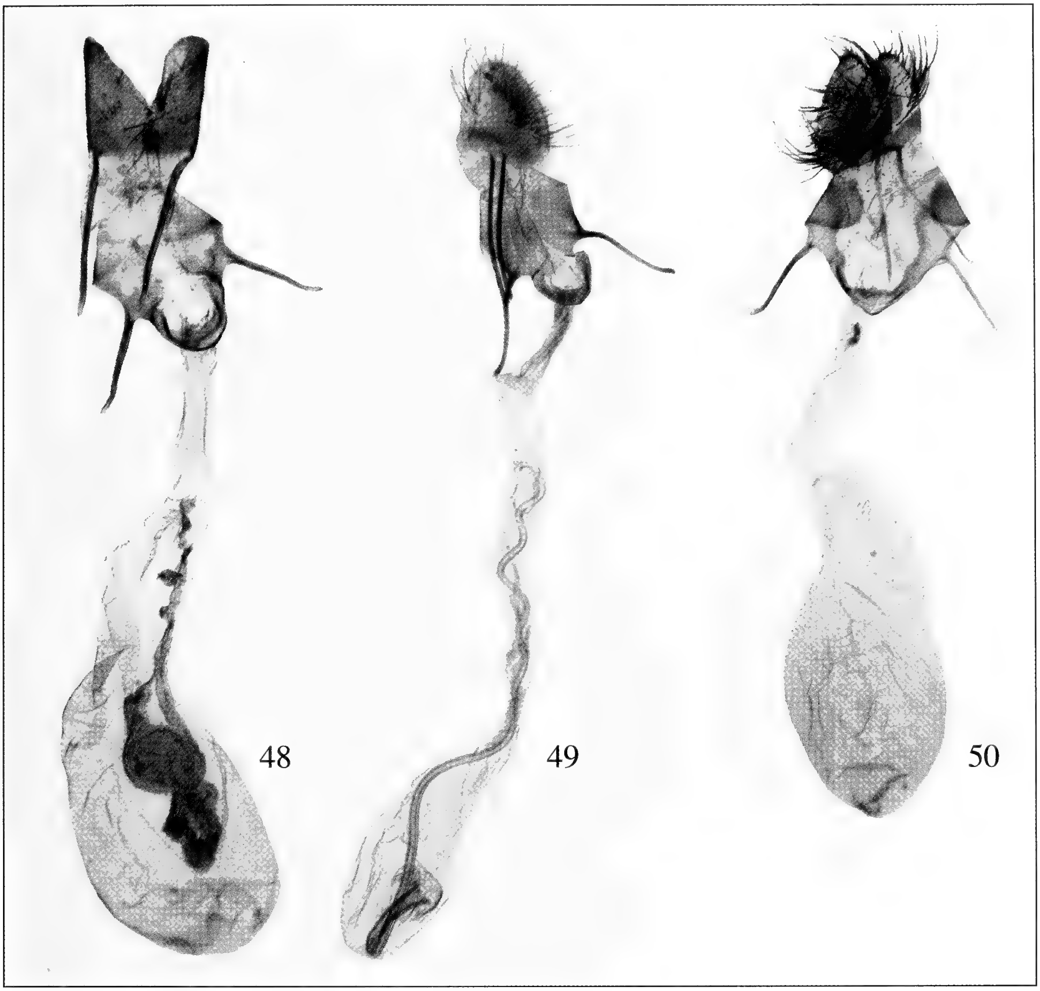
Epiparasia incertella (Herrich-Schäffer, 1861). – Caradja 1920: 94; Huemer, Karsholt, & Sauter 1996: 341–345, figs. 1–9.

Epidola halmyropis Meyrick, 1926: 270–271, **syn. n.** Holotype ♂ (by monotypy) with labels: handwritten (Meyrick) "Indersky, Uralsk, B. 26.4.07" (black ink on white paper), printed "Holo-type" (round, red-edged BMNH label), printed "Meyrick Coll., B.M. 1938-290" (on white paper – BMNH registration label), handwritten "*Epidola halmyropis* Meyr., Holotype ♂" (black ink on off-white paper), handwritten "data published as "June", ("4" on specimen) " (black ink on white paper), printed "Abdomen missing" (on blue paper) (BMNH).

Metanarsia (*Metanarsia*) *incertella* (Herrich-Schäffer, 1861). – Piskunov 1990: 95.

Metanarsia incertella (Herrich-Schäffer, 1861). – Ponomarenko 2000: 222.

Material. Holotype ♂ (by monotypy) with labels: handwritten "Sarepta | C. 60. | Type | zu A..kh.f.15b." (black ink on white paper in green box), printed "Holotype" (round, red-edged BMNH label), printed "Coll. Möschl[er]." (on white paper), printed "Origin." (on pink paper), printed, with handwritten inscriptions "Holotype ♂ | *Anacampsis ?* | *incertella* H.-S. | teste K. Sattler 1986" (on white paper), printed "ex coll. STAUIDINGER" (on white paper) (ZMHB). **Russia:** ♂, Kapustin Jar, Astrakh. obl., 10.8.74, na svet, Utochkin (ZMKU). **Kazakhstan:** 7♂, dolina reki Tcharyn, 15 km W Tchundzha, Jasenevaja roshcha, 7.vii.1994, svet, I. Kostjuk leg. (gen. prep. 15/03, 25/03) (ZMKU). **Uzbekistan:** ♂, ♀,



Figs. 48–50. Female genitalia of *Metanarsia* spp.: **48.** *M. modesta*, Ukraine (gen. prep. 47/03). **49.** *M. dahurica* sp. n., paratype, Russia: Chitinskaja obl. (gen. prep. 42/03). **50.** *M. piskunovi* sp. n., holotype, Mongolia (gen. prep. 33/03)

Ajakguzhumdy, 40 km O Dzhingil'dy, Kyzylkum, 9.v.1970, 17.v.1965, M. Falkovitsh (gen. prep. 40/03) (ZIN). **Mongolia:** ♂, Mongolskiy Altai, 30 km N Biger, polupustunja, H–1350, 23.vi.1999, P. Ustjuzhanin (gen. prep. 21/03) (ZMKU).

Redescription. Length of forewing 8.0–13.0 mm. Head, thorax, and tegulae cream. Labial palpus strongly projecting over head; segment 2 about 1.5–2 times length and 1.5 times width of segment 3, its outer surface yellowish-cream, inner surface lighter, off-white. Scape same colour as head with pecten of numerous long hair-like scales. Forewing uniformly yellowish-cream or with more or less distinct longitudinal line which can be divided into separate brown patches. Hindwing light grey.

Male genitalia. Uncus broad, with deep apical depression. Cucullus finger-like, broadened towards apex, apex rounded, covered with short setae, slightly longer than uncus. Sacculus about half length of cucullus, with one lateral and three apical teeth. Lobes of posterior margin of vinculum more or less prolonged, weakly setosed. Saccus short, broadly rounded. Aedeagus short, about as long as sacculus, proximal half strongly sclerotized, base bifurcated, apex with small teeth.

Female genitalia. Papillae anales elongated, densely covered with long setae. Apophyses posteriores about twice length of apophyses anteriores. Corpus bursae very long, evenly broadened distally.

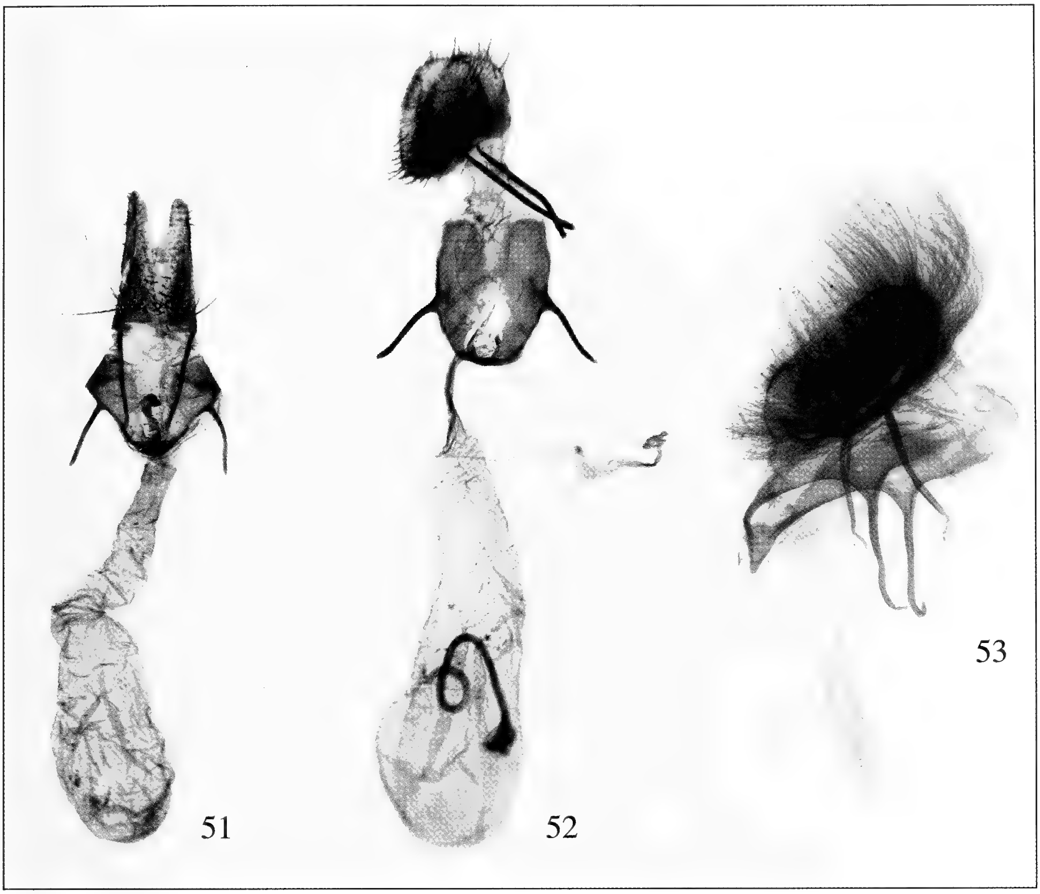
Variation. According to Huemer et al. (1996: 342) *M. incertella* shows extensive variation in the colour of the forewing and its markings from uniformly yellowish-cream without any marking to dark, greyish-brown with distinct brown lines and patches. At my disposal I had uniformly white specimens from Turkmenistan, yellowish-cream ones from Kazakhstan, whereas the male from Mongolia had a weakly expressed brown longitudinal line. Specimens from Turkey (Huemer et al. 1996, fig. 8) differed from specimens from Kazakhstan, Uzbekistan, and Mongolia in the shape of the vinculum lobes which was distinctly broader and rounded apically. There is also some variation in the shape of the apical depression of the uncus and in the length of the saccus in the male genitalia. One female from Tunisia (Huemer et al. 1996, fig. 9) slightly differed from females from Turkmenistan in the narrower lateral sclerotization of segment VIII.

Remarks. *M. incertella* is easily recognizable externally by the long and strongly recurved labial palpus. The male genitalia resemble those of *M. scythiella* and *M. kosakewitshi* but clearly differ in the narrower sacculus without deep triangular depression on the inner margin, the shorter saccus, the short triangular gnathos, the deeper apical depression of the uncus, and the shorter aedeagus. The female genitalia are clearly distinguished by the weakly sclerotized ductus bursae, which is distinctly separated from the corpus bursae.

Hypsipselon rigidellum var. *zeroudellum* Chrétien, 1915 (Tunisia), *Gelechia rhamiferella* Lucas, 1940 (Algeria), and *Epidola halmyropis* Meyrick, 1926 (W Kazakhstan, Indersky) were considered possible synonyms of *M. incertella* (Huemer et al. 1996: 341). This opinion was based on the examination of specimens that fit the original descriptions well and that originated from the type localities of these taxa. Thus, these presumed synonymies are quite plausible, but I was unable to check the type material of the first two taxa for confirmation. Unfortunately, the holotype of *E. halmyropis* lacks the abdomen, and although it corresponds well to *M. incertella* in wing pattern (Fig. 15), it differs in its unusually small size (wingspan 12 mm). Taking into consideration the extensive variation in external characters of *M. incertella* and the fact that W Kazakhstan (Uralsk) is the type locality for *E. longivitella*, I establish hereby the presumed synonymy of *M. incertella* Herrich-Schäffer, 1861 with *E. halmyropis* Meyrick, 1926 **syn. n.**

Life history. Adults fly from May to early August, up to about 2000 m in mountains (Huemer et al. 1996: 342).

Distribution. Russia (Volgogradskaja oblast', Astrakhanskaja oblast'), Kazakhstan, Uzbekistan, Mongolia. Known also from Spain, Algeria, Morocco, Tunisia, Russia: South and East of European part, South Siberia (Krasnojarsk), Turkey, West China (Caradja 1920: 94; Huemer et al. 1996: 342).



Figs. 51–53. Female genitalia of *Metanarsia* spp.: **51.** *M. alphitodes*, Uzbekistan (gen. prep. 39/03). **52.** *M. incertella*, Uzbekistan (gen. prep. 40/03). **53.** *M. partilella*, Uzbekistan (gen. prep. 45/03).

The *Metanarsia partilella*-group

Scape with dense brush of short setae; gnathos sucker-like; valva not entirely divided into cucullus and sacculus; aedeagus long, not bifurcated at base; papillae anales hairy; ductus bursae extremely short.

Metanarsia partilella (Christoph, 1887) **Figs. 17, 27, 47, 53**

Teleia partilella Christoph, 1887a: 167.

Teleia partilella Christoph, 1887. – Christoph 1889: 57, pl. 3 fig. 9.

Metanarsia (*Parametanarsia*) *partilella* (Christoph, 1887). – Piskunov 1988: 365, figs. 8–9.

Material. Lectotype ♂ (designated by K. Sattler in Piskunov 1988: 365) with labels: circle of green paper, handwritten "♂, Askhabad (recto) Partitella (verso) (on white paper), printed "coll. b.[yvshego] Vel.[ikogo] Kn.[jazja] Nikolaja Mikhailovicha" (on white paper, in Cyrillic characters), printed "Lectotype ♂, *Teleia partitella* Christ., teste K. Sattler, 1978" (on white paper), handwritten (Piskunov) "♂, *Metanarsia partitella* (Christoph, 1877), Piskunov det., 1981" (on white paper), printed "Hololectotypus" (on red paper). 2♂, 2♀, **Turkmenistan**, Repetek, SE Karakumy, 6,11,15,24.v.1981, Falkovitsh (gen. prep. 43/03, 45/03) (ZIN). ♂, **Uzbekistan,** Zhamansai, Kyzylkum, 25.v.1970, Falkovitsh (gen. prep. 32/03) (ZIN).

Redescription. Length of forewing 10.0–11.0 mm. Head white. Tegulae white mottled with grey scales mainly at base. Thorax covered with white, grey-tipped scales. Labial palpus relatively short; segment 2 broad, grey, apex white, about 1.5 times length of segment 3; segment 3 straight, grey, with few white scales. Scape grey, apex with white ring, other antennal segments dark grey with white ring. Forewing greyish-white, divided by two white fasciae into separated grey patches: first near base, second in middle and two small patches in subapical area; cilia grey. Hindwing dark grey.

Male genitalia. Uncus sub-oval, sparsely covered with short setae, with very small triangular apical depression. Gnathos large, strongly curved in distal one-third. Cucullus and sacculus broadly fused at base. Cucullus constricted at base, apex rounded, without setae. Sacculus about half as long and as wide as cucullus, without apical teeth. Vinculum lobes very short, triangular. Saccus short, sub-rectangular. Aedeagus longer than tegumen and uncus, slightly curved in middle, gradually narrowed towards apex, with very small subapical teeth.

Female genitalia. Papillae anales large, densely covered with very long, hair-like setae. Apophyses posteriores about as long as apophyses anteriores. Lateral part of segment VIII narrowly sclerotized; anterior margin triangular. Corpus bursae very thin and short, not exceeding length of papillae anales and segment VIII.

Variation. There is a slight variation in the shape of the grey patches of the forewing.

Remarks. *M. partilella* is easily recognizable externally by the unique wing pattern and the scape with a dense brush of short setae. The male genitalia are characterized by the very long aedeagus, the slender sacculus without apical teeth, and the large sucker-like gnathos. The female genitalia are clearly distinguished by the extremely short bursa and the papillae anales covered with very long, hair-like setae.

Life history. Adults fly in May.

Distribution. Turkmenistan, Uzbekistan.

Acknowledgements

I wish to express my gratitude to Drs S. Yu. Sinev, M. I. Falkovitsh, and A. L. Lvovsky for their assistance during my work with the collection of the ZIN and Dr K. Sattler (BMNH) for valuable information about some species and for providing a photograph of the holotype of *Epidola halmyropis*. I am very much obliged to I. Kostjuk (ZMKU), J. Kullberg (ZMUH), and Dr P. Ustjuzhanin (Novosibirsk) for loans and gifts of material, and to Dr R. Gaedike (DEI), Dr P. Huemer (TLMF), Dr B. Landry (MHNG), Dr W. May (ZMHB), Mr O. Karsholt (ZMUC), Dr Y. Nekrutenko (SIZK), Dr M. Nuss (MTD), Dr S. Sinev (ZIN) for critical comments on the manuscript, linguistic corrections and various help during the preparation of the manuscript.

References

Amsel, H. G. 1959. Irakische Kleinschmetterlinge, II. – Bulletin de la Société Royale Entomologique d'Egypte **43**: 41–83.

Bidzilya, O.V., Budashkin, Yu. I. & I. Yu. Kostjuk 1998. Additions to the Fauna of Microlepidoptera of Transbaikalia. – Zhurnal Ukrainskoho entomolohichnogo tovarystva **4** (1–2): 33–63 (in Russian).

Budashkin, Yu. I. & I. Yu. Kostjuk 1994. On the fauna of the Microlepidoptera of Transbaikalia. – In: Cheshuekrylye Zabaikalya. Trudy zapovednika "Dahursky" 2: 5–30 – Institute of Zoology, Kiev (in Russian).

Caradja, A. 1920. Beitrag zur Kenntnis der geographischen Verbreitung der Mikrolepidopteren des palaearktischen Faunengebietes nebst Beschreibung neuer Formen. III. Teil. – Deutsche Entomologische Zeitschrift Iris **34**: 75–179.

Christoph, H. 1885. Lepidoptera aus dem Achal-Tekke-Gebiete. Zweiter Theil. – *In*: N. M. Romanoff (Réd.), Mémoires sur les Lépidoptères, St. Pétersbourg **2**: 119–171, pls. 6–8, 15.

Christoph, H. 1887a. Diagnosen neuer Lepidopteren aus Tekke. – Stettiner Entomologische Zeitung **48** (4–6): 162–167.

Christoph, H. 1887b. Lepidoptera aus dem Achal-Tekke-Gebiete. Dritter Theil. – *In*: N. M. Romanoff (Réd.), Mémoires sur les Lépidoptères, St. Pétersbourg **3**: 50–125, pls. 3–5.

Christoph, H. 1889. Lepidoptera aus dem Achal-Tekke-Gebiete. Vierter Theil. – *In*: N. M. Romanoff (Réd.), Mémoires sur les Lépidoptères, St. Pétersbourg **5**: 1–58, pls. 1–3.

Clarke, J. F. G. 1969. Family Gelechiidae (A–G). Pp. 221–537, pls. 109–267. – *In*: Clarke, J. F. G. Catalogue of the Type Specimens of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick **VI.** Glyphipterigidae Gelechiidae (A–G). – Trustees of the British Museum (Natural History), London.

Emelyanov, I. M. & V. I. Piskunov 1982. New data of the fauna of the gelechiid and anarsiid moths (Lepidoptera: Gelechiidae, Anarsiidae) of Mongolia, the USSR and North China. – Nasekomye Mongolii **8**: 366–407. – Leningrad, Nauka (in Russian).

Gerasimov, A. M. 1930. Zur Lepidopteren-Fauna Mittel-Asiens. I. Microheterocera aus dem District Kaschka-Darja (SO-Buchara). – Yezhegodnik zoologicheskogo Muzeya Akademii Nauk SSSR **31** (1): 21–48.

Herrich-Schäffer, G. A. W. 1861. Neue Schmetterlinge aus Europa und den angrenzenden Ländern **3**: 25–32, 8 pls. Regensburg.

Huemer, P., Karsholt, O. & W. Sauter 1996. The genus *Epiparasia* Rebel, 1914 in Spain (Lepidoptera: Gelechiidae). – SHILAP Revista de lepidopterología **24** (96): 341–345.

ICZN (International Commission on Zoological Nomenclature) 1999. International Code of Zoological Nomenclature. Fourth Edition. – International Trust for Zoological Nomeclature, London. – xxix + 306 p.

Karsholt, O. & P. Huemer 1995. Additions and corrections to the Gelechiidae fauna of Italy (Lepidoptera). – Bollettino di Zoologia agraria e di Bachicoltura Ser. II, **27** (1): 1–17.

Karsholt, O. & T. Riedl 1996. Gelechiidae. Pp. 103–122. – *In*: O. Karsholt & J. Razowski (eds.), The Lepidoptera of Europe. – Apollo Books, Stenstrup.

Kostjuk, I. Yu., Budashkin, Yu. I. & M. I. Golovushkin 1994. Cheshuekrylye zapovednika "Dahursky" (Annotirovannyi spisok vidov) – Institute of Zoology, Kiev. – 36 pp. (in Russian).

Lvovsky, A. L. & V. I. Piskunov 1989. The gelechiid moths (Lepidoptera: Gelechiidae) of the Transaltai Gobi. – Nasekomye Mongolii, Leningrad, Nauka **10**: 521–571 (in Russian).

Meyrick, E. 1891. A fortnight in Algeria, with description of new Lepidoptera. – Entomologist's Monthly Magazine **27**: 9–13, 55–62.

Meyrick, E. 1926. Exotic Microlepidoptera **3** (9): 257–288.

Piskunov, V. I. 1988. Results of the study of the type specimens of Gelechiid Moths (Lepidoptera: Gelechiidae) in the collections of Zoological Museum of the Moscow State University and Zoological Institute of the Academy of the Sciences of the USSR. – Entomologicheskoe obozrenie **67** (2): 360–368. (in Russian).

Piskunov, V. I. 1990. A new species and two new synonyms of the palaearctic Gelechiid-Moths (Lepidoptera, Gelechiidae). – In: Novosti faunistiki i sistematiki: 95–97. – Naukova dumka, Kiev (in Russian).

Ponomarenko, M. G. 2000. New species and new synonym of the genus *Metanarsia* Staudinger (Lepidoptera, Gelechiidae). – Tinea **16** (4): 222–225.

Rebel, H. 1914. Über eine Mikrolepidopterenausbeute aus dem westlichen Thian-Schan-Gebiet. – Deutsche Entomologische Zeitschrift Iris **28**: 271–278.

Staudinger, O. 1871. Beschreibung neuer Lepidopteren des europäischen Faunengebiets. – Berliner Entomologische Zeitschrift **14**: 273–336.

Gerhard M. Tarmann 2004. Zygaenid moths of Australia. A revision of the Australian Zygaenidae (Procridinae: Artonini). With colour paintings by František Gregor. – Monographs on Australian Lepidoptera **9**. – CSIRO Publishing, Collingwood (Australia). 248 pp. – Hardcover (ISBN: 0 643 06798 1) AU$ 180.00.

All Australian zygaenids belong to the subfamily Procridinae. Up until now, very little information was available on them, apart from old-style species descriptions. In a new volume of the Monographs on Australian Lepidoptera, Gerhard Tarmann (Innsbruck) provides a comprehensive revision of the Australian Forester moths, a group of 10 genera and 43 species. Nearly half of the taxa treated in the book, i.e. four genera and 21 species, are new to science, and information is provided for the first time on the life history of five genera.

The introductory chapters provide details on zygaenid morphology, life history (including phenology, larval host plants, cyanogenesis, defensive biology, pheromones, etc.), phylogeny, and historical biogeography. A cladistic analysis is given for the Australian genera of Artonini, with three extralimital genera of Procridini as outgroup. The characters and character states are described in detail, and the character-matrix and statistics for all trees are listed. However, no statistic values are given in the cladogram to show how much support exists at each node.

The second part of the book provides keys to all genera and species of Australian Procridinae. Each species is described in detail, with illustrations of male and female adults and genitalia, a diagnosis, and information on life history when available. A distribution map and a list of synonyms are also given for each taxon.

The illustrations are numerous and well prepared. Outstanding are the 114 finely detailed colour paintings of the moths shown larger than life size by the acclaimed artist František Gregor (Brno). The additional 448 figures include photographs of the genitalia of both sexes (so far as known) and of other diagnostic structures, scanning electron micrographs, and seven pages of colour photographs illustrating live preimaginal stages and adults as well as larval host plants and habitats.

A checklist of the taxa, a list of localities, and an index to scientific names make the book easy to use.

The book provides comprehensive and new information on Australian Zygaenidae and can be recommended to anybody who is interested in this fauna or in zygaenids in general, independently whether the interest is in systematics, life history, or conservation. Because of its comprehensive introduction to Zygaenidae, the book enables any biologist to find her/ his way into this group; therefore, it can be recommended also to researchers who are studying basic or applied topics on zygaenids.

FRANCESCA VEGLIANTE & MATTHIAS NUSS

Syrianarpia faunieralis sp. n. from the Cottian Alps of Italy (Crambidae: Scopariinae)

MAURO GIANTI

Via Divisione Alpina Cuneense 17, I-12023 Caraglio (CN), Italy;
e-mail: maurogianti@yahoo.com, mgianti@libero.it

Summary. In this paper a new species belonging to the genus *Syrianarpia* Leraut, 1982 is described. At the present state of our knowledge, three species are included in the genus *Syrianarpia*: *S. mendicalis* (Staudinger, 1879) from Iran, Turkey and Ukraine, *S. kasyi* Leraut, 1984 from Iran, and *S. faunieralis* sp. n. from the Cottian Alps (Italy).

Résumé. Le travail présente la description d'une nouvelle espèce du genre *Syrianarpia* Leraut, 1982. A l'état actuel de nos connaissances trois espèces appartiennent au genre *Syrianarpia*: *S. mendicalis* (Staudinger, 1879) de l'Iran, de la Turquie et de l'Ukraine, S. *kasyi* Leraut, 1984 de l'Iran, et *S. faunieralis* sp. n. des Alpes Cottiennes en Italie.

Key words. *Syrianarpia faunieralis* sp. n., Alps, Italy, Pyraloidea, Crambidae, Scopariinae.

Introduction

The description of the genus *Syrianarpia* by Leraut is quite recent (1982), the type species being *S. osthelderi* Leraut, 1982. Nuss (1999) established the synonymy between *S. osthelderi* and *S. mendicalis* (Staudinger, 1879) (*Metasia*). The main feature that characterises the genus in genitalia is the presence on the vesica of one cornutus, straight in shape and basally slightly enlarged, and the absence of protruding appendices on the inner side of the valva. On the underside of the forewing, as in many other genera belonging to the family Crambidae, the retinaculum is provided with a "hamus" that helps locking the frenulum in place. Till now the genus was represented by two species: *S. kasyi* Leraut, 1984 from Iran and *S. mendicalis* (Staudinger, 1879) from Turkey, Iran, and also from Ukraine (Crimea) (Bidzilya & Budashkin 2004). A third species is here described from the Alps in Western Europe. The limited data available on this genus indicate that their representatives are chiefly mountain species; specimens of *S. mendicalis* verified by Nuss (1999) were collected at elevations between 900 and 1600 m above sea level, while specimens belonging to *S. kasyi* were collected at 2000 m (Derbend, 25 km North of Teheran). The two male specimens of the species described below were collected around 2500 meters on a mountain summit of the Cottian Alps.

Methods

All comparisons involving biometrical data of the other *Syrianarpia* species were based on existing literature. Microphotographs were obtained with a Reichert Stereostar zoom microscope equipped with an Olympus digital camera.

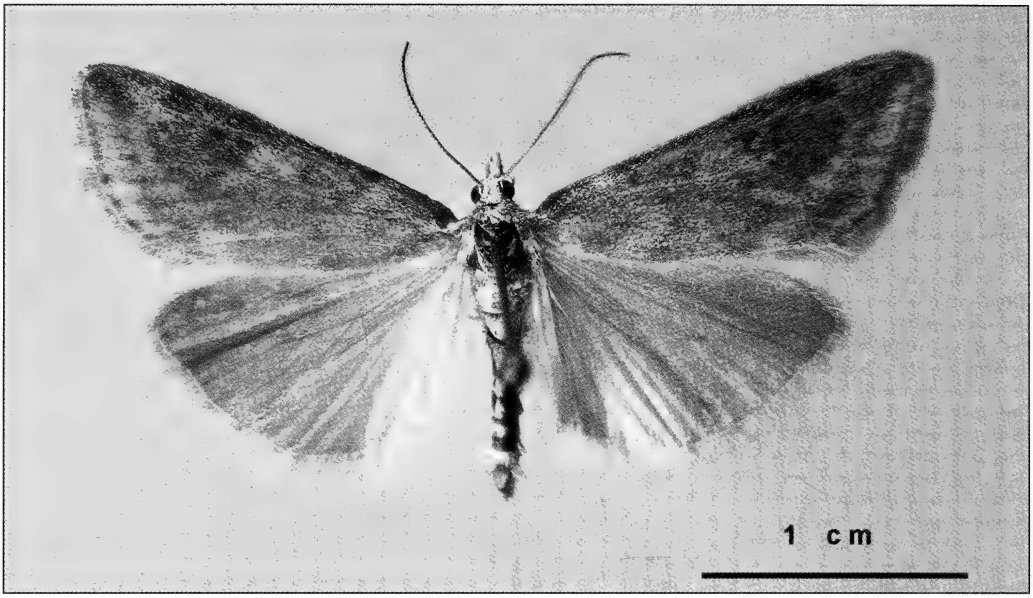


Fig. 1. *Syrianarpia faunieralis* **sp. n.** ♂ Paratypus.

Syrianarpia faunieralis sp. n.

Material. Holotype ♂, '[**Italy**], Piemonte, CN | Valle Grana | Cima Fauniera m. 2500, | 23.vii.2001, leg. M.Gianti', deposited at the Zoologische Staatssammlung München, Germany, prep. n. MG H 182. – Paratype ♂, '[**Italy**], Piemonte, CN | Valle Grana | Cima Fauniera m. 2500, | 19.vii.2001, leg. M. Gianti', coll. Gianti.

Description. A large species; forewing length 16 mm excluding fringe; fringe about 1 mm long; wingspan 31–33 mm. Forewing ground colour brownish-grey, paler in some areas forming faintly contrasted pattern; discoidal stigma well marked, especially distal one; postmedian and subterminal lines very distinct. Hindwing slightly paler, faintly scaled. Head frontal and occipital regions whitish to pale grey, upperside of palpi concolorous, underside brown (Figs. 3–4). Antennae approximately 8 mm long.

Male genitalia. Uncus progressively slender from base to distal end, apex blunt. Gnathos as long as uncus and sharply pointed. Juxta rather long (0.8 mm), regularly narrowing and rounded at apex. Valva rounded, median portion wider than basal and apical ones (see Fig. 2). Phallus about 1.5 mm long; ductus ejaculatorius inserting near middle; cornutus about 0.5 mm long.

Diagnosis. The forewings are pointed and their shape and pattern remind those of *S. mendicalis*, but *S. faunieralis* is larger than all other members of the genus (forewing length 16 mm versus 7–11 mm). In male genitalia the uncus is progressively decreasing in width toward apex, whilst in *S. mendicalis* it is slightly enlarged just before the tip, or nearly globulous. The valva is more rounded in *S. faunieralis*, especially the lower margin, while it is very straight in *S. mendicalis,* the costa in particular. The juxta is evenly tapering in *S. faunieralis*, whereas it has a conspicuous and long pointed tip in *S. mendicalis*. The insertion of the ductus ejaculatorius in the new taxon is located near the middle of the phallus, while it is closer to the anterior tip in *S. mendicalis*. The

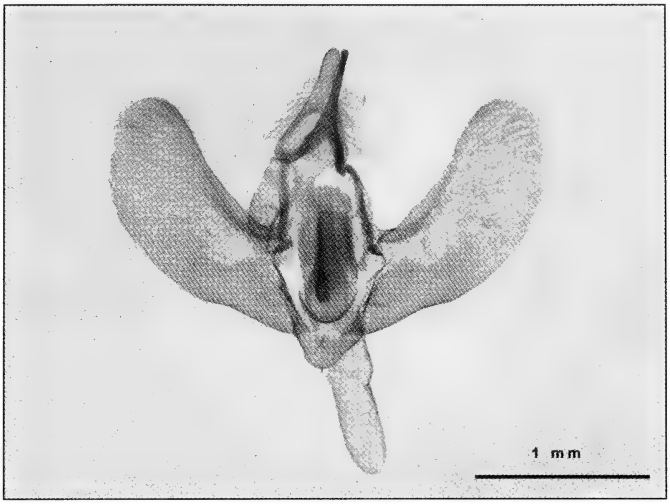


Fig. 2. *Syrianarpia faunieralis* **sp. n.** Holotypus, ♂ genitalia with phallus in situ (prep. MG H 182).

cornutus is approximately one third the length of the phallus in *S. faunieralis*, whilst in *S. mendicalis* it is about one fifth of that length. *S. kasyi* has genitalia roughly similar to those of the new species, but they are distinctly smaller, the juxta is more pointed at the tip, and both the wing pattern and shape are very different.

Derivatio nominis. From the type locality, Cima Fauniera, a mountain in the Grana Valley, Southern Cottian Alps, Piedmont, Italy.

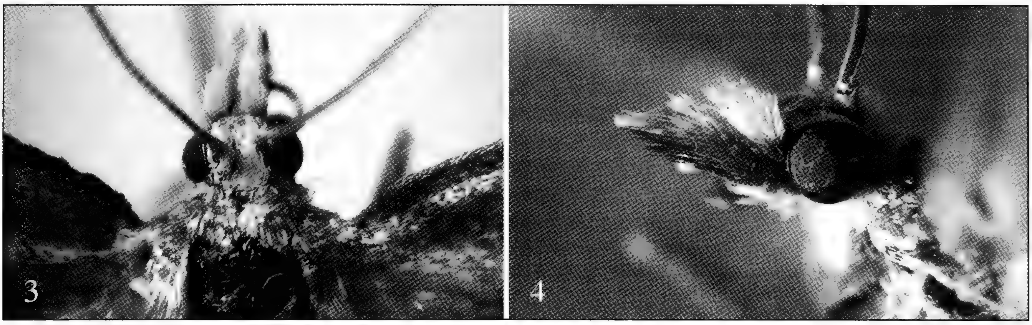
Distribution. Known only from the type locality. Very likely the species could be present in the French Cottian Alps.

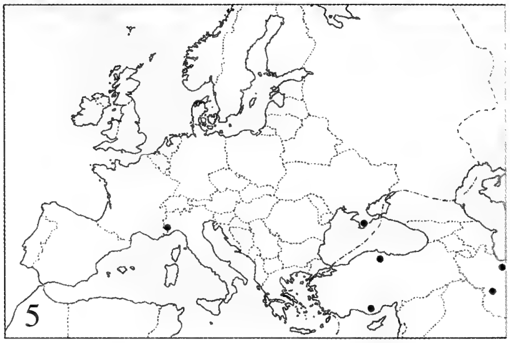
Discussion

The discovery of this new species from a relatively well-investigated geographical area is just another example of how mountain districts are worth studying. The finding is even more surprising due to the size of the new described insect, which can be placed amongst the largest European Scopariinae. Even with the limited present state of knowledge, we can reasonably suppose that *S. faunieralis* represents an endemic alpine species, possibly restricted to the southwestern Alps. Further investigations of the neighbouring mountainous districts will probably disclose the real distribution range of the species.

More than 220 species of Lepidoptera are today known to be endemic to the Alps (Huemer 1998) and a large percentage of them are exclusive to one sector, i.e. western, central, or eastern Alps. Almost all of these species are characteristic of alpine and subalpine elevations, whilst only very few endemics are typical of the collin or nival altitudinal zones.

So far, very little is known about *S. faunieralis*. No females were collected nor observed. The larval food, early stages, and life history are unknown. Little more is documented about the habitat. The locality is the same as that of the Italian colony of the geometrid moth *Glacies belzebuth* (Praviel, 1938), an alpine endemic (cf. Gianti 2002). The biotope is extremely fragmentary, i.e. greatly variable from place to place, even on short distances, and this makes it difficult to obtain information on the real ecological





Figs. 3–5. *Syrianarpia faunieralis* **sp. n.** ♂ Paratypus, head. **3.** Dorsal view. **4.** Lateral view.
5. Known distribution of the genus *Syrianarpia* Leraut, 1982.

requirements of the species. Moths appear to be uncommon. During several excursions in search of *G. belzebuth*, only two adults of *S. faunieralis* were observed. These were discovered flying in daylight near the ground, in small grass patches amongst emerging rocky substrate.

Acknowledgements

I wish to express my gratitude to Giorgio Baldizzone (Asti, Italy) for most helpful suggestions concerning the form of the paper, and to Matthias Nuss (Dresden, Germany) for critically reading the manuscript and for constructive analysis. In addition I am much grateful to Peter Huemer (Innsbruck, Austria) for literature provision and for kindly reading the manuscript. Bernard Landry read the final manuscript and improved the English language.

References

Bidzilya, O. V. & Yu. I. Budashkin, 2004. Novi znakhidky luskokrylykh (Lepidoptera) v Ukrayini [New records of Lepidoptera from Ukraine]. – Pratsi Zoologichnoho Muzeju Kyivs'koho Natsional'noho Universytetu imeni Tarasa Shtvchenka, Kyiv **2**: 59–68 (in Ukrainian).

Gianti, M. 2002. Remarks on the morphology and habitat of *Glacies belzebuth* (Praviel, 1938) – Nota lepidopterologica **24** (2001) (4): 59–68.

Huemer, P. 1998: Endemische Schmetterlinge der Alpen - ein Überblick (Lepidoptera). – Stapfia, Linz **55**: 229–256.

Leraut, P. 1982. Contribution à l'étude des Scopariinae. 2. Onze nouveaux taxa (dont deux nouveaux genres) de la zone ouest-paléarctique (Lep. Crambidae) – Alexanor, Paris, **12**, suppl. **6**: [1]–[18].

Leraut, P. 1984. Contribution à l'étude des Scopariinae. 4. Révision des types décrits de la région paléarctique occidentale, description de dix nouveaux taxa et ébauche d'une liste des espèces de cette région (Lep. Crambidae). – Alexanor, Paris, **13** (1983) (4): 157–192.

Nuss, M. 1999. Revision der Gattungen der Scopariinae – Nova Supplementa Entomologica **13**: 3–151.

Accelerated development of *Maculinea rebeli* larvae under artificial conditions (Lycaenidae)

ANDRÁS TARTALLY

University of Debrecen, Faculty of Sciences, Department of Evolutionary Zoology and Human Biology, Hungary, H-4010 Debrecen, P.O.B. 3; e-mail: tartally@delfin.unideb.hu

Abstract. In the years 2000 to 2003, 93 *Maculinea alcon* ([Denis & Schiffermüller], 1775) larvae from three localities in Hungary and 261 *M. rebeli* (Hirschke, 1904) larvae from three localities in Hungary and from one locality in Austria were introduced into 103 *Myrmica* colonies in the laboratory. Seven specimens of *M. rebeli* pupated after only about a month in artificial *Myrmica scabrinodis* Nylander, 1846, *My. sabuleti* Meinert, 1860 and *My. salina* Ruzsky, 1905 nests. This phenomenon was found in each of the four studied populations. Two pupae successfully eclosed, one 32 and the other 47 days after adoption. The other five pupae died. These results confirm observations that the developmental time of *M. rebeli* larvae can be plastic. A similarly accelerated development of *M. alcon* larvae was never observed. The accelerated development of *M. rebeli* larvae might be attributed to (1) the higher temperatures in the laboratory as compared with natural conditions, and/or to (2) the artificial *Myrmica* nests which were more exposed to light than under natural conditions, and/or to (3) the balanced artificial diet that the *Myrmica* colonies received.

Key words. *Maculinea, Myrmica,* myrmecophily, host ant, ant diet, accelerated development.

Introduction

Larvae of *Maculinea* van Eecke, 1915 are obligate parasites of *Myrmica* Latreille, 1804 (Hymenoptera: Formicidae) colonies for most of their life. It has long been known that the butterflies have an annual life cycle, with larvae living for about 10–11 months in *Myrmica* ant nests (Thomas 1995; Thomas & Elmes 1993, 2001; Thomas & Wardlaw 1992; Thomas et al. 1989, 1993; Wardlaw et al. 2000). More recently, it has been shown that some larvae live for an additional year in the ant nests, for a total of about 22–23 months (Als et al. 2001; Elmes et al. 2001; Schönrogge et al. 2000; Thomas et al. 1998). While rearing *Maculinea rebeli* (Hirschke, 1904) larvae in the laboratory, an unexpectedly accelerated development was observed, with pupation as soon as a month after adoption.

Although genetic (Als et al. 2004; Bereczki et al. in press) and morphological (Pech et al. 2004) differentiation between the traditionally separated species *M. alcon* ([Denis & Schiffermüller], 1775) and *M. rebeli* is rather low, the two taxa have different physiological and ecological adaptations (see e.g. Schönrogge et al. 2000; Thomas et al. 1989). I use *'M. rebeli'* for populations which develop on *Gentiana cruciata* and *'M. alcon'* for those which develop on *G. pneumonanthe*. However, the host plant affinities of these two taxa need to be re-investigated for their significance for identification purposes (see e.g. Kolev 2002; Munguira & Martin 1999; Sielezniew & Stankiewicz 2004).

Material and Methods

Between 2000 and 2003, 93 *Maculinea alcon* and 261 *M. rebeli* larvae were reared in 103 artificial laboratory colonies of *Myrmica*. For this purpose, plants of

G. pneumonanthe with eggs of *M. alcon* from three localities (Hungary: Fülesd, Gyöngyös, Mátraszentimre) and plants of *G. cruciata* with eggs of *M. rebeli* from four localities (Austria: Hochschwab; Hungary: Bükk-plateau, Bükkszentkereszt, Jósvafő) were collected. In the laboratory the gentians were kept in glasses of water placed in plastic basins, and could be kept fresh for 2–3 weeks while the *Maculinea* larvae emerged. Fourth instar larvae were collected using a fine brush as they dropped from the flowers in the evenings, and were transferred straight into the foraging arena of an artificial *Myrmica* nest to be adopted by the ants. Before introduction, the length of each caterpillar was measured with a ruler. Caterpillars were remeasured after one month by putting the ruler to the glass that covered the artificial nests.

The *Myrmica* colonies usually were collected from the same sites as the gentians. Each colony contained at minimum one queen and 100 workers. They were kept in Debrecen (Hungary) in unheated nests (made from clay and glass) joined by silicon tubes to plastic arenas. These nests were not covered to exclude the light, but were kept in places that never received direct sunlight. The laboratory was not air-conditioned in the summer, but was heated in the colder seasons. The temperature that the *Myrmica* nests experienced was less variable than under natural conditions, and was often up to 25° C in the warmer periods. A part of the nest area was always kept wet by a cotton wool strand that connected the clay with water. To feed the ants, the arenas of the nests were always provided with a cube of sugar, and various insects (mainly cut-up mealworms, larvae and pupae) as well as granules of a dry diet at a minimum of once a week (see appendix). The cube of sugar provided continuous food while the dry diet provided the proteins (and maybe essential vitamins and minerals) when there were not enough insects to feed the ant colonies.

The following *Myrmica* species (identified by Tartally & Csősz) were used: *My. lonae* Finzi, 1926 (1 culture); *My. vandeli* Bondroit, 1920 (1 c.); *My. rugulosa* Nylander, 1849 (1 c.); *My. salina* Ruzsky, 1905 (3 c.); *My. specioides* Bondroit, 1918 (3 c.); *My. gallienii* Bondroit, 1919 (7 c.); *My. schencki* Viereck, 1903 (8 c.); *My. ruginodis* Nylander, 1846 (8 c.); *My. rubra* (Linnaeus, 1758) (9 c.); *My. sabuleti* Meinert, 1860 (9 c.) and *My. scabrinodis* Nylander, 1846 (35 c.).

When a butterfly larva pupated, it was removed from the ants using a pair of fine forceps and placed in a plastic box with ventilation holes and a moist sponge pad at the bottom. This was thought to be important because the ants damage the eclosed butterflies if they are not able to escape from a closed artificial nest and if they are not discovered and separated in time (Elfferich 1988). Voucher samples of ants, dead pupae, exuviae, and butterflies are stored in the author's collection.

Results

Several larvae died during the period of adoption and the next few days. After this critical period their mortality was lower and the *M. rebeli* larvae usually grew very quickly. They were about 3 mm long on introduction, and usually they had grown to about 15 mm a month later. However, seven of them pupated after about a month in different ant nests. These were associated with three *Myrmica* species and came from

Tab. 1. The *Maculinea rebeli* larvae that pupated in about a month in the laboratory.

Locality	Host	Date of adoption	Date of pupation	Date of eclosion
Hungary / Bükk-plateau	*My. sabuleti*	27.07.2002	15.08.2002	28.08.2002
Hungary / Bükk-plateau	*My. scabrinodis*	27.07.2002	28.08.2002	died
Hungary / Bükkszentkereszt	*My. scabrinodis*	11.07.2002	13.08.2002	27.08.2002
Hungary / Bükkszentkereszt	*My. scabrinodis*	11.07.2002	13.08.2002	died
Hungary / Jósvafő	*My. salina*	11.07.2002	15.08.2002	died
Hungary / Jósvafő	*My. scabrinodis*	11.07.2002	10.08.2002	died
Austria / Hochschwab	*My. sabuleti*	14.07.2003	16.08.2003	died

each of the four *M. rebeli* populations studied (Tab. 1). Such a quick development in *M. alcon* larvae was never observed in my experiments during the first months. The *M. alcon* larvae also were about 3 mm long on introduction, but they had grown only to ca. 5 mm a month later and remained about this size in the winter. Two male butterflies from the seven pupae emerged. One of them eclosed 32, the other 47 days after adoption as freshly moulted fourth instar larvae (Tab. 1). These specimens were smaller than average (the forewing length of the one from Bükkszentkereszt was 15 mm and the one from Bükk-plateau 15.5 mm), but similarly small specimens often occur under natural conditions. The fast-developing specimens did not show any other obvious differences compared with field-grown specimens. The other five pupae became rotten or dried out under the unnatural air humidity of the laboratory.

Discussion

The fast-pupating larvae were reared by three different species of *Myrmica*: *My. scabrinodis*, *My. sabuleti*, and *My. salina*. According to field observations, the former two are suitable host ants for *M. rebeli* in Hungary (Tartally & Csősz 2004) and *My. sabuleti* is also suitable in Eastern-Austria (Steiner et al. 2003). However, there are no records of *My. salina* as a host of *M. rebeli* yet (Als et al. 2004; Tartally & Csősz 2004). It is important to note that in well-fed laboratory nests the survival of adopted larvae is usually better than in nature (Elmes et al. 2004; Schönrogge et al. 2004).

The fast development of *M. rebeli* under laboratory conditions might be caused by (1) the warmer temperatures in comparison to natural conditions (Wardlaw 1991; Wardlaw et al. 1998), and/or (2) the artificial *Myrmica* nests being more exposed to light than under natural conditions (the more abundant light could influence the larval development of lycaenid butterflies; see e.g. Høegh-Guldberg 1968), and/or (3) the more balanced diet the *Myrmica* colonies received – thus, my diet seems to be suitable for *Myrmica* colonies as supplementary food.

Elmes & Thomas (pers. comm.) recorded similarly short times of development for *M. rebeli* from the Pyrenees and the Southern Alps under unnaturally warm conditions and with abundant food. Hence, an accelerated development is known from several populations and is not a unique phenomenon. These results support the plasticity of the developmental time of *M. rebeli* as the larvae develop during one or two years in nature (Elmes et al. 2001; Schönrogge et al. 2000; Thomas et al. 1998) or have a conspicuous accelerated development within one year under favourable conditions. In addition, based on my own observations, there is no indication of a two-year development of *M. rebeli* in Hungary since I have never found semi-developed *M. rebeli* larvae in *Myrmica* nests during the flying period. On the other hand, some semi-developed *M. alcon* larvae were observed in various Hungarian sites during the flying period. According to Varga (pers. comm.), 'dwarf' adults of *M. rebeli* regularly appear in several Hungarian populations at the end of the flying period (end of June to mid-July, depending on year and elevation). However, in the laboratory, the two dwarf specimens eclosed in late August. This suggests that undernourished *M. rebeli* larvae may also fully develop within one year under natural conditions and a partly bivoltine life cycle in nature seems to be unlikely. It is known that the growth of the one-year *M. rebeli* larvae tend to be fast immediately after adoption, stops during winter (meaning that they go into diapause in nature), and resumes in the spring just before pupation (Thomas et al. 1998). However, according to my laboratory observations the development of *M. rebeli* larvae can be continuous (without diapause) under favourable conditions, contrary to that of *M. alcon*. These differences were also observed when I reared *M. alcon* and *M. rebeli* larvae under the same laboratory conditions but in *Manica rubida* (Latreille, 1802) colonies (Tartally 2004). Further studies are still necessary to investigate the temporal dynamics of the development within *M. rebeli* and *M. alcon* populations and to understand the ecological circumstances influencing these dynamics.

Acknowledgements

I would like to thank Dr. David R. Nash, Enikő Tóth, Dr. Graham W. Elmes, Dr. Jeremy A. Thomas, Péter Kozma, Sándor Csősz, Dr. Sándor Szabó, Dr. Zoltán S. Varga and the referees for their help and for their critical comments. I very much appreciate the careful editing of the manuscript. Research has been funded by the EC within the RTD project "MacMan" (EVK2-CT-2001-00126).

References

Als, T. D., D. R. Nash & J. J. Boomsma 2001. Adoption of parasitic *Maculinea alcon* caterpillars (Lepidoptera: Lycenidae) by three *Myrmica* ant species. – Animal Behaviour **62**: 99–106.

Als, T. D., R. Vila, N. P. Kandul, D. R. Nash, S.-H. Yen, Y.-F. Hsu, A. A. Mignault, J. J. Boomsma & N. E. Pierce 2004. The evolution of alternative parasitic life histories in Large Blue butterflies. – Nature **432**: 386–390.

Bereczki, J., K. Pecsenye, L. Peregovits & Z. Varga (in press). Pattern of genetic differentiation in the *Maculinea alcon* species group (Lepidoptera, Lycaenidae) in Central Europe. – Journal of Zoological Systematics and Evolutionary Research.

Bhatkar, A. P., & W. H. Whitcomb 1970. Artificial diet for rearing various species of ants. – Florida Entomologist **53**: 229–232.

Buschinger, A. & E. Pfeifer 1988. Effects of nutrition on brood production and slavery in ants (Hymenoptera, Formicidae). – Insectes Sociaux **35**: 61–69.

Elfferich, N.W. 1988. Zuchterfahrungen mit *Maculinea alcon* (Denis & Schiffermüller, 1775) (Lepidoptera, Lycaenidae). – Mitteilengen der Entomologischen Gesellschaft Basel **38**: 134–150.

Elmes, G. W., J. A. Thomas, M. L. Munguira & K. Fiedler 2001. Larvae of Lycaenid butterflies that parasitize ant colonies provide exceptions to normal insect growth rules. – Biological Journal of the Linnean Society **73**: 259–278.

Elmes, G. W., J. C. Wardlaw, K. Schönrogge & J. A. Thomas 2004. Food stress causes differential survival of socially parasitic larvae of *Maculinea rebeli* (Lepidoptera, Lycaenidae) integrated in colonies of host and non-host *Myrmica* species (Hymenoptera, Formicidae). – Entomologia Experimentalis et Applicata **110**: 53–63

Høegh-Guldberg, O. 1968. Evolutionary Trends in the Genus *Aricia* (Lep.). *Aricia* Studies No. 9. – Natura Jutlandica No. 14, Aarhus, Denmark, 77 pp.

Hölldobler, B. & E. O. Wilson 1990. The Ants. – Springer Verlag, Berlin, 732 pp.

Kolev, Z. 2002. The species of *Maculinea* van Eecke, 1915 in Bulgaria: distribution, state of knowledge and conservation status (Lycaenidae). – Nota lepidopterologica **25**: 177–190.

Munguira, M. L. & J. Martin (eds.) 1999. Action Plan for the *Maculinea* butterflies in Europe. – Nature and Environment, No 97. Council of Europe Publishing, Strasbourg. 64 pp.

Pech, P., Z. Fric, M. Konvička & J. Zravý 2004. Phylogeny of *Maculinea* blues (Lepidoptera: Lycaenidae) based on morphological and ecological characters: evolution of parasitic myrmecophily. – Cladistics **20**: 362–375.

Schönrogge, K., J. C. Wardlaw, J. A. Thomas & G. W. Elmes 2000. Polymorphic growth rates in myrmecophilous insects. – Proceedings of the Royal Society of London, Series B **267**: 771–777.

Schönrogge, K., J. C Wardlaw, A. J. Peters, S. Everett, J. A. Thomas & G. W. Elmes 2004. Changes in chemical signature and host specificity from larval retrieval to full social integration in the myrmecophilous butterfly *Maculinea rebeli*. – Journal of Chemical Ecology **30**: 91–107.

Sielezniew, M. & A. Stankiewicz 2004. *Gentiana cruciata* as an additional host plant of *Maculinea alcon* on a site in eastern Poland (Lycaenidae) – Nota lepidopterologica **27**: 91–93.

Steiner F., M. Sielezniew, B. C. Schlick-Steiner, H. Höttinger, A. Stankiewicz & A. Górnicki 2003. Host specificity revisited: New data on *Myrmica* host ants of the Lycaenid butterfly *Maculinea rebeli*. – Journal of Insect Conservation **7**: 1–6.

Tartally, A. 2004. Is *Manica rubida* (Hymenoptera: Formicidae) a potential host of the *Maculinea alcon* (Lepidoptera: Lycaenidae) group? – Myrmecologische Nachrichten **6**: 23–27.

Tartally, A. & S. Csősz 2004. Adatok a magyarországi *Maculinea* fajok (Lepidoptera: Lycaenidae) hangyagazdáiról. (Data on the ant hosts of the *Maculinea* butterflies (Lepidoptera: Lycaenidae) of Hungary.) – Természetvédelmi Közlemények **11:** 309–317.

Thomas, J. A. 1995. The ecology and conservation of *Maculinea arion* and other European species of large blue butterfly. **13**: 180–196. – *In*: Pullin, A. & H. Chapman (eds.), Ecology and conservation of butterflies. – Chapter, London

Thomas, J. A., & G. W. Elmes 1993. Specialized searching and the hostile use of allomones by a parasitoid whose host, the butterfly *Maculinea rebeli*, inhabits ant nests. – Animal Behavior **45**: 593–602.

Thomas, J. A., & G. W. Elmes 2001. Food-plant niche selection rather than the presence of ant nests explains oviposition patterns in the myrmecophilous butterfly genus *Maculinea*. – Proceedings of the Royal Society of London, Series B **268**: 471–477.

Thomas, J. A., G. W. Elmes & J. C. Wardlaw 1993. Contest competition among *Maculinea rebeli* butterfly larvae in ant nests. – Ecological Entomology **18**: 73–76.

Thomas, J. A., G. W. Elmes & J. C. Wardlaw 1998. Polymorphic growth in larvae of the butterfly *Maculinea rebeli*, a social parasite of *Myrmica* ant colonies. – Proceedings of the Royal Society of London, Series B **265**: 1895–1901.

Thomas, J. A., G. W. Elmes, J. C. Wardlaw & M. Woyciechowski 1989. Host specificity among *Maculinea* butterflies in *Myrmica* ant nests. – Oecologia **79**: 452–457.

Thomas, J. A. & J. C. Wardlaw 1992. The capacity of *Myrmica* ant nest to support a predacious species of *Maculinea* butterfly. – Oecologia **91**: 101–109.

Wardlaw, J. C. 1991. Techniques for rearing *Myrmica* ants (Hym.) and *Maculinea rebeli* Hir. caterpillars (Lep., Lycaenidae). – Entomologist's Monthly Magazine **127**: 233–241.

Wardlaw, J. C., G. W. Elmes & J. A. Thomas 1998. Techniques for studying *Maculinea* butterflies: I. Rearing *Maculinea* caterpillars with *Myrmica* ants in the laboratory. – Journal of Insect Conservation **2**: 79–84.

Wardlaw, J. C., J. A. Thomas & G. W. Elmes 2000. Do *Maculinea rebeli* caterpillars provide vestigial mutuality benefits to ants when living as social parasites inside *Myrmica* ant nests? – Entomologia Experimentalis et Applicata **95**: 97–103.

Appendix

The recipe of the dry diet

Ingredients. 100 cm^3 (=14–15 g) freeze-dried fish [1]
1 level tablespoon of flour
1 pinch of sea salt
1 vitamin pill [2]
1 egg

[1] You can buy it in well-equipped pet shops as food for cats and turtles (I used a Hungarian product: Bio-Lio). If you cannot find freeze-dried fish you can dry some lean pieces of cooked fish or chicken in the sun or under an infra-red lamp.

[2] Choose the type that contains the daily portion of multiple vitamins, essential minerals, and salts for an adult (I used Supradyn).

Preparation. Grind the fish into powder and mix it with the flour, the salt, and the pulverised pill. Beat the egg slightly and add a little to the dry components. You need to get a hard paste in order to be able to form a ball, then leave it to desiccate for about half an hour. When its consistency is suitable, grate it with a cheese grater onto a sheet of paper. You will get various sizes of granules. Spread the granules on the paper and leave them to dry for about a day. The dried granules keep their quality (= the ants like them) for about half a year at room temperature in a dark and ventilated place.

I have planned this diet to culture *Myrmica* colonies because it is essential for the *Myrmica* colonies to be fed with protein and sugar (Wardlaw et al. 1998). However, the Bhatkar diet (Bhatkar & Whitcomb 1970) – which is presumably the most popular artificial ant diet (see e.g. Hölldobler & Wilson 1990) – contains very little protein (Buschinger & Pfeifer 1988).

Prominent shoots are preferred: microhabitat preferences of *Maculinea alcon* ([Denis & Schiffermüller], 1775) in Northern Germany (Lycaenidae)

Annabell Küer[1] & Thomas Fartmann[2]

[1] Steinfurter Str. 502, D-48159 Münster, email: annabell.kueer@web.de
[2] Institute of Landscape Ecology, Department of Community Ecology, University of Münster, Robert-Koch-Straße 26, D-48149 Münster, email: fartmann@uni-muenster.de (corresponding author)

Abstract. The egg deposition behaviour of the Alcon Blue, *Maculinea alcon* ([Denis & Schiffermüller], 1775), was investigated in summer 2002 on a military training area near Osnabrück (North Rhine-Westphalia, Northern Germany). The study aims to analyse oviposition patterns on the flowers of the host plant *Gentiana pneumonanthe* (Marsh Gentian) and microhabitat characteristics of the chosen shoots. All possible host plants and all eggshells of *M. alcon* were counted and various characteristics of the host plant as well as the surrounding vegetation structure were recorded. A total of 1,787 eggs was counted on 124 out of 219 *Gentiana* shoots in an area of 3,200 m^2. About 70% were laid on the calyx and 25% on the flower. The vegetation (*Juncus-Succisa pratensis* association with patches of *Ericion tetralicis*) was generally dense and rather high. Occupied specimens had almost always a luxuriant growth and were mostly higher than the surrounding vegetation. In a logistic regression model the height-difference between the plant and the vegetation (prominence), the number of flowers per shoot, and the number of further shoots in the surrounding explained 78% of observed plant occupancy patterns. Finally suggestions to maintain and stabilize Alcon Blue populations are given.

Zusammenfassung. Das Eiablageverhalten des Lungenenzian-Ameisenbläulings, *Maculinea alcon* ([Denis & Schiffermüller], 1775), wurde im Sommer 2002 auf einem Truppenübungsplatz in der Nähe von Osnabrück (Nordrhein-Westfalen, Norddeutschland) untersucht. Ziel der Arbeit war es, Eiablagemuster an den Blüten der Wirtspflanze *Gentiana pneumonanthe* (Lungenenzian) sowie Mikrohabitatpräferenzen bei der Belegung zu studieren. Dazu wurden alle Lungenenziansprosse und die Eier von *M. alcon* gezählt. Verschiedene Parameter der Wirtspflanzen sowie die Vegetationsstruktur im Umkreis von 50 cm wurden aufgenommen. Von insgesamt 219 Sprossen auf einer Fläche von 3.200 m^2 waren 125 mit 1.787 Eiern belegt. Etwa 70% davon wurden an den Kelch geheftet und 25% an die Blüte. Die Vegetation (*Juncus-Succisa pratensis*-Assoziation mit einzelnen *Ericion tetralicis*-Flecken) war meist sehr dicht und relativ hoch. Belegte Lungenenzian-Exemplare waren in der Regel üppig und überragten größtenteils die umgebende Vegetation. Ein Modell der logistischen Regression zeigt, dass mit Hilfe der Höhendifferenz zwischen Spross und Vegetation, der Zahl der Blüten und der Anzahl der umgebenden Lungenenzian-Sprosse 78% der Daten korrekt vorhergesagt werden. Abschließend werden Vorschläge zum Erhalt und zur Stabilisierung von Populationen des Lungenenzian-Ameisenbläulings gemacht.

Key words. Alcon Blue, egg deposition, *Gentiana pneumonanthe*, *Maculinea alcon*, Marsh Gentian, management, microhabitat preferences, Germany.

Introduction

Habitat quality has been shown to be as important for the persistence of butterfly metapopulations as the degree of patch isolation and patch size (Anthes et al. 2003; Dennis & Eales 1997; Thomas et al. 2001). Thomas et al. (2001) and WallisDeVries (2004) pointed out that the criteria are not alternatives but should be considered complementarily. While many studies have recently addressed the effect of patch size and isolation on population dynamics for various butterflies, habitat quality is still comparably ill-defined for many endangered species. Habitat preferences of butterflies are often largely determined by the requirements of the preimaginal stages since the eggs are not and the larvae are only slightly mobile (Fartmann 2004; Porter 1992). In case of adverse weather or restricted food supply they are not able to escape. Therefore, the evaluation of habitat quality for a particular species requires a detailed knowledge of the preferences of ovipositing females and the survival of preimaginal stages under various conditions and across regions.

Here we studied the larval habitat preference of the Alcon Blue (*Maculinea alcon* ([Denis & Schiffermüller], 1775)). Although the butterfly genus *Maculinea* van Eecke, 1915 has attracted considerable attention because of its extraordinary relationship with ants of the genus *Myrmica* Latreille, 1804 (Munguira & Martin 1999; Als et al. 2004), recent descriptions of larval habitat requirements are scarce. The status of the Alcon Blue has been assessed as vulnerable in Europe (van Swaay & Warren 1999) and as endangered in Germany (Pretscher 1998); in North Rhine-Westphalia the species is critically endangered (Dudler et al. 1999). In many parts of Germany it is extinct (Fig. 1). Whereas quite a lot of research has addressed the relationship between *M. alcon* larvae and their host ants (e.g. Als et al. 2001; Elfferich 1988; Elmes et al. 1994; Liebig 1989; van Dyck et al. 2000), the relationship between *M. alcon* and its host plant *Gentiana pneumonanthe* (Marsh Gentian) is much less studied. Krismann (2000) studied oviposition patterns on the host plant and found a preference for egg-laying on the calyx. WallisDeVries (2004) compared habitat characteristics of occupied and unoccupied sites at a mesoscale of 10 × 10 m. The preferred vegetation structure for egg deposition is mostly known for the sibling species *Maculinea rebeli* (Hirschke, 1904) (Dolek et al. 1998; Kockelke et al. 1994; Meyer-Hozak 2000) but not for *M. alcon*, yet Marktanner (1985) observed that it avoids dense and overshadowed vegetation. The status of both forms as distinct species is strongly questioned by the recent genetical data (Als et al. 2004).

This study aims to increase our knowledge of the microhabitat structure at *M. alcon* oviposition sites. In particular we considered the following questions:

(i) What are the oviposition patterns on the Marsh Gentian?

(ii) Which kind of vegetation structure does the Alcon Blue prefer for egg deposition?

(iii) Which conclusions can be drawn for the management of the Alcon Blue sites?

Material and Methods

Study species. *Maculinea alcon* ([Denis & Schiffermüller], 1775) has a scattered distribution across Europe up to East Asia (Wynhoff 1998). In Germany the Alcon Blue is mainly found on the foothills of the Alps and in the Northwestern Lowlands (Fig. 1). Its flight period in Germany extends from early July to mid-August (Ebert & Rennwald 1991; Wynhoff et al. 1999). *M. alcon* thrives on moist meadows, wet heathland and fens with stands of its host plant, the Marsh Gentian (*Gentiana pneumonanthe*). In the Alps the Willow Gentian (*G. asclepiadea*) is used as well. The Alcon Blue has a complex life cycle and is dependent not only on the presence of its host plant but also on the presence of host ants of the genus *Myrmica*. In Southern Europe and the pre-alpine region of Germany (Nunner pers. comm.) only *M. scabrinodis* Nylander, 1846 serves as a host. In Middle and Northern Europe it is fully replaced by *M. rubra* (Linnaeus, 1758) and *M. ruginodis* Nylander, 1846 (Elmes et al. 1998). Females of *M. alcon* lay their eggs on the buds of *G. pneumonanthe*. Through basal hatching the larvae get into the flower and feed there until the fourth larval stage. After emerging from the flower head they let themselves drop on the ground and wait to be carried into

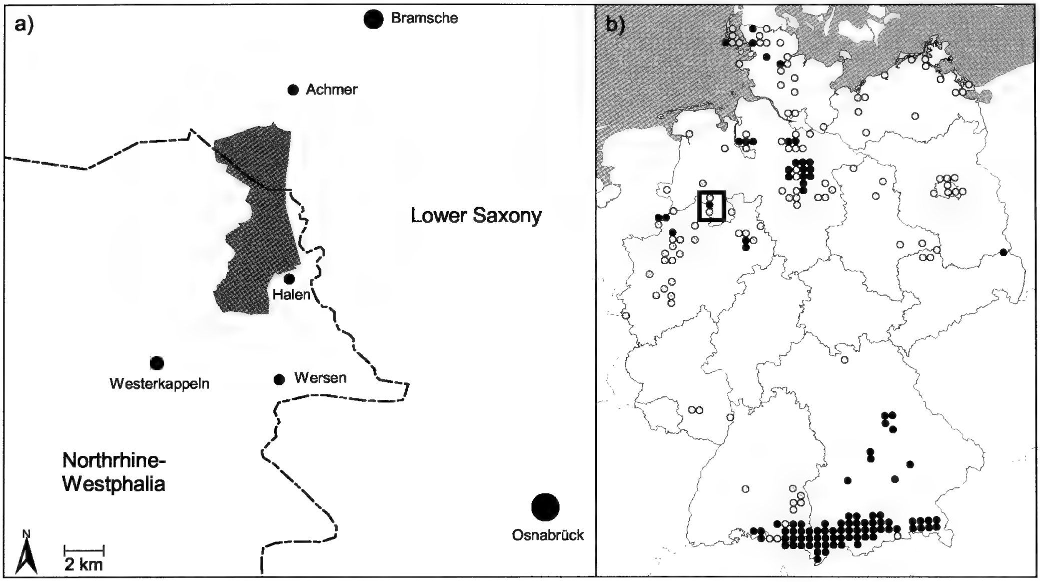


Fig. 1. Study area in Northern Germany (a) and distribution of *Maculinea alcon* in Germany (b). Grid: 10' × 6' geographic grid. Grey dots: data before 1985, black dots: data since 1985, data from: BLfU (2001), de Lattin (1957), Ebert & Rennwald (1991), Habel (2003), Harkort (1975), Kinkler & Schmitz (1971), Kolligs (2003), natural history museum Muenster (own observation), Retzlaff (1973), Retzlaff et al. (1993), Stamm (1981), Wagener & Niemeyer (2003) and M. Goldschalt, H. G. Joger, A. Krismann, A. Nunner, T. Marktanner, R. Reinhardt, T. Schulte (in each case pers. comm.).

a nest of their host ant where they live 10 to 22 months until pupation (Schönrogge et al. 2000; Thomas et al. 1998).

G. pneumonanthe (Gentianaceae) is distributed throughout Europe and Asia and has its core range in Western Europe (Korneck et al. 1998). The perennial plant flowers between July and September on oligotrophic humid sites such as litter meadows ('Streuwiesen') and moist to wet heathland (Oberdorfer 2001; Sebald et al. 1996). The light-requiring *G. pneumonanthe* grows up to 50 cm high with up to 10 shoots and up to 25 flowers per shoot (Ellenberg 1996; Rose et al. 1998). The reproduction only takes place by the means of its small seeds, which are adapted to short distance wind dispersal (Oostermeijer et al. 1998). For successful germination the seeds require moist and bare soil (Kesel & Urban 1999).

In Central Europe and in Germany *G. pneumonanthe* is declining. This is due to an intensified agricultural use on one hand. On the other hand the abandonment of smaller unprofitable habitats supports the succession on these sites. Both factors endanger the survival of the Marsh Gentian.

Study area. The study area is located in the district Steinfurt in the north of North Rhine-Westphalia adjacent to Lower Saxony (Fig. 1). The study site is part of a military training area. The vegetation is dominated by wet grasslands (*Molinietalia*) with some patches of *Agrostietalia* and *Nardo-Callunetea*. *Gentiana pneumonanthe* was growing within two sites (7,500 m^2 and 15,000 m^2) of the study area, but only on the bigger site *Maculinea alcon* was present in 2002. This place was surrounded by wood and consisted of the dominating *Juncus-Succisa pratensis* association with patches of *Ericion tetralicis*. Within this site the host plant grew on an area of about 3,200 m^2.

Tab. 1. Habitat structure parameters at occupied (n = 124) and unoccupied (n = 95) *Gentiana pneumonanthe* shoots (Mann-Whitney *U* Test: *** P <0.001, * P <0.05). *n G. pneumonanthe*: number of other shoots near the observed specimen; prominence: gentian shoot height minus average vegetation height.

Parameter	Minimum – Maximum		Median		U	P
	occupied	unoccupied	occupied	unoccupied		
Flowers per shoot	1–14	1–10	4	2	2847	***
Shoot height [cm]	22–60	22–51	39	35	3784	***
Average vegetation height [cm]	25–55	25–55	45	50	3397	***
Prominence [cm]	-29–20	-30–6	-3.4	-15	2030	***
n *Gentiana pneumonanthe*	0–13	0–11	5	4	4981	*
Horizontal herbaceous cover [%] in 30 cm	0–95	2.5–95	10	50	3751	***

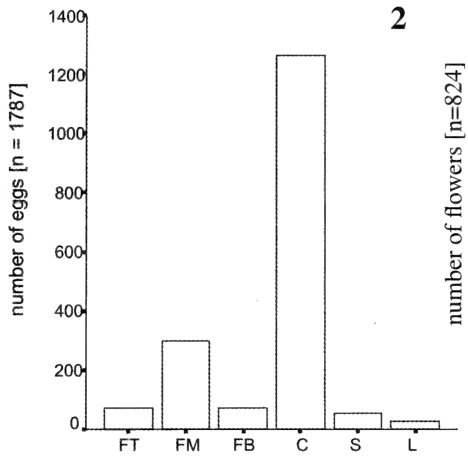
Field Study. In summer 2002 after the flight period of *Maculinea alcon* all shoots of *Gentiana pneumonanthe* were checked for eggs. For each gentian shoot we determined total height, the number of flowers and the height of each flower. The eggshells were counted bud-wise distinguishing between top, middle and base of flower, calyx, leave and stalk. For microhabitat analysis the following parameters were collected within a radius of 50 cm around the shoot: distance to the next shoot, number of other shoots, the maximum and average vegetation height, the vegetation cover and horizontal vegetation cover in 10 to 45 cm height above soil surface (estimated in 5%-steps). A grid of 10 × 10 m was put on the study site to determine these parameters also on a bigger scale. For data analysis we calculated the difference of the shoot height and average vegetation height to show the 'prominence' of the host plant. Negative values express a negative prominence, which means the shoot is smaller than the surrounding vegetation. Positive values show accordingly a positive prominence of the gentian shoot.

Data Analysis. Literature data showed that a single *Maculinea alcon* female lays on the average 50–100 eggs (Maes et al. 2004). Meyer-Hozak (2000) found out that the sibling species *Maculinea rebeli* lays 100–150 eggs per female. The primary sex ratio in a population is 1 : 1 (for *M. rebeli*: Kockelke et al. 1994; Meyer-Hozak 2000). We therefore used the total egg count from this study to estimate the adult population size in 2002.

To assess the explanatory power of different variables on the occupancy of gentian shoots we used a stepwise-forward logistic regression. All statistical analysis was performed with SPSS 11.0.1 statistical analysis package.

Results

We found a total of 219 Marsh Gentian shoots with 824 flowers. Of those, 124 shoots (57%) and 473 flowers (57%) were occupied with 1,787 eggs. Based on the total egg count the adult population size was estimated at 18–36 individuals. The preferred place of oviposition was the calyx in 70% of the cases, followed by the flower with 25%. The stem and the leaves played a minor role in egg deposition (Fig. 2). The height distribution of the eggs and the flowers were quite similar. About 2/3 of both flowers and eggs were found at 26 to 40 cm above ground (Fig. 3).



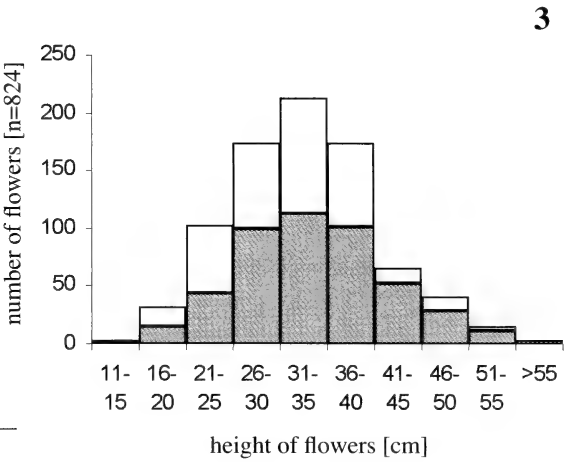


Fig. 2. Oviposition places on *Gentiana pneumonanthe* (FT = flower top, FM = flower middle, FB = flower base, C = calyx, S = stalk, L = leave).
Fig. 3. Height of occupied (grey) and unoccupied (white) flowers of *Gentiana pneumonanthe*.

The vegetation at the egg-deposition places was relatively high and dense. Maximum vegetation height ranged from 80 to 100 cm. Vegetation cover was mostly 100%, only in some cases it was with 80–95% slightly less dense. The Marsh Gentians were scattered over the whole site but had a clustered occurrence in some places especially along old tank tracks. Most part of the study site was dominated by the Purple Moor Grass (*Molinia caerulea*) and was characterized by a vivid change of hummocks and hollows. Only some gentian shoots were found on a drier and more even area, which was dominated by the Tufted Hair-grass (*Deschampsia cespitosa*).

Occupied gentians were generally higher and had more flowers than unoccupied specimen. High average vegetation height and low horizontal vegetation cover decreased the likelihood of a host plant to be accepted for oviposition (Tab. 1). Most occupied stalks were higher or only little lower than the average vegetation (Fig. 4). The more prominent a shoot the more eggs it received (Fig. 5).

The distribution of occupied and unoccupied Marsh Gentian shoots was best explained by the combination of height difference (prominence), number of flowers per stalk and number of other Marsh Gentian shoots in the proximity. The logistic regression model classified 78% of the data correctly by means of these three parameters (Tab. 2).

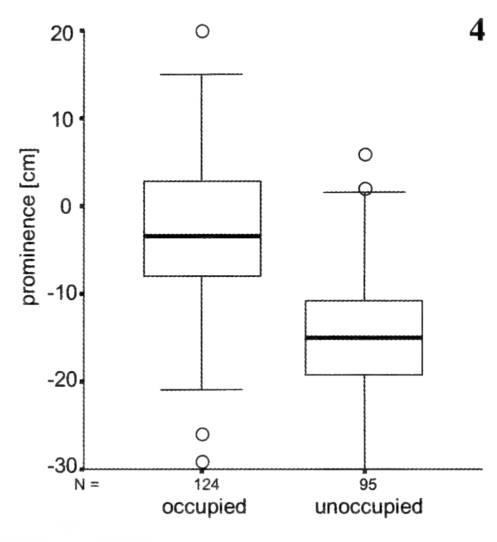
The hatched grids in Fig. 6 show the average height difference. The more prominent the gentian shoots were the more likely they were to be chosen for oviposition.

Discussion

Microclimatic aspects play an important role in butterfly oviposition (Fartmann 2004; Porter 1992; Thomas et al. 1998). As all gentians grew in sunny areas they were theoretically equally available for egg deposition. However, only about half of the shoots were occupied with eggs. Not only the size of the plant and the number of flowers,

Tab. 2. Stepwise-forward logistic regression model on the influence of habitat structure parameters on the egg deposition preference of *Maculinea alcon* (host plant shoots n = 219). n.s. = not significant; n *Gentiana pneumonanthe*: number of other shoots near the observed specimen; prominence: gentian shoot height minus average vegetation height.

Parameter	Coefficient B	SD	P	R	Model improvement Chi²
Constant	-0.027	0.497	n.s.	·	.
Prominence [cm]	0.143	0.025	<0.001	0.326	76.49
Flowers per shoot	0.263	0.089	<0.005	0.150	10.83
n *Gentiana pneumonanthe*	0.139	0.052	<0.05	0.132	7.78
Shoot height [cm]	0.657	-	n.s.	0.000	.
Average vegetation height [cm]	0.657	-	n.s.	0.000	.
Horizontal herb cover [%]	0.159	-	n.s.	0.000	.
Model summary	$Chi^2 = 95.1$, df = 3, P <0.001				
Correctly classified	78.1%				



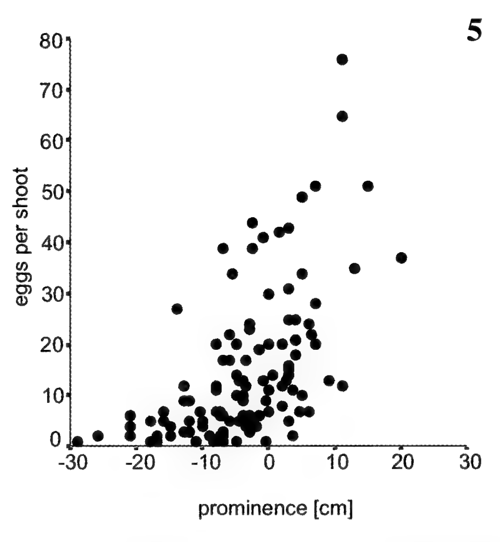


Fig. 4. Difference of hostplant height and average vegetation height (prominence) of occupied and unoccupied *Gentiana pneumonanthe* shoots (Mann-Whitney *U* Test: U = 2030, P <0.001). Compare Tab. 1 for statistics.

Fig. 5. Number of eggs per *Gentiana pneumonanthe* shoot in relation to the prominence (host plant shoots n = 124). $r_s = 0.622$, n = 124, P <0.01. Prominence: gentian shoot height minus average vegetation height.

but especially the shoot height relative to the height of the surrounding vegetation are important. Results of the logistic regression model show that the preferred oviposition places are shoots with many flowers that protrude the vegetation and are surrounded by other *Gentiana* shoots.

It is a common phenomenon that females choose large and conspicuous host plant individuals (Porter 1992). *Maculinea rebeli* prefers luxuriant specimens of its host plant *Gentiana cruciata* that are easy to reach (Dolek et al. 1998; Meyer-Hozak 2000). First, visual attraction is an important factor when searching for a suitable host plant

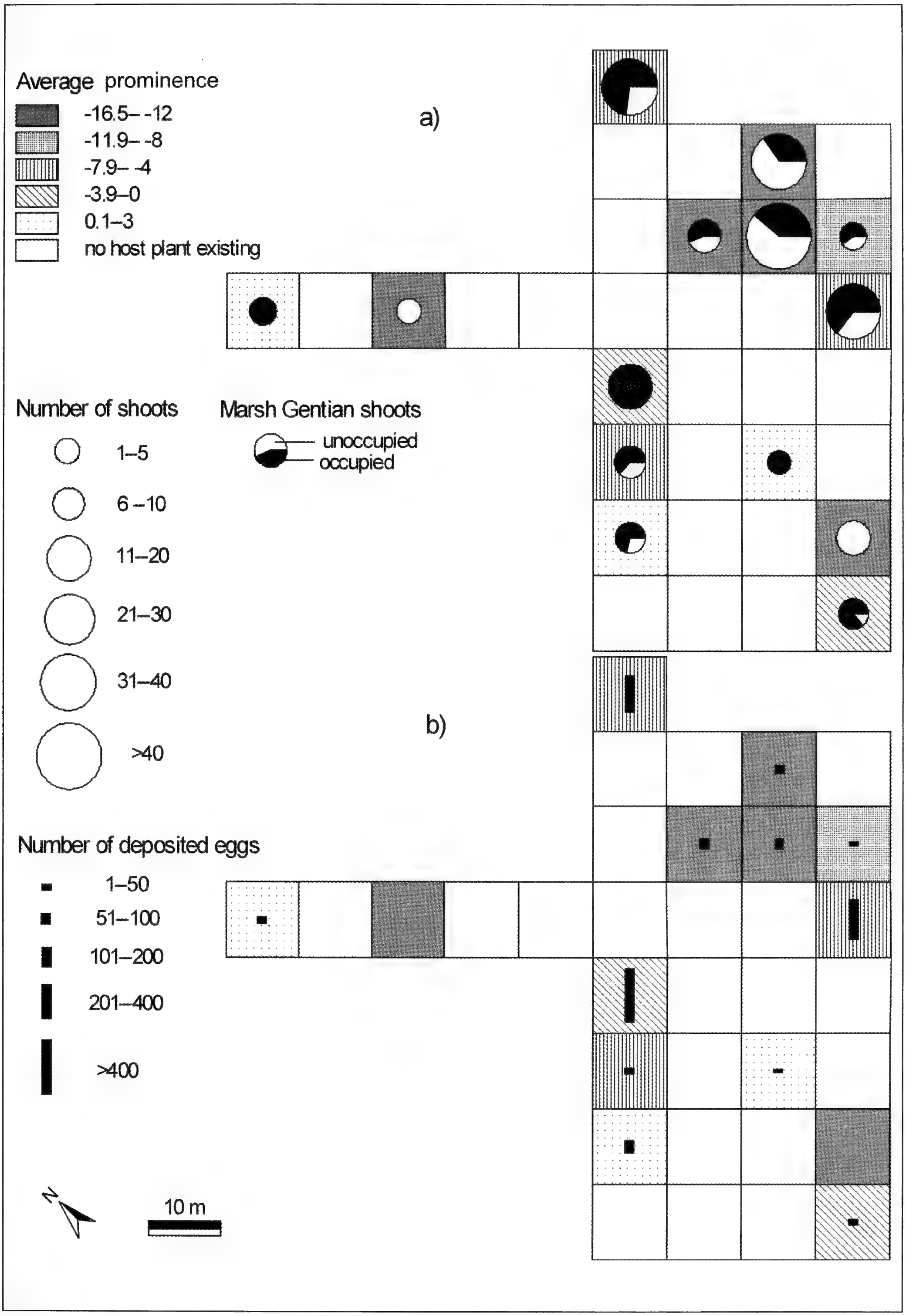


Fig. 6. Occupied and unoccupied Marsh Gentian shoots (a) and number of deposited eggs (b) per grid in relation to promincence. The average prominence is the median of all recorded height differences per grid.

(Dolek et al. 1998). Prominent shoots can be seen easily and are hence predestined as oviposition site. Second, shoots that grow higher than their surrounding vegetation are less shaded and offer better microclimatic conditions for a quick development of eggs and larvae. Besides it is risky to lay eggs on gentians hidden in dense vegetation because of the orb-web spiders, which are common in unmown meadows in this time of the year (Nunner pers. comm.). Third, bigger gentians may produce bigger buds and therefore offer more food resources for the larvae.

Over occupation of the shoots is seldom. Only 10 out of 124 shoots had more than 6 eggs per flower. About 4 to 6 *Maculinea alcon* larvae can feed on one flower (Elmes & Thomas 1987; Ebert & Rennwald 1991), which means that for almost all larvae there are sufficient food resources.

Despite the impression that the striking white eggs of *M. alcon* are mainly laid on the blue flowers of *Gentiana pneumonanthe*, we found almost three quarters of the eggs on the calyx but only one quarter on the flower. On the foothills of the Alps, Krismann (2000) found a similar distribution pattern on both *G. pneumonanthe* and *G. asclepiadea*. This oviposition pattern makes sense taking into account that the larvae of *M. alcon* leave the eggs through basal hatching (Thomas et al. 1991). They bore through the calyx and directly move to their food resource, the plant ovary.

Since *M. alcon* larvae hatch rapidly, the strong exposition of the eggs might be contributing to a fast larval development (Porter 1992). Within 3–4 weeks the larvae have to reach the fourth larval instar and need therefore optimal microclimatic conditions such as on the concealed flowers are provided. Although the eggs are more or less unprotected and very conspicuous, they are rarely parasitised. This may be due to the thick eggshells, which effectively prevent perforation by parasitoid wasps (Thomas et al. 1991). Thick eggshells may further protect against bad or hot weather.

The study site lies fallow; there is no regular utilization or care. Therefore it is dominated by the Purple Moor Grass (*Molinia caerulea*). Vegetation cover was mostly 100%. Nevertheless the Marsh Gentian is able to survive in such dense vegetation because of its longevity (Rose et al. 1998). On the study site mostly adult *G. pneumonanthe* grow. Oostermeijer et al. (1994) call this population type 'senile'. However, a senile population provides advantage for *M. alcon* regarding the suitability of egg deposition as most of the plants are relatively high and mostly covered with several flowers. This is reflected in the proportion of occupied gentians, which was with over 50% very high (compare Habel 2003; Krismann 2000). Still for a long-term survival of the gentian population and also of the Alcon Blue population a rejuvenation of the host plants is necessary which means creating gaps of bare soil.

There are different ways to assure the regeneration of *G. pneumonanthe* populations. Kesel & Urban (2000) and WallisDeVries (2004) suggest that small-scale sod cutting is best to promote existing gentian populations. Gaps are created in which the seeds can germinate and the young seedlings can grow protected. Though mowing is probably the better alternative to prevent from floristic impoverishment, to keep the vegetation open and to support the growth of accessible gentian shoots (Nunner pers. comm.). The best time is in October when the gentian seeds are mature and the *M. alcon* larvae are adopted (Briemle & Ellenberg 1994; Nunner pers. comm.). The hay should be taken away to prevent litter accumulation (Fartmann & Mattes 1997). Trautner et al. (2004) and WallisDeVries (2004) suggest that extensive grazing is also appropriate as management for *M. alcon* habitats with *G. pneumonanthe* as host plant. The gentian plants grow less luxurious but the small flowers seem to offer enough food for the *Maculinea* larvae until adoption. However, grazing is not an alternative when *G. pneumonanthe* sites are small because of the risk of local overgrazing or when *G. asclepiadea* is the host plant because it is more sensitive to browsing.

As most Marsh Gentian plants on the study site grow along old tank tracks it may be supposed that occasional mechanic disturbance through tanks or other means can have positive effects if it happens only every couple of years.

Acknowledgements

The idea for this study came from C. Artmeyer. H. Mattes gave expert advice about the manuscript. We thank N. Anthes, K. Arnold, G. Hermann, A. Nunner and M. WallisDeVries for valuable comments. Distribution data of *Maculinea alcon* were provided by H. Dudler, M. Goldschalt, H. G. Joger, A. Krismann, T. Marktanner, A. Nunner, R. Reinhardt and H. Retzlaff.

References

Als, T. D., D. R. Nash & J. J. Boomsma 2001. Adoption of parasitic *Maculinea alcon* caterpillars (Lepidoptera: Lycaenidae) by three *Myrmica* ant species. – Animal Behaviour **62**: 99–106.

Als, T. D., R. Vila, N. P. Kandul, D. R. Nash, S.-H. Yen, Y.-F. Hsu, A. A. Mignault, J. J. Boomsma & N. E. Pierce 2004. The evolution of alternative parasitic life histories in large blue butterflies. – Nature **432**: 386–390.

Anthes, N., T. Fartmann, G. Hermann & G. Kaule 2003. Combining larval habitat quality and metapopulation structure – the key for successful management of pre-alpine *Euphydryas aurinia* colonies. – Journal of Insect Conservation **7**: 175–185.

Bayerisches Landesamt für Umweltschutz (BLfU) 2001. Artenschutzkartierung Bayern: Arbeitsatlas Tagfalter – Augsburg.

Briemle, G. & H. Ellenberg 1994. Zur Mahdverträglichkeit von Grünlandpflanzen. – Natur und Landschaft **69**: 139–147.

de Lattin, G. 1957. Die Lepidopteren-Fauna der Pfalz. I. Teil. – Mitteilungen der Pollichia (ser. 4) **3**: 51–167.

Dennis R. L. H. & H. T. Eales 1997. Patch occupancy in *Coenonympha tullia* (Müller, 1764) (Lepidoptera: Satyrinae): habitat quality matters as much as patch size and isolation. – Journal of Insect Conservation **1**: 167–176.

Dolek, M., A. Geyer & R. Bolz 1998. Distribution of *Maculinea rebeli* and hostplant use on sites along the river Danube. – Journal of Insect Conservation **2**: 85–89.

Dudler, H., H. Kinkler, R. Lechner, H. Retzlaff, W. Schmitz & H. Schumacher 1999. Rote Liste der gefährdeten Schmetterlinge (Lepidoptera) in Nordrhein-Westfalen. Pp. 575–626. – *In*: Landesanstalt für Ökologie, Bodenordnung und Forsten/Landesamt für Agrarordnung Nordrhein-Westfalen (LÖBF), Rote Liste der gefährdeten Pflanzen und Tiere in Nordrhein-Westfalen, 3. Fassung – LÖBF-Schriftenreihe 17, Recklinghausen.

Ebert, G. & E. Rennwald 1991. Die Schmetterlinge Baden-Württembergs **2** (2). – Ulmer, Stuttgart. 535 pp.

Elfferich, N. W. 1988. Zuchterfahrungen mit *Maculinea alcon* (Denis & Schiffermüller, 1775) (Lepidoptera, Lycaenidae). – Mitteilungen der Entomologischen Gesellschaft Basel **38**: 134–150.

Ellenberg, H. 1996. Vegetation Mitteleuropas mit den Alpen in ökologischer, dynamischer und historischer Sicht. – Ulmer, Stuttgart. 1059 pp.

Elmes, G. W. & J. A. Thomas 1987. Die Gattung *Maculinea*. Pp. 354–368. – *In*: Lepidopterologen-Arbeitsgruppe, Tagfalter und ihre Lebensräume. – Schweizerischer Bund für Naturschutz, Basel.

Elmes, G. W., J. A. Thomas, O. Hammarstedt, M. L. Munguira, J. Martin & J. Van Der Made 1994. Differences in host-ant specificity between Spanish, Dutch and Swedish populations of the endangered butterfly *Maculinea alcon* (Denis et. Schiff.) (Lepidoptera). – Memorabilia Zoologica **48**: 55–68.

Elmes, G. W., J. A. Thomas, J. C. Wardlaw, M. E. Hochberg, R. T. Clarke & D. J. Simcox 1998. The ecology of *Myrmica* ants in relation to the conservation of *Maculinea* butterflies. – Journal of Insect Conservation **2**: 67–78.

Fartmann, T. 2004. Die Schmetterlingsgemeinschaften der Halbtrockenrasen-Komplexe des Diemeltales – Biozönologie von Tagfaltern und Widderchen in einer alten Hudelandschaft. – Abhandlungen aus dem Westfälischen Museum für Naturkunde **66** (1): 1–256.

Fartmann, T. & H. Mattes 1997: Heuschreckenfauna und Grünland – Bewirtschaftungsmaßnahmen und Biotopmanagement. Pp. 179–188. – *In*: H. Mattes (ed.), Ökologische Untersuchungen zur Heuschreckenfauna in Brandenburg und Westfalen. – Arbeiten aus dem Institut für Landschaftsökologie Münster **3**.

Habel, J. C. 2003. Auswirkungen der Fragmentierung von Lebensräumen am Beispiel von *Maculinea alcon* (Denis & Schiffermüller 1775). – Diplomarbeit, Institut für Ökologie und Umweltchemie, Universität Lüneburg. 83 pp.

Harkort, W. 1975. Schmetterlinge in Westfalen (ohne Ostwestfalen). Fundortkarten und Fundortlisten (Stand: Ende 1974). – Dortmunder Beiträge zur Landeskunde: Naturwissenschaftliche Mitteilungen **9**: 33–102.

Hochberg, E., J. A. Thomas & G. W. Elmes 1992. A modelling study of the population dynamics of a Large Blue butterfly, *Maculinea rebeli*, a parasite of red ant nests. – Journal of Animal Ecology **61**: 397–409.

Kesel, R. & K. Urban 1999. Population dynamics of *Gentiana pneumonanthe* and *Rhynchospora fusca* during wet heathland restoration. – Applied Vegetation Science **2**: 149–156.

Kesel, R. & K. Urban 2000. Species dynamics in wet heathland restoration. – Proceedings IAVS Symposium: 286–290.

Kinkler, H. & W. Schmitz 1971. Die Tagfalter des Bergischen Landes. – Jahresberichte des Naturwissenschaftlichen Vereins Wuppertal **24**: 20–63.

Kockelke, K., G. Hermann, G. Kaule, M. Verhaagh & J. Settele 1994. Zur Autökologie und Verbreitung des Kreuzenzian-Ameisenbläulings, *Maculinea rebeli* (Hirschke, 1904). – Carolinea **52**: 93–109.

Kolligs, D. 2003. Schmetterlinge Schleswig-Holsteins. – Wachholtz, Kiel. 212 pp.

Korneck, D., M. Schnittler, F. Klingenstein, G. Ludwig, M. Takla, U. Bohn & R. May 1998. Warum verarmt unsere Flora? Auswertung der Roten Liste der Farn- und Blütenpflanzen Deutschlands. Pp. 299–444. – *In*: Bundesamt für Naturschutz (eds.), Ursachen des Artenrückgangs von Wildpflanzen und Möglichkeiten zur Erhaltung der Artenvielfalt. – Schriftenreihe für Vegetationskunde **29**, Bonn Bad Godesberg.

Krismann, A. 2000. Zum Eiablageverhalten von *Maculinea alcon* (D. & S., 1775) an *Gentiana pneumonanthe* und *Gentiana asclepiadea*. Pp. 103–110. – *In*: J. Settele & S. Kleinewiedtfeld (eds.), Populationsökologische Studien an Tagfaltern **2**. UFZ-Bericht. – UFZ Leipzig-Halle, Leipzig.

Liebig, W.-H. 1989. Bemerkungen zur Biologie von *Maculinea alcon* Schiff. (Lep., Lycaenidae). – Entomologische Nachrichten und Berichte **33**: 117–121.

Maes, D., W. Vanreusel, W. Talloen & H. van Dyck 2004. Functional conservation units for the endangered Alcon Blue butterfly *Maculinea alcon* in Belgium (Lepidoptera: Lycaenidae). – Biological Conservation **120**: 229–241.

Marktanner, T. 1985. Die Bedeutung des Schwalbenwurzenzians als Futterpflanze von *Maculinea alcon* (Lep.: Lycaenidae) im oberschwäbischen Alpenvorland und die Verbreitung der Lycaenide in diesem Raum. – Entomologische Zeitschrift **95**: 257–272.

Meyer-Hozak, C. 2000. Population biology of *Maculinea rebeli* (Lepidoptera: Lycaenidae) on the chalk grasslands of Eastern Westphalia (Germany) and implications for conservation. – Journal of Insect Conservation **4**: 63–72.

Munguira, M. L. & J. Martin 1999. Action plan for the *Maculinea* Butterflies in Europe. – Nature and Environment **97**. Council of Europe Publishing, Strasbourg. 63 pp.

Oberdorfer, E. 2001. Pflanzensoziologische Exkursionsflora für Deutschland und angrenzende Gebiete. – Ulmer, Stuttgart. 1051 pp.

Oostermeijer, J. G. B., R. V. T. Veer & J. C. M. Den Nijs 1994. Population structure of the rare, long-lived perennial *Gentiana pneumonanthe* in relation to vegetation and management in the Netherlands. – Journal of Applied Ecology **31**: 428–438.

Oostermeijer, J. G. B., S. H. Luijten, Z. Krenová & H. C. M. Den Nijs 1998. Relationships between population and habitat characteristics and reproduction of the rare *Gentiana pneumonanthe* L. – Conservation Biology **12**: 1042–1053.

Porter, K. 1992. Eggs and egg-laying. Pp. 46–72. – *In*: Dennis, R. L. H. (ed.), The ecology of butterflies in Britain. – Oxford University Press, Oxford.

Pretscher, P. 1998. Rote Liste der Großschmetterlinge (Macrolepidoptera). – Schriftenreihe Landschaftspflege und Naturschutz **55**: 87–111.

Retzlaff, H. 1973. Die Schmetterlinge von Ostwestfalen-Lippe und einigen angrenzenden Gebieten Hessens und Niedersachsens (Weserbergland, südöstliches Westfälisches Tiefland und östliche Westfälische Bucht). I. Teil. – Berichte des Naturwissenschaftlichen Vereins Bielefeld **21**: 129–248.

Retzlaff, H., H. Dudler, C. Finke, R. Pähler, K. Schnell & W. Schulze 1993. Zur Schmetterlingsfauna von Westfalen. Ergänzungen, Neu- und Wiederfunde. – Mitteilungen der Arbeitsgemeinschaft ostwestfälisch-lippischer Entomologen **9** (2): 37–66.

Rose, R. J., R. T. Clarke & S. B. Chapman 1998. Individual variation and the effects of weather, age and flowering history on survival and flowering of the long-lived perennial *Gentiana pneumonanthe*. – Ecography **21**: 317–327.

Sebald, O., S. Seybold, G. Philippi & A. Wörz (eds.) 1996. Die Farn- und Blütenpflanzen Baden-Württembergs, vol. **5**: Spezieller Teil (Spermatophyta, Unterklasse Asteridae) Buddlejaceae bis Caprifoliaceae. – Ulmer, Stuttgart. 539 pp.

Schönrogge, K., J. C. Wardlaw, J. A. Thomas & G. W. Elmes 2000. Polymormphic growth rates in myrmecophilous insects. – Proceedings of the Royal Society of London B **267**: 771–777.

Stamm, K. 1981. Prodomus der Lepidopteren-Fauna der Rheinlande und Westfalens. – Solingen.

Thomas, J. A., M. L. Munguira, J. Martin & G. W. Elmes 1991. Basal hatching by *Maculinea* butterfly eggs: a consequence of advanced myrmecophily. – Biological Journal of the Linnean Society **44**: 175–184.

Thomas, J. A., D. J. Simcox, J. C. Wardlaw, G. W. Elmes, M. E. Hochberg & R. T. Clarke 1998. Effects of latitude, altitude and climate on the habitat and conservation of the endangered butterfly *Maculinea arion* and its *Myrmica* ant hosts. – Journal of Insect Conservation **2**: 39–46.

Thomas J. A., N. A. D. Bourn, R. T. Clarke, K. E. Stewart, D. J. Simcox, G. S. Pearman, R. Curtis & B. Goodger 2001. The quality and isolation of habitat patches both determine where butterflies persist in fragmented landscapes. – Proceedings of the Royal Society of London B **268**: 1791–1796.

Trautner, J., G. Hermann & J. Rietze 2004. Weidewirkungen auf Tierarten und Zönosen. Pp. 275–285. – *In*: D. Lerderbogen, G. Rosenthal, D. Scholle, J. Trautner, B. Zimmermann & G. Kaule (eds.), Allmendweiden in Südbayern: Naturschutz durch landwirtschaftliche Nutzung. – Angewandte Landschaftsökologie Heft **62**. Bundesamt für Naturschutz (BfN), Bonn.

van Dyck, H., J. G. B. Oostermeijer, W. Talloen, V. Feenstra, A. van der Hidde & I. Wynhoff (2000). Does the presence of ants matter for oviposition to a specialized myrmecophilous *Maculinea* butterfly? – Proceedings of the Royal Society of London B **267**: 861–866.

van Swaay, C. A. M. & M. Warren 1999. Red data book of European butterflies (Rhopalocera). – Nature and Environment **99**. Council of Europe Publishing, Strasbourg. 260 pp.

Wagener, S. & B. Niemeyer 2003. Beitrag zur Großschmetterlingsfauna des Kreises Borken. – Abhandlungen aus dem Westfälischen Museum für Naturkunde **65** (1/2): 149–201.

WallisDeVries, M. F. 2004. A quantitative conservation approach for the endangered butterfly *Maculinea alcon*. – Conservation Biology **18**: 489–499.

Wynhoff, I. 1998. The recent distribution of the *Maculinea* species. – Journal of Insect Conservation **2**: 15–27.

Wynhoff, I., C. A. M. Van Swaay & J. Van Der Made 1999. Veldgids Dagvlinders. – Stichting Uitgeverij KNNV, Utrecht. 224 pp.

SOCIETAS EUROPAEA LEPIDOPTEROLOGICA e.V.

Nota lepidopterologica wird den Mitgliedern der SEL zugesandt. Die Mitgliedschaft bei SEL steht Einzelpersonen und Vereinen nach Maßgabe der Satzung offen. Der Aufnahmeantrag ist an den Mitgliedssekretär Willy O. de Prins, Nieuwe Donk 50, B-2100 Antwerpen, Belgien; e-mail: willy.deprins@antwerpen.be zu richten. Das Antragsformular ist im Internet auf der Homepage der SEL unter http://www.soceurlep.org erhältlich.
Der Mitgliedsbeitrag ist jährlich am Jahresanfang zu entrichten. Er beträgt für Einzelpersonen € 35,00 bzw. für Vereine € 45,00. Die Aufnahmegebühr beträgt € 2,50. Die Zahlung wird auf das SEL-Konto 19 56 50 507 bei der Postbank Köln (BLZ 370 100 50) erbeten. Seit dem 1. Juli 2003 gibt es einen neuen, (preiswerteren) Weg für Geldüberweisungen innerhalb der EU. Die neuen Standardformulare erfordern eine International Bank Account Number (IBAN) und einen Bank Identifier Code (BIC). Für das SEL Postbankkonto ist die IBAN DE63 3701 0050 0195 6505 07 und die BIC lautet PBNKDEFF.
Mitteilungen in Beitragsangelegenheiten sind an den Schatzmeister Manfred Sommerer, Volpinistr. 72, D-80638 München; e-mail: Sommerer.Manfred@t-online.de zu richten.
Der Verkauf von Einzelheften und älteren Jahrgängen von *Nota lepidopterologica* sowie der Verkauf der Zeitschrift an Nichtmitglieder erfolgt durch Apollo-Books, Kirkeby Sand 19, DK-5771 Stenstrup, Dänemark; e-mail: apollobooks@vip.cybercity.dk.
Adressenänderungen bitte sofort dem Mitgliedssekretär oder dem Schatzmeister mitteilen!

Nota lepidopterologica is sent to the members of SEL. The membership is open to individuals and associations as provided for by the statutes of SEL. Applications for membership are to be addressed to the Membership Secretary Willy O. de Prins, Nieuwe Donk 50, B-2100 Antwerpen, Belgium; e-mail: willy.deprins@antwerpen.be. The application form will be found on the SEL homepage http://www.soceurlep.org.
The annual subscription is to be paid at the beginning of the year. It is € 35.00 for individuals or € 45.00 for associations. The admission fee is € 2.50. Payments requested to SEL account no. 19 56 50 507 at Postbank Köln [Cologne] (bank code 370 100 50). From July 1st, 2003, a new (cheaper) way of money transfer within the EU will be available. The new standard forms require the International Bank Account Number (IBAN) and the Bank Identifier Code (BIC). For the SEL Postbank account, the IBAN is DE63 3701 0050 0195 6505 07, and the BIC is PBNKDEFF.
Back numbers of *Nota lepidopterologica* may be obtained from, and orders of *Nota lepidopterologica* from non-members are serviced by Apollo-Books, Kirkeby Sand 19, DK-5771 Stenstrup, Denmark; e-mail: apollobooks@vip.cybercity.dk.
Changes of addresses should be immediately communicated to the Membership Secretary or the Treasurer.

Nota lepidopterologica est envoyé aux membres de la SEL. L'affiliation est possible, pour les personnes individuelles aussi bien que pour les associations, en accord avec les statuts de la SEL. Les demandes d'affiliation doivent être adressées au Secrétaire des Membres Willy O. de Prins, Nieuwe Donk 50, B-2100 Antwerpen, Belgique; courriel: willy.deprins@antwerpen.be.
Le formulaire d'affiliation est disponible par le biais de la page web de la SEL http://www.soceurlep.org.
La contribution annuelle est payable au début de l'année. Elle est de € 35,00 pour les personnes individuelles et de € 45,00 pour les associations. Les frais d'admission s'élèvent à € 2,50. Les payements doivent être effectués sur le compte SEL n° 19 56 50 507 auprès de la Postbank Köln [Cologne] (code bancaire 370 100 50). Les nouveaux formulaires requièrent le Numéro de compte banquaire international (NCBI) et le Code identificateur de banque (CIB). Pour le compte postal de la SEL, le NCBI est DE63 3701 0050 0195 6505 07 et le CIB est PBNKDEFF.
Pour toute question en rapport à la souscription ou aux payements, veuillez contacter le Trésorier, Manfred Sommerer, Volpinistr. 72, D-80638 Munich; courriel: Sommerer.Manfred@t-online.de.
Les anciens volumes de *Nota lepidopterologica* peuvent être obtenus et les commandes concernant cette revue de la part de non-membres effectuées auprès de Apollo-Books, Kirkeby Sand 19, DK-5771 Stenstrup, Danemark; courriel: apollobooks@vip.cybercity.dk.
Tout changement d'adresse doit être communiqué immédiatement soit auprès du Secrétaire des Membres, soit auprès du Trésorier.