

Natural History Museum Library



000162859

RDW 2006



1382-6 (top)

THE NATURAL
HISTORY MUSEUM
29 JUN 2005
PLEASE
RETURN TO THE

NOTA

LEPIDOPTEROLOGICA

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



Vol. 28 No. 1 2005

HONORARY MEMBERS

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

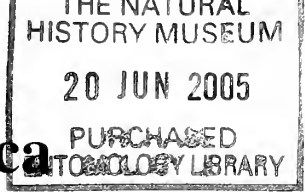
COUNCIL

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)

© Societas Europaea Lepidopterologica (SEL)
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 28 No. 1

Dresden, 07.06.2005

ISSN 0342-7536

Editor

Dr Matthias Nuss, Staatliches Museum fuer Tierkunde Dresden,
Koenigsbruecker Landstr. 159, D-01109 Dresden;
e-mail: matthias.nuss@snsd.smwk.sachsen.de

Editorial Board

Dr Enrique Garcia-Barros (Madrid, E), Dr Roger L. H. Dennis (Wilmslow, UK),
Dr Axel Hausmann (Munich, D), Dr Peter Huemer (Innsbruck, A), Ole Karsholt (Copenhagen, DK),
Dr Bernard Landry (Genève, CH), Dr Yuri P. Nekrutenko (Kiev, UA),
Dr Erik van Nieuwerkerken (Leiden, NL), Dr Thomas Schmitt (Trier, D),
Dr Wolfgang Speidel (Bonn, D)

Contents

Svetlana V. Nedoshivina & Vadim V. Zolotuhin

A new subspecies of *Pelatea klugiana* (Freyer, 1836) from the
Middle Volga Region of Russia with notes on its morphology and
life history (Tortricidae) 3

Axel Hausmann & Anthony Seguna

Lithostege fissurata Mabille, 1888 from Malta, new for the fauna
of Europe (Geometridae, Larentiinae) 11

Matthias Nuss

Revision of *Evergestis anartalis* (Staudinger, 1892) comb. rev.
from Central Asia (Pyraloidea: Crambidae: Evergestinae) 17

Zdravko Kolev

Polyommatus dantchenkoi (Lukhtanov & Wiemers, 2003) tentatively
identified as new to Europe, with a description of a new taxon
from the Balkan Peninsula (Lycaenidae) 25

Zdravko Kolev

New data on the taxonomic status and distribution of
Polyommatus andronicus Coutsis & Ghavalas, 1995 (Lycaenidae) 35

Dmitry A. Komarov & Vadim V. Zolotuhin	
A new species of <i>Melharia</i> Chrétien, 1915 (Cossidae)	
from the Lower Volga Region	49
Andreas Tränkner & Matthias Nuss	
Risk spreading in the voltinism of <i>Scolitantides orion orion</i> (Pallas, 1771)	
(Lycaenidae)	55
András Tartally	
<i>Neotypus melanocephalus</i> (Hymenoptera: Ichneumonidae): the first record	
of a parasitoid wasp attacking <i>Maculinea teleius</i> (Lycaenidae)	65
Josef Jaroš & Jan Liška	
The geographic range of <i>Rhyacionia hafneri</i> (Rebel, 1937)	
(Tortricidae)	69
Book review	70

A new subspecies of *Pelatea klugiana* (Freyer, 1836) from the Middle Volga Region of Russia with notes on its morphology and life history (Tortricidae)

SVETLANA V. NEDOSHIVINA¹ & VADIM V. ZOLOTUHIN²

Department of Zoology, Uljanovsk State Pedagogical University, pl. 100-letiya Lenina, 4, RUS-432700 Uljanovsk, Russia; e-mail: ¹tortrica@mail.ru¹; ulgpu@mv.ru²

Abstract. *Pelatea klugiana verucha* ssp. n. is described from the Middle Volga Region of Russia within the limits of the southern Uljanovsk Province. Data on its life history and morphology of the preimaginal stages are given. The species is noted from Russia for the first time.

Zusammenfassung. Eine neue Unterart, *Pelatea klugiana verucha* ssp. n., wird aus dem südlichem Teil des Uljanowsk-Gebietes in Russland beschrieben. Bemerkungen zur Lebensweise sowie zur Raupen- und Puppenmorphologie werden gegeben. Die Art wird erstmals für Russland gemeldet.

Резюме. Новый подвид листовертки пионовой, *Pelatea klugiana verucha* ssp. n., описывается из южных районов Ульяновской области России. Приведены данные по его биологии и морфологии гусеничной и куколочной стадий. Вид впервые отмечается с территории России. Голотип нового таксона хранится в коллекции Зоологического института Российской Академии Наук (г. Санкт-Петербург).

Key words. Lepidoptera, Tortricidae, *Pelatea*, Russia, new subspecies, biology, larval and pupal morphology.

Introduction

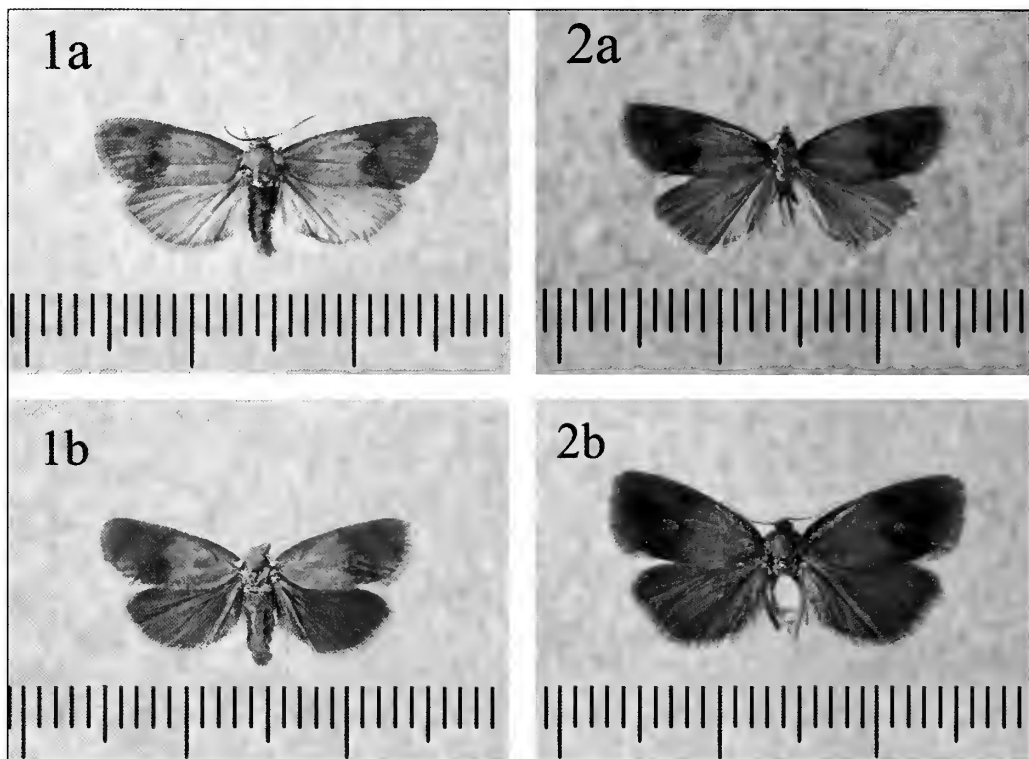
A large sample of a tortricid moth has been reared from *Paeonia tenuifolia* during expeditionary trips 1996–2003 through the right bank of the middle Volga Region (south of the Uljanovsk Province). Firstly, the species has been identified as *Pelatea klugiana* (Freyer, 1836) known within the limits of the former USSR only from the Carpathians (Kuznetsov 1978; Razowski 2001, 2003). Hence, subsequent comparison with material from the Alps has allowed to consider this population of the Russian plane in a rank of a separate subspecies. Its description is given below.

Abbreviations

EMEM	Entomological Museum of Dr. Ulf Eitschberger, Marktleuthen, Germany
SamGU	Zoological Museum of the Samara State University, Samara, Russia
SarGU	Zoological Museum of the Saratov State University, Saratov, Russia
UIGPU	Zoological Museum of the Uljanovsk State Pedagogical University, Uljanovsk, Russia
ZISP	Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia
ZMHUB	Zoological Museum of the Humboldt University, Berlin, Germany

Pelatea klugiana verucha ssp. n.

Material. Holotype ♂, **Russia**, Middle Volga Region, 140 km S Uljanovsk, vill. Srednikovo outsc., Mt. Atmala, mixed forest on chalk hills, 27.vi.1996 (e. l., from *Paeonia tenuifolia*), Zolotuhin leg. (ZISP). – Paratypes: 15♂, 9♀ same data as holotype, but 26.–29.vi.1996 (e. l.) Zolotuhin leg. (UIGPU), 6 specimens, same data (ZISP, SamGU, SarGU); 1♂, 2♀ same data, but 17.–18.vi.2003 (e. l.), Nedoshivina leg. (UIGPU); 47♂, 19♀, Saratov prov., Khlvalynsk distr., 5 km NW Novaja Jablonovka, Armejskye Mts., SW slope of hill forest-setppe, 29.–31.v.2004 (e. l., collected 19.v.2004), Anikin leg. (SarGU). Also as paratypes the following material is designated: 8 last instar larvae and 7 pupae preserved in 1:1 mixture of 80% ethanol and glycerine (ZISP, UIGPU).

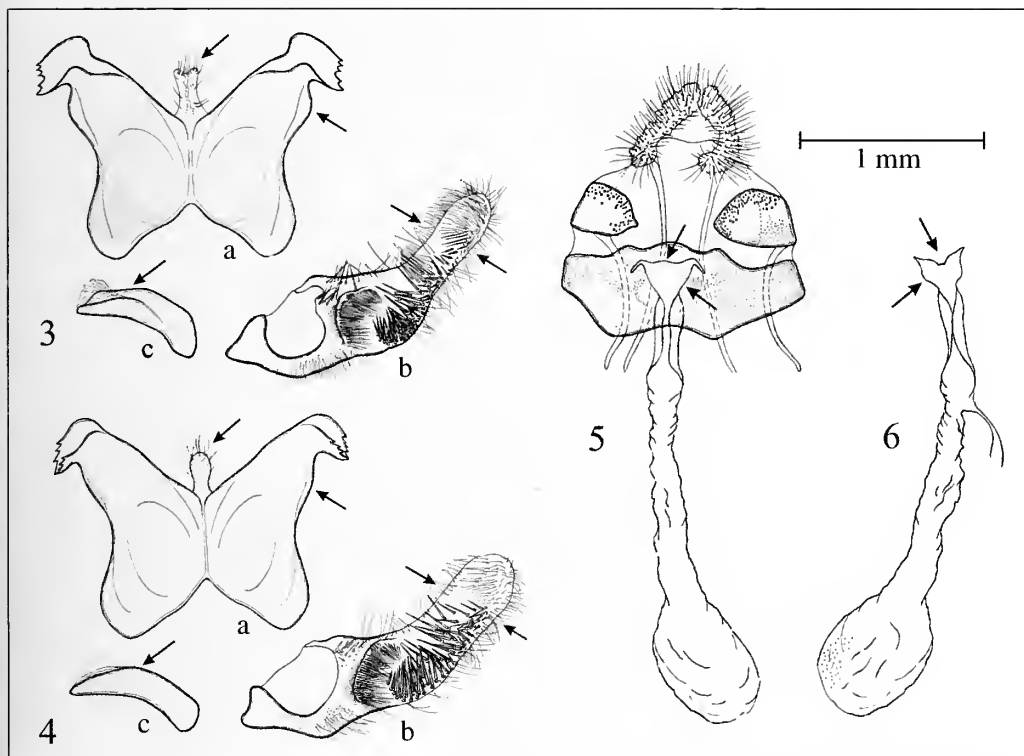


Figs. 1–2. Adults of *Pelatea klugiana*. **1.** *P. klugiana verucha* ssp. n., paratypes. **2.** *P. klugiana klugiana*, from South Tyrol. **a.** male. **b.** female.

Description (Fig. 1). **Male.** Forewing length 9.0–9.3 mm. Costal fold absent. Forewing light, brownish-olive with reddish-brown to pinkish outer half, crossing by vague silver net. Discal spot dark brown, often broadened to transversal band. Cilia light reddish-brown. Hind wings light, brownish olive with darker, narrow outer field. Cilia of the groundcolour. Body dark brown; tegulae with a tuft of reddish-yellow scales, metathorax with two reddish tufts; top of the abdomen with reddish-yellow hairs. Individual variation is observed in intensity of wing coloration from light brownish olive with pinkish spots to dark olive brown with dark pink spots but specimens with those extreme developed characters could be found rarely within large samples.

Female (Fig. 1b). With the same characters of pattern and coloration but somewhat larger (forewing length 9.2–9.5 mm) and more robust; silver net on the fore wings more vague; hind wings dark grey, without basal lightening, with light, brownish olive cilia.

Male genitalia (Fig. 3). As in the nominate subspecies. They are very remarkable at a whole and therefore outline clearly this genus from related genera. The new subspecies is characterized by slender cucullus and more compact groups of setae on its inner surface, more concave outer margin of lateral processes of tegumen, bilobed uncus and especially by the shape of the phallus having opening of vesica lateral. No cornuti are present.



Figs 3-6. Genitalia of *Pelatea klugiana*. **3.** *P. klugiana verucha* ssp. n., holotype ♂. **4.** *P. klugiana klugiana*, ♂; a - tegumen, b - valva, c - phallus. **5.** *P. klugiana verucha* ssp. n., paratype ♀. **6.** *P. klugiana klugiana*, ♀, internal parts.

Female genitalia (Fig. 5). As in the nominate subspecies and characterized by conical antrum as well as prominent margin of ostium. No distinct signa are visible but very vague sclerotization could be found on caudal part of bursa copulatrix.

Last instar larva (Figs. 7-9). 10 mm with maximal width 2.5 mm. Head and prothoracic shields black, well sclerotized, shining. Cuticula of the body weak and can be easily damaged just with tender pressure. Body pattern absent; coloration of subhypodermal type then the caterpillar is colored by haemolymph in dark green or malachite-green. Setae long, elastic, greyish.

Chaetotaxy (Fig. 7). Two D setae present on each segment. On T1 both are on the shield, on T2-T3 they are on the common pinacula, but on A1-A9 setae of D group are arranged each to separate pinacula. D1 is above D2 on T1-T2 and on A1-A8 but under of and anterior to D2 on T3. On A9, D2 is above D1, and situated on the separate pinacula closed to anal shield, as well as D1 is arranged to its own. SD1 and SD2 arranged to the shield on T1. On T2-T3 both are on the same pinacula, SD2 is above SD1. On other segments (except A9-A10), SD2 is minute and located anteriodorsal to the spiracle on A1-A7, but on A8 SD2 is anterior and SD1 is anteriodorsal to the spiracle. SD2 is absent on A9. SV group on T1 as well as on A1-A8, is bisetose. On other segments (except A10) it is unisetose. Three L setae on T1 are on common pinaculum. On T2, L1

and L2 share a pinaculum, and L3 is on its own. On T1, L1 is between L2 and L3, on T2-T3 L3 posteriodorsal to the others, L1 above L2. But on A1-A9, L3 posteroventral to others and L2 above L1; on A9, they all situated on a common pinacula. On all abdominal segments L group is also trisetose. V1 seta is presented on all segments. Proprioceptor MD1 have relatively constant position anteroventral to D1 on all segments, except T1 and A10 where it is absent. MSD1 and MSD2 present only on T2-T3, where they arranged anterior to SD pinacula, MSD1 above MSD2. Chaetotaxy of the larval head as figured (Fig. 8).

Pupa (Figs. 10–12). Body length 7.0–10.5 mm. Coloration dark, yellowish brown. Frons flat and smooth. Proboscis extended to about one third of forewing length. Antenna extended more than two thirds of forewing length, and fore leg extended to about half of forewing length and mid leg somewhat longer. Forewing extended to posterior margin of 4th abdominal segment or ended slightly before. Veins distinct. Spiracles small, rounded oval. A2-A8 with two rows of dorsal spines. A1 and A9 with one cephalic row. Cremaster ventrally wrinkled, with lateral teeth. Cauda with 4 pairs of yellowish brown hooked setae. Anal rise with a pair of hooked setae on each side.

Diagnosis. Similar to the nominate subspecies but differs by smaller size (10.0–10.7 mm in the nominate subspecies), much lighter coloration and narrower wings. Silver net of forewing scales in the new subspecies much more vague. Diagnostic characters could be found also in genitalia. In the nominate subspecies the cucullus is broader, with less compact groups of setae on its inner surface, less concave outer margin of lateral processes of tegumen, unilobed uncus and dorsal opening of vesica as well as antrum is cup-shaped and margin of ostium is cut. Comparison with another species of the genus, *Pelatea assidua* Meyrick, 1914 from Taiwan, has not been possible because of absence of the material in European museums.

Distribution. Known only from the type locality – outskirts of Srednikovo vill. of the Uljanovsk Province (Fig. 18–19). Besides that, very characteristic damage of peonies by the caterpillars are known from Vjazovyj Gaj vill. (about 32 km to the south from the type locality). Without doubts, *Pelatea klugiana verucha* ssp. n. is connected closely in its distribution with the range of the food plant although is known not from all its populations (fig. 20). As a matter of fact, *Paeonia tenuifolia* grows in the Uljanovsk District exclusively on carbonat soils, mainly on chalk, in sparse forest-steppe associations and on stepped slopes (Maslennikov 1995). The range of the new subspecies is isolated geographically from the range of the nominated subspecies native to the mountain ranges of Central and Southern Europe.

Life history. Caterpillars of the species feed on different species of peonies. Foodplant in Central Europe – *Paeonia rosea* (Kuznetsov 1978; Razowski 2001, 2003) and small sample of moths reared from *P. officinalis* at our disposal from EMEM. In the Uljanovsk District caterpillars were collected from *P. tenuifolia*. Related species *P. biebersteiniana* with stronger and denser leaves is settled by the species not willingly. Larvae live in small colony from 2 to 5 specimens. They weave densely the growing buds of young sprout with silk thread forming some kind of silk nest. These dense nests are visible well on *Paeonia* bushes from afar (Fig. 13). Inside that, the caterpillars move on silk tunnels, feeding inside not coming on outer surface. Pupation within silk nest.

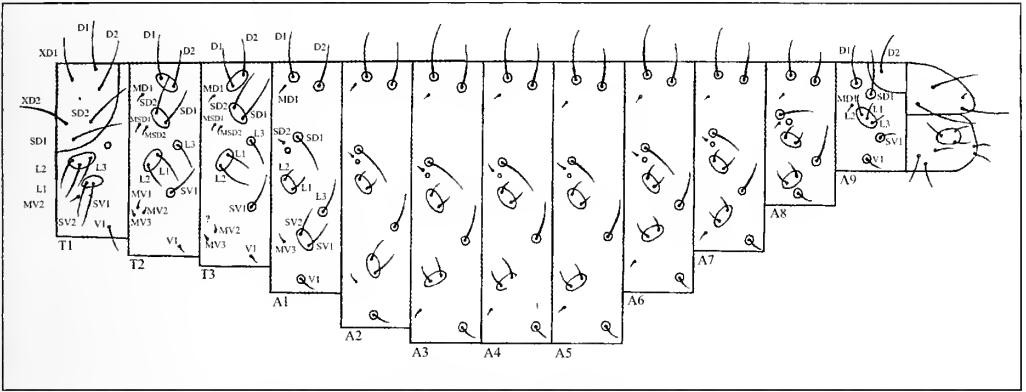


Fig. 7. Body chaetotaxy of the larva of *Pelatea klugiana verucha* ssp. n.

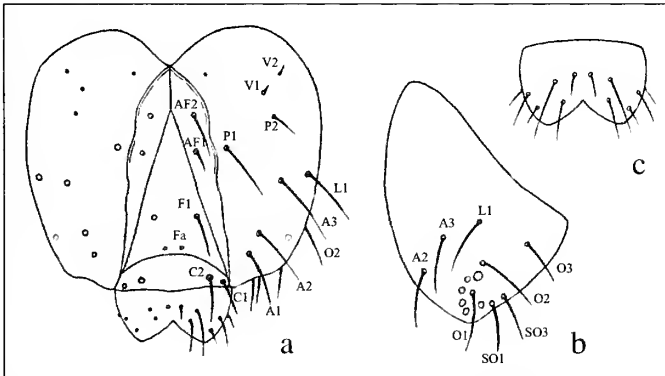
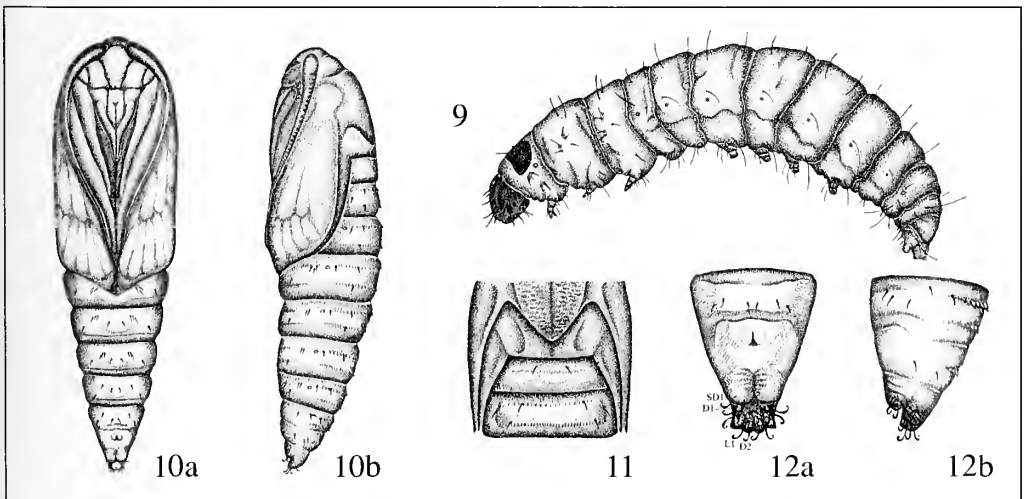


Fig. 8. Head chaetotaxy of the larva of *Pelatea klugiana verucha* ssp. n., a. frontal. b. lateral. c. labrum.



Figs. 9-12. Immature stages of *Pelatea klugiana verucha* ssp. n. 9. Last instar larva. 10. Pupa. 11. metathorax and abdominal segments I-II of the pupa (dorsal view). 12. Cremaster and abdominal segments VIII-X of the pupa. a. ventral. b. lateral.



Figs. 13–19. Life history of *Pelatea klugiana verucha* ssp. n. **13.** Silk nests forming by larvae on *Paeonia* bushes. **14.** Imago on the host plant. **15.** Larva. **16.** Larva inside the silk nest. **17.** Pupal exuviae in the silk nest. **18–19.** Type locality.

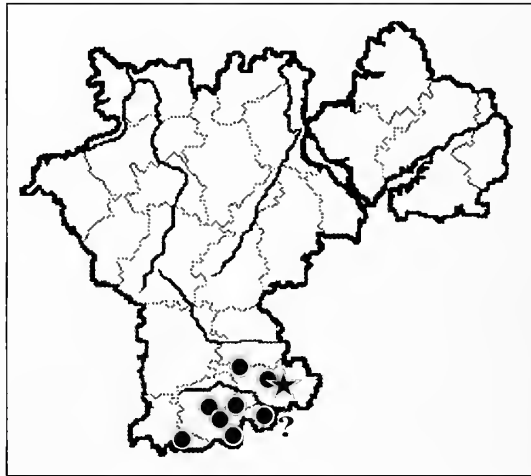


Fig. 20. Distribution of *Pelatea klugiana verucha* ssp. n. in the Uljanovsk Province. ● Locations of *Paeonia*. ★ Type locality of *Pelatea klugiana verucha* ssp. n. ? Unconfirmed occurrence of the moth-species.

Shortly before hatching (for 4–5 minutes), the pupa protrudes from the nest (Fig. 17). Emerging during all a day. Sex ratio males : females as 3:1 in first days and about 7:1 later. Moths are not mobile and only shortly flit being disturbed; they hold near by food plant and can be collected from it with the hand (Fig. 14). The subspecies has been not collected on artificial light. Flight period short (some days), and emerging from pupa is

synchronous, within 4–7 days. Develops one generation per year. Hibernating stage is unknown (egg, caterpillar within egg shell or young caterpillar?).

Some parasitoids were reared from the nests: *Temelucha* sp. (Ichneumonidae: Cremastinae), *Chelonus annulipes* Wsm. (Braconidae) as well as larvae of a very small unidentified tachinid fly, not developed into imago.

Comparative material examined of *Pelatea klugiana*: 1♂ **France**, Cannes Const.; 1♂ **Spain**, San Idefonso, 84. m.; 1♂ Sierra de Alfacar, m., 89; 1♂ Granada m.; 1♂ Siera de Hueter, m. 80; 1♂ **Italy**, Carniolia; 2♀ Trentino, Mt. Baldo, Mt. Altissimo, 1450 m, ex *Paeonia officinalis*, 6. & 8.vi.1958, Jaeckh leg. (all ZMHUB); 2♂, 2♀ Mt. Baldo, late vi.1967 (e. l.), Pfister leg.; 3♂ Mt. Baldo, Corne Piana, 1600 m, late vi.1961 (e. l.), Burmann leg.; 7♂, 1♀ Mt. Baldo, mid vi.1958, Pfister leg. (all EMEM).

Derivatio nominis. The subspecies is named after Mrs Vera Isajeva (Uljanovsk, Russia) who took an active participation in collecting of entomological material and made a contribution to the knowledge of the entomofauna of the Uljanovsk District.

Remarks. The species is here recorded from Russia for the first time.

Acknowledgements

We are grateful to Mrs V. Isajeva and Mr A. Isajev (Uljanovsk) for their help in many aspects. We want to thank Dr. V. I. Kuznetsov (St. Petersburg) for taxonomic advices, Dr. V. I. Tobias and Dr. R. Kasparjan (both St. Petersburg) who kindly identified the parasitoids. We also owe our special thanks to Dr. V. V. Anikin (Saratov) for his contribution to a knowledge of species biology in Saratov Province. And we thank Mr A. Noem for his help in technical work.

References

- Kuznetsov, V.I. 1978. Tortricidae. – *In*: Medvedev G. S., Keys to the insects of the European part of the USSR 4 (1). – Leningrad, “Nauka”. Pp. 193–710 (in Russian).
- Maslennikov, A.V. 1995. On distribution and ecology of *Paeonia tenuifolia* L. on the Central part of Cis-Volga height. pp. 93–94. – *In*: Flora of Central Russia [Flora Tsentral’noj Rossii]. – Moscow State University, Moscow (in Russian).
- Razowski, J. 2001. Die Tortriciden (Lepidoptera, Tortricidae) Mitteleuropas. – F. Slamka, Bratislava. 319 pp.
- Razowski, J. 2003. Tortricidae (Lepidoptera) of Europe 2. Olethreutinae. – F. Slamka, Bratislava, 301 pp.

Lithostege fissurata Mabille, 1888 from Malta, new for the fauna of Europe (Geometridae, Larentiinae)

AXEL HAUSMANN¹ & ANTHONY SEGUNA²

¹ Zoologische Staatssammlung München, Münchhausenstr. 21, D-81247 Munich, Germany; e-mail: Axel.Hausmann@zsm.mwn.de

² 68 'Redeemer' Triq L-Emigranti, Naxxar NXR 05, Malta; e-mail: seguna@onvol.net

Abstract. The first record of *Lithostege fissurata* Mabille, 1888 for Malta Island and for the fauna of Europe is presented. *L. inanis* Prout, 1941 is downgraded (again) to subspecies of *L. fissurata*. *L. bifissana* Rebel, 1911 is downgraded from species rank to synonymy of *L. notata* Bang-Haas, 1906.

Zusammenfassung. *Lithostege fissurata* Mabille, 1888 wird für Malta und damit erstmals für die europäische Fauna nachgewiesen. *L. inanis* Prout, 1941 wird wieder auf den Rang einer Unterart von *L. fissurata* herabgestuft. *L. bifissana* Rebel, 1911 ist ein jüngeres Synonym von *L. notata* Bang-Haas, 1906.

Key words. *Lithostege fissurata*, Geometridae, fauna of Europe, Malta, synonymy.

Introduction

When Müller (1996) listed 915 European geometrid species, the fauna was thought to be well known. However, during the preparation of the book series “The Geometrid moths of Europe”, several new species were discovered. The new European checklist, which was published recently on the internet, contains 957 species (Hausmann 2004). The fauna of Malta included 52 geometrid moth species in Valletta (1973) and 57 species in Müller (1996). Sammut (2000) listed 89 geometrid species for the island, but many of these records are based on doubtful sources. According to Hausmann & Viidalepp (2004) there are 59 valid records while eight additional species await confirmation.

Eleven *Lithostege* species were mentioned by Hausmann & Viidalepp (2004). However, one of them, *L. cinerata* Turati, 1924 (sensu Hausmann 2004), has to be deleted because it was recently replaced by the description of *Lithostege clarae* Gastón & Redondo, 2004. The latter name was added to the faunal inventory ‘at the last minute’ (July 2004) and the name of the sister species could not be removed from the list. With the discovery of *L. fissurata*, the number of European *Lithostege* taxa increases to the following eleven species:

The *bosporaria* species-group

Lithostege bosporaria (Herrich-Schäffer, 1848)

The *farinata* species-group

Lithostege coassata (Hübner, 1825)

Lithostege farinata (Hufnagel, 1767)

Lithostege duponcheli Prout, 1938

Lithostege palaestinensis Amsel, 1935

Lithostege clarae Gastón & Redondo, 2004 (= *L. cinerata* sensu Hausmann & Viidalepp 2004)

Lithostege griseata ([Denis & Schiffermüller], 1775)

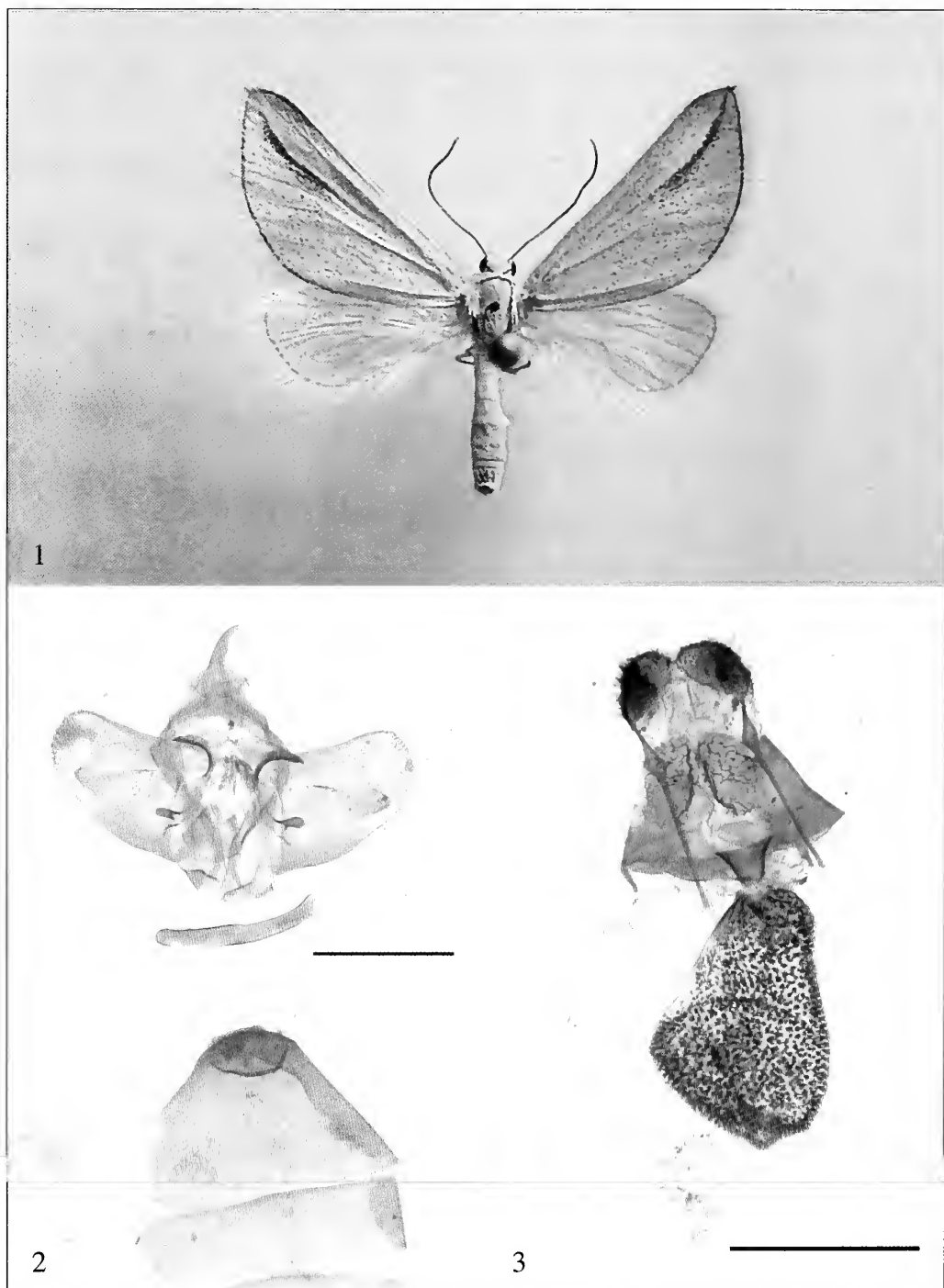
Lithostege fissurata Mabille, 1888

Lithostege infuscata (Eversmann, 1837)

Lithostege odessaria (Boisduval, 1848)

The *castiliaria* species-group

Lithostege castiliaria Staudinger, 1877



Figs. 1–3. *Lithostege fissurata* Mabille, 1888. **1.** Habitus of specimen from Malta (photo: A. Seguna). **2.** Male genitalia of specimen from Tunisia and sternum A8 (photos: A. Hausmann). **3.** Female genitalia of specimen from Tunisia (photo: A. Hausmann). Scale bars 1 mm.

***Lithostege fissurata* Mabille 1888**

(Figs. 1–3)

Lithostege fissurata Mabille, 1888: 58 (type locality: Tunisia). Holotype ♀ (ZSM/Herbulot, examined; topotypical material of both sexes dissected: Figs. 2, 3).

Lithostege inanis Prout in Seitz, 1941: 331, “pl. 34i” (Scoble 1999), “pl. 34a” in the text of Prout (1941: 331), but not illustrated under both indications in the German edition of Seitz (type locality: Saudi Arabia: Khafa). Holotype ♂ (BMNH, examined; topotypical material of both sexes dissected). Wiltshire 1990 (synonym); Scoble 1999 (bona sp.); here regarded as subspecies of *L. fissurata* **stat. rev.**

Lithostege fitzgeraldi Wiltshire, 1947: 10, fig. 15, text-fig. 10 (type locality: Saudi Arabia, Artawiya, Nejd). Holotype ♂ (BMNH, examined). Scoble 1999 (junior synonym of *L. f. inanis*).

Material. 1♂, **Malta**, Qrendi, San Niklaw, 7.iii.2004, coll. Denis Magro, at light. Additionally examined (ZSM): 5♂♀ **Tunisia**, 11♂♀ **Algeria**, 1♂1♀ **Libya**, 4♂♂ **S. Israel** (Arava valley: Yotvata), 21♂♀ **Saudi Arabia**; 1♀ **SE. Iran** (Balutshistan).

Diagnosis. (Fig. 1). Wingspan: 19–28 mm. Wing shape with the generic characteristics of *Lithostege*, i.e. small, hindwing round, forewing termen convex, forewing apex slightly pointed. Ground colour of hindwing dirty white, that of forewing pale cream-coloured. No wing pattern except for the broad dark grey apical streak, which may, in about 5% of the specimens occasionally be absent or very weakly marked. In subsp. *inanis* this apical streak is always absent, hindwing darker than in nominate subspecies, usually darker than forewing. Sternum A8 in both sexes posteriorly sclerotised to a rounded lobe.

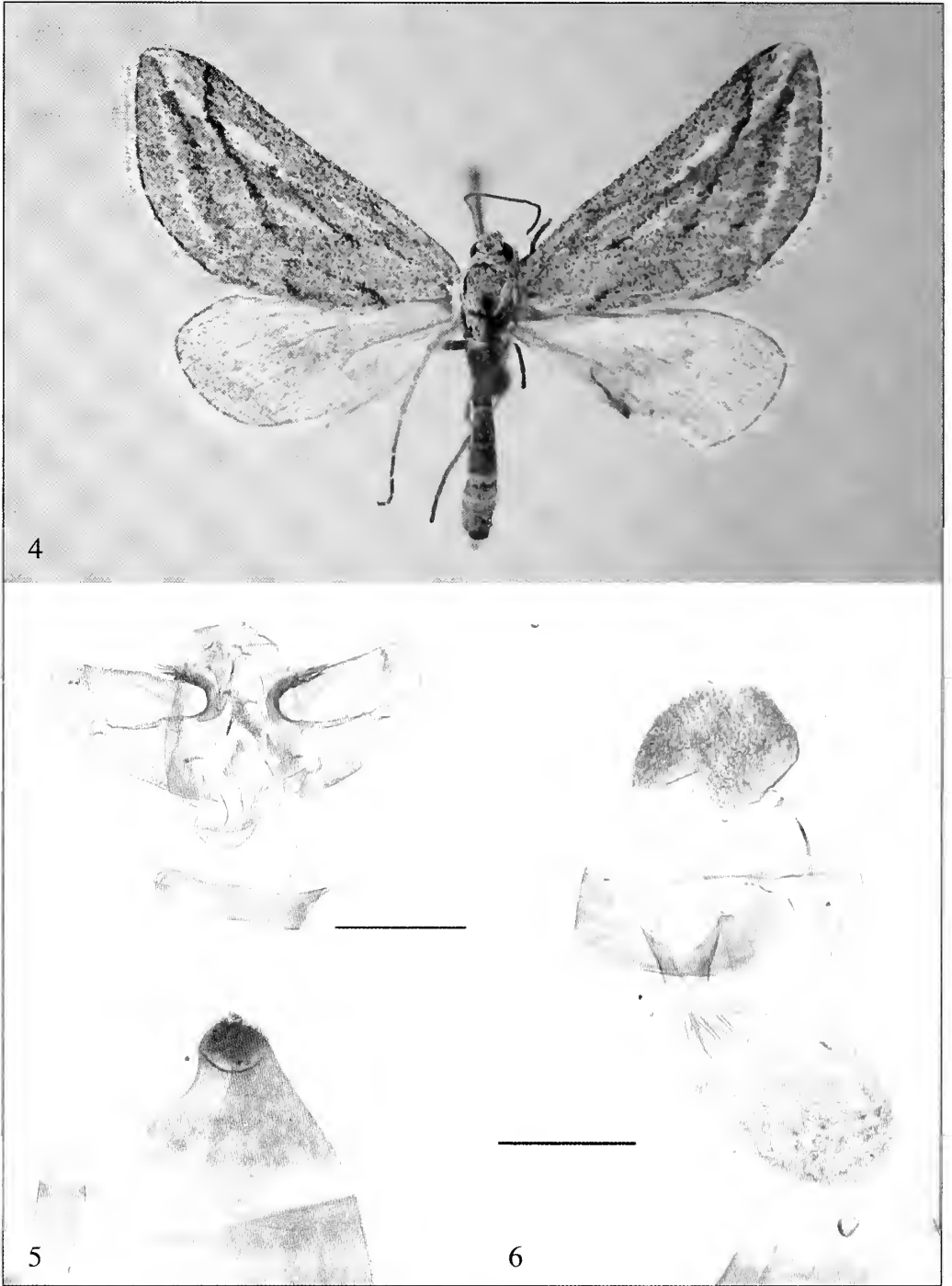
Male genitalia (Fig. 2). Uncus short, stout, tapered. Valva short and broad. Posterior basal process of valva short, strongly curved, spinulose at tip. Anterior basal process of valva short and rounded. Aedeagus short.

Female genitalia (Fig. 3). Apophyses anteriores very short. Antrum trapezoid or sub-triangular. Ductus bursae very short. Corpus bursae globular or slightly elongate, covered all over with spinules.

Distribution. Nominate subspecies from western Algeria to Libya, south-eastern Egypt (Wiltshire 1949), Israel (new for the fauna of Israel; Arava valley: ZSM). Subspecies *inanis* from Saudi Arabia to south-eastern Iran (new for the fauna of Iran; Balutshistan: ZSM) and southern Iraq (Wiltshire 1952).

Life history. Univoltine. Label data indicate a flight period spanning from early March to early May (nominate subspecies), and from mid-February to mid-March in ssp. *inanis*. Vertical distribution from 0 m up to 800 m above sea level. The moth was caught in Malta near a coastal steppe which includes plants like the Sea squill (*Urginea maritima*), Branched Asphodel (*Asphodelus aestivus*), and Spurges (*Euphorbia* spp.). Egg described in Prout (1937). Other immature stages unknown.

Remarks. After examination of numerous topotypical specimens exactly corresponding to the original description, the taxon “*L. bifissana* Rebel, 1911”, described from the Jordan valley (Israel/Jordan) in comparison with *L. fissurata*, and treated as a separate species in Scoble (1999), must be downgraded to the synonymy of *L. notata* Bang-Haas, 1906 (syn. n.) (Figs. 4–6). The habitus and morphology of *L. fissurata* support its position in the *Lithostege farinata* species-group. The peculiar wing pattern excludes confusion with any other of the known *Lithostege* species, at least in the nominate



Figs. 4–6. *Lithostege notata* Bang-Haas, 1906 (= *bifissana* Rebel, 1911). **4.** Habitus of specimen from Jordan, 20 km NE Dead Sea. **5.** Male genitalia and sternum A8 (Israel, southern Dead Sea region). **6.** Female genitalia (Israel, southern Dead Sea region) (photos: A. Hausmann). Scale bars 1 mm.

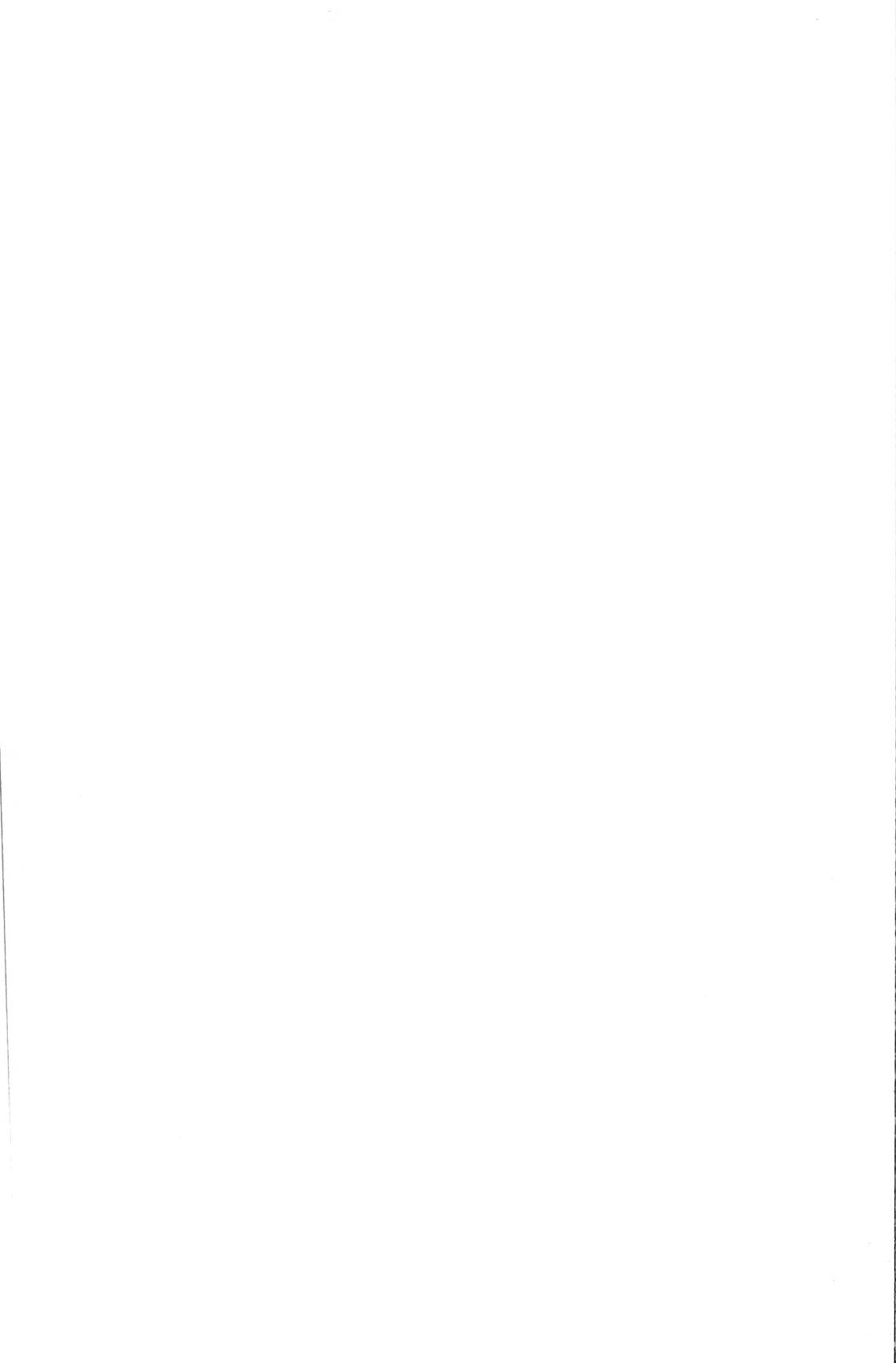
subspecies. This new record shows that apart from new entries by ‘species splitting’, there are still some ‘spectacular’ Macrolepidoptera species awaiting discovery on the territory of Europe. However, it remains unclear whether *L. fissurata* is just a rare species, overlooked due to the early flight season, or a recent coloniser of the island of Malta, or a rare migrant from North Africa.

Acknowledgements

We are indebted to Denis Magro for the loan of the material in question.

References

- Hausmann, A. 2004. The Fauna of Europe, Geometridae. – <http://www.faunaeur.org/>.
- Hausmann, A. & J. Viidalepp 2004. Larentiinae. – *In*: A. Hausmann, The Fauna of Europe, Geometridae. – <http://www.faunaeur.org/>.
- Mabille, P. 1888. Descriptions d'espèces nouvelles de Lépidoptères de Tunisie et d'Algérie. – Bulletin de la Société entomologique de France 1888: 42–43, 51–52, 58–59.
- Müller, B. 1996. Geometridae. pp. 218–249. – *In*: O. Karsholt & J. Razowski, The Lepidoptera of Europe, a Distributional Checklist. – Apollo Books, Stenstrup, 380 pp.
- Prout, L. B. 1934–1935, additions 1938. Brephinae, Oenochrominae, Hemitheinae, Sterrhinae, Larentiinae. – *In*: Seitz, A., Die Groß-Schmetterlinge der Erde, Suppl. 4. – Verlag A. Kernen, Stuttgart.
- Sammut, P. M. 2000. Il-Lepidoptera. – Publikazzjonijiet Indipendenza, Malta, 245 pp.
- Scoble, M. J. 1999. Geometrid Moths of the World: a catalogue (Lepidoptera, Geometridae). Vols. 1 and 2. – CSIRO Publishing and Apollo Books, Stenstrup. 1016 pp. + 129 pp. index.
- Prout, L. B. 1920–1941. Die indoaustralischen Spanner. – *In*: Seitz, A., Die Groß-Schmetterlinge der Erde, vol. 12. – Verlag A. Kernen, Stuttgart, 356 pp.
- Valletta, A. 1973. The Moths of the Maltese Islands. – Progress Press, Malta, 118 pp.
- Wiltshire, E. P. 1947. Middle East Lepidoptera VII: New species and forms from Egypt and Arabia. – Bulletin de la Société Fouad I^{er} d'Entomologie 31: 1–11, pl.
- Wiltshire, E. P. 1949. The Lepidoptera of the Kingdom of Egypt, Pt. 2. – Bulletin de la Société Fouad I^{er} d'Entomologie 33: 381–457.
- Wiltshire, E. P. 1952. Further New records of Lepidoptera from Cyprus, Iraq and Persia (Iran). – Entomologist's Record and Journal of Variation 63, suppl. 10: 1–6.
- Wiltshire, E. P. 1990. An illustrated, annotated catalogue of the Macro-Heterocera of Saudi Arabia. – Fauna of Saudi Arabia 11: 91–250.



Revision of *Evergestis anartalis* (Staudinger, 1892) comb. rev. from Central Asia (Pyraloidea: Crambidae: Evergestinae)

MATTHIAS NUSS

Museum für Tierkunde, Königsbrücker Landstr. 159, D-01109 Dresden.

e-mail: matthias.nuss@snsd.smwk.sachsen.de

Abstract. The nomenclature of *Evergestis anartalis* (Staudinger, 1892) **comb. rev.**, a species which has been described three times and of which the names have been placed in three different subfamilies of Crambidae, is investigated. The generic name *Maelinoptera* Staudinger, 1893 **syn. n.** is revised as a junior subjective synonym of *Evergestis* Hübner, 1825 and the type-species of this monotypic genus, *Hercyna anartalis* Staudinger, 1892, is transferred to *Evergestis*. *Evergestis heliacalis* Zerny, 1914 **syn. n.** and *Noctuelia anartalis* Hampson, 1918 **syn. n.**, are considered as junior subjective synonyms of *Evergestis anartalis* (Staudinger, 1892) (*Hercyna*). *Evergestis anartalis* Hampson, 1918 (*Noctuelia*) therefore becomes a junior secondary homonym of *Evergestis anartalis* (Staudinger, 1892) (*Hercyna*). Lectotypes of *Hercyna anartalis* Staudinger, 1892 and *Evergestis heliacalis* Zerny, 1914 are designated. *Evergestis anartalis* (Staudinger, 1892) is redescribed; adults, male and female genitalia are illustrated. According to the specimens investigated, it is assumed that *Evergestis anartalis* is endemic to sub-alpine and alpine altitudes in Central Asia.

Key words. *Evergestis anartalis*, taxonomic revision, Central Asia, alpine altitudes, endemic species.

Introduction

After Staudinger (1892: pl. 3 fig. 17) already figured *Hercyna anartalis*, he provided the description of this species a year later and described the genus *Maelinoptera* to include *Hercyna anartalis* only (Staudinger 1893: 72–73). Already Meyrick (1890: 457–458), Rebel (1901: 56) and Zerny (1914: 326) included *anartalis* Staudinger in the genus *Evergestis* Hübner, 1825 but did not mention *Maelinoptera*. Subsequently, Klima (1939: 334) treated *Maelinoptera* as a synonym of *Evergestis*. However, *Maelinoptera* was later placed in Pyraustinae (Pyraloidea: Crambidae) by Fletcher & Nye (1984: 60), and the same authors distinguish the Evergestinae with the type genus *Evergestis* as a distinct group from Pyraustinae. The type series of *Hercyna anartalis* Staudinger is deposited at the Museum für Naturkunde in Berlin. However, a specimen looking externally conspecific with *anartalis* Staudinger and labelled as type of *anartalis* Hampson has been found also in the collection of The Natural History Museum in London (BMNH). Subsequent search in the card index of the BMNH referred to an original reference from which it is evident that Hampson (1918: 406–407) described a new species under the name *Noctuelia anartalis*. According to current classification, *Noctuelia* Guenée, 1854 belongs to the subfamily Odontiinae (Pyraloidea: Crambidae). Searching the literature, a further description has been detected of a species which seems to have affinities to *Hercyna anartalis* Staudinger, too. It is the description of *Evergestis heliacalis* by Zerny (1914: 326–327, pl. 26 fig. 26), which according to current classification belongs to Evergestinae. Thus, three species descriptions have been found in literature which are under the suspicion to belong to one species, or to a few closely related species, which however are assigned to three different subfamilies of Crambidae, depending on the reference used. Due to this confusing situation, the types of all three taxa, as well as additional specimens have been investigated and the results are presented in the following.

Abbreviations

BMNH	The Natural History Museum, London.
MTD	Museum für Tierkunde, Dresden.
NMW	Naturhistorisches Museum, Wien
SMF	Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main
ZMHB	Museum für Naturkunde der Humboldt-Universität zu Berlin

***Evergestis anartalis* (Staudinger, 1892) comb. rev.**

Hercyna anartalis Staudinger, 1892: 466, pl. 3 fig. 17; 1893: 72 (type-locality: 'Centralasien').

Noctuelia anartalis Hampson, 1918: 406–407 (type-locality: 'E-Turkestan') **syn. n., junior secondary homonym.**

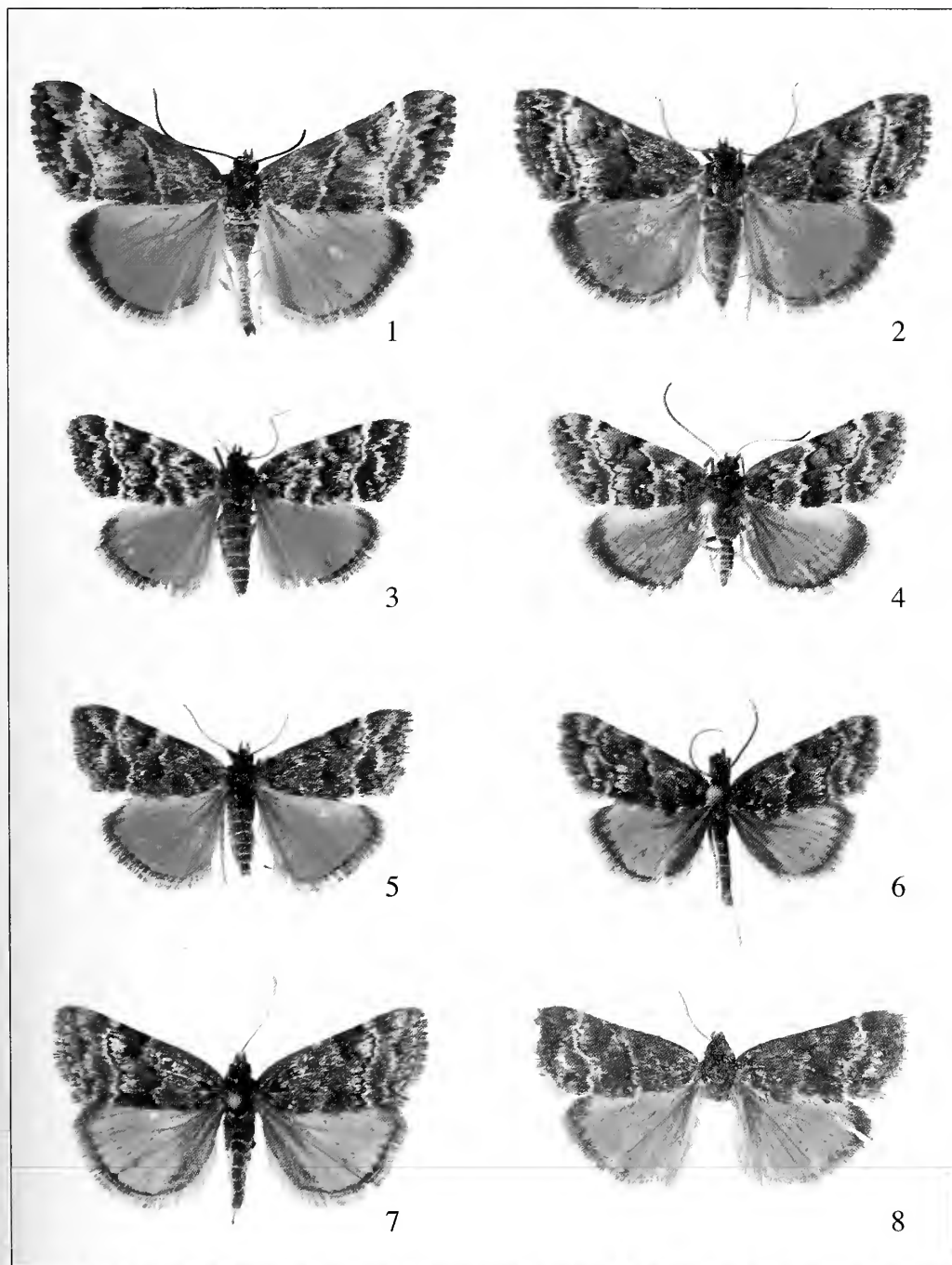
Evergestis heliacalis Zerny, 1914: 326–327, pl. 26 fig. 26 (type-locality: 'Djarkent Ili-Gebiet') **syn. n.**

Material. *Hercyna anartalis* Staudinger: Lectotype ♂ 'Origin', [Uzbekistan, Namangan, 40°57'N 71°40'E], '*Hercyna anartalis* | Staudinger, 1892 | det & coll Stdr 3#18 | teste M. Nuss, 1998', 'Lectotype | *Hercyna anartalis* | Staudinger, 1892 | des. M. Nuss, 2005' (hereby designated), 'prep. no. | 1040 | M. Nuss, 2005', ZMHB. – Paralectotypes: 3♂, 2♀, same data as lectotype; 1♀ Margelan [Alai, 40°24'N 71°43'E]; 1♀ **Kyrgyzstan**, Osch [40°29'N 72°51'E]; 1♂ Alexandergebirge (Kirgizskiy Khrebet, 42°30'N 73°30'E); 2♂, 2♀ **Kazakhstan**, Alatau [Dzungarischer Ala-Tau, 45°10'N 81°00'E]; 1♀ Kuldja [=Kuldsha, = **China**, Xinjiang, Gulja 43°57'N 81°24'E]; 1♂, 1♀ **Altai**; ZMHB. – *Noctuelia anartalis* Hampson: Holotype (by monotypy) ♀ 'Type', 'Turkestan | A. Avinoff. | 1913–191.', '*Noctuelia* | *anartalis* | type ♀. Hmps. n.', 'B.M. Pyralidae | Genitalia slide | No. 20282 ♀' (gen. prep. Nuss 828), BMNH. – *Evergestis heliacalis* Zerny: Lectotype ♂, with white label, printed: 'Asia centr. | [Kazakhstan] Ili Gebiet | Umg. Djarkent | Coll. Wagner', white label handwritten in black ink: '20.7.[19]10', white label handwritten in black ink: '*Evergestis* | *heliacalis* Zerny | ♂ [and in red ink:] Type', white label, printed: 'prep. no. | 1039 | M. Nuss, 2005' [prep. no. NMW: 16847], red label, printed: 'Lectotypus | *Evergestis heliacalis* | Zerny, 1914 | des. M. Nuss, 2005', (hereby designated), NMW. Paralectotypes: 2♀, same data. [but no date given], (one ♀ without abdomen), NMW. – **Additional material.** 1♂ **Kyrgyzstan**, Chatkal'skij Chrebet, Sarsuta Pass (41°31'N 70°46'E), 2800 m, 26.vi.1998, leg. et coll. Karisch; 1♂, 1♀ Turkestan Mts., Ak-Terek, Noodzhailo valley, 3000–3400 m, 1.–14.vii.1999, Petrov leg., MTD; 1♂ Alayskij Mts., Taldykpass, 3550 m, 39°46'N 73°09'E, 13.vii.1998, Nuss leg., MTD; 2♂, 1♀ Alai, Paravicini Coll. B.M. 1937–383, BMNH. 1♂ **Kazakhstan**, Ili Gebiet, Djarkent (= Dzarkent, = Panfilov 44°10'N 80°01'E), coll. Möbius, MTD; 1♂ Zailijskij Alatau, Turgen valley, 43°15'N 77°52'E, 2400 m, 19.vi.2000, Nuss leg., MTD; 1♀ same data, but 2660 m; 3♂ Zailijskij Alatau, 43°05'N 77°04'E, 3300 m, 5.–6.vii.2000, Nuss leg., MTD. 2♀ **China**, Xinjiang, Korla, ZMHB; 1♂ Tura, coll. A. Seitz, SMF.

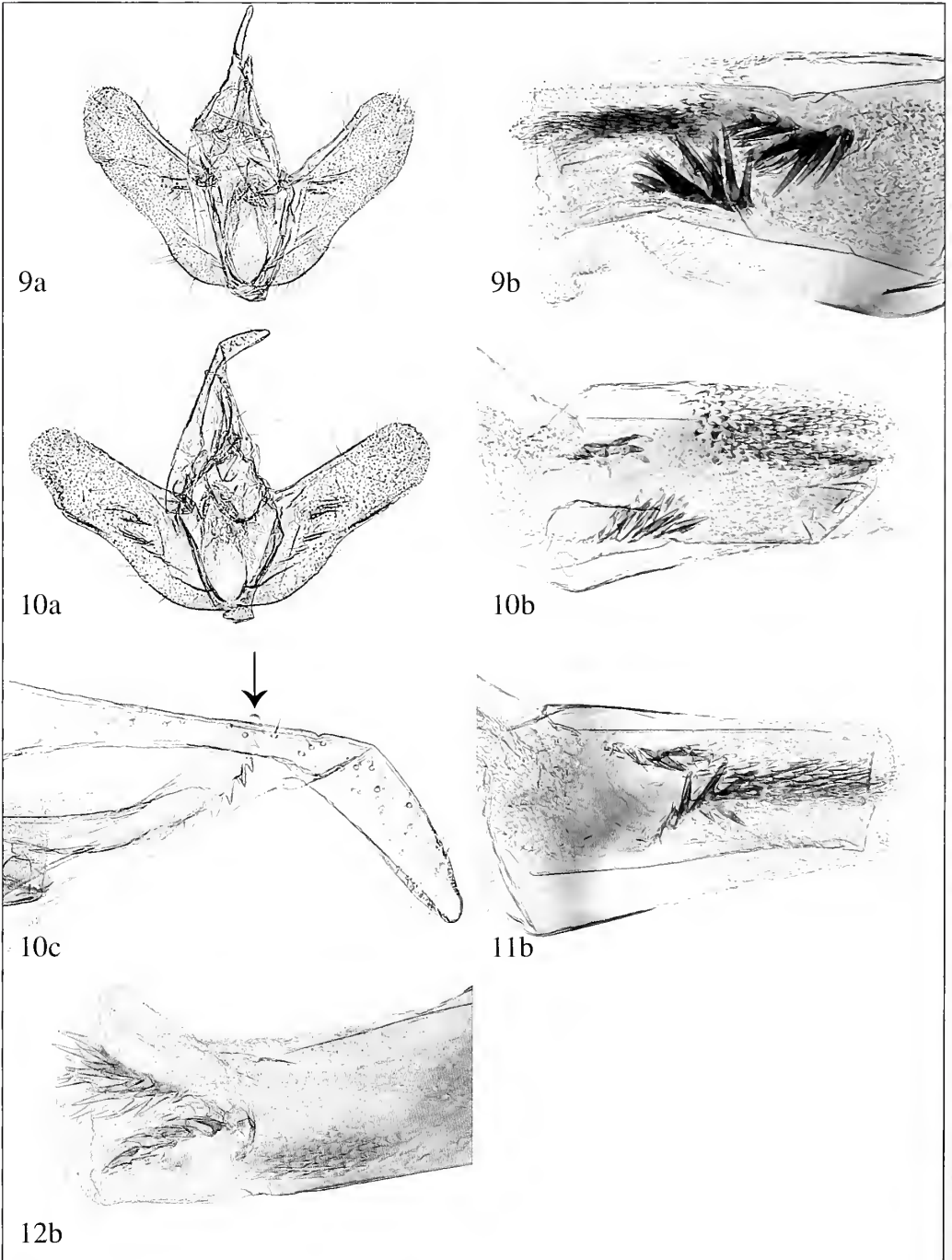
Description of the lectotype of *E. anartalis* (Staudinger), ♂ (Fig. 1).

Head. Globular; labial palpi porrect, as long as diameter of eyes, long and white scaled ventrally, light brown coloured laterally; maxillary palpi slender, cylindrical, upright; flagellum slenderly filiform, flagellomeres slightly prismatic, dorsally whitish brown scaled, ventrally densely setose. Head dorsally covered with spatulate scales, coloured brown, intermixed with white; ventrally predominantly white scaled; long hair-like scales are intermixed around the head, with the exception of compound eyes.

Thorax. Dorsally dominantly covered with spatulate scales, coloured brown, black and white; intermixed with white hair-like scales. Ventrally predominantly scaled with white, hair-like scales, also at coxae and femora. Forewing 12 mm long, dorsal side dominant brown coloured; basal area with a white, dentate line proximal of antemedian line; antemedian line white, dentate, black edged towards median space; distal discocellular stigma X-like, black; postmedian line yellowish white, S-like bent from anterior to posterior margin of wing, proximally black edged and with broad cream-white band; at termen a white, strongly dentate line, black edged toward termen; fringe brown and white chequered. Hindwing dorsally dominant indian yellow coloured, with



Figs. 1-8. Adults of *Evergestis anartalis* (Staudinger, 1892). **1.** Lectotype, ♂, *Hercyna anartalis* Staudinger, 1892, from Namangan (ZMHB). **2.** Paralectotype, ♀, *Hercyna anartalis* Staudinger, 1892, from Namangan (ZMHB). **3.** Paralectotype, ♀, *Hercyna anartalis* Staudinger, 1892, from the Alay Mts. (ZMHB). **4.** Paralectotype, ♂, *Hercyna anartalis* Staudinger, 1892, from the Alexander Mts. (ZMHB). **5.** Paralectotype, ♀, *Hercyna anartalis* Staudinger, 1892, from the Alatau Mts. (ZMHB). **6.** Lectotype, ♂, *Evergestis heliacalis* Zerny, 1914 from Panfilov (NMW). **7.** Paralectotype, ♀, *Evergestis heliacalis* Zerny, 1914 from Panfilov (NMW). **8.** Holotype, ♀, *Noctuella anartalis* Hampson, 1918 (BMNH).



Figs. 9–12. Male genitalia of *Evergestis anartalis* (Staudinger, 1892). **9.** Lectotype of *E. anartalis* (Staudinger), prep. Nuss 1040. **10.** Lectotype of *E. heliacalis* Zerny, prep. Nuss 1039. **11.** Paralectotype, *E. anartalis* Staudinger, prep. Nuss 1041 (same specimen as Fig. 4). **12.** Paralectotype, *E. anartalis* Staudinger from Namangan, prep. Nuss 831. **a.** male genitalia. **b.** posterior end of phallus with cornuti. **c.** distal tip of gnathos (arrow) and uncus.

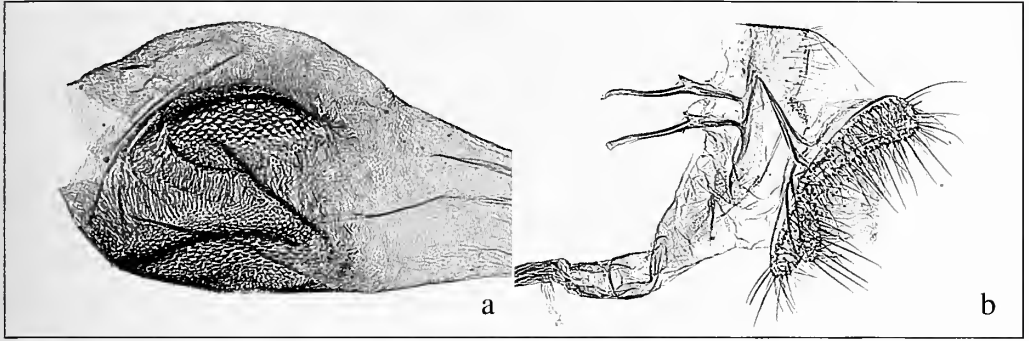


Fig. 13. Female genitalia of *Evergestis anartalis* (Staudinger, 1892), paralectotype from Alay Mts., prep. Nuss 829. **a.** bursa copulatrix. **b.** colliculum, segment VIII and papillae anales (from left to right).

dark brown margin; fringe brown at base, pale ochre distally. All wings ventrally pale yellow; forewings with conspicuous black-brown distal discoidal stigma, pale brown coloured apex, which is interrupted by a yellow line at costa; hindwings with brown apex too, and an inconspicuous spotted line parallel to termen. Male retinaculum with hamus.

Abdomen. Dorsally brown scaled, white edge along posterior margin of tergites; ventrally predominantly white coloured.

Male genitalia (Figs. 9–12). Uncus triangular. Gnathos slightly bent; broadly articulating along ventral edge of tegumen as characteristic for Evergestinae; dentate dorsally before distal tip. Valvae with straight dorsal edge, ventrally at base strongly convex, a folded, slightly stronger sclerotised field medially; juxta elongate ovate; vinculum slender. Phallus conspicuously blunt angled after two thirds from the anterior; opening of ductus ejaculatorius just anterior to this angle; within the posterior third, there are two ventro-lateral elongate fields of thorn-like cornuti close to the posterior edge of the phalldeme; anterior to this fields there are two lateral groups of larger cornuti, too.

Female genitalia (Fig. 13). Corpus bursae globular, with a pair of signa composed of numerous rectangular sclerites, surrounded by needle-like sclerotisations; cervix bursae large funnel shaped; ductus bursae narrow; colliculum and antrum dorsally forming a sclerotised ring, open ventrally; sternite VIII very narrow; apophyses anteriores and apophyses posteriores short; papillae anales connected dorsally, strongly setose.

Variation (Figs. 2–8, 9–12b). Forewing length 8–12 mm; the six specimens from Namangan, north of the Fergana Valley, present a larger forewing length (11–12 mm) as all other specimens, including the primary types of *Evergestis heliacalis* and *E. anartalis* (Hampson) (8–10 mm). The quantity of hair like scales varies, especially around the head and dorsal side of thorax. Forewing dorsally with white basal line in some specimens absent, antemedian line and subterminal line more or less inconspicuous, shape of S-bent postmedian line varies slightly; and scales covering the hamus are pale yellow or brown coloured. The hindwing with dark-brown marginal band variable in width; the basal area in some specimens with large brown field, in some specimens occupying

the entire inner edge of wing; ventrally, the spotted line is absent in some specimens. In male genitalia, dentation at distal tip of gnathos is reduced in some specimens and size of cornuti varies slightly. Variation of different characters do not correspond to each other. Females with somewhat broader forewings, comparing specimens of the same size.

Generic placement. The genus *Maelinoptera* Staudinger, 1893 with its only included species *Hercyna anartalis* Staudinger, 1892 has been described mainly by the presence of intensively yellow coloured hindwings, while most *Evergestis* species have pale-brown hindwings. However, all other morphological characters used for generic concepts in Evergestinae are so similar to *Evergestis*, that *Maelinoptera* Staudinger, 1893 **syn. rev.** is revised as a synonym of *Evergestis* Hübner, 1825 (type species: *Pyralis margaritalis* [Denis & Schiffermüller], 1775) here. So far, *Evergestis* is not proven as a monophyletic group, but the species included are so similar in morphology, especially that of genitalia, that there is no reason to doubt that they constitute a natural group. Some characters the *Evergestis* species have in common are in male genitalia the long and slender uncus and gnathos, the latter distally toothed and articulating from the ventral edges of tegumen, a long juxta, the valvae are simple and unarmed, and the phallus is obtusely angled behind the middle, in some species with cornuti. The females have well developed papillae anales, the bursa copulatrix is globular and has a pair of large signa (Munroe 1973; Goater, in press).

Life history. Adults have been collected between 19.vi.–20.vii. The early stages are unknown.

Distribution. The species is known only from Central Asia. All records with reliable data are related to localities at 2400–3550 m altitude, the sub-alpine and alpine meadows. Thus, it is assumed that *E. anartalis* Staudinger is endemic to the high mountains of Central Asia.

Remarks. The few specimens available for study suggests that only the six specimens from Namangan in the Fergana Valley present a larger forewing length (11–12 mm), while all other specimens with a smaller forewing length (8–10 mm) probably originate from higher altitudes, as indicated by those specimens collected more recently with more precise data. The specimens originating from higher altitudes also seem to have more black pigments suffused on thorax and forewings, as well as a higher quantity of hair like scales at head and thorax. Therefore, it might be possible that at least some of the variable character states are related to altitudinal adaptation. However, few specimens have been investigated only and it remains interesting to learn more about the factors influencing the variation. Overall variation shows no constant and distinct characters to separate species of the *Evergestis anartalis* complex. Therefore, *Evergestis heliacalis* Zerny, 1914 **syn. n.** and *Noctuelia anartalis* Hampson, 1918 **syn. n.** are synonymised here with *Evergestis anartalis* Staudinger, 1892 (*Hercyna*). Thus, *Noctuelia anartalis* Hampson becomes a junior secondary homonym of *Evergestis anartalis* Staudinger. In order to clearly verify the status of the species group names for the taxa investigated and to fix their name bearing types, lectotypes are designated for *Hercyna anartalis* Staudinger, 1892 and *Evergestis heliacalis* Zerny, 1914.

Acknowledgements

I am grateful to Sabine Gaal-Haszler (NMW), Timm Karisch (Dessau, Germany), Wolfram Mey (ZMHB) and Wolfgang Nässig (SMF) for the loan of specimens as well as to Michael Shaffer & Kevin Tuck (BMNH) for access to the collections under their care.

References

- Fletcher, D.S. & I.W.B. Nye 1984. The generic names of moths of the world. **5**. Pyraloidea. – Trustees of the British Museum (Natural History), London: i–xvi, 1–185.
- Goater, B., in press. Evergestinae. – *In*: B. Goater, M. Nuss & W. Speidel, Pyraloidea I (Crambidae: Acenropinae, Evergestinae, Heliiothelinae, Schoenobiinae, Scopariinae). – *In*: P. Huemer & O. Karsholt, Microlepidoptera of Europe **4**. – Apollo Books, Stenstrup.
- Hampson, G. F. 1918. Descriptions of new Pyralidae of the subfamily Pyraustinae. – *Annals and Magazine of Natural History* (ser. 9) **2**: 393–407.
- Hübner, J. 1816–1826 [‘1816’]. Verzeichniss bekannter Schmettlinge [sic]. – Augsburg: bey dem Verfasser zu finden. – pp. (Verzeichniß) [1]–[3]–4–6–[7]–8–431, (Anzeiger) [1]–2–72.
- Klima, A. 1939. Pyralididae: Subfam.: Pyraustinae I. pp. 225–383. – *In*: F. Bryk, Lepidopterorum Catalogous **94**. – Verlag Gustav Feller, Neubrandenburg.
- Meyrick, E. 1890. On the classification of the Pyralidina of the European fauna. – *Transactions of the Entomological Society of London*: 429–492, pl. 15.
- Munroe, E. G. 1974. Pyraloidea, Pyralidae comprising the subfamily Evergestinae. Pp. 251–304, pls. 1–13, pls. A–K, pp. xv–xx. – *In*: R. B. Dominick et al., *The Moths of America north of Mexico* **13.1C**. – E.W. Classey and R.B.D. Publications Inc., London.
- Rebel, H. 1901. Catalog der Lepidopteren des palaearktischen Faunengebietes. 2. Theil: Famil. Pyralidae–Micropterygidae. – Berlin (R. Friedländer & Sohn), pp. 1–368.
- Staudinger, O. 1892. Folgende auf Tafel III abgebildete Arten werden im nächsten Bande dieser Zeitschrift noch beschrieben. – *Deutsche entomologische Zeitschrift Iris*, Dresden **5**: 466, pl. 3.
- Staudinger, O. 1893. Beschreibungen neuer palaearktischer Pyraliden. – *Deutsche entomologische Zeitschrift Iris*, Dresden **6**: 71–82.
- Zerny, H. 1914. Über paläarktische Pyraliden des k.k. naturhistorischen Hofmuseums in Wien. – *Annalen des k.k. naturhistorischen Hofmuseums Wien* **28**: 295–348, pl. 25–26.

***Polyommatus dantchenkoii* (Lukhtanov & Wiemers, 2003) tentatively identified as new to Europe, with a description of a new taxon from the Balkan Peninsula (Lycaenidae)**

ZDRAVKO KOLEV

Porttikujja 4 E 101, FIN – 00940 Helsinki, Finland; e-mail: zdravko.kolev@helsinki.fi

Abstract. Karyological data have revealed the presence of a taxon corresponding to the recently described *Polyommatus (Agrodiaetus) dantchenkoii* (Lukhtanov & Wiemers, 2003) in the Rhodopi Mts. of Bulgaria. The find expands greatly the range of this karyospecies, previously known only from Van Province in SE Turkey. This population is identical in karyotype structure and haploid chromosome number ($n=41-42$) and has a generally similar external and genital morphology than *P. (A.) dantchenkoii*. On the other hand, the Rhodopi population differs morphologically from nominotypical *P. (A.) dantchenkoii* as well as from all other Balkan taxa of brown *Agrodiaetus*. For these reasons this population is here described as a separate taxon, *Polyommatus dantchenkoii orphicus* ssp. n.

Key words. karyotype, chromosome, *Polyommatus*, *Agrodiaetus*, *dantchenkoii*, *aroaniensis*, *ripartii*, *admetus*, Lycaenidae, Lepidoptera, Europe, Balkan Peninsula, Bulgaria, Rhodopi, *orphicus* new subspecies.

Introduction

The systematics of *Agrodiaetus* Hübner, 1822, a subgenus of *Polyommatus* Latreille, 1804 is presently in a state of upheaval. In addition to the steady flow of descriptions of new taxa, the first molecular phylogenies of the group (Wiemers 2003; Kandul et al. 2004) provided entirely new insights on the relationships within this highly complex and diverse subgenus. Most challenging is the taxonomy of the so-called monomorphic or ‘brown’ taxa, so named because of the uniform brown colour of the male upperside, similar to that of the female. The high species diversity of this group was brought to light in the 1960’s by the pioneering karyological research of H. De Lesse. Nowhere in the subgenus is reliance on karyology as important for taxonomy and systematics as in the brown taxa. Currently four species of brown *Agrodiaetus* are known from the Balkan Peninsula: *P. (A.) admetus* (Esper, [1783]), *P. (A.) ripartii* (Freyer, 1830), *P. (A.) aroaniensis* (Brown, 1976), and *P. (A.) nephohiptamenos* (Brown & Coutsis, 1978). The last two species are endemic to this region. Despite this diversity (the highest in Europe), karyological research on the Balkan brown *Agrodiaetus* has been sporadic to date and has concentrated almost exclusively on Greek populations (Brown 1976; Brown & Coutsis 1978; Coutsis et al. 1999; Wiemers 2003). The recent reports of *P. (A.) aroaniensis* and *P. (A.) nephohiptamenos* as new to Bulgaria (Kolev 1994) and *P. (A.) aroaniensis* as new to Former Yugoslav Republic of Macedonia (Kolev & Poorten 1997) have been based on morphological and anatomical characters. The only published karyological data from elsewhere in the peninsula remain those of H. de Lesse, who sampled *P. (A.) ripartii* and *P. (A.) admetus* in westernmost Bulgaria (Kalotina checkpoint) en route to Asia Minor (de Lesse 1960).

In 1999 a large mixed population of brown *Agrodiaetus* in the Rhodopi Mts. of southern Bulgaria has been found, which consists of two morphologically very similar taxa, *P. (A.) ripartii* and an unknown taxon. Analysis of karyological samples revealed that the latter differs from *P. (A.) ripartii* and *P. (A.) aroaniensis* in its karyotype as

well as morphology. The karyotype of the Rhodopi population is identical with that of the recently described *P. (A.) dantchenkoii* (Lukhtanov & Wiemers, 2003) which so far is known only from its type locality, the Van Province of south-eastern Turkey (Lukhtanov et al. 2003). Thus the Rhodopi population can be considered the first record of *P. (A.) dantchenkoii* for the whole of Europe. However, the morphological differences between nominotypical *P. (A.) dantchenkoii* and the Rhodopi population as well as their considerable geographical separation prompted me to offer the following description of a new subspecies.

Abbreviations

IZS	Institute of Zoology, Sofia
n	haploid chromosome number
NMNHS	National Museum of Natural History, Sofia
ZK	collection of Zdravko Kolev, Helsinki

Methods

For karyological analysis males were collected and kept alive in moistened paperbags until the extraction of their testes was possible. Testes were fixed in a 3:1 solution of 96% ethanol and glacial acetic acid and refrigerated until further study. Preparations were made at the Department of Genetics, University of Turku (Finland) following an advanced methodology for studying holokinetic chromosomes developed by Dr. Seppo Nokkala (e.g. Grozeva & Nokkala 1996). Countable metaphase plates were photographed at a magnification of 1000× with an Olympus DP11 microscope digital camera system mounted on an Olympus BH-2 light microscope. The brightness and contrast of the digital images were enhanced for printing in Jasc Paint Shop Pro 7.04; no other image processing was applied.

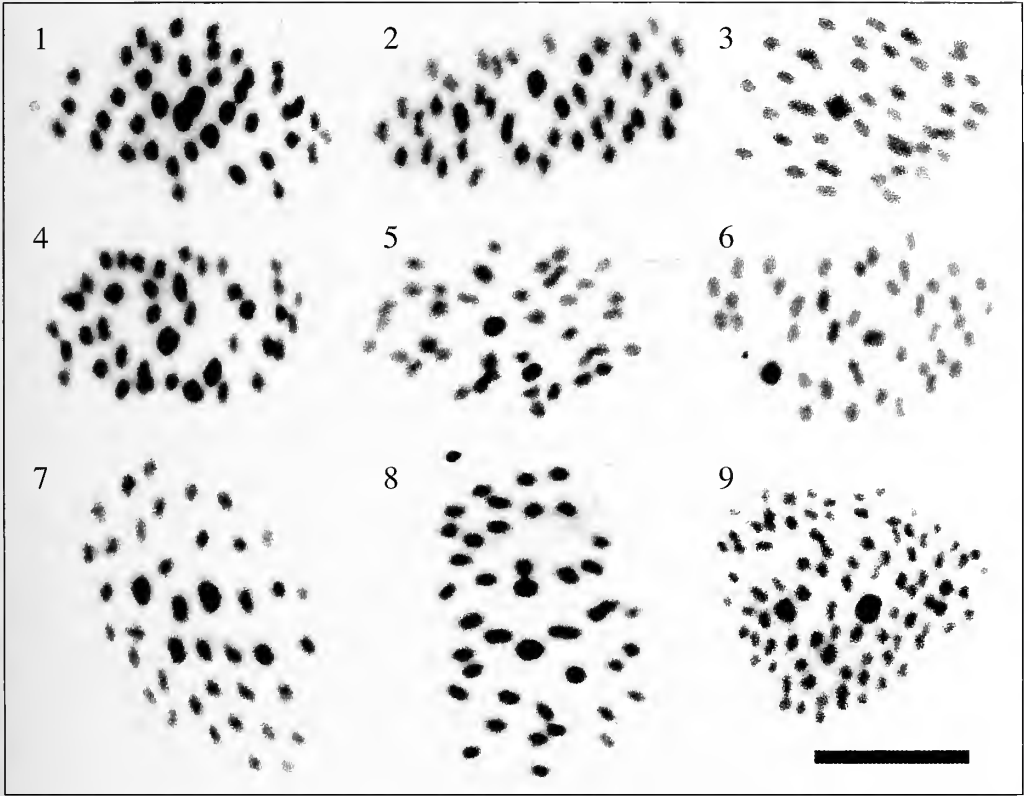
For studying the genitalia, abdomens were macerated in a 10% solution of KOH, the genital structures were extracted, cleaned, measured, and drawn immersed at a magnification of 50× with the aid of camera lucida attached to a Wild stereo-microscope.

In attempting to establish the distribution of the new taxon and its relatives in Rhodopi, the public collections of the National Museum of Natural History (Sofia), the Institute of Zoology (Sofia), and the Museum of Natural History (Burgas) were examined. Additional material was received from the private collections of Mr. Julius Ganey (Sofia) and Dr. Stoyan Beshkov (Sofia).

Polyommatus dantchenkoii orphicus ssp. n.

Figs. 1–8, 10–18, 33, 34, 39, 42

Material. Holotype ♂, white printed label 'S BG [Bulgaria], Rhodopi Mts., l open dry rocky slopes above l Hvoyna village, 800-950 m l 7.vii.1999, Z. Kolev leg.'; white hand-written label 'ZK99017'; red printed label 'HOLOTYPE | *Polyommatus dantchenkoii orphicus* ssp. n. | Z. Kolev det.'; ZK. – Paratypes 6♂, 2♀: same white printed labels as holotype except 1♀ (Figs. 11, 34), 'S BG [South Bulgaria], Rhodopi Mts., l open dry rocky slopes above l Hvoyna village, 800-950 m l 6.vii.1999, Z. Kolev leg.'; white hand-written labels (5♂) 'ZK99001', 'ZK99004', 'ZK99010', 'ZK99018' and 'ZK99019'; red printed label 'PARATYPE | *Polyommatus dantchenkoii orphicus* ssp. n. | Z. Kolev det.'; ZK. Part of the type material is to be deposited in NMNHS. – **Additional material.** 1♂: S Bulgaria, Rhodopi Mts., Lukovitsa gorge near Asenovgrad town, 400 m, 21.vi.1986, Beshkov leg., ZK; 1♀: same data but 21.vii.1998, Kolev leg., ZK; 1♀: Rhodopi Mts., "Persenk" mine, 25.vii.1977, Ganey leg., ZK; 1♀: Rhodopi Mts., vic. Gela village, 1500 m, 23.vii.1999, Kolev leg., ZK.



Figs. 1–8. Metaphase plates of *P. (A.) dantchenkoii orphicus* ssp. n. **1.** n=42, paratype (Fig. 16), prep. ZK99001-02. **2.** n=41, same specimen as Fig. 1, prep. ZK99001-15. **3.** n=42, same specimen as Fig. 1, prep. ZK99001-24. **4.** n=41, paratype (Fig. 14), prep. ZK99004-02. **5.** n=42, same specimen as Fig. 4, prep. ZK99004-14. **6.** n=42, holotype (Fig. 10), prep. ZK99017-04. **7.** n=41, same specimen as Fig. 6, prep. ZK99017-07. **8.** n=42, paratype (Fig. 15), prep. ZK99019-01.

Fig. 9. Metaphase plate of *P. (A.) ripartii* n=90, same specimen as Figs. 28 & 35, prep. ZK99011-02. Scale bar = 10 μ m.

Description. **Measurements.** Relatively large for a brown *Agrodiaetus*. Male forewing length 13.0–18.2 mm (holotype 17.0 mm), mean 16.65 mm (8♂), female forewing length 14.5–16.5 mm, mean 15.3 mm (5♀).

Upperside. Resembles *P. (A.) aroaniensis* closely in both sexes. Ground colour dark brown with silky sheen and, in males, an extensive androconial field on forewing. Veins relatively inconspicuous in both sexes, not markedly darker than ground colour, giving upperside a smooth appearance. Discoidal spot in females darker than ground colour. Fringe brown, on hindwing brown or brownish-grey on distal half.

Underside. Ground colour warm, light to medium yellowish-brown, with basal half of forewing tinged colder grey. **Forewing:** Postdiscal black ocelli prominent, forming strongly curved row in spaces M3, Cu1 and Cu2, with ocelli in spaces Cu1 and Cu2 on straight, or nearly so, line with discoidal spot. Space M2, along vein M3, with narrow, diffuse but well visible white streak connecting discoidal and postdiscal spots in space M2 and often extending a short distance distad from latter. **Hindwing:** Greenish iridescent basal suffusion absent or almost so. Postdiscal black ocelli usually

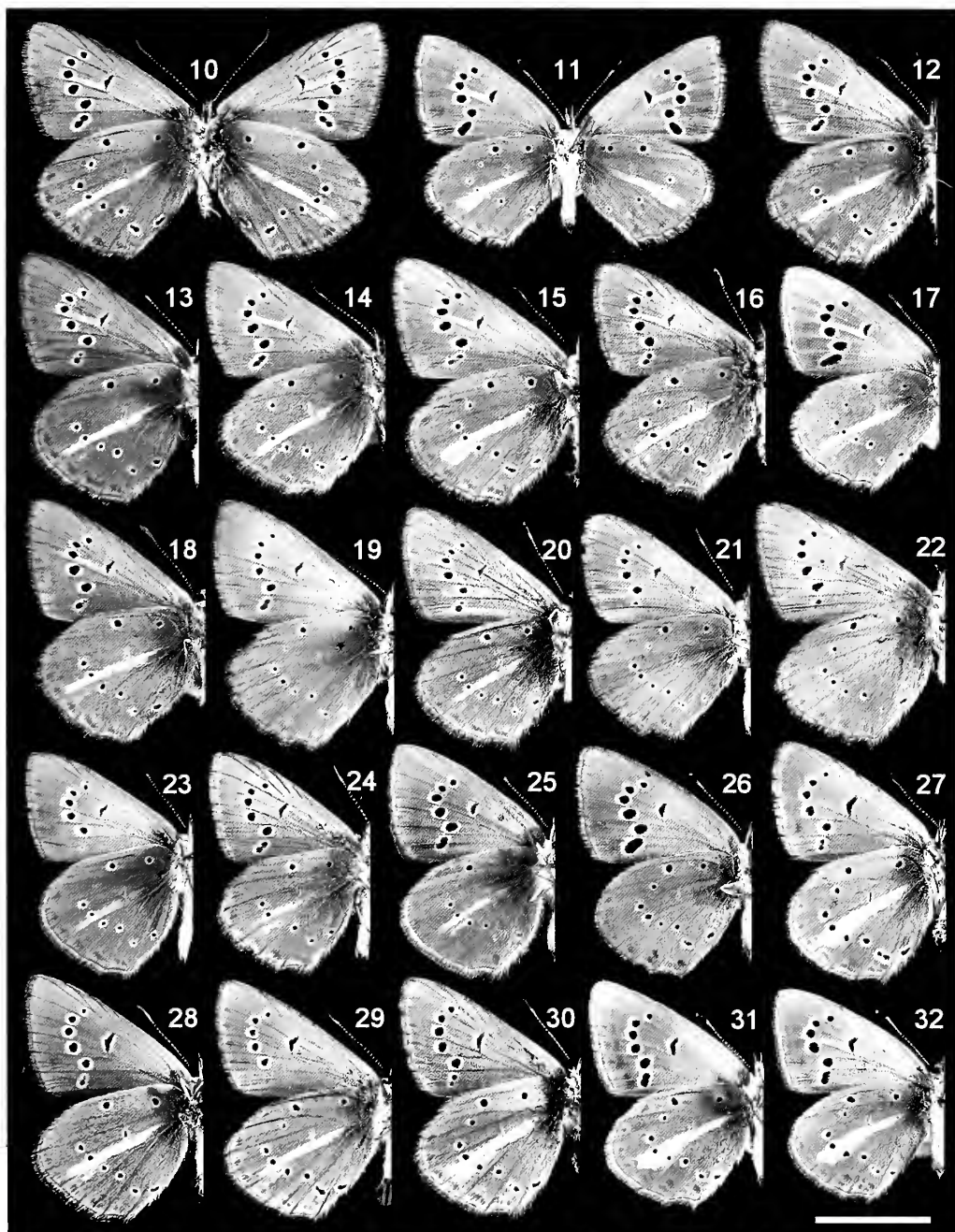
well-defined and in complete series, seldom some reduced. Ocelli in spaces M3, Cu1, Cu2 and A2 situated more basad than in *P. (A.) ripartii*, identical to those of *P. (A.) d. dantchenkoi* and *P. (A.) aroaniensis*. White streak in space M2 always prominent and sharply defined, its expression independent of degree of reduction of postdiscal ocelli. Submarginal markings diffuse and faint, only slightly darker than ground colour; reddish submarginal lunules absent or very faint and exceedingly small.

Male genitalia (Figs. 39 a, b, c). As in *P. (A.) aroaniensis* (Fig. 40) and *P. (A.) d. dantchenkoi*, of the 'long type' (Kolev & De Prins 1995). Valva 3.00–3.20 mm long, mean 3.11 mm (6 ♂), being significantly ($P < 0.001$, two-tailed *t*-Test assuming equal variances) longer than in *P. (A.) ripartii* (Fig. 41): 2.36–2.71 mm, mean 2.59 mm (13 ♂). Within each taxon the length of valva generally increases with increasing individual size, as is only to be expected, but the morphometric difference between the male genitalia of *P. (A.) dorphicus* and *P. (A.) ripartii* is clearly not a function of of variable individual size. This is evident from Fig. 47, which shows a consistent gap between the ranges of variance in valva length of syntopic samples of the two taxa. This gap is remarkably wide, particularly in view of the almost total overlap of variance ranges in forewing length between the two taxa. Besides, the effect of individual variation on genital size can be eliminated by calculating and comparing individual values of the unit-less index FWL/VL, which is obtained by dividing the forewing length (FWL in mm) by the valva length (VL in mm). This index is 5.38–5.69 (mean 5.5683, 6 ♂) for *P. (A.) dorphicus* and 5.97–6.73 (mean 6.38, 13 ♂) for *P. (A.) ripartii*. The differences between the means of these non-overlapping ranges of variance is statistically significant ($P < 0.001$, two-tailed *t*-test assuming equal variances). In other words, the valva of *P. (A.) orphicus* is disproportionally longer, relative to individual size, than that of *P. (A.) ripartii*.

Female genitalia (Fig. 42). Henia similar to that of *P. (A.) aroaniensis* (Fig. 43), with minor differences in sclerotisation and dimensions of unknown significance due to very limited number of females available for dissection. Henia of *P. (A.) ripartii* clearly shorter and stouter (Fig. 44), that of *P. (A.) admetus* much longer and more slender (Fig. 45).

Karyotype (Figs. 1–8). Clear countable metaphase plates, mostly MI, were obtained in preparations of five males: ZK99001, ZK99004, ZK99010, ZK99017, and ZK99019. In all plates that could be counted precisely the haploid chromosome number was $n=41-42$. The karyotype is identical in structure and chromosome number to that of *P. (A.) d. dantchenkoi* (Lukhtanov et al. 2003: 66) and in structure also to that of *P. (A.) aroaniensis* (Coutsis et al. 1999).

Differential diagnosis. From nominotypical *P. (A.) dantchenkoi* the new taxon is distinguished by the presence of a white postdiscal streak on the forewing underside, a generally larger postdiscal ocelli on the hindwing underside, and less contrasting veins on the upperside. From *P. (A.) aroaniensis*, which it resembles extremely closely on the upperside, the new taxon is distinguished by the constant presence of a clear white postdiscal streak on the forewing underside, as a rule a complete series of larger postdiscal spots on the underside, and the constant presence on the hindwing underside of a white streak (completely absent in at least half of the individuals in any given population of *P. (A.) aroaniensis*) which is wider, better defined, and more contrasting than in *P. (A.) aroaniensis* individuals possessing such a streak. From the sympatric and syntopic *P. (A.) ripartii* the new taxon is distinguished by the presence on the forewing underside of a white postdiscal streak and on average a more strongly curved row of postdiscal spots, and on the upperside the veins are less pronounced and



Figs. 10–18. Undersides of *P. (A.) dantchenkoi orphicus* ssp. n. **10.** Holotype ♂, S Bulgaria, Rhodopi Mts., open dry rocky slopes above Hvoyna village, 800–950 m, 7.vii.1999, Z. Kolev leg., ZK. **11–18.** Paratypes, same data, Figs. 12–16, 18: ♂; Figs. 11, 17: ♀, and Fig. 11 6.vii.1999. – **Figs. 19–26.** Underside of *P. (A.) aroamensis*. **19.** ♂, SW Bulgaria, S Pirin Mts., vic. Paril village, 850–950 m, 30.vi.1994. **20.** ♂, SW Bulgaria, Mt. Alibotush, Hambar Dere gorge, 1500–1600 m, 11.vii.1993. **21, 22.** ♀, same data as Fig. 20, but 3.vii.1994. **23, 24.** ♂, S Bulgaria, Rhodopi Mts., vic. ‘Trigradski skali’ chalet, ca. 1400 m, 11.vii.2003. **25.** ♀, same data, as Fig. 19, but 1.vii.2003. **26.** ♀, SE Bulgaria, Stara Planina Mts., vic. Sliven, ca. 1000 m, 1–2.viii.1999. – **Figs. 27–32.** Undersides of *P. (A.) ripartii*. **27–30.** ♂, same data as Figs. 10–18. **31–32.** ♀, same data as Figs. 10–18. Scale bar = 1 cm.

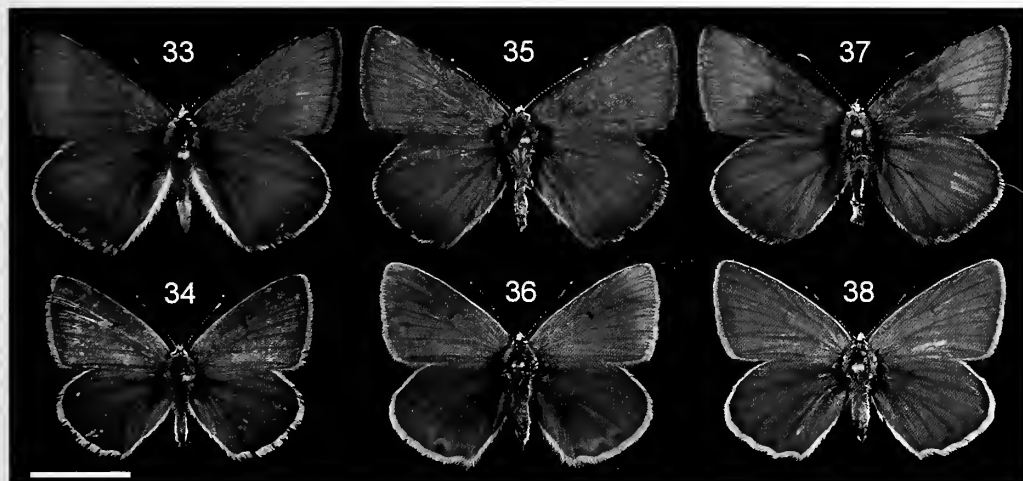
concolorous with the ground colour or only slightly darker. Worn individuals of the two taxa may be indistinguishable externally. A character that appears useful for separation of *P. (A.) ripartii* and *P. (A.) orphicus* is the longer valva in the male genitalia of *P. (A.) orphicus* which in the studied samples shows no numerical overlap with *P. (A.) ripartii* (see above). However, the samples studied are small and a further research into the significance of this character is therefore necessary. From the sympatric *P. (A.) admetus* the new taxon is very easily separated on account of the very distinct appearance of *P. (A.) admetus*, especially its strongly marked underside which almost never has a hindwing streak in the western part of the species' range.

Derivatio nominis. The adjective *orphicus* has two meanings: 'without apparent significance to the senses nor obvious to the intelligence; beyond ordinary understanding'; and 'ascribed to Orpheus'. Both meanings apply to *P. (A.) orphicus*: the former alludes to the highly cryptic appearance of the new taxon which can easily be confused with the sympatric *P. (A.) ripartii*, while the latter meaning refers to the range of *P. (A.) orphicus*: the Rhodopi Mountains, home to the mythical Thracian poet and musician Orpheus.

Life history. *P. (A.) orphicus* inhabits xerothermic and xeromontane calcareous localities. The vegetation of the type locality is sparse and dominated by low-growing xerophytous calciphilous species, with scattered *Juniperus* bushes and low *Pinus nigra* trees. In all known localities *P. (A.) orphicus* ssp. n. is syntopic with *P. (A.) ripartii*, which is widespread and abundant in calcareous habitats in the western Rhodopi (pers. observ.). The lowest known locality of *P. (A.) orphicus*, the gorge of Lukovitsa river, is a xerothermic submediterranean habitat supporting a very large population of *P. (A.) admetus* and a very small population of *P. (A.) ripartii*. In the type locality the ratio *ripartii* : *orphicus* equals 2.6 based on the collected unbiased sample of 32 specimens. There are as yet no observations regarding the larval host-plant of the new taxon.

Distribution. Collection material from three further localities in the western Rhodopi agrees well with *P. (A.) orphicus*, but this additional material (see above) is not included in the type series because no karyological data from these localities are available so far. Three known localities of *P. (A.) orphicus* (including the type locality) are situated in the gorge of the Chepelarska river at altitudes between 400 and 1100 m, the fourth (vic. Gela village) is on the northern slope of the Mursalitsa ridge at 1500 m. The habitats are situated on mostly karstified Proterozoic marbles of the Dobrostan formation (Zagorchev 1995) which are widespread in the western Rhodopi. Thus, it is to be expected that this taxon occurs elsewhere in Rhodopi as well.

Records of *P. (A.) aroaniensis* from Rhodopi have been very scarce so far. In Greece only two localities are known at low altitude in the southern foothills of the massif (Kolev & van der Poorten 1997; Coutsis & Ghalavás 2001). In the collection of IZS are preserved 1♂ from the 'Skalni Mostove' karst arches and 1♀ from the 'Kolarovski Livadi' locality, both specimens completely lacking a white streak on the hindwing underside. The first of these records corroborates a record of *P. (A.) aroaniensis* from "Čudnite mostovi" ['Chudnite Mostove' karst arches very close to Skalni Mostove] (Bálint 1995), based on specimens lacking a streak (Z. Bálint, in litt.). This locality is in immediate proximity to the known range of *P. (A.) orphicus*. In addition, during a short visit to the vicinity of 'Trigradski skali' chalet on 11.vii.2003 I collected a small sample (3♂, 1♀) with various degrees of reduction of the streak on the hindwing underside and lacking postdiscal streak on the forewing underside (Figs. 23, 24). Thus these specimens correspond well to *P. (A.) aroaniensis* and differ from *P. (A.) orphicus*



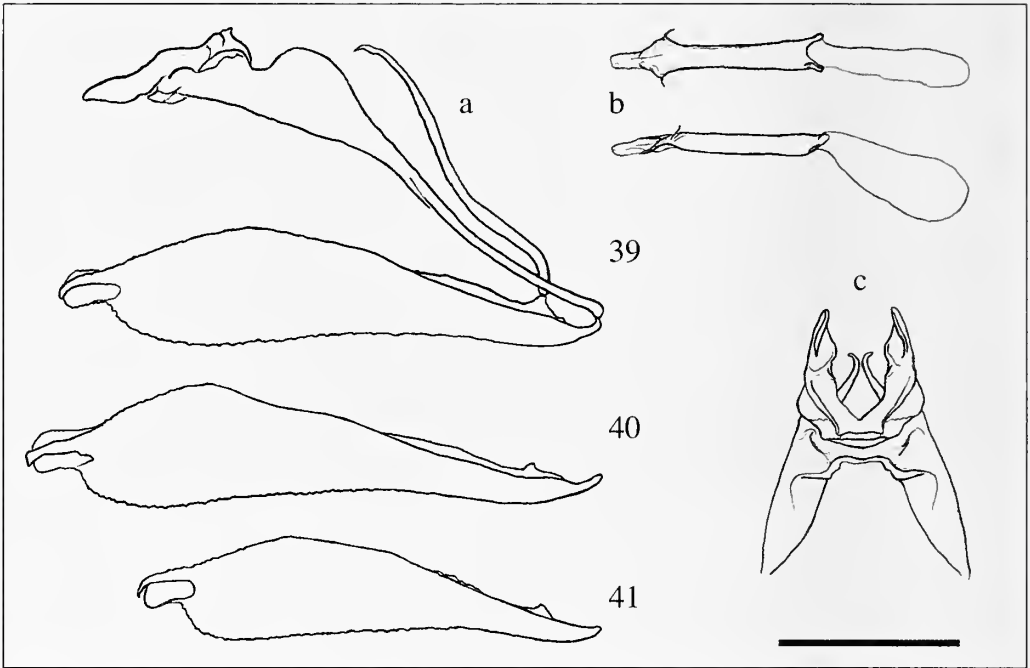
Figs. 33–34. Uppersides of *P. (A.) dantchenkoi orphicus* ssp. n. 33. Paratype ♂, S Bulgaria, Rhodopi Mts., open dry rocky slopes above Hvoyna village, 800–950 m, 6.–7.vii.1999 (same specimen as Fig. 13). 34. Paratype ♀, same data as Fig. 33 (same specimen as Fig. 11). – Figs. 35–36. Uppersides of *P. (A.) aroaniensis*. 35. ♂, SW Bulgaria, S Pirin Mts., vic. Paril village, 850–950 m, 30.vi.1994 (same specimen as Fig. 19). 36. ♀, same data as Fig. 35, but 1.vii.2003 (same specimen as Fig. 25). – Figs. 37–38. Uppersides of *P. (A.) ripartii*. 37. ♂, same data as Fig. 33 (same specimen as Fig. 28). 38. ♀, same data as Fig. 33 (same specimen as Fig. 31). Scale bar = 1 cm.

(samples for karyological analysis could not be obtained). The known records of *P. (A.) orphicus* and *P. (A.) aroaniensis* in Bulgaria are shown in Fig. 46. Syntopy of these two taxa has not been established so far, but is very likely in view of the very close proximity of their known ranges.

Discussion

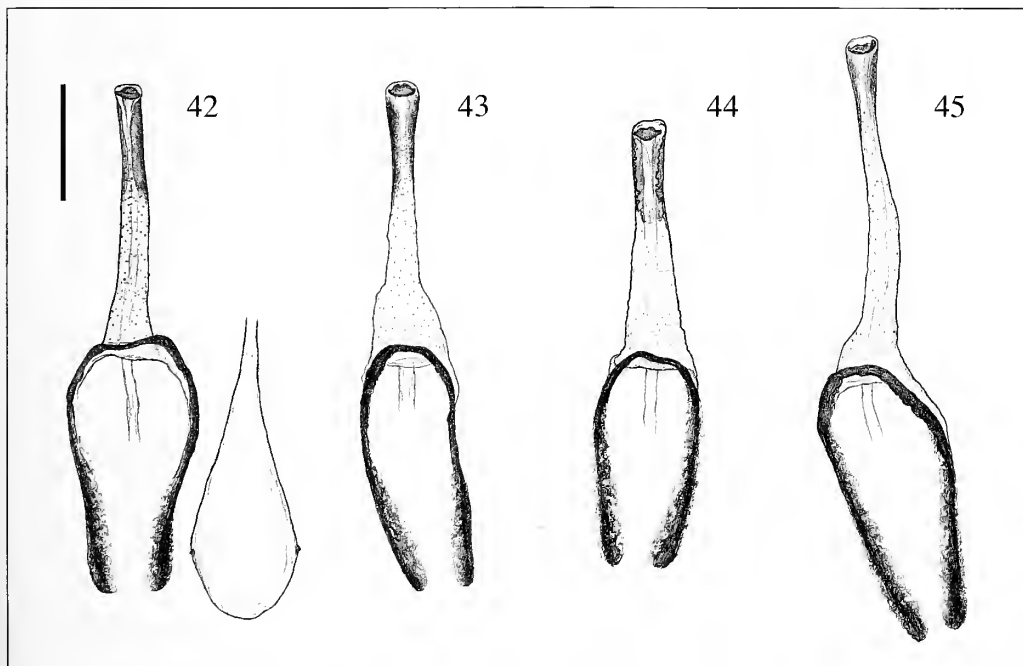
Morphologically *P. (A.) dantchenkoi orphicus* combines characters of *P. (A.) aroaniensis* (smooth dark brown upper side with inconspicuous veins) with characters of *P. (A.) ripartii* and nominotypical *P. (A.) dantchenkoi* (white streak on hindwing underside always present and very prominent; postdiscal ocelli usually prominent). The most conspicuous external character that separates *P. (A.) dorphicus* from these and all other *Agrodiaetus* taxa examined is the constant presence in the studied material of *P. (A.) dorphicus* of a whitish postdiscal streak along vein M3 in space M2 on the forewing underside. Based on examined material and photographs of brown *Agrodiaetus*, such a streak also occurs at very low frequencies in some taxa that have an underside hindwing streak. Thus, I have found only one specimen of Bulgarian *P. (A.) ripartii* with a forewing streak among more than 60 specimens examined.

Recent DNA research (Wiemers 2003; Kandul et al. 2004) indicates that the closest relatives of *P. (A.) d. dantchenkoi* are the Turkish taxa *P. (A.) alcestis* (Zerny, 1932) with $n=19-21$ and *P. (A.) [eriwanensis] interjectus* (de Lesse, 1960) with $n=29-32$ (Wiemers 2003), and the Transcaucasian *P. (A.) eriwanensis eriwanensis* (Forster, 1960) with $n=29-34$ (Lukhtanov et al. 2003; Kandul et al. 2004). Lukhtanov et al. (2003) stated that nominotypical *P. (A.) dantchenkoi* is also phenotypically most similar to *P. (A.) e. eriwanensis* and *P. (A.) e. interjectus*. According to Wiemers (2003) these taxa form a



Figs. 39–41. Male genitalia. **39.** *P. (A.) dantchenkoii orphicus* ssp. n., paratype (ZK99001) (same specimen as Fig. 16). **a.** lateral view, aedeagus removed, setae and membranous parts omitted. **b.** dorsoventral (above) and lateral (below) view of aedeagus including caecum. **c.** uncus and tegumen, dorsal view. **40.** Valva of *P. (A.) aroaniensis*, SW Bulgaria, Mt. Alibotush, Hambar Dere gorge, 1500–1600 m, 3.vii.1994 (same specimen as Fig. 22). **41.** Valva of *P. (A.) ripartii* (ZK99005), S Bulgaria, Rhodopi Mts., open dry rocky slopes above Hvoyna village, 800–950 m, 6–7.vii.1999. Scale bar = 1 mm.

cluster whose sister group is formed by the closely related *P. (A.) aroaniensis* and *P. (A.) humedasa* (Toso & Baletto 1976), the latter endemic to the Aosta valley in northern Italy. The taxonomic status of *P. (A.) orphicus* as presently proposed is tentative. It is possible that this taxon is a distinct species despite the identical karyotypes of *P. (A.) d. dantchenkoii*. Conspecificity of *P. (A.) orphicus* and *P. (A.) aroaniensis* is unlikely considering the difference of six chromosome pairs in their karyotypes (Lukhtanov et al. 2003), the morphological differences, and the fact that these taxa occur in close proximity, possibly sympatrically and syntopically, in the western Rhodopi. Conspecificity with *P. (A.) dantchenkoii* might be challenged by the morphological differences between the two taxa and the considerable distance between their ranges. This distance, over 1500 km, is particularly great considering the very small ranges of many *Agrodiaetus* taxa. It must also be stressed that nominotypical *P. (A.) dantchenkoii* is so far only known from a region characterized by very high butterfly endemism, especially among Lycaenidae. This region has very little zoogeographical affinity with the central Balkan Peninsula in general and the Rhodopi Mts. in particular. While the occurrence of *P. (A.) dantchenkoii* further west in Turkey is not impossible, it is notable that so far other researchers have not come across such karyologically distinct populations in central Turkey. Thus, for the time being *P. (A.) dorphicus* is not given species status owing to the fact that its karyotype is identical to that of *P. (A.) dantchenkoii*. Molecular studies are needed to resolve the status of this new taxon.



Figs. 42–45. Female genitalia. **42.** *P. (A.) dantchenkoi orphicus* ssp. n., paratype (same specimen as Fig. 17). **43.** *P. (A.) aroaniensis*, SW Bulgaria, S Pirin Mts., vic. Paril village, 850–950 m, 30.vi.1994. **44.** *P. (A.) ripartii* (ZK99005), S Bulgaria, Rhodopi Mts., open dry rocky slopes above Hvoyna village, 800–950 m, 6.–7.vii.1999. **45.** *P. (A.) admetus*, S Bulgaria, Rhodopi Mts., vic. Asenovgrad, Asenova krepost, 400–500 m, 17.vii.1992. Scale bar = 1 mm.

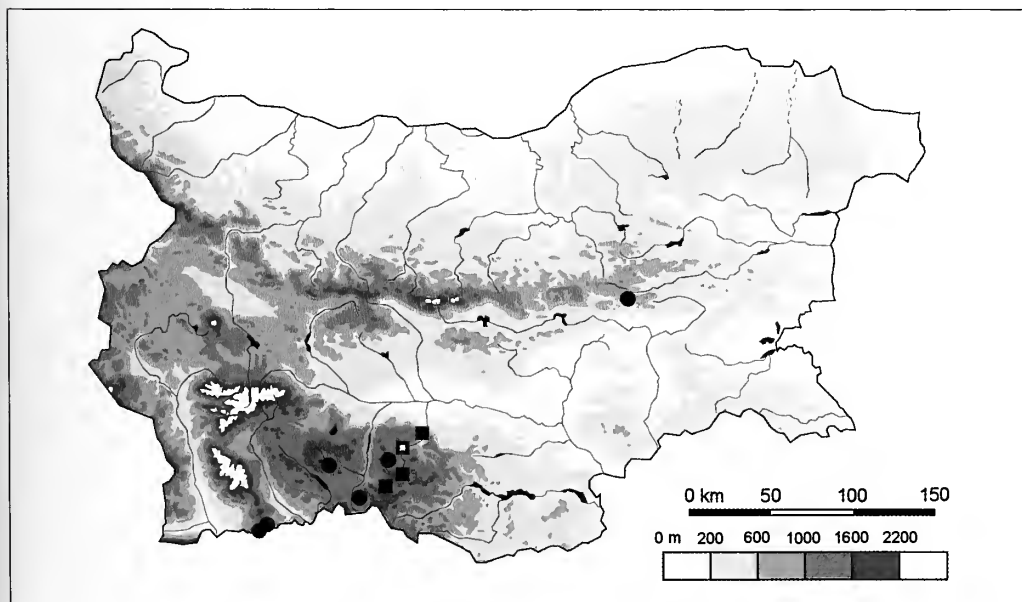


Fig. 46. Map of Bulgaria with records of *P. (A.) dantchenkoi orphicus* (squares; white-centred: type locality) and *P. (A.) aroaniensis* (circles).

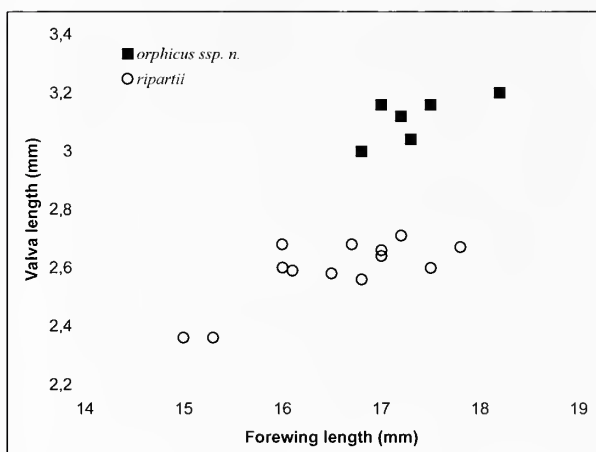


Fig. 47. Scatter diagram of individual values of forewing and valva length in *P. (A.) orphicus* (squares) and sympatric and syntopic *P. (A.) ripartii* (circles). All specimens determined from chromosome counts. Note the virtually complete overlap of forewing lengths of the two taxa but the lack of overlap between their valva length.

Acknowledgements

I thank Dr. Seppo Nekkala (Department of Genetics, University of Turku, Finland) and Dr. Snezhana Grozeva (Institute of Zoology, Sofia, Bulgaria) for their invaluable assistance with the karyological methods used in this study and the many inspiring discussions on the subject. Thanks to Dr. Stoyan Beshkov (National Museum of Natural History, Sofia, Bulgaria) and Mr. Julius Ganey (Sofia, Bulgaria) for providing material from their collections, and to Prof. Dr. Alexi Popov (National Museum of Natural History, Sofia, Bulgaria) and Mr. Alexander Slivov (Institute of Zoology, Sofia, Bulgaria) for providing access to the public collections under their care.

References

- Bálint, Z. 1995. Adalékok a Balkán boglárkalepke-faunájához (Lepidoptera, Lycaenidae) [Contributions to the lycaenid butterfly fauna of the Balkans (Lepidoptera, Lycaenidae)]. – *A Janus Pannonius Múzeum Évkönyve* **39**: 69–77 (in Hungarian).
- Brown, J. 1976. Notes regarding previously undescribed European taxa of the genera *Agrodiaetus* Hübner, 1822 and *Polyommatus* Klus, 1801 (Lep., Lycaenidae). – *Entomologist's Gazette* **27**: 77–84.
- Brown, J. & J. Coutsis 1978. Two newly discovered lycaenid butterflies (Lepidoptera: Lycaenidae) from Greece, with notes on allied species. – *Entomologist's Gazette* **29**: 201–213.
- Coutsis, J. G. & N. Ghavalás 2001. The skippers and butterflies of the Greek part of the Rodópi massif (Lepidoptera: Hesperioidea & Papilionoidea). – *Phegea* **29** (4): 143–158.
- Coutsis, J. G., J. Puplesiene & W. De Prins 1999. The chromosome number and karyotype of *Polyommatus (Agrodiaetus) ripartii* and *Polyommatus (Agrodiaetus) aroaniensis* from Greece (Lepidoptera: Lycaenidae). – *Phegea* **27** (1): 81–84.
- Grozeva, S.M. & S. Nekkala 1996. Chromosomes and their meiotic behavior in two families of the primitive infraorder Dipsocoromorpha (Heteroptera). – *Hereditas* **125**: 31–36.
- Hesselbarth, G., H. van Oorschot & S. Wagener 1995. Die Tagfalter der Türkei unter Berücksichtigung der angrenzenden Länder. – Selbstverlag Sigbert Wagener, Bocholt. vols. 1–2, 1354 pp., vol. 3, 847 pp.
- Kandul N. P., V. A. Lukhtanov, A. V. Dantchenko, J. W. S. Coleman, C. H. Sekercioglu, D. Haig & N. E. Pierce 2004. Phylogeny of *Agrodiaetus* Hübner 1822 (Lepidoptera: Lycaenidae) inferred from mtDNA sequences of COI and COII and nuclear sequences of EF1-11: karyotype diversification and species radiation. – *Systematic Biology* **53** (2): 278–298.
- Kolev, Z. 1994. Two *Polyommatus (Agrodiaetus)* species new to Bulgaria, with notes on the related Bulgarian taxa (Lepidoptera: Lycaenidae). – *Phegea* **22** (2): 61–71.
- Kolev, Z. & D. van der Poorten 1997. Review of the distribution of the Balkan endemic *Polyommatus (Agrodiaetus) aroaniensis* (Lepidoptera: Lycaenidae). – *Phegea* **25** (1): 35–40.
- Lesse, H. de 1960. Les nombres de chromosomes dans la classification du groupe d'*Agrodiaetus ripartii*. – *Revue française d'Entomologie* **27**: 240–264.
- Lukhtanov, V. A., M. Wiemers & K. Meusemann 2003. Description of a new species of the "brown" *Agrodiaetus* complex from South-East Turkey. – *Nota lepidopterologica* **26** (1/2): 65–71.
- Wiemers, M. 2003. Chromosome differentiation and the radiation of the butterfly subgenus *Agrodiaetus* (Lepidoptera: Lycaenidae: Polyommatus) – a molecular phylogenetic approach. PhD Thesis, Bonn – September 2003, 204 pp.
- Zagorchev, I. 1995. Pirin – geological guidebook. – Academic Publishing House "Prof. Marin Drinov", Sofia. 70 pp., 1 map.

New data on the taxonomic status and distribution of *Polyommatus andronicus* Coutsis & Ghavalas, 1995 (Lycaenidae)

ZDRAVKO KOLEV

Porttikuja 4 E 101, FIN-00940 Helsinki, Finland; e-mail: zdravko.kolev@helsinki.fi

Summary. This paper details the first records of the poorly known and controversial taxon *Polyommatus andronicus* Coutsis & Ghavalas, 1995 from Southwestern Bulgaria (Mt. Alibotush, southern and central Pirin Mts.). This is a significant extension of the known range of this taxon, previously known only from NE Greece. The characters used to justify the species status of *P. andronicus* are re-evaluated. Statistical confirmation was obtained for the differences in mean wing length and male genitalia size, which support the specific distinctness of this taxon. The geographical and altitudinal range, habitat preferences, possible effects of human activity on its distribution, as well as the conservation status of *P. andronicus* are discussed.

Key words. Lepidoptera, Lycaenidae, *Polyommatus*, *P. icarus*, *P. andronicus*, genitalia, taxonomy, biometrics, sympatry, syntopy, distribution, endemism, Balkan Peninsula, Bulgaria.

Introduction

The nominal taxon *Polyommatus andronicus* Coutsis & Ghavalas, 1995 was described from north-eastern Greece on the basis of several morphological, anatomical, and ecological differences from its closest relative, the widespread *Polyommatus icarus* (Rottemburg, 1775). Compared to *P. icarus*, the original description states that *P. andronicus* is larger and with slightly broader forewings; the upperside colour in males is darker, deeper violet-blue; and the male and female genitalia are constantly and disproportionately larger. In addition, *P. andronicus* was reported to be univoltine and found only higher than 1000 m, being syntopic and synchronous with second-brood *P. icarus* (Coutsis & Ghavalas 1995). Coutsis & Ghavalas (1996) reported one further difference: under UV-light the wing underside was found to have a different reflection pattern, being as a whole more reflective in *P. andronicus* than in *P. icarus*.

Ten years later, the taxonomic status of *P. andronicus* is still ambiguous. Although some recent authors listed it as such (e.g. Karsholt & Razowski 1996; Tolman & Lewington 1997; Tolman 2001), others did not recognize it as separate from *P. icarus* (Kudrna 1996, 2002; Bálint & Johnson 1997). The latter view is not difficult to understand. *P. icarus* exhibits considerable individual, seasonal and geographical variation over its vast range and, while actually noting this, Coutsis & Ghavalas (1995) stated that “superficial differentiating characters [between *P. icarus* and *P. andronicus*] are, as far as we can tell, statistical rather than absolute.” However, regrettably, they did not back their claim with the statistical analysis that such a claim invites. Moreover, a very recently published molecular study seemed to seal the fate of *P. andronicus* as just another synonym of *P. icarus*: the former was found to be exceedingly close genetically to Greek *P. icarus* and its separation from the latter was stated to have been “based on disputable evidence” (Wiemers 2003: 90). Yet the fact remains that to this day no one has specifically set out to refute or confirm the evidence presented by Coutsis & Ghavalas (1995).

Coutsis & Ghavalas (1995) stated that *P. andronicus* was only found on the closely clustered massifs of Falakró, Meníkio, and Órvilos in the district of Drama. Órvilos is a compact massif straddling the border between Greece and Bulgaria and is known in the latter country under the names Alibotush and Slavyanka. I collected on Alibotush on several occasions, most extensively during July 1993 and 1994. In 1996, after acquainting myself with the description of *P. andronicus*, I re-examined my material from Alibotush and discovered a large *Polyommatus* female corresponding closely to that description. This female, collected on 11.vii.1993 in the karst gorge of Hambar Dere, southwest of Paril village at an altitude of ca. 1400 m, markedly exceeds the maximum size reached by female *P. icarus* in Bulgaria. Its forewing measures 18.6 mm against a maximum of 17.0 mm for the Bulgarian female *P. icarus* that I examined (n=34♀), which is also exactly the maximum reported for Greek female *P. icarus* (Coutsis & Ghavalas 1995). The tentative identification of this specimen as *P. andronicus* was confirmed by John G. Coutsis who examined its genitalia in 1997 and found them to be of the large *P. andronicus* type (Coutsis, pers. comm.). This female represents the first record of *P. andronicus* from Bulgaria, which I communicated to Tom Tolman. On the basis of this information, Alibotush was listed as part of the range of *P. andronicus* (Tolman 2001: 122).

The large size of this female and its genitalia show that it conforms to the description of the nominal taxon *Polyommatus andronicus*, but this in itself does not constitute proof of specific distinctness of this taxon from *P. icarus*. Such evidence, as was said above, is sorely needed. The lack of more specimens from Alibotush and the difficult access to this border region unfortunately prevented me from gathering a more representative sample for assessing the taxonomic rank of *P. andronicus*. This discovery, however, prompted me to conduct purposeful search for *P. andronicus* in other mountains immediately adjacent to Alibotush.

Methods

Material. Specimens with *P. icarus*-like morphology were collected on two separate field trips to the southern and central parts of the Pirin range, situated immediately to the north of Alibotush. The study area is shown in Fig. 25. In geomorphological terms Pirin and Alibotush are really no more than parts of the same massif (Zagorchev 1995) with their flora also showing a great degree of similarity (Bondev 1991) and it was expected that their butterfly faunas would also be very similar, as indeed they turned out to be. The first trip, carried out during 25.–26.vii.1998, concentrated on the region between the Popovi Livadi pass (ca. 1400 m) and the highest summit of central Pirin, Orelek (2099 m). On my second trip, during 30.vi.–4.vii.2003, I was accompanied part of the time by Mr. Slobodan Davkov (Skopje). Together we studied more exhaustively the region which I had visited in 1998, collecting as low as ca. 700 m in southern Pirin. Following that I visited the montane and subalpine zone of southern Pirin, in the region of its highest peak, Sveshtnik (1975 m). In preparation for this comparative analysis, I also collected a comparative sample of *P. icarus* from various other localities in Bulgaria encompassing the whole resident altitudinal range of *P. icarus* from sea level

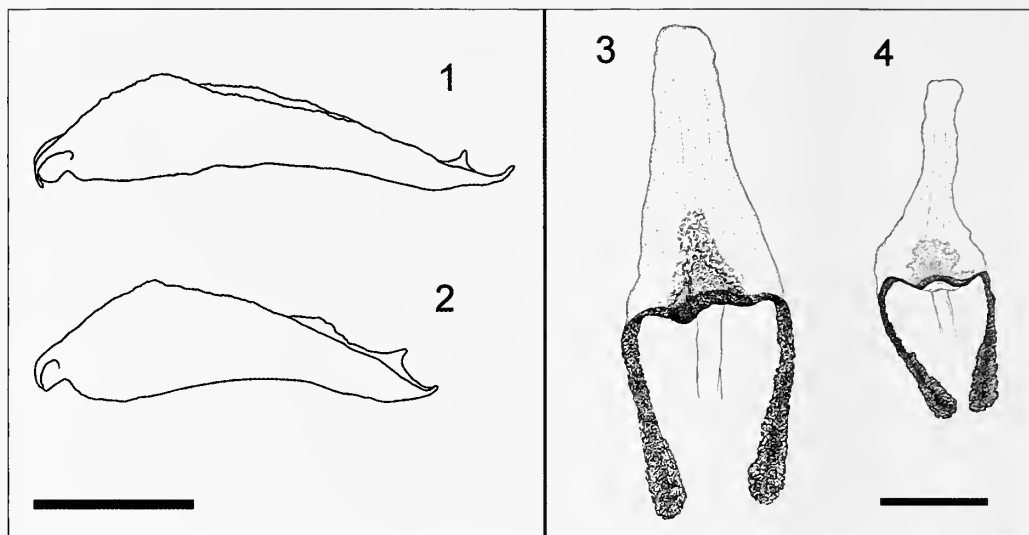
to ca. 1900 m and the whole gamut of habitats occupied by *P. icarus*, from xerothermic to subalpine.

Wing and genital measurements were taken using an eyepiece-mounted scale bar on a Wild stereomicroscope. Wings of set specimens were measured from wing base to tip, including fringe, with an accuracy of 0.1 mm. Genitalia were extracted following maceration of the abdomen in a 10 % solution of KOH, cleaned of residual tissue, and measured. The length of the male genitalia was measured from the base to the tip of the valva with an accuracy of 0.01 mm. In addition, the numerical data provided by Coutsis & Ghavalas (1995) for Greek *P. icarus* and *P. andronicus* were included in the analysis. For the wing (FWL) and valva (VL) measurements a unit-less index FWL/VL was calculated to eliminate the effect of overall size variation. The means were statistically evaluated using a Student's two-tailed *t*-Test with assumed equal variances.

Karyology. The haploid chromosome number in *P. icarus* and all studied species of the *Peros-eroides* complex is $n=23$ (Robinson 1971: 569). However, *P. buzulmavi* Carbonell, 1992 from the Turkish provinces of Hakkari and Van, a taxon morphologically similar to *P. icarus* and *P. andronicus*, has a very different karyotype with $n=45$ (Puplesiene & Olivier 2000). It was therefore considered of importance to study the karyotype of specimens tentatively identified as *P. andronicus*. Testes were extracted, fixed in the field in a 3:1 solution of 96 % ethanol and glacial acetic acid, and refrigerated until further study. Preparations were made at the Department of Genetics, University of Turku, Finland following a methodology developed by Dr. Seppo Nokkala (Grozeva & Nokkala 1996). Countable first-metaphase (MI) plates were photographed at a magnification of 1000 \times with an Olympus DP11 microscope digital camera system mounted on an Olympus BH-2 light microscope. The brightness and contrast of the images were enhanced in Jasc Paint Shop Pro 7.04; no other post-processing was applied.

Results

Already on first examination in the field most of the collected specimens fell naturally into two groups: smaller, lighter blue males corresponding to *P. icarus* and larger, darker males corresponding to *P. andronicus* as described by Coutsis & Ghavalas (1995). However, external characters (size, colour, underside pattern) and condition of the individuals were found to be variable to the extent that the placement of many specimens was uncertain. For this reason, the first stage of the analysis was a morphometric study of the male genitalia, the only character that according to Coutsis & Ghavalas (1995) shows no numerical overlap between the two taxa. Rather than applying statistical analysis, these authors illustrated the forewings and valvae of eight *P. icarus* and six *P. andronicus* specimens on pls. 5–9 (pp. 154–156). While showing the existence of size differences, this form of presentation is not well suited for assessing their significance, especially as all illustrated *P. icarus* are of approximately the same large to very large size and thus do not reflect the size variation in this species as a whole.



Figs. 1–2. Lateral view of the left valva (setae omitted). **1.** *P. andronicus* ♂, Central Pirin, below Dobro Pole plateau, 1800–1900 m, 26.vi.1998 (forewing length 17.7 mm). **2.** *P. icarus* ♂, East Bulgaria, East Stara Planina Mts., Karandila nature park, 1000 m, 16.vi.1999 (forewing length 17.7 mm).

Figs. 3–4. Dorsoventral view of the female genitalia (bursa and part of ductus bursae omitted). **3.** *P. andronicus* ♀, Central Pirin, Popovi Livadi – Orelek, 1600 m, 2.vii.2003 (forewing length 17.3 mm). **4.** *P. icarus* ♀, Pirin, Popovi Livadi, 1400 m, 1.vii.2003 (forewing length 14 mm). Scale bars = 1 mm.

Genitalia. There is a strong dichotomy in the size of male and female genitalia in the sample from Pirin (Figs. 1–4). The valva length values fall into two clear-cut groups with no overlapping values whatsoever (Figs. 5, 6), and their means of variance differ very significantly ($P < 0.0001$). Values and variance in these groups match well the numerical values given by Coutsis & Ghavalas (1995). Given these strong similarities, for simplicity throughout this chapter I shall refer to the group with smaller male and female genitalia as the ‘(Pirin) *P. icarus*’ and to that with larger genitalia as the ‘(Pirin) *P. andronicus*’ respectively. Note however that this should not be taken as a taxonomic conclusion regarding the species status of the latter taxon at this point.

Coutsis & Ghavalas (1995) stated that the male genitalia of *P. andronicus* are disproportionately larger than those of *P. icarus*, but this assertion was not tested in a statistically meaningful way. To do this the FWL/VL ratio is used here (Tab. 1). The mean ratio for *P. andronicus* (5.66) is significantly ($P < 0.0001$) smaller than the mean ratio for *P. icarus* (6.38). This confirms that in *P. andronicus* the genitalia are on average larger relative to the individual’s size than they are in *P. icarus*.

Female genitalia in the Pirin material likewise show a clear dichotomy in the size and shape of genitalia, though this is more difficult to quantify and analyze because, on one hand, the female genitalia are largely membranous and thus susceptible to distortion, and on the other hand, the number of available *P. andronicus* females was very small. Due to this a statistical analysis was not attempted. Nevertheless, the difference observed bears out the observations of Coutsis & Ghavalas (1995), with the genitalia being clearly longer and more massive in Pirin *P. andronicus* than in Pirin and other Bulgarian *P. icarus* (Figs. 3, 4).

Tab. 1. Pooled key measurements of males of *P. icarus* from the Pirin Mts., *P. andronicus* and *P. icarus* from other localities in Bulgaria, as well as of *P. icarus* and *P. andronicus* from Greece (the latter taken from Coutsis & Ghavalas 1995), with confidence levels for the differences in means (Student's two-way *t*-Test).

Character	<i>P. icarus</i> (52 ♂)			<i>P. andronicus</i> (29♂)			confidence level (P)
	min	max	mean	min	max	mean	
Forewing length FWL (mm)	11.3	17.7	15.42	16.10	19.50	18.07	<0.0001
Valva length VL (mm)	1.96	2.62	2.42	2.84	3.50	3.19	<0.0001
Index FWL/VL	5.59	7.06	6.38	5.21	6.16	5.66	<0.0001

Morphology. Having established the marked dichotomy of the Pirin sample in terms of genital characters, it has to be seen if and how these differences in genital morphology correlate with differences in external morphology.

Size. The Pirin *P. icarus* correspond well to other Bulgarian *P. icarus* from similar altitudes (700–1850 m) while the Pirin *P. andronicus*, collected between 1600 and 1950 m, are on average larger. The female from Alibotush clearly falls inside this latter group. As was said above, the forewing length variance of the Pirin *P. andronicus* partially overlaps that of Bulgarian *P. icarus* (see Tab. 1 and Figs. 7–22). Nevertheless, the difference between the means is statistically very significant ($P < 0.0001$) in the males (Tab. 1), and whereas an insufficient number of females of Pirin *P. andronicus* was available for analysis, there appears to be a similar degree of difference in female wing length too.

Wing shape. Coutsis & Ghavalas (1995) stated that the forewing in male *P. andronicus* is broader than in *P. icarus*, and illustrated this with drawings of forewings to scale (pp. 154–156) but, again, provided no numerical values. Examination of my material does not support this character, which shows no clear correlation with the two distinct valva types. Many Pirin *P. andronicus* (e.g. Fig. 13) have markedly narrow and pointed forewings while many Pirin (and other Bulgarian) *P. icarus* have very broad wings. Variation in this character is so considerable in both groups that further analysis was not considered necessary.

Upperside colour in males. Coutsis & Ghavalas (1995) noted that on average male *P. andronicus* have a deeper, darker blue upperside colour than *P. icarus*. Such difference however is difficult to see in colour plate 10 of the original description, where in addition the blue of both *P. icarus* and *P. andronicus* specimens has an unnatural, silvery cast when compared to actual specimens. The Pirin *P. andronicus* do have a remarkably uniform darker blue corresponding well to the description of *P. andronicus*, while fresh *P. icarus* from Pirin are generally lighter, as in most other Bulgarian *P. icarus*. However, this difference, if at all real, is clearly visible only in fresh or almost fresh specimens. In older males of both series the upperside colour is more difficult to determine due to loss of wing scales and membrane. Furthermore,

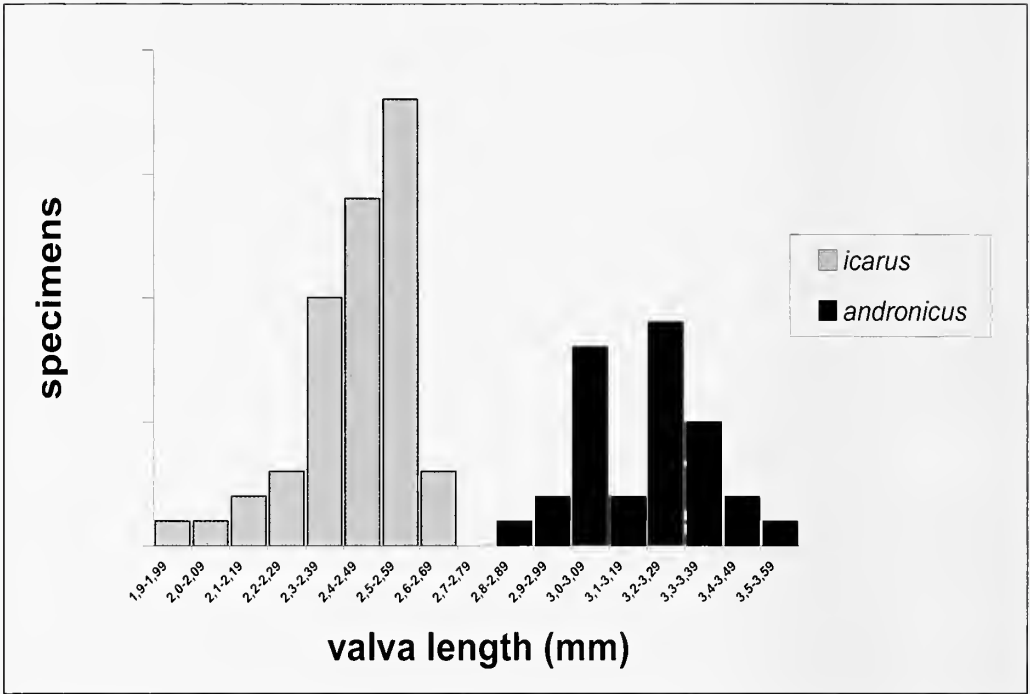


Fig. 5. Distribution of valva length values in male *P. icarus* and *P. andronicus*. Original data from Bulgaria are combined with numerical data from Coutsis & Ghavalas (1995).

the tone of the male upperside colour exhibits great seasonal and individual variability in *P. icarus*, even in fresh specimens. Likewise, occasionally, *P. andronicus* males have a lighter blue shine similar to that of *P. icarus* (Coutsis & Ghavalas 1995: pl. 10 fig. 4). The female upperside ground colour and the development and colour of the submarginal lunules are identical in the Pirin *P. icarus* and *P. andronicus*. Compared to the former, as well as other Bulgarian *P. icarus*, the only difference appears to be that Pirin *P. andronicus* females either lack completely (as does the Alibotush female) or have very limited blue basal suffusion. This suffusion is much more variable and often very extensive in other Bulgarian *P. icarus*. This upholds the stated difference between females of Greek *P. andronicus* and *P. icarus* (Coutsis & Ghavalas 1995).

Underside pattern. There is considerable variation both in terms of ground colour and development of maculation in both series. The Pirin *P. andronicus* are on average slightly more boldly marked with larger black spots. The wedge-shaped distal extensions of the white ring surrounding the discal spot on the fore- and hindwings are on average longer, wider at the base, and altogether more prominent than in Pirin or other Bulgarian *P. icarus*. However, there is some variation in this character in *P. icarus*, with these wedge-like markings being sometimes well developed. The metallic blue-green basal suffusion on the underside of the hindwing is extensive in Pirin *P. andronicus* males while on average much more restricted or nearly absent in the summer brood male Pirin (and other Bulgarian) *P. icarus*. A few very worn *P. icarus*

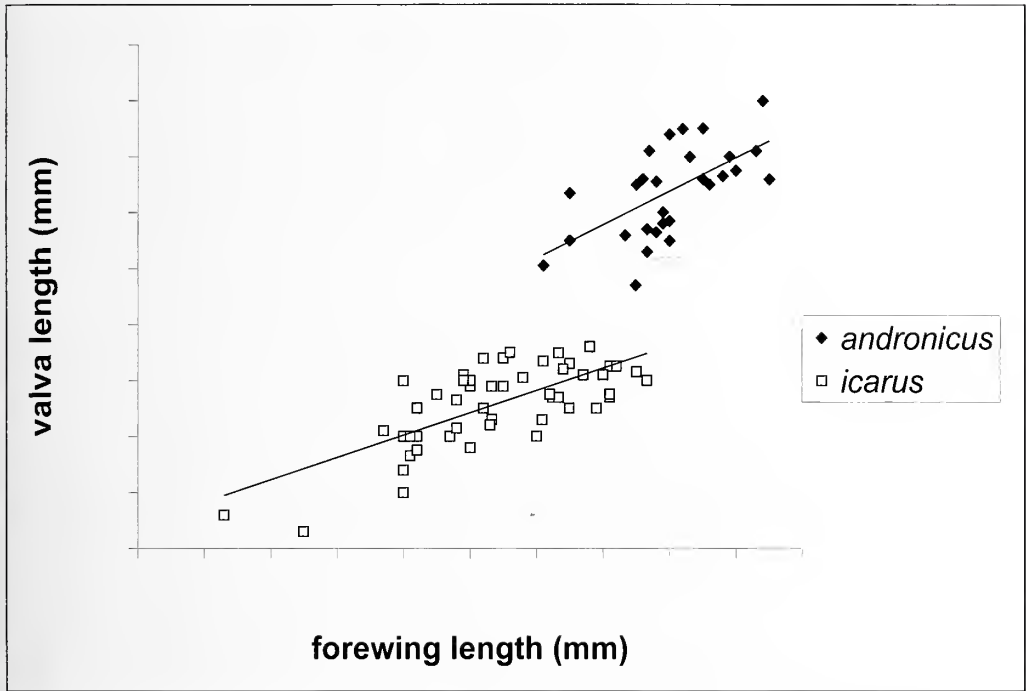


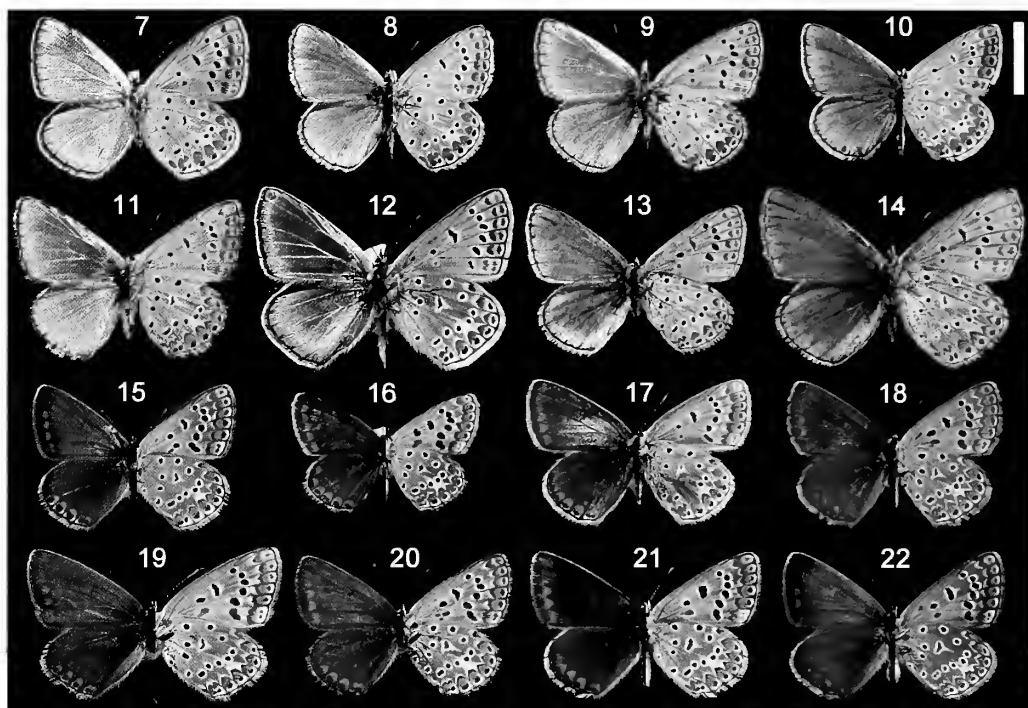
Fig. 6. Correlation of valva and forewing lengths of male *P. andronicus* and *P. icarus*, with trend lines. Original data from Bulgaria are combined with numerical data from Coutsis & Ghavalas (1995).

of the spring brood collected at higher altitudes in Pirin show extensive basal suffusion similar to that of the Pirin *P. andronicus*. All of these traits correspond to those observed in Greek *P. andronicus* and *P. icarus* (Coutsis & Ghavalas 1995).

Karyotype. More than 20 countable first-metaphase (MI) plates with a stable haploid number of $n=23$ (Fig. 23) were found in preparations of testes from two males of Pirin *P. andronicus* (No ZK0303 and No ZK0304). The karyotype of *P. andronicus* is thus identical to that of *P. icarus*.

Altitudinal range, sympatry and syntopy. The Pirin *P. icarus* were found in flowery open places in the deciduous and coniferous forest zones from the lowest foothills to the tree line at 1800–1850 m. This corresponds well to the upper limit of the resident range of *P. icarus* on other high mountains in Bulgaria (pers. observ.) and Greece (Coutsis & Ghavalas 1995). In contrast, Pirin *P. andronicus* were not found lower than 1500 m, but as high as ca. 1950 m. However, my observations at the latter altitude, on the slopes below the summit of Orelek, indicate that *P. andronicus* may range freely as high as Orelek itself (2099 m); there is certainly no physical barrier to prevent them from doing so and the habitats close to the summit are basically the same as at 1950 m.

In Pirin *P. icarus* and *P. andronicus* were found syntopically in flowery open habitats (roadsides, forest glades, and subalpine meadows) between ca. 1500–1850 m; no habitat segregation was apparent between the two there. This situation closely corresponds to



Figs. 7–22. Uppersides (two upper rows) and undersides (two lower rows) of *P. icarus* (7–10, 15–18) and *P. andronicus* (11–14, 19–22). 7–4: ♂♂, 15–22: ♀♀. 7, 12, 14, 15, 22. Central Pirin, Popovi Livadi – Orelek, 1600 m, 2.vii.2003. 8. South Pirin, Popovi Livadi – Sveshtnik, 1400–1500 m, 3.vii.2003. 9. East Stara Planina Mts., Karandila nature park, 1000 m, 1–2.viii.1999. 10, 16. Pirin, Popovi Livadi, 1400 m, 1.vii.2003. 11, 21. South Pirin, Sveshtnik, 1850–1950 m, 3.vii.2003. 13, 20. Central Pirin, below Dobro Pole plateau, 1800–1900 m, 26.vi.1998. 19. Alibotush, Hambar Dere gorge, 1400 m, 11.vii.1993. 17. Rhodopi, Smolyan, 1000 m, 16.v.1990. 18. Same data as 3, but 19.–20.vii.1999. All leg. et coll. Kolev. Scale bar = 1 cm.

that described for *P. icarus* and *P. andronicus* in NE Greece, except that in Greece the published upper limit for both *P. icarus* and *P. andronicus* is given as 1800 m (Coutsis & Ghavalas 1995). However, this is rather due to the fact that observations from higher altitudes are lacking so far and *P. andronicus* is expected to occur higher than 1800 m in its Greek range as well (Coutsis, in litt.). In confirmation of this I am informed that *P. andronicus* has been discovered between 1900 and 2000 m on Falakró in the summer of 2004 (Davkov, in litt.).

Vol t i n i s m . Judging by the condition of the Pirin *P. andronicus* collected in the first days of July 2003, some of which were very worn, it can be concluded that the first had emerged already in mid-June. Emergence appears to be protracted: among the small, as a whole very worn series collected in late July 1998, there were a male and a female in relatively good condition. Thus, it can be anticipated that the imago flies from the second half of June till early or mid-August, like other univoltine Lycaenidae inhabiting this altitude zone in the study region, such as e.g. *Lycaena candens*, *Plebeius artaxerxes*, *Polyommatus eroides*, *P. escheri dalmaticus*, *P. nephohiptamenos*, and *P. coridon*. All these species were encountered during both collecting seasons and their emergence had

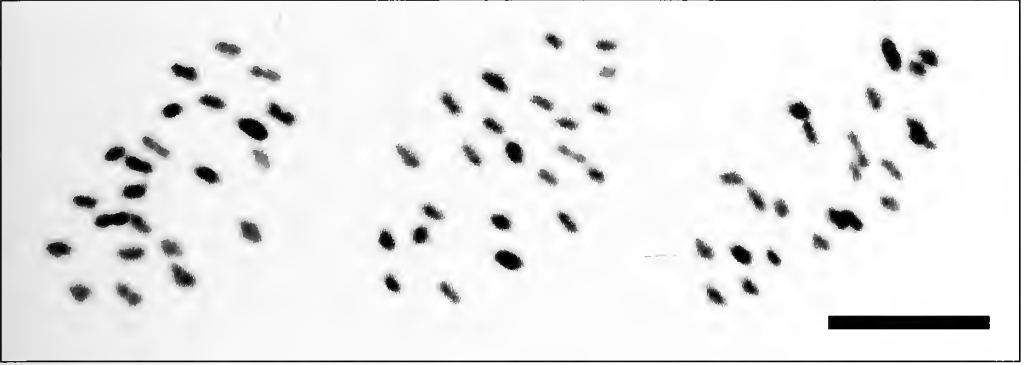


Fig. 23. Karyotype (MI) of *Polyommatus andronicus* ♂, Central Pirin, Popovi Livadi – Orelek, 1600 m, 2.vii.2003, fixation No ZK0303. Scale bar = 10 μ m.

either already begun or was just beginning in early July 2003. The emergence of Pirin *P. andronicus* begins clearly earlier than most of the above species excluding *P. escheri dalmatica*. Thus, although for now I assume that the Pirin *P. andronicus* develop in a single generation, as concluded by Coutsis & Ghavalas (1995), I cannot exclude the possibility that a second, perhaps only partial, generation can develop in particularly favourable years at lower altitudes (1500–1600 m). I have found such partial second generation for *P. artaxerxes* and *P. escheri dalmatica* in the second half of August at lower altitudes in Rhodopi (unpublished data).

Most specimens of *P. icarus* collected by myself on Pirin, as mentioned above, are second-generation specimens though their condition is variable. On average, however, these are in better condition than the Pirin *P. andronicus*, which shows that their emergence begins somewhat later than the latter. This situation matches well the one outlined by Coutsis & Ghavalas (1995) for sympatric Greek *P. icarus* and *P. andronicus*.

Discussion

Taxonomy. To summarize the above findings, the analyzed sample from central and southern Pirin can be divided into two groups. The butterflies of the ‘*P. icarus*-like’ group occur from 700 m (the lowest studied altitude) to ca. 1850 m, have constantly smaller male and female genitalia, two generations annually, and identical size and external characters than other Bulgarian *P. icarus*. The individuals of the ‘*P. andronicus*-like’ group occur from ca. 1400–1500 m to at least 1950 m (and probably higher), are on average larger than both the former group and other Bulgarian *P. icarus*, have on average a darker male upperside colour and heavier underside spotting, and their male and female genitalia are constantly larger irrespective of the individual’s size. These two groups occur syntopically and synchronously between 1500 and 1850 m. The correlated differences in external and genital morphology, voltinism and altitudinal range displacement with partial syntopy and synchrony between the ‘Pirin *P. icarus*’ and ‘Pirin *P. andronicus*’ represent exactly the same situation as that



Fig. 24. Habitat of *Polyommatus andronicus* and *P. icarus* above the tree line at ca. 1850 m in South Pirin (in the background is Šveshtnik peak, 1975 m), 3.vii.2003.

described for Greek *P. icarus* and *P. andronicus* by Coutsis & Ghavalas (1995). The only explanation for the observed phenomenon is that the two groups of butterflies up till now referred to as ‘Pirin *P. icarus*’ and ‘Pirin *P. andronicus*’ do indeed represent two specifically distinct entities: respectively, the ubiquitous *P. icarus* and the montane *P. andronicus*. Hence, the results presented here confirm the conclusions of Coutsis & Ghavalas (1995). On the other hand, it is found that differences stated by Coutsis & Ghavalas (1995) in external characters such as forewing shape, upperside colour in males, and underside pattern are too variable to be reliable identification markers. In addition, there are no differences between the karyotypes of the two species.

In reality, what is traditionally known as the widespread Palearctic species *P. icarus* is a complex of an unknown number of specifically distinct taxa, of which *P. andronicus* is only one. Another possibly distinct species is the taxon *P. tumangensis* Im, 1988 from North Korea and the Russian Primorye. This taxon is larger than *P. icarus* (forewing length up to 19 mm) and is univoltine (Gorbunov 2001: 142–143), thus representing, in a very superficial sense, an ‘equivalent’ of *P. andronicus*. From a European perspective a recent molecular study (Wiemers 2003) revealed that “while populations [of *P. icarus*] from Spain to Iran appear as a monophyletic group (including the Greek *Polyommatus andronicus* Coutsis & Ghavalas, 1995 which has been separated only recently from *P. icarus* based on disputable evidence), the Moroccan specimen of *P. icarus* is placed outside this clade. This result came as a surprise because Northwest African populations of *P. icarus* are thought to represent the same subspecies as in Europe [...]. The COI and ITS-2 p-distances between the Moroccan and Eurasian populations of *P. icarus* differ to

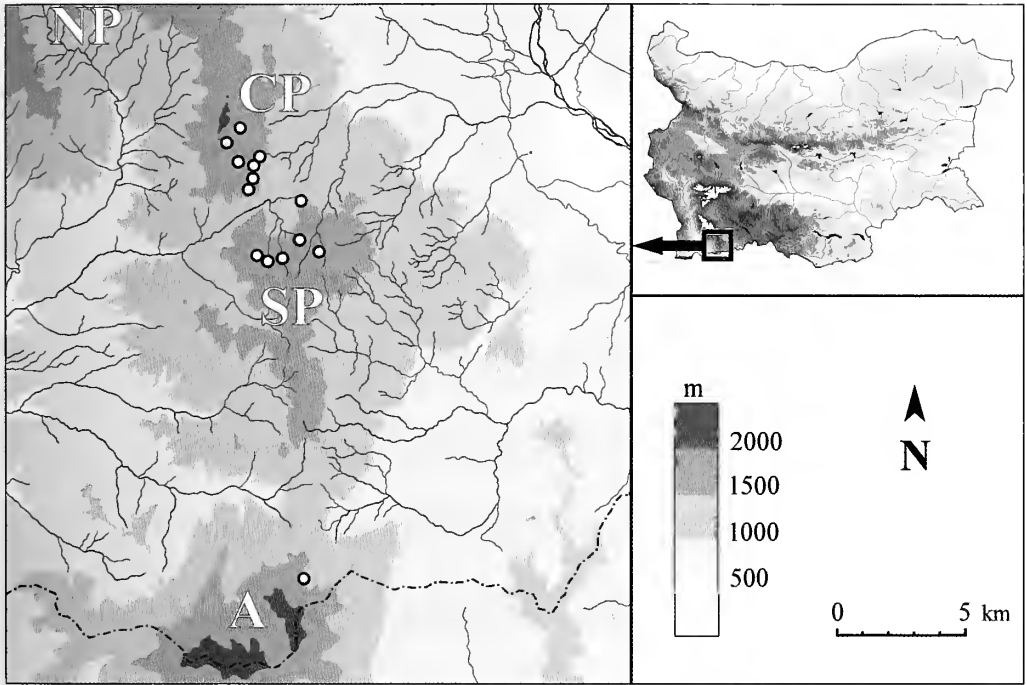


Fig. 25. Known localities (white-centered circles) of *Polyommatus andronicus* in Bulgaria. A. Alibotush. SP. Southern Pirin. CP. Central Pirin. NP. Northern Pirin.

a much higher degree than in other species [...], including those with well differentiated subspecies in Northwest Africa (like *Polyommatus amandus*), and are on the level of well differentiated species. The Moroccan specimen also differs in phenotype from the other *P. icarus* (f. *celina* Austaut), but *P. icarus* is an extremely variable species throughout its vast, trans-Palaeartic distributional range. Without further material it cannot be decided if Northwest African populations of *P. icarus* are so divergent from Eurasian ones that they should better be seen as representing a distinct *Polyommatus* species.”

It would seem that the molecular data obtained by Wiemers disprove conclusively the taxonomic distinctness of *P. andronicus*. However, I do not see this to be the case. The observed morphological and genital differences between partly sympatric and syntopic *P. icarus* and *P. andronicus* in both Greece and Bulgaria agree entirely, and it is impossible to explain these in any other way than by accepting the existence of two biological species – no matter how closely related genetically. There is little doubt that the species status of *P. andronicus* is justified. This situation is a good reminder that genetic distances provide a measure on relatedness, not a straightforward indication of taxonomic status, and also exposes the risks inherent in basing taxonomic decisions on results from limited DNA sequences. If anything, then, the DNA data available so far should make taxonomists scrutinize more closely what is currently known as ‘*P. icarus* s. str.’ (excluding *P. andronicus*), as several good species can be expected to exist within this taxon, even inside the western Palearctic. Further DNA studies on this complex, involving COII sequences as well, are most desirable. It is worth

remembering that, beside *P. andronicus*, three other species-level taxa very similar to *P. icarus* were described from Europe in recent years: *P. abdon* Aistleitner & Aistleitner, 1994 from Southern Spain, and *P. elena* Stradomsky & Arzanov, 1999 and *P. neglectus* Stradomsky & Arzanov, 1999 from the steppes of easternmost Europe. All of these are presently considered synonyms of *P. icarus* (Kudrna 1996; Tshikolovets 2003), and due to lack of material it has not been possible to reassess their status here. However, several circumstances of interest must be noted with respect to the latter two taxa. Stradomsky & Arzanov (1999) reported that *P. elena* and *P. neglectus* are sympatric and syntopic with *P. icarus* while showing differences in genital structure. Particularly remarkable is the sclerotization pattern in the female genitalia which differ drastically from what I have myself observed in females of Bulgarian *P. icarus* and *P. andronicus*.

The only character that could not be evaluated in the present study is the difference between *P. icarus* and *P. andronicus* in the UV-reflective pattern of the wing underside reported by Coutsis & Ghavalas (1996). Such differences are perhaps of little taxonomic significance. The quantity of UV-reflected pigments stored in the wings of *P. icarus* is heavily dependent on the flavonoid content of the legume plant parts eaten by the larvae; inflorescences are richer in flavonoids than leaves of the same plant, and in laboratory rearings it is possible to vary the UV-reflectivity of *P. icarus* individuals by varying the larval diet (Burghardt et al. 1997). Thus, the differences observed by Coutsis & Ghavalas (1996) could have been induced by differing larval diets of syntopic *P. icarus* and *P. andronicus*, the latter feeding predominantly on inflorescences. This might indicate that in conditions of syntopy these two taxa prefer different parts of the same plants, thereby reducing competition for a common food resource.

Ecological preferences of *P. andronicus*. This is a xeromontane species that prefers flowery rocky habitats between 1000 and 1950 m (Fig. 24), possibly reaching up to ca. 2100 m (see above). All known localities are on partly karstified Proterozoic marble of the Dobrostan formation (Zagortchev 1995). The larval host plant remains unknown.

My detailed observations in Pirin show that there is an altitudinal displacement between the two species. While *P. icarus* barely reaches above the tree line (just as in other Bulgarian mountains), *P. andronicus* inhabits also higher, subalpine habitats considerably above the tree line, including barren karst terrain. In Pirin the two species occur together over most of the altitudinal range of *P. andronicus*, 1500–1850 m. This, however, may be a relatively recent development brought about by human interference with the natural succession of the vegetation. I observed the highest density of *P. andronicus* (including all females seen and a pair in copula) in southern Pirin on the slopes of Sveshtnik peak above the tree line (between 1800 and 1950 m). Only a few males were recorded below that altitude, invariably flying rapidly along narrow dirt roads in otherwise contiguous dense coniferous forest. In central Pirin most butterflies were found in sheltered, sunny flower-rich roadsides along the road leading to Orelek, at altitudes of 1500–1600 m. In both central and southern Pirin all habitats currently utilized by *P. andronicus* between 1500 and 1750 m owe their existence to human activities that have led to disruptions in the forest cover.

Therefore the primary post-glacial habitat of *P. andronicus* under a natural vegetational succession appears to have been flowery subalpine grassland on stony calcareous ground at and above the natural tree line, i.e. higher than 1700–1800 m (Fig. 24). This

is supported by the difference in the lowest altitude at which *P. andronicus* occurs in Greece (1000 m: Coutsis & Ghavalas 1995) and Bulgaria (central and southern Pirin: 1500 m, Alibotush: ca. 1400 m, but based on only one specimen). From these numbers it appears that in Bulgaria *P. andronicus* does not reach as low as in Greek mountains. A possible reason for this can be fact that in Greece *P. andronicus* finds even more favourable conditions for downward dispersal on account of Greek mountains being on the whole much more deforested than Bulgarian mountains (Coutsis & Ghavalas 1991; Polunin 1997). My observations in southern Pirin suggest that males of *P. andronicus* in particular can fly long distances down into the forest using man-made ‘corridors’ such as roads. It is also certain that these human activities must have also facilitated the simultaneous *upward* dispersal of *P. icarus*, thereby enhancing the contact between the two species.

Range and conservation status of *P. andronicus*. The newly discovered Bulgarian localities (Fig. 25) significantly expand the total distribution of *P. andronicus*. This Balkan endemic is now known to be restricted to several massifs clustered in a small area between the valleys of Struma/ Strimon and Mesta/ Nestos. In my opinion there is little chance of any further significant additions to the known range of this species. One further region deserves attention in this regard, namely the karst section of northern Pirin below Vihren peak. At ca. 1800–2000 m in the vicinity of ‘Vihren’ chalet there are karstified marble slopes with xerophyllous plant communities dominated by sparse *Pinus heldreichii* stands that are similar to the communities found at that altitude on Alibotush (pers. observ.). As was said above, *P. andronicus* has successfully adapted to secondary, man-made habitats and has thus managed to considerably expand its altitudinal range in the historical past. That having been said, this species does nevertheless have a very limited range and should probably be regarded as ‘Vulnerable’ and of high conservation interest on a European scale.

Conclusion

The present study provides independent and full support to the conclusions of Coutsis & Ghavalas (1995) regarding the specific distinctness of *P. andronicus*. This is so far the only known sibling species of *P. icarus* in Europe and, what is especially interesting, the two occur in partial syntopy and synchrony. This offers good opportunities for research on the ecology of both species.

The significance of the morphological characters of *P. andronicus* was re-assessed and the conclusions of Coutsis & Ghavalas (1995) are largely confirmed. However, I found that the male upperside colour and forewing shape are too variable in both *P. andronicus* and *P. icarus* to present reliable differences. *P. andronicus* is found to be an even larger species than originally described, with the forewing of the largest Bulgarian specimens measuring 19.5 mm (male) and 18.6 mm (female).

The Bulgarian localities reported here expand considerably the known distribution of this Balkan endemic. My observations on its habitat preferences and altitude range in Bulgaria lead me to conclude that in the historical past this species has apparently benefited considerably from human activity (deforestation, road building) allowing it to expand its range to lower, previously heavily forested, regions. A ‘Vulnerable’ status is nevertheless considered justified in the light of its very limited total range.

Acknowledgements

I thank Dirk van der Poorten and Willy De Prins (Belgium, Antwerpen) for the interesting discussions on the taxonomic status of *P. andronicus*. The kind hospitality of Willy De Prins made it possible for me to study the paratypes of *P. andronicus* in the now-dissolved Vlaamse Lepidoptera Collectie Antwerpen. John G. Coutsis (Greece, Athens) was especially helpful in confirming my identification of the first known Bulgarian specimen of *P. andronicus*. I thank Mr. Slobodan Davkov (Republic of Macedonia, Skopje) for his inspiring company on my second field trip in 2003 and for the communication of his 2004 find of *P. andronicus* on Falakró.

References

- Bálint, Z. & K. Johnson 1997. Reformation of the *Polyommatus* section with a taxonomic and biogeographic overview (Lepidoptera, Lycaenidae, Polyommataini). – *Neue entomologische Nachrichten* **40**: 1–68.
- Bondev, I. 1991. [The vegetation of Bulgaria. Map 1: 600.000 with explanatory text]. – St. Kliment Ohridski University Press, Sofia, 184 pp., 1 map sheet (in Bulgarian).
- Burghardt, F., K. Fiedler & P. Proksch 1997. Uptake of flavonoids from *Vicia villosa* (Fabaceae) by the lycaenid butterfly, *Polyommatus icarus* (Lepidoptera: Lycaenidae). – *Biochemical Systematics and Ecology* **25** (6): 527–536.
- Coutsis, J. G. & N. Ghalalás 1991. *Agriades pyrenaicus* (Boisduval, 1840) from N. Greece and notes on *Apatura metis* (Freyer, [1829]) from N.E. Greece (Lepidoptera: Lycaenidae, Nymphalidae). – *Phegea* **19**: 133–135.
- Coutsis, J. G. & N. Ghalalás 1995. Notes on *Polyommatus icarus* (Rottemburg, 1775) in Greece and the description of a new *Polyommatus* Latreille, 1804 from northern Greece (Lepidoptera: Lycaenidae). – *Phegea* **23**: 145–156.
- Coutsis, J.G. & N. Ghalalás 1996. Ultra-violet reflection pattern in *Polyommatus andronicus* Coutsis & Ghalalás, 1995 and *Polyommatus icarus* (Rottemburg, 1775) (Lepidoptera: Lycaenidae). – *Phegea* **24**: 167–169.
- Gorunov, P. Y. 2001. The butterflies of Russia: classification, genitalia, keys for identification (Lepidoptera: Hesperioidea and Papilionoidea). – Thesis, Ekaterinburg, 320 pp.
- Grozeva, S. M. & S. Nokkala 1996. Chromosomes and their meiotic behavior in two families of the primitive infraorder Dipsocoromorpha (Heteroptera). – *Hereditas* **125**: 31–36.
- Karsholt, O. & J. Razowski 1996. The Lepidoptera of Europe: A distributional checklist. – Apollo Books, Stenstrup, 380 pp.
- Kudrna, O. 1996. Mapping European Butterflies: Handbook for Recorders. – *Oedippus* **12**: 1–60.
- Kudrna, O. 2002. The Distribution Atlas of European Butterflies. – *Oedippus* **20**: 1–342.
- Polunin, O. 1997. Flowers of Greece and the Balkans – a field guide. – Oxford University Press, xv + 592 pp., 64 pls.
- Puplesiene, J. & A. Olivier 2000. The karyotype and chromosome number of *Polyommatus buzulnavi* (Lycaenidae). – *Nota lepidopterologica* **23**: 71–77.
- Robinson, R., 1971. Lepidoptera genetics. – Pergamon Press, Oxford – Braunschweig, 687 pp.
- Stradomsky, B.V. & Yu. G. Arzanov 1999. *Polyommatus elena* sp. n. and *Polyommatus neglectus* sp. n. – new taxones <sic> of the family Lycaenidae (Lepidoptera). – *Kharkov Entomological Society Gazette* **7** (2): 17–21 (in Russian, with English summary).
- Tshkolovets, V.V. 2003. Butterflies of Eastern Europe, Urals and Caucasus. An Illustrated guide. – Kyiv – Brno, 176 pp.
- Tolman, T.W. 2001. Photographic Guide to the Butterflies of Britain and Europe. – Oxford University Press, xvi + 305 pp.
- Tolman, T.W. & Lewington, R. 1997. Butterflies of Britain and Europe. – Collins Field Guide Series, HarperCollins Publishers, 320 pp., 104 pls.
- Zagorchev, I. 1995. Pirin – geological guidebook. – Academic Publishing House “Prof. Marin Drinov”, Sofia, 70 pp. + 1 map sheet.

A new species of *Meharia* Chrétien, 1915 (Cossidae) from the Lower Volga Region

DMITRY A. KOMAROV¹ & VADIM V. ZOLOTUHN²

¹ The laboratory preservation of surroundings of Volgograd department of Privolzhskoy train-service, ul. Buchanzeva 48, RUS-Volgograd; e-mail: komarov@tele-kom.ru

² Department of Zoology, Uljanovsk State Pedagogical University, pl. 100-letiya Lenina 4, RUS-432700 Uljanovsk, Russia; e-mail: ulgpu@mv.ru

Abstract. *Meharia scythica* sp. n. is described from the Astrakhan Region of Russia. A diagnosis of the genus *Meharia* Chrétien, 1915, is given, here listed for the first time from Russia and Europe as a whole. The holotype of the new taxon is kept in the collection of the entomological Museum of Thomas J. Witt (Germany, Munich).

Zusammenfassung. *Meharia scythica* sp. n. wird aus Rußland, Astrakhan Gebiet, beschrieben. Von der Gattung *Meharia* Chrétien, 1915, hier erstmalig für Rußland sowie Europa nachgewiesen, wird eine Gattungsdiagnose gegeben. Der Holotypus der neuen Art wird in der Sammlung des entomologischen Museums Thomas J. Witt (München) deponiert.

Резюме. С территории Астраханской области России описан *Meharia scythica* sp. n. Дан диагноз рода *Meharia* Chrétien, 1915, впервые отмечаемого для территории России и Европы в целом.

Key words. Lepidoptera, Cossidae, *Meharia*, new species, Russia, Volga Region.

Introduction

A small sample of remarkable cossid moths was collected in August 1996 in the Akhtuba District of the northern Astrakhan Province (the Lower Volga Region of Russia) near Baskuntschak Lake by the senior author. The moths were later identified by the junior author as an undescribed species of primitive cossids of the genus *Meharia* Chrétien, 1915. Taking into consideration that this genus is for the first time noted from Russia and is absent from the Key for the European part of the country (Zagulajev 1978), a description of the new species and a diagnosis of the genus are given below.

Meharia Chrétien, 1915 was established in the Tineidae as a monotypic genus for *Meharia incurvariella* Chrétien, 1915 with type locality Biskra, Algeria. Later, this species was considered conspecific with *Alavona semilactea* Warren & Rothschild, 1905. In 1951, the genus was transferred to the Cossidae by Bradley (1951: 178).

Blalia vittata Rungs, 1943, the type species of *Blalia* Rungs, 1943, described from Sahara, Morocco, is a junior synonym of *M. incurvariella*. Therefore, *Blalia* is a junior subjective synonym of *Meharia* (Fletcher & Nye 1982).

The species of the genus are mostly very similar, apart from color pattern. The mesepimeron is rather triangular and lacks a pale band; the labrum has more or less developed pilifers; the pronotum is low; the metascutum is medially wide; the metascutellum is medially wide and more or less antero-medially extended; tergite I is membranous in its anterior half; the parepisternum anteriorly is well separated from basisternum II; the upper parepisternal suture is set diagonally over pre-episternum II; the mesomeron is slightly narrower than eucoxa II; eucoxa III is wide; the midtibial spurs are located at or slightly beyond the middle of the tibia;



Fig. 1. *Meharia scythica*, holotype ♂.

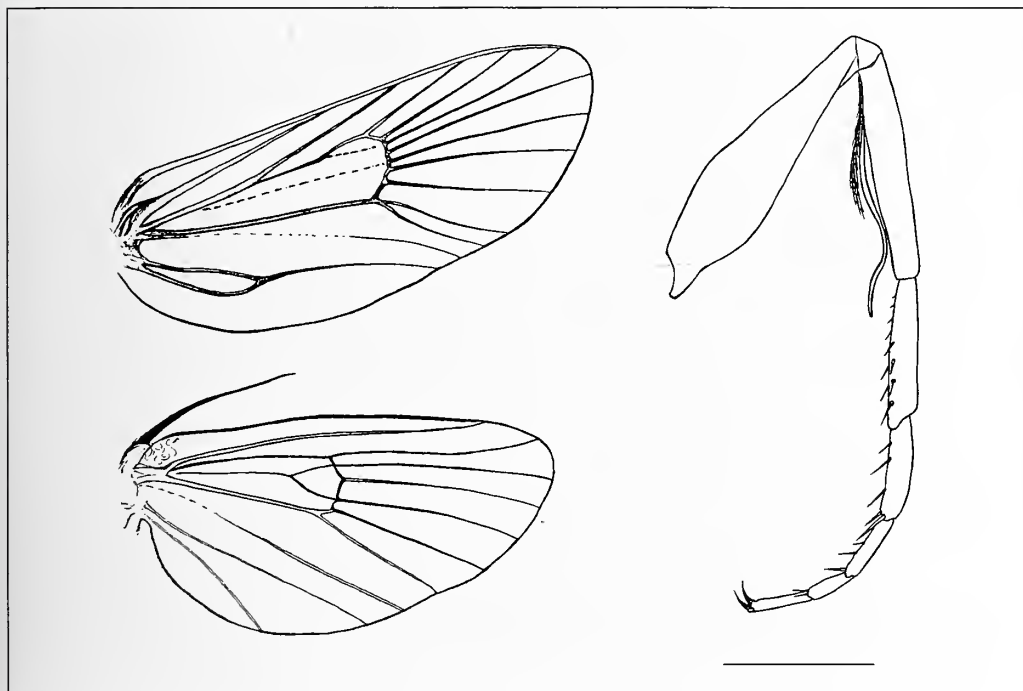
the fifth tarsomere is approximately 0.8 times the length of the fourth; the forewing is widened at about one-third of its length; CuA2 in the forewing is very distal; the costal region of the hindwing is narrowing very distally; and the anal plate is long. Because of these characteristics, *Meharia* was excluded from the Cossidae, but not attributed to any family by Schoorl (1990: 244). However, in our opinion *Meharia* is considered to be part of the Cossidae. Knowledge on the peculiarities of the preimaginal stages would be especially interesting to define its phylogenetic relationships more precisely.

Meharia Chrétien, 1915: 367

Type species: *Meharia incurvariella* Chrétien, 1915: 368, fig. 11, by monotypy.

Blalia Rungs, 1943: 174. Type species: *Blalia vittata* Rungs, 1943, by original designation.

Diagnosis. Small cossids with elegant, long body. Wing expanse 20–32 mm. Eyes nude. Male antennae bipectinate until the apex, with long rami. Proboscis absent. Labial palpus about 1.5 time longer than eye diameter, horizontal; third segment about 3.5 time shorter than second and somewhat directed downward. Legs long and thin, foretibia without spurs but with long band-shaped epiphysis and hair pencil near base; metatibia with two pairs of spurs, the inner ones much stronger. Forewing narrow and elongated, with rounded external margin; pattern of primitive net-like type with lighter



Figs. 2-3. *Meharia scythica*. 2. Venation. 3. ♂ fore leg (scale bar 1 mm).

spots or bands on greyish or brownish ground color; stroke pattern elements as typical for the family are absent in *Meharia*. Hindwing without pattern, usually dark colored.

Venation (Fig. 2). Forewing Sc free as well as bases of all 5 R; M2 practically in the middle between M1 and M3; bases of both cubitals free or shortly stalked; A1 weak, distally developed as fold; A2 and A3 anastomosed on distal half but basal fork well developed; R-Cu cell with M branch and additional radial cellula. Hindwing bases of all veins free; three anals developed but A1 present in basal third only as fold; R-Cu cell with well developed, ramified medial branch.

Male genitalia. Simple, with unpaired uncus, cone-shaped gnathos, weakly sclerotized costa on valva and well-developed saccus; juxta as a plate, weakly attached with phallus and bases of valvae; phallus tubular, straight or slightly curved, with distinct sclerotized knob on distal edge, without cornuti but with zones of weak sclerotization on vesica.

Female. Unknown.

Preimaginal instars. Unknown.

Life history. The genus is native to arid (mainly desert, semi-desert and steppe) biotopes, where the larvae probably develop on (?in) roots and bulbs. Moths fly at dusk and first half of night low above the ground and are attracted to artificial lights.

Diversity and distribution. The specific composition of *Meharia* is not completely known. Apart from the new species describing here, the following taxa are known: the type-species *M. semilactea* Warren & Rothschild, 1905 (northern Africa to Arabia and

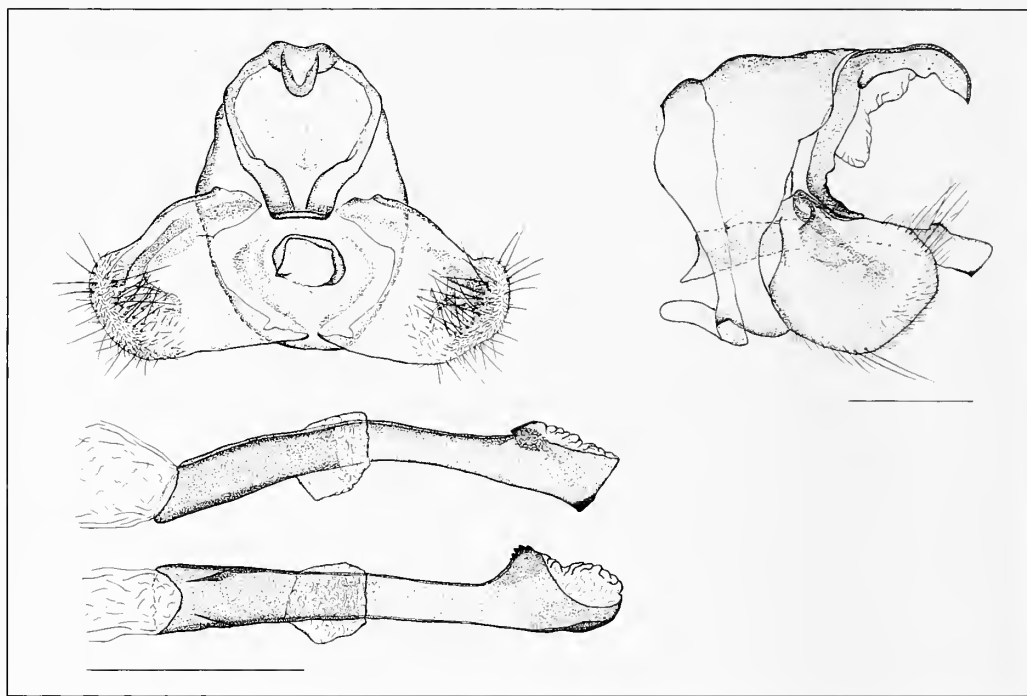


Fig. 4. *Meharia scythica* sp. n., paratype: male genitalia (above, left: caudal view; above, right: lateral view) and phallus shown lateral (above) and dorsal view below (scale bar 0.5 mm).

Iran, with further names introduced for local populations *incurvariella* Chrétien, 1915, *vittata* Rungs, 1943, *persica* Wiltshire, 1946 – their status needs special investigation), *M. philbyi* Bradley, 1952 (Saudi Arabia) and *M. tanganyikae* Bradley, 1952 (Africa, Tanganyika and Tindiga). Validity and rightfulness of the synonymization of the taxa listed above need special investigation. The genus is for the first time here noted from Russia and Europe as a whole.

Meharia scythica sp. n.

Material. Holotype: ♂ [Russia] Astrakhan Prov., Akhtuba Distr., passing-track Martovsky, outsk. Bolshoe Bogdo Mt., lum., 21.viii.1996, D. Komarov leg. (coll. Museum Thomas Witt, Munich, later assigned to Zoologische Staatssammlung München). – Paratypes: 3♂, same data, coll. Zoological Institute (St. Petersburg) and coll. D. Komarov.

Diagnosis. This taxon clearly differs from all other species of the genus by the more uniform coloration without contrasting bands and spots as well as by the dark hindwings. The male genitalia can be recognized by the rounded valvae and the weak sclerotization of their costal margins. The only known species from the western Palaearctic, *Meharia semilactea* Warren & Rothschild, 1905, can be separated nicely by the white or whitish transversal bands on the brown ground color in the forewing (de Freina & Witt 1990).

Description. Male (Fig. 1). Head and body with yellowish to cream-colored scales; abdomen darker. Underside with whitish scales; distal edges of abdominal segments ringed with yellowish scales. Forewing length 12 mm. Forewing with dark yellowish-

white ground color and darker reddish-brown to greenish-brown scales forming tessellate pattern with prominent basal, anal, and costal spots. Cilia with two rows of scales, the inner reddish with brown tips and the outer, checkered, yellowish and brown. Hindwings dark grey to blackish without pattern, basal field with prominent, whitish bunch of hair-like scales; cilia as in forewing but outer row unchecked, whitish. Venation (Fig. 2) as described for genus. Foretibia (Fig. 3) with long, S-shaped epiphysis and distinct hair bunch at about 2/3 of length.

Male genitalia (Fig. 4). Uncus narrow; valvae short and rounded with weak costa, covered on inner surface with numerous, elongated, strong setae; phallus long, slightly curved, with short dorso-lateral sclerotization.

Habitat. The type-series was collected at light in the Achtuba District of the Astrakhan Province in the vicinity of Baskuntschak Lake (by Bolshoe Bogdo Mt.). The natural vegetation in the area is that of desert steppes dominated by *Artemisia lerchiana*, *Agropyron desertorum*, *Stipa sareptana*, *Festuca valesiaca* s.l., frequently in an assemblage with wormwood (*Artemisia pauciflora*) on saline soils. Predominance of annual and biennial plants (*Descurainia sophia*, *Lepidium perfoliatum*, *Sisymbrium altissimum* etc.) is typical for passing-track Martovsky. Along the railway line, which is directed NNW-SSE, is a rather wide forest belt with a predominance of *Ulmus pumila*. The railway is a path for various weeds and adventive plants growing in appreciable quantities on the embankment. Many of these plants are not native to the area (for example, species of *Papaver*). Five to eight kilometres eastwards from the railroad the unique biotopes of Mount Bolshoe (Large) Bogdo contain significant floristic diversification and a lot of rare plants. In the south-east of the mountain lies an austral karst field (Shar-bulak) with numerous karst gullies, in which *Crataegus ambigua*, *Prunus spinosa*, and *Rosa* spp. can be found.

The climate of the area is sharply continental, droughty. The average precipitation for one year is about 250 mm, but the evaporation is much higher: about 1500 mm. The average annual temperature is +7.7°C. The strong daily and seasonal differences in temperature are characteristic. In summer, the air temperature can rise up to +44°C, while in winter it can go down to -37°C.

Life history. The moths were collected while flying to the light of mercury lamps (250 W). They sat on the ground some distance from the lamp.

Distribution. The species is known only from its type locality – the northern part of the Astrakhan Province of Russia. It undoubtedly has a wider distribution in desert and steppe biotopes of the Kalmyk Republic, Lower Volga, and western Kazakhstan.

Acknowledgements

Our special thanks go to Dr Roman V. Yakovlev (Russia, Barnaul) for his bibliographic help and support during this investigation, Alexandre V. Popov (Russia, Volgograd) for a characteristic of the vegetation at the type locality, and Svetlana V. Nedoshivina (Russia, Uljanovsk) for technical assistance.

References

- Bradley, J. D. 1951. Notes on the family Arrhenophanidae (Lepidoptera: Hereoneura), with special reference to the morphology of the genitalia, and descriptions of one new genus and two new species. – The Entomologist **84**: 178–185.

- Chrétien, P. 1915. Contribution à la connaissance des Lépidoptères du Nord de l'Afrique. – Annales de la Société Entomologique de France **84**: 367–368.
- Fletcher, D. S. & I. W. B. Nye 1982. The Generic Names of Moths of the World. Vol. 4. – Trustees of the British Museum (Natural History), London. 192 pp.
- Freina, J. de & T. J. Witt 1990. Die Bombyces und Sphinges der Westpalaearktis. Band 2. – Edition Forschung & Wissenschaft, München. 140 pp.
- Rungs, Ch. 1943. III. Notes de lépidoptérologie marocaine (XI). Addition à la faune du Maroc: Lépidoptères des régions sahariennes. – Bulletin de la Société des Sciences Naturelles et Physiques du Maroc **22**: 174–177.
- Schoorl, J. W. 1990. A phylogenetic study on Cossidae (Lepidoptera: Ditryisia) based on external adult morphology. – Zoologische Verhandlungen **263**: 1–296.
- Zagulajev, A. K. 1978. Fam. Cossidae. – *In*: Medvedev G. S., Key to the Insects of European Part of the USSR. 4 Lepidoptera, Part 1: 177–186. – Nauka, Leningrad. (in Russian).

Risk spreading in the voltinism of *Scolitantides orion orion* (Pallas, 1771) (Lycaenidae)

ANDREAS TRÄNKNER¹ & MATTHIAS NUSS²

¹ Antonstr. 39, D-01097 Dresden, Germany; e-mail: andreastraenkner@web.de

² Museum für Tierkunde, Königsbrücker Landstr. 159, D-01109 Dresden, Germany; e-mail: matthias.nuss@snsd.smwk.sachsen.de

Abstract. As far as known the Chequered Blue (*Scolitantides orion* (Pallas, 1771)) develops either one or two generations per year. To clarify the voltinism strategy adopted by a population of this species in eastern Germany, we continuously monitored them under natural conditions in 2004. In parallel, breeding-experiments were undertaken in four cages placed within the habitat. Both sets of observations revealed three distinct generations of adults, but only two generations of preimaginal stages were detected per year. The first adults emerged from diapausing pupae in spring. This first generation of adults produced a second generation (the first preimaginals of this season) which developed diapausing as well as non-diapausing pupae. Adults of this second generation again produced diapausing and non-diapausing pupae (the second generation of preimaginals of this season). From the non-diapausing pupae emerged a third generation of adults, which however did not reproduce. The first generation of every year is recruited from all diapausing pupae of the two preimaginal generations of the preceding year. This voltinism is interpreted as a risk-spreading strategy that allows the plastic development of a maximum number of generations during one season. In the study area, the larvae of *S. orion orion* feed exclusively on *Sedum maximum* and the facultatively myrmecophilous larvae were associated with ant species of Formicinae as well as Myrmicinae, but also developed without such an association. Five ant species were identified in these associations, *Formica* (*Serviformica*) *glauca* Ruzsky, 1895, *Lasius* (*Lasius*) *emarginatus* Olivier, 1791, *Tetramorium impurum* (Förster, 1850), *Formica* (*Serviformica*) *fusca* Linnaeus, 1758, and *Camponotus ligniperda* Latreille, 1802, and the first three species are recorded for the first time to be associated with this lycaenid species.

Key words. diapause, plastic voltinism, risk spreading, *Scolitantides orion*, Lycaenidae, facultative myrmecophily, ant species, host plant, *Sedum maximum*.

Introduction

The Chequered Blue (*Scolitantides orion* (Pallas, 1771)) is a Palaearctic species occurring from the Atlantic coast to Japan (Coulondre 1994; Tolman & Lewington 1998). Within this region, the distribution of *S. orion* is a patchy pattern of several disjunct areals, for which six subspecies are recognised: *S. o. orion* from Central and southeastern Europe and Turkey; *S. o. parvula* de Sagarra, 1926 from the Pyrénées and the Iberian Peninsula; *S. o. ultraornata* Verity, 1937 from southern Fenno-Scandia; *S. o. tyleri* Evans, 1924 from Tibet; *S. o. ornata* Staudinger, 1892 from Central Asia to the Far East, and *S. o. jezoensis* Matsumura, 1919 from Japan (Coulondre 1994). In Germany several populations occur in Hesse, Rhineland-Palatinate, Baden-Wuerttemberg, Bavaria, Thuringia, and Saxony (Gaedike & Heinicke 1999). *S. orion* is a xerothermophilous species. Populations usually occur in sunny places within mountainous areas, often in river valleys (Settele et al. 1999; Huemer 2004). Despite the fact that *S. orion* is generally well known to lepidopterists certain features of its life history are still insufficiently studied. One controversial issue is the number and phenology of generations per year and these are the main foci of the study presented here. The data available for *S. o. orion* suggest that there are different numbers of

generations per year. One generation is stated for populations from Central Europe (Tolman & Lewington 1998), but two are reported for several areas in Switzerland (Tolman & Lewington 1998; Lepidopterologen-Arbeitsgruppe 1994). Forster & Wohlfahrt (1955) generally mentioned two generations for Central Europe but only one at the upper altitudinal limit of the species' distribution in the Alps. Within the Czech Republic two generations were reported from Central Bohemia (Srdinko 1912), but only one from Moravia (Kudla 1951). Two generations are also mentioned from South Tyrol (Huemer 2004). Even within Germany, different numbers of generations per year have been recorded for various regions. While in Rhineland-Palatinate there appears to be only one generation (Reinhardt & Kinkler 2004), a partial second generation occurs in Thuringia (Bergmann 1952), and two generations are recorded from Saxony (Reinhardt 2003). According to Coulondre (1994), voucher specimens of the second generation of *S. o. orion* in insect collections represent only 0–10% of the quantity of the first generation. As many of these data are based on voucher specimens collected in different years, we investigated the phenology in one population in eastern Germany in order to obtain reliable data for an entire season. Observations made on larval host plant use and on their associated ants are mentioned as well.

Methods

The study site is situated to the north-west of Meissen (Germany: Saxony) in a south-facing granite-quarry that is extremely xerothermic on most of its surface. Here large stands of *Sedum maximum* are growing. However, plants like *Himmulus lupulus*, *Rosa canina*, and *Rubus* sp. are encroaching this area and three more *Sedum* species, viz. *Sedum acre*, *S. sexangulare*, and *S. rupestre*, are also present.

Usually, our observations of *S. orion* in this habitat took place every second day, but every day during periods when butterflies were emerging or when a generation was about to be completed. Thus, observations were made on the following days: April 21, 23, 27, 28, 29; May 03, 04, 11, 14, 18, 19, 24, 27, 28; June 01, 03, 04, 07, 09, 11, 14, 15, 21, 22, 23, 24, 25, 26, 28, 30; July 01, 02, 04, 05, 06, 07, 08, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 25, 27, 29, 30; August 02, 03, 04, 05, 06, 08, 09, 11, 12, 14, 16, 18, 19, 21, 22, 24, 26, 30; and September 02, 03, 04, 06, 07, 08, 10, 13, 14, 17, 19, 20, 22, 23 2004. No observations were undertaken during strong rains or thunderstorms. At the end of April and the beginning of June the stands of *S. acre*, *S. sexangulare*, and *S. rupestre* were intensively investigated for the presence of eggs and larvae of *S. orion*.

Four cages were installed in the habitat to observe the development of *S. orion* under somewhat controlled conditions. Each cage was composed of two plastic dishes covered by a mosquito net held by willow rods. The measurements for each cage were 60×40×30 cm. The plastic dishes were filled with a mixture of sterilised soil from the quarry habitat and commercial potting soil. One dish of each cage was planted with *S. maximum* from the quarry habitat after the plants had been checked to be free of aphids, thrips, hover fly larvae, and immatures of *S. orion*. The second dish contained different plants: cage 1, 2 and 2a were planted with *Sedum album* from the Dresden

Botanical Garden, cage 3 received only a large stone, and cage 4 a mixture of *S. maximum* and *S. rupestre* from the Dresden Botanical Garden. Between all plants we placed stones of about 8 cm in diameter. The cages were controlled during each visit to the site and were moisturised if necessary. Cages 1, 2 and 3 were installed on April 23. Cages 1 and 2 were covered immediately. Cage 3 was left uncovered until the first eggs were laid on its *S. maximum* plants, which happened until April 27. On April 29 two females of *S. orion* were placed in cage 1 and one in cage 2 for oviposition. In cage 1 all fully developed larvae pupated in places where they could be controlled easily. Thus, all pupal shells could be removed after the adults emerged while generation 3 started to develop. In cage 2 pupation often took place in hidden places. Therefore, after the emergence, copulation, oviposition, and death of the adults of the second generation their eggs were transferred to a new cage called cage 2a, while the pupae of the second generation that had not yet emerged were left in cage 2. Cage 4 was installed on May 19 and one *S. orion* female was put inside the same day. On September 20 all cages were removed and inspected in detail. The remaining pupae were placed in a plastic container on mosses and left outdoor.

Results

Field observations

Flight times in the field (Fig. 1). First generation. Butterflies of the first generation were noted during two months from April 21 to June 21. The first eggs on *Sedum maximum* were found on April 27. No *S. orion* of this first generation flew after June 21, though the weather was sunny, warm, and dry.

Second generation. On July 4 an obviously freshly-emerged adult of *S. orion* was detected. Two butterflies were observed on each of the following four days. The main flight activity lasted between July 12 and August 6. After August 6 the number of observed specimens decreased until August 12, when the last two adults of the second generation were seen, even though the weather was warm and dry afterwards.

Third generation. An obviously freshly-emerged adult of *S. orion* was detected on August 21 and also on August 22. During the following days, the weather was cold and rainy and thus it was impossible to observe any butterfly. At the beginning of September the weather became warm and sunny again and during the hot day of September 4 another adult *S. orion* was seen. This summer-like weather continued until September 17. During this period, three butterflies were observed on September 8 and 10, two butterflies on September 14 and 17, and the last one on September 19.

Host plants of the larvae. The larvae were found exclusively on *Sedum maximum*, though congeneric *S. acre*, *S. rupestre*, and *S. sexangulare* were also present in the study area.

Association with ants. *S. orion* larvae were observed in association with four species of Formicinae ants: *Camponotus ligniperda* Latreille, 1802, *Formica (Serviformica) fusca* Linnaeus, 1758, *Formica (Serviformica) glauca* Ruzsky, 1895, and *Lasius (Lasius) emarginatus* Olivier, 1791.

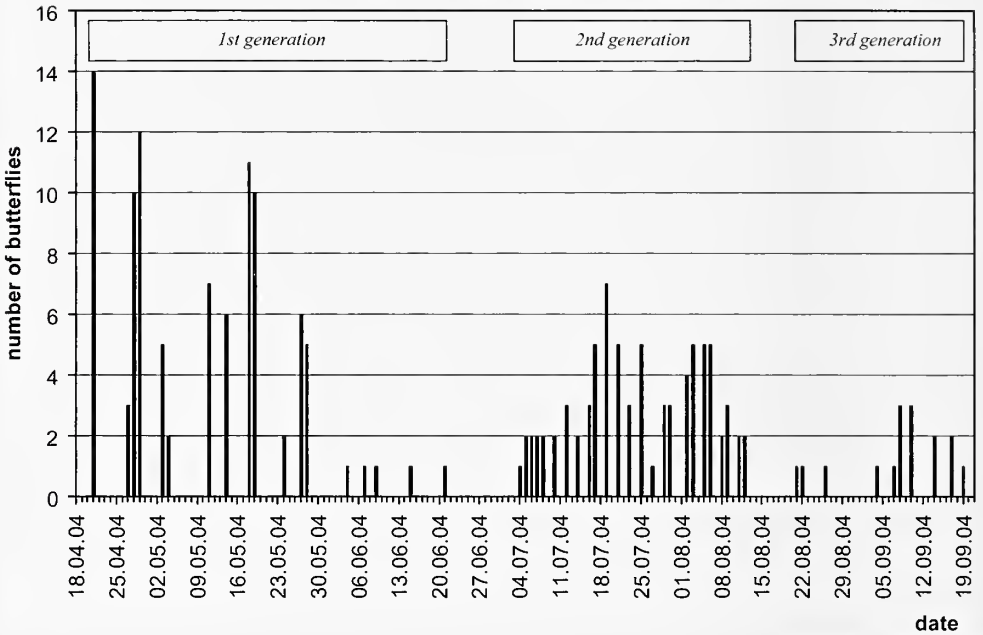


Fig. 1. Number of adult *S. orion* in the study area during 2004. Double counts cannot be excluded because specimens were not marked.

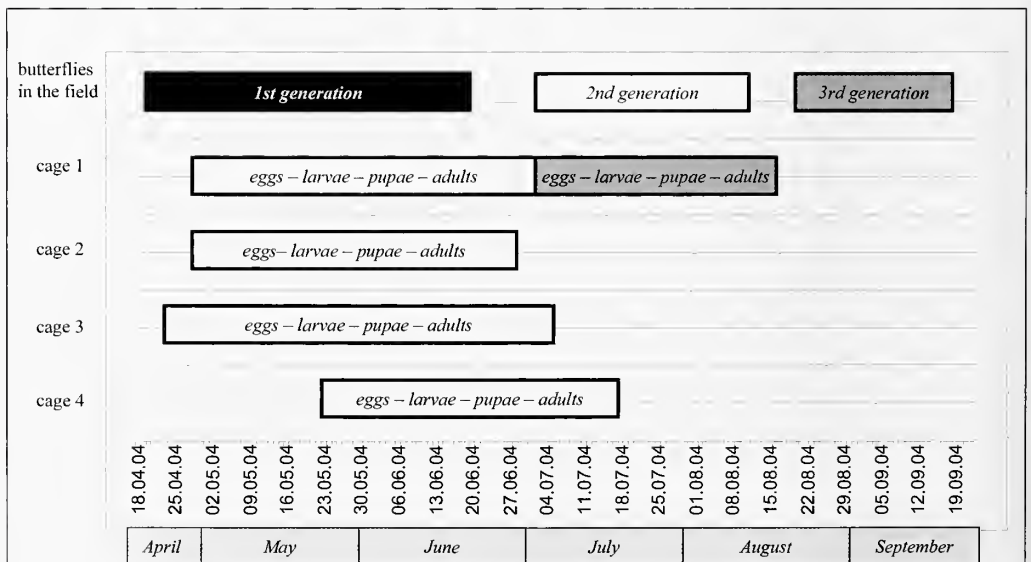


Fig. 2. Phenology of *S. orion* in cages in relation to flight periods in the field. Each bar for each cage starts with oviposition and ends with butterfly emergence. Development until the third generation was completed in cage 1 only (black bar: first generation; white bars: second generation; grey bars: third generation).

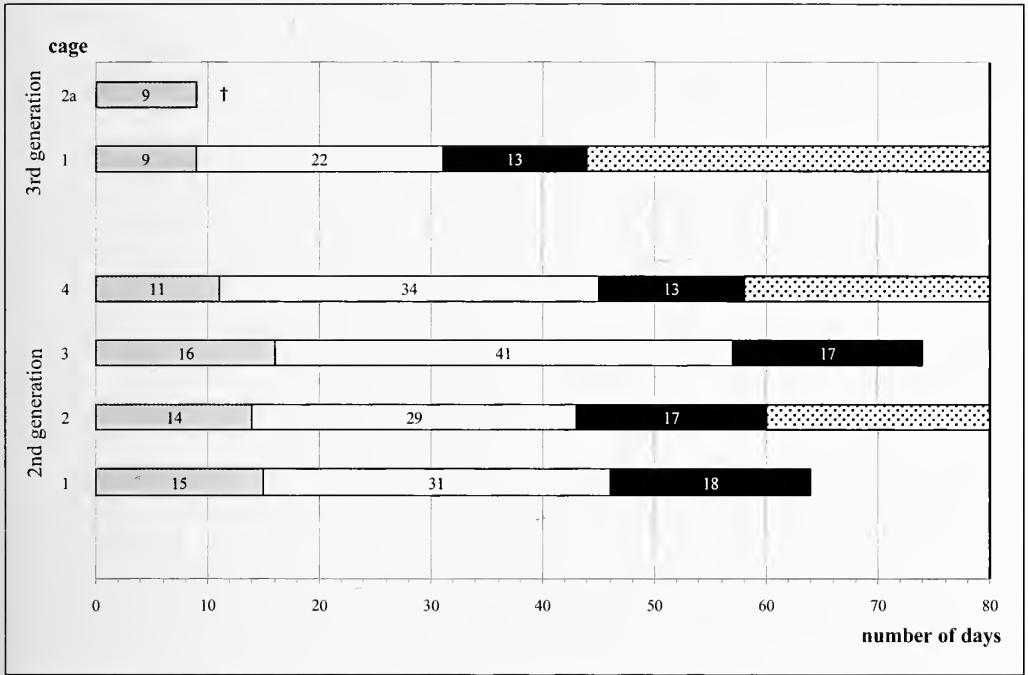


Fig. 3. Duration of development of the preimaginal stages of *S. orion*. Grey bar: egg stage; white bar: larval stages; black bar: non-diapausing pupae; black and dotted bar: diapausing pupae. The right edge of the black bars also indicates the beginning of the emergence of the adults.

Observations in cages

Figs. 2, 3

Case 1. Development of the second generation. On May 3 we found the freshly-laid eggs of the two *S. orion* females that had been inside the cage since April 29. All 17 eggs were laid on *Sedum maximum*, though *S. album* was present too. Eight larvae developed to the pupal stage, from which six adults emerged on July 3 and subsequent days. The remaining two pupae did not emerge, but died and were removed later. The development of eggs required about 15 days, whereas the development of larvae took about 31 days and the development of pupae about 16 days. All adults emerged within three days. The entire developmental period of the second generation lasted about nine weeks. After the larvae became seven millimetres long, they were associated with *Lasius emarginatus* until the pupal stage. Since it was possible to find all pupae, cage 1 was used to study the development of the following generation also.

Development of the third generation. The butterflies of the second generation emerged on July 3 and the first copulation was observed on July 4. On July 5 the first eggs were found on *S. maximum*. Again *S. album* was not used for oviposition. Subsequently, nine larvae developed to the final stage. The larvae were first visited by *L. emarginatus* when they were about four millimetres long. Egg development required about nine days whereas the development of larvae took about 22 days and that of

pupae about 13 days. At that time it was impossible to detect the pupae without taking apart the entire cage. On August 18 emerged the first adult of the third generation after a development from egg to adult of about 44 days. This butterfly remained alone and finally died between August 27 and 29. When the cage was inspected in autumn two live pupae were found hidden deeply in the plastic dish. However, six other pupae were not found.

Cage 2 and 2a. Development of the second generation. The female placed inside this cage laid eggs that we found on May 3. 40 eggs were attached to *Sedum maximum*, but 17 eggs also on *S. album*. L1-larvae were mining inside the leaves of the latter plant species but all of them died. 15 L1-larvae developed on *S. maximum*, feeding on the youngest leaves at the tip of the plants and after pupating from June 13 onwards. After some of the *S. maximum* plants had been totally defoliated by the feeding larvae three of the full-grown larvae continued feeding on *S. album*. However, after adding two *S. maximum* plants they returned to this food source. Finally, five pupae were detected only, but seven imagines emerged between June 30 and July 4. The inspection of the cage on September 20 revealed only one live pupa. Thus, seven individuals from the original 15 L1-larvae were missing at the end. Egg development required about 14 days whereas the development of larvae took about 29 days and the development of non-diapausing pupae about 16 days. The adults emerged during three days. The entire time of development lasted 8.5 weeks. *Tetramorium impurum* (Förster, 1850) ants were present when L1-larvae emerged, and first associations were observed one day later. Workers of *Formica glauca* were observed for the first time inside the cage and in association with the larvae when these reached 10 millimetres long.

Development of the third generation. On July 2 the first *S. orion* eggs were found on newly added *S. maximum* plants. No eggs were laid on *S. album*. The plants with the eggs were then transferred into cage 2a where larvae emerged after nine days. A thunderstorm destroyed this cage on July 20 and all larvae were lost.

Cage 3. Development of the second generation. On April 27 the first *S. orion* eggs were found on *S. maximum* plants in this still open cage. Eggs were laid between April 23 (day of installation of cage during cold and rainy weather) and April 27. Larvae emerged after 16 days, pupated after 41 additional days, and the pupal stage required about 17 days. Thus, the entire period from egg to adult comprised about 74 days. On June 21 two of the full-grown larvae drowned in a little puddle that formed after three days of rain. On July 8 one imago emerged while a pupae was found dead. 17 days after the emergence of larvae the first ants were detected inside the cage. At that time, the larvae already had a length of nine millimetres. *Formica (Serviformica) fusca* was the first ant species to be observed in a clear association with the *S. orion* larvae. One week later workers of *Tetramorium impurum* were found also. They were temporarily seen together with workers of *F. fusca* on the same shoot of a *S. maximum* plant but always at different *S. orion* larvae. Breeding was not continued in this cage.

Cage 4. Development of the second generation. The *S. orion*-female placed in this cage lived for 11 days, from 19 until 30 May. Oviposition took place during six days and resulted in 84 eggs, three on one *S. maximum* shoot, 61 eggs on

another, and 20 eggs on a third shoot. No eggs were found on many other available *S. maximum* shoots. Larvae emerged after 10 days, developed for 34 days, and the pupal stage lasted 13 days. The first adult emerged on July 21 and died on July 28. A second adult emerged on July 30 and died on August 2. These two adults died without reproductive success. On August 6 two other dead butterflies with undeveloped wings were detected. There was no more emergence. Developmental time from egg to adult took about 58 days. During the inspection of the cage on September 20, 21 living pupae were found. After all *S. maximum* plants became leafless many full-grown larvae continued feeding on *S. rupestre*, but returned to *S. maximum* when this plant species was provided again. No ants visited this cage.

Spring 2005. Altogether, 24 diapausing pupae survived the winter of 2004/2005. The adults emerged in late April 2005.

Discussion

This study focuses mainly on the phenology and voltinism of *S. o. orion*. It was especially important to have a high rate of field observations to detect the short, but clear breaks in flight activity between generations and to avoid misinterpretations resulting from bad weather conditions with no flight activity. Our continuous observations in the field as well as in cages show clearly that *S. o. orion* developed three generations in the study area during 2004.

So far as we could verify, previous reports of one or two generations per year were derived from single observations or collection specimens, but not from continuous observations of the development of individual specimens in the field. Moreover, Reinhardt (2003), Reinhardt & Hardtke (2003), and Reinhardt & Kinkler (2004) constitute their interpretations on samples of adults from small areas, but amalgamate samples from different years to one hypothetical year. Thus, these authors could not recognise the short interruptions in the flight activity between generations of *S. o. orion* because the phenology varies too much between years. Furthermore, the samples analysed from Saxony by Reinhardt (2003) and Reinhardt & Hardtke (2003) did not comprise voucher specimens from the entire period during which the adults of *S. o. orion* are on the wing.¹

The development of three generations in the study area might be correlated to local circumstances and thus can not necessarily be generalised. We assume that the variable numbers of generations per year reported in the literature (Kudla 1951; Bergmann 1952; Forster & Wohlfahrt 1955; Henriksen 1982; Koch 1984; Tolman & Lewington 1998; Reinhardt 2003; Huemer 2004; Reinhardt & Kinkler 2004) are related to altitude and latitude of the habitats, and thus to different ecological conditions, i.e. temperature and length of growing season. These abiotic factors are well known to influence the

¹ It is anecdotal that lepidopterists from Dresden and its vicinity traditionally visit the *S. orion* habitats along the right edge of the Elbe during May since decades, combining their excursions with a visit in the nearby restaurants to enjoy the Asparagus season. Thus, voucher specimens from this area well represent the first generation, but significantly less so for subsequent generations.

developmental rate (Fischer & Fiedler 2002) and dormancy (Müller 1992) of insects. Thus, all data available suggest that *S. orion* has a plastic developmental strategy depending on local climatic conditions.

However, our study on *S. o. orion* did not compare the influence of, e.g. temperature in different populations. Instead, one population was investigated at a very restricted location and thus it can be assumed that all specimens observed were influenced by abiotic factors in the same manner. Besides the fact that *S. o. orion* develops three generations the synchronous development of diapausing and non-diapausing pupae in the second as well as the third generations is a phenomenon hitherto not recorded in the literature. The factors influencing the development of these diapausing pupae are still unknown since dormancy-inducing exogenic abiotic factors can be excluded at least for the second generation. Müller (1992) refers to the possibility of endogenic factors inducing dormancy in insects in the absence of exogenic dormancy-inducing factors. He calls such a prospective dormancy parapause. However, a prospective dormancy does not explain the coexistent development of diapausing and non-diapausing pupae. The strategy for a genotype to develop both non-diapausing and diapausing phenotypes in one generation is described by Hopper (1999) as "risk-spreading," though the mechanism underlying this risk-spreading and its genetical basis are still unknown. The discovery of this phenomenon in *S. o. orion* was unexpected. Thus, no statistically relevant numbers of diapausing and non-diapausing pupae were noted. However, the fact that this species has the ability for "risk-spreading" guarantees a maximum number of generations per year under the relevant local conditions – and thereby a higher offspring number. Moreover, the ability for "risk-spreading" may explain why only one or two generations are recorded for *S. orion* from areas with shorter vegetation periods as in mountain hills or at more northerly latitudes. It can also explain why a 'partially second generation' is frequently recorded for *S. o. orion* (Bergmann 1952; Coulondre 1994; Lepidopterologen-Arbeitsgruppe 1994).

All observations made in the study area revealed that larvae of *S. o. orion* developed on *Sedum maximum* while all larvae fed with *S. album* died. In contrast, Weidemann (1995) records that *S. orion* develops on *Sedum album* too, but it is questionable whether this record is just taken from Henriksen (1982) who mentions this host plant for *S. o. ultraornata* from Fenno-Scandia. Host plant quality can influence the development of insects, it can also influence diapause and voltinism under constant photoperiod and temperature as shown for *Choristoneura rosaceana* (Lepidoptera: Tortricidae) by Hunter et al. (1996). Such observations pose the question whether the varying voltinism observed for different *S. orion* populations may also depend on the host plant used by the larvae.

In the Elbe valley west of Dresden *S. o. orion* develops new generations as long as favourable conditions exist. Apparently, the third generation appears so late during the season that the adults do not reproduce successfully, but diapausing pupae of the second and third generations guarantee the survival of the population.

Our observations confirm that *S. orion* larvae are steady, but facultatively myrme-

cophilous, since larvae developed without ants in cage 4 as well. Until now, ant species associated with *S. orion* have only rarely been recorded (cf. Aigner-Abafi 1899; Malicky 1969; Fiedler 1991). In the present study, *Formica (Serviformica) glauca*, *Lasius (L.) emarginatus* (Formicinae), and *Tetramorium impurum* (Myrmicinae) were found in association with *S. orion* larvae for the first time. *Camponotus ligniperda* and *Formica (Serviformica) fusca* have also been observed in association with *S. orion*, which is already recorded by Fiedler (1991) and Saarinen (1995). Anyhow, the attractiveness of *S. orion* larvae for ants appears to be very high because all larvae in the field were found in association with ants. In fact, *S. orion* was one of the earliest European lycaenid species on which the phenomenon of myrmecophily was studied (Ehrhardt 1914; cf. Malicky 1969; Fiedler 1991).

Acknowledgements

The first author wishes to thank Rolf Entzeroth (Technical University Dresden) for participating in taking care of the diploma thesis. Barbara Ditsch and Ingo Uhlemann (Botanical Institute, Technical University Dresden) kindly provided and identified the *Sedum* plants. We thank Conny Hättasch and Katja Bochnig (Dresden) for their assistance in different technical matters. We appreciate the constructive discussions on *S. orion* and its host plants in the vicinity of Dresden with Hans-Jürgen Hardtke (Possendorf), Michael Kurze (Dresden), and Hanno Voigt (Dresden). Konrad Fiedler (Wien) provided critical and helpful comments on the manuscript, and Bernard Landry (Genève) kindly checked the English text.

References

- Aigner-Abafi, L. 1899. Über die myrmekophile *orion*-Larve. – *Illustrierte Zeitschrift für Entomologie* **4**: 124.
- Bergmann, A. 1952. Die Großschmetterlinge Mitteldeutschlands **2**. – Urania, Jena. 495 pp.
- Coulondre, A. 1994. Systématique et répartition de *Scolitantides orion* (Pallas, 1771) (Lepidoptera: Lycaenidae). – *Linneana belgica* **14**: 383–420.
- Ehrhardt, R. 1914. Über die Biologie und Histologie der myrmekophilen Organe von *Lycaena orion*. – *Berichte der naturforschenden Gesellschaft zu Freiburg i. Br.* **20**: xci–xcviii.
- Fiedler, K. 1991. Systematic, evolutionary, and ecological implications of myrmecophily within the Lycaenidae (Insecta: Lepidoptera: Papilionoidea). – *Bonner Zoologische Monographien* **31**: 1–210.
- Fischer, K. & K. Fiedler 2002. reaction norms for age and size at maturity in response to temperature: a test of the compound interest hypothesis. – *Evolutionary Ecology* **16**: 333–349.
- Forster, W. & T. A. Wohlfahrt 1955. Die Schmetterlinge Mitteleuropas **2**: Tagfalter. – Franckh'sche Verlagshandlung Stuttgart. 126 pp. 28 pls.
- Gaedike, R. & W. Heinicke 1999. Verzeichnis der Schmetterlinge Deutschlands. – *Entomofauna Germanica* **3**. – *Entomologische Nachrichten und Berichte*, Dresden, Beiheft 5: 1–216.
- Henriksen H. J. & I. Kreutzer 1982. The butterflies of Scandinavia in nature. – Skandinavisk Bogforlag, Odense.
- Hopper, K. R. 1999. Risk-spreading and bet-hedging in insect population biology. – *Annual Review of Entomology* **44**: 535–60.
- Huemer, P. 2004. Die Tagfalter Südtirols. – Veröffentlichung des Naturmuseums Südtirol **2**. – Folio Verlag, Wien. 232 pp.
- Hunter, M. D. & J. N. McNeil 1996. Host-plant quality influences diapause and voltinism in a polyphagous insect herbivore. – *Ecology* **78** (4): 977–986.
- Koch, M. 1984. Wir bestimmen Schmetterlinge. – Neumann, Leipzig & Radebeul. 792 pp.
- Kudla, M. 1951. Quelques notes sur l'écologie et l'apparition de l'espèce *Scolitantides orion* Pall. (Lep., Lyc.). – *Acta societatis entomologicae czechoslovenicae* **48** (2): 132–134 (in Czech).

- Lepidopterologen-Arbeitsgruppe 1994 (4th edn.). Tagfalter und ihre Lebensräume **1**. – Schweizerischer Bund für Naturschutz, Basel. 516 S.
- Malicky, H. 1969. Versuch einer Analyse der ökologischen Beziehung zwischen Lycaeniden (Lepidoptera) und Formiciden (Hymenoptera). – Tijdschrift voor Entomologie **112**: 213–298.
- Müller, H.-J. 1992. Dormanz bei Arthropoden. – Gustav Fischer, Jena. 289 pp.
- Reinhardt, R. 2003. Beitrag zur Biologie und Generationsfolge des Fetthenne-Bläulings *Scolitantides orion* (Pallas, 1771) in Sachsen (Lep., Lycaenidae). – Entomologische Nachrichten und Berichte **47** (3–4): 165–172.
- Reinhardt, R. & H.-J. Hardtke 2004. *Scolitantides orion* (Pallas, 1771) – Sammlungsmaterial aus dem Staatlichen Museum für Tierkunde Dresden sowie weitere sächsische Daten [LEP-Lyc]. – Mitteilungen Sächsischer Entomologen **68**: 10–12.
- Reinhardt, R. & H. Kinkler 2004. Ein weiterer Beitrag zur Generationsfolge von *Scolitantides orion* (Pallas, 1771) insbesondere im Rheinland (Lep., Lycaenidae) sowie ergänzende Funddaten aus Bayern und Thüringen. – Entomologische Nachrichten und Berichte **48** (3–4): 167–172.
- Saarinen, P. 1995. Kalliosinisiiven (*Scolitantides orion*) ekologia ja esiintymisen Lohjalla vuosima 1991–92. – Baptria **20** (4): 195–198.
- Settele, J., R. Feldmann & R. Reinhardt 1999. Die Tagfalter Deutschlands. – Ulmer, Stuttgart. 452 pp.
- Srdinko, J. 1912. Beitrag zur Kenntnis von *L. orion*. – Internationale Entomologische Zeitschrift, Guben. **6**: 102–103.
- Tolman, T. & R. Lewington 1998. Tagfalter Europas und Nordwestafrikas (Deutsche Übersetzung von M. Nuß). – Franckh-Kosmos, Stuttgart. 319 pp., 104 pls.
- Weidemann, H.-J. (1995): Tagfalter: Beobachten, Bestimmen. – 2., völlig neu bearb. Aufl. – Naturbuchverlag, Augsburg. 659 S.

Neotypus melanocephalus (Hymenoptera: Ichneumonidae): the first record of a parasitoid wasp attacking *Maculinea teleius* (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. A *Maculinea teleius* (Bergsträsser, 1779) pupa was found near Meszes (NE-Hungary) in a *Myrmica scabrinodis* Nylander, 1846 nest. Some hours later emerged a wasp that proved (det. K. Horstmann) to be *Neotypus melanocephalus* Gmelin, 1790 (Ichneumonidae). The wasp with the exuvium and specimens of the host ant are deposited in the Hymenoptera Collection of the Hungarian Natural History Museum (25.vii.2002; Meszes; leg. A. Tartally). It would be desirable to obtain more *Neotypus* specimens from *M. teleius* pupae to test if the wasp really is *N. melanocephalus*, or a form of *N. pusillus* Gregor, 1940, or even a new cryptic species of *Neotypus*.

Key words. *Neotypus*, *Maculinea*, *Myrmica*, Ichneumonidae, Lycaenidae, parasitoid, Hungary.

The larvae and pupae of four of the five European species of *Maculinea* van Eecke, 1915 butterflies are known hosts of parasitoids from the Ichneumonidae family. The two cuckoo *Maculinea* species for which the caterpillars are fed by worker ants (Thomas & Elmes 1998) have *Ichneumon* sp. parasitoids. *Ichneumon eumerus* Wesmael, 1857 was recorded as a parasitoid of *M. rebeli* (Hirschke, 1904) and the same or a sibling *Ichneumon* species attacks *M. alcon* ([Denis & Schiffermüller], 1775) as well (Thomas & Elmes 1993; Munguira & Martin 1999; Sielezniew & Stankiewicz 2004; Thomas, Fitton & Hilpert, pers. comm.). Two of the three *Maculinea* species, of which the caterpillars are predators of ant broods (Thomas & Elmes 1998), have *Neotypus* parasitoids: *N. pusillus* Gregor, 1940 was bred from *M. nausithous* (Bergsträsser, 1779) (Thomas & Elmes 1993) and another *Neotypus* sp. from *M. arion* (Linnaeus, 1758) (Thomas, Wardlaw & Fitton, pers. comm.). So far as known, each of these parasitoids is host-specific to a single *Maculinea* species, but until now no parasitoid wasp of the predatory *M. teleius* (Bergsträsser, 1779) was known.

Maculinea species and their parasitoids are of high interest to evolutionary and conservation ecology because of their extreme adaptations to a myrmecophilous life-style and because all are rare and globally endangered (IUCN 2004; Hochberg et al. 1996; Munguira & Martin 1999). The larvae of these butterflies feed briefly on specific foodplants before being adopted by *Myrmica* ants (Hymenoptera: Formicidae) in which colonies they live as social parasites for 11–23 months (Thomas & Elmes 1998). *Neotypus pusillus* oviposits on young *M. nausithous* larvae on the larval foodplant while *Ichneumon* spp., perhaps in response to the different population structure found in cuckoo species, penetrate *Myrmica* nests to seek *Maculinea* larvae (Thomas & Elmes 1993). These parasitoids both emerge from host pupae inside ant colonies and are presumed to have similar specialisations to those described for *I. eumerus* (Thomas et al. 2002) to escape unharmed from nests.

Between 2000 and 2003, hundreds of *Myrmica* nests at eight sites were examined for caterpillars, pupae, and exuvia of *M. teleius* to measure host specificity and to investigate whether parasitoids of this butterfly occur in the Carpathian Basin, Hungary.

Twenty-four caterpillars, one exuvium, and eight pupae of *M. teleius* were found at five sites. One of the pupae contained a parasitoid. This was collected on 25 July 2002 near the village of Meszes (NE-Hungary; Borsod-Abaúj-Zemplén County) in a marshy meadow with a profusion of *Sanguisorba officinalis* (I intentionally do not give the exact location as a precaution against collectors; only two more pupae were found there but these were not parasitized). The pupal cases of *M. teleius* and *M. nausithous* are hard to distinguish, but this pupa was found in a *Myrmica scabrinodis* Nylander, 1846 nest within one meter from a *S. officinalis* plant. *My. scabrinodis* is the main host ant of *M. teleius* in Europe (Thomas et al. 1989; Stankiewicz & Sielezniew 2002; Tartally & Csósz 2004) and no other species of *Maculinea* nor any other foodplant of *Maculinea*, occur at this site (Varga, pers. comm.). Moreover, *M. nausithous*, the only other *Maculinea* species that uses *S. officinalis*, is not known from NE-Hungary (Bálint 1996). Based on this evidence, this pupa was identified as *M. teleius*. Some hours after collection, a wasp hatched from this pupa. The wasp with the exuvium and specimens of the host ant (*My. scabrinodis*) were placed into a small vial with 75% ethanol. The full sample is deposited in the Hymenoptera Collection of the Hungarian Natural History Museum (25.vii.2002; Meszes; Tartally leg.). The wasp was sent to Dr. Klaus Horstmann (Theodor-Boveri-Institut für Biowissenschaften, Würzburg) for determination; it proved to be *Neotypus melanocephalus* Gmelin, 1790, a species that had not previously been recorded as a parasitoid of any *Maculinea* host (Thomas, pers. comm.).

There are several known *M. nausithous* populations infected by *N. pusillus* that co-occur with *M. teleius* in Europe, but in those studied in the Rhône valley (France), there is strong evidence that *N. pusillus* never parasitizes *M. teleius* (Thomas, pers. comm.). It would be worth checking more widely whether *N. pusillus* uses only *M. nausithous* as a host or whether it can infect *M. teleius* too. This is important because *N. melanocephalus* has, at times, been synonymised with *N. pusillus*; but current studies in the EU 'MacMan' programme suggest that *N. melanocephalus* is a cryptic sibling species (Thomas, pers. comm.), a phenomenon well known in parasitoid taxa (Godfray 1994). It would be desirable to obtain more *Neotypus* specimens from *M. teleius* pupae and to test whether this wasp really is *N. melanocephalus*, or a form of *N. pusillus*, or even a new cryptic species of *Neotypus*. If, as I suspect, it is both a good species and specific to *M. teleius*, then, like other parasitoids of *Maculinea*, it will by definition be rarer and more threatened than its host, and its populations will be in greater need of conservation (Hochberg et al. 1996; Thomas et al. 2002).

Acknowledgements

I would like to thank Enikő Tóth, Dr. Jeremy A. Thomas, Dr. Klaus Horstmann, Sándor Csósz, and Dr. Zoltán S. Varga for their help. The research was funded by the EC within the RTD project "MacMan" (EVK2-CT-2001-00126).

References

- Bálint, Zs. 1996. A Kárpát-medence nappali lepkéi I. rész. [Butterflies of the Carpathian Basin vol. 1] – Magyar Madártani és Természetvédelmi Egyesület, Budapest. 183 pp.
- Godfray, H. C. J. 1994. Parasitoids. – Princeton University Press, Princeton. 488 pp.
- Hochberg, M. E., G. W. Elmes, J. A. Thomas & R. T. Clarke 1996. Mechanisms of local persistence in coupled host-parasitoid associations: the case model of *Maculinea rebeli* and *Ichneumon eumerus*. – Philosophical Transactions of the Royal Society of London. Biological Science **351**: 1713–1724.
- International Union for Conservation of Nature and Natural Resources (IUCN) 2004. IUCN Red list of threatened animals. A global species assessment. – The IUCN Species Survival Commission, Cambridge. 217 pp. (full list of species also at <http://www.iucnredlist.org>)
- 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.
- Sielezniew, M. & A. M. Stankiewicz 2004. Simultaneous exploitation of *Myrmica vandeli* and *M. scabrinodis* (Hymenoptera: Formicidae) colonies by the endangered myrmecophilous butterfly *Maculinea alcon* (Lepidoptera: Lycaenidae). – European Journal of Entomology **101**: 693–696.
- Stankiewicz A. & M. Sielezniew 2002. Host specificity of *Maculinea teleius* Bgstr. and *M. nausithous* Bgstr. (Lepidoptera: Lycaenidae) the new insight. – Annales Zoologici **52**: 403–408.
- Tartally, A. & S. Csősz 2004. Adatok a magyarországi *Maculinea* fajok (Lepidoptera: Lycaenidae) hangyagazdairól. [Data on the ant hosts of the *Maculinea* butterflies (Lepidoptera: Lycaenidae) of Hungary.] – Természetvédelmi Közlemények **11**: 309–317.
- Thomas, J. A. & G. W. Elmes 1993. Specialised searching and the hostile use of allomones by a parasitoid whose host, the butterfly *Maculinea rebeli*, inhabits ant nests. – Animal Behaviour **45**: 593–602.
- Thomas, J. A. & G. W. Elmes 1998. Higher productivity at the cost of increased host specificity when *Maculinea* butterfly larvae exploit ant colonies through trophallaxis rather than by predation. – Ecological Entomology **23**: 457–464.
- 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. J. Knapp, T. Akino, S. Gerty, S. Wakamura, D. J. Simcox, J. C. Wardlaw & G. W. Elmes 2002. Parasitoid secretions provoke ant warfare. – Nature **417**: 505–506.



The geographic range of *Rhyacionia hafneri* (Rebel, 1937) (Tortricidae)

JOSEF JAROŠ¹ & JAN LIŠKA²

¹ Institute of Entomology, Czech Academy of Sciences, Branišovská 31, CZ-370 05 České Budějovice, Czechia; e-mail: jaros@entu.cas.cz

² Forestry and Game Management Research Institute, Strnady 136, CZ-156 04 Praha 5 – Zbraslav, Czechia; e-mail: liska@vulhm.cz

Recently, Huemer (2003) redescribed the tortricid moth *Rhyacionia hafneri* (Rebel, 1937) and recorded this species from Slovenia for the first time. Huemer (2003) also illustrated diagnostic characters and discussed the distribution of *R. hafneri* and closely related taxa. It seems that *R. hafneri* is a locally distributed, probably rare submediterranean species. With the exception of the type locality 'Dalmatia – Knin' (coastal Croatia) and records from three localities in Slovenia (Huemer 2003), no other distributional data are available and the life history remains unknown. Referring to Huemer's (2003) diagnosis and additional data provided by Razowski (2004), several additional specimens of *R. hafneri* have now been discovered:

Material. 3♂, 2♀ **Slovenia**, Nanos Mts, Strmec (45°50'N, 14°00'E), 800 m a.s.l., 28.v.2000, Liška leg., Liška & Jaroš coll.; 1♀ **Bulgaria**, foothills of the Rhodope Mts., Asenovgrad (42°00'N, 24°55'E), 300 m a.s.l., 29.v.1984, Jaroš leg. et coll.; 2♀ **Hungary**, Vertés Hills, Csákberény (47°20'N, 18°15'E), 350 m a.s.l., 8.v.2003, Liška leg. et coll.; 1♀ **Czechia**, South Moravia, Ketkovice (49°10'N, 16°15'E), 360 m a.s.l., 28.v.1999, Šumpich leg. et coll.; 1♂ Bílé Karpaty Mts, Čertoryje National Reserve, (48°50'N, 17°25'E), 350 m a.s.l., 5.–7.vi.1997, Šumpich leg. et coll.; 1♀ Moravský kras (Moravian Karst), Olomučany (49°20'N, 16°40'E), 500 m a.s.l., 23.v.2002, Z. Laštůvka leg., Jaroš coll.

All the localities are characteristic limestone habitats. The dominant native pine species of the Slovenia and Bulgaria localities is *Pinus nigra*, which is undoubtedly the food plant of *R. hafneri* there. In the Vertés Hills (Hungary) and the three localities of South Moravia (Czechia) the only native pine species is *P. sylvestris* (but *P. nigra* was introduced into these areas more than 100 years ago and now is quite common). Therefore, it is possible that *R. hafneri* spread to Central Europe when *P. nigra* was planted there by foresters. On the other hand, most localities of *P. nigra* and associated *R. hafneri* in Slovenia, Bulgaria and Croatia are certainly autochthonous (cf. Meusel et al. 1965), but recently *P. nigra* has been extensively planted in all these countries. It is expected that *R. hafneri* will be found also in northern Italy, Austria, Romania and southern Slovakia, where *P. nigra* is also planted by foresters in some regions. Food plant studies and monitoring of the distribution and spread of *R. hafneri* in Europe are badly needed.

Acknowledgements

We are grateful to Zdeněk Laštůvka and Jan Šumpich for providing us with the material of *R. hafneri* from Czechia. The study was partially supported by a Grant of the Czech Academy of Sciences IQS500070505.

References

- Huemer, P. 2003. *Rhyacionia hafneri* (Rebel, 1937) sp. rev., eine verkannte Wicklerart aus dem Mittelmeergebiet (Lepidoptera: Tortricidae). – Entomologische Zeitschrift (Stuttgart) **113**: 98–101.
- Meusel, H., E. Jäger & E. Weinert 1965. Vergleichende Chorologie der Zentraleuropäischen Flora. Karten. – Gustav Fischer Verlag, Jena, 258 pp.
- Razowski, J. 2004. Tortricidae (Lepidoptera) of Europe, Vol. 2: Olethreutinae. – F. Slamka, Bratislava, 301 pp.

Hausmann, A. 2004: Sterrhinae. – In: A. Hausmann (ed.), *The Geometrid Moths of Europe 2*: 600 pp. – Apollo Books, Stenstrup (ISBN 8788757374). DKK 960.

The latest volume of *The Geometrid Moths of Europe* treats the geometrid subfamily Sterrhinae that includes several taxonomically challenging genera, such as *Idaea* and *Scopula*. Although the Sterrhinae fauna of northern Europe is well-known the opposite is true for southern Europe. The taxonomical information of that fauna has been scattered through the literature, which has often not only been inaccessible both to scientists and amateurs, but also dubious because many of the authors have not been aware of work of others. Therefore an identification book that brings together all that knowledge has been long awaited.

The book treats 196 species of Europe and its adjoining countries, including those of North Africa. It proposes 102 taxonomic changes including descriptions of three new species. The book opens with a short introduction to methodological notes, which is followed by a systematic account of taxa. Diagnoses are given for the subfamily, and for the six tribes and 18 genera to which the species are classified. Species' descriptions contain list of synonyms, available and unavailable names. Diagnoses of imagos and genitalia are short, but this is justifiable because descriptions are accompanied with numerous text-figures and photos, which quite easily guide the reader to look into appropriate characters. For each species a distribution map is presented, accompanied with a written description of distribution area. There are separate sections for phenology, biology, habitat, parasitoids, similar species, and if necessary, for remarks. These are followed by high-quality colour plates, depicting a large number of specimens and showing the variation of external features. The plates that contain small species have been enlarged. For each species a drawn picture of male and female genitalia is shown. The book ends with a systematic check-list of European and its adjoining regions' fauna.

The book is designed for species identification and for this purpose it is excellent. The author has examined an impressive number of 300 000 specimens during the preparation of this volume which certainly gives reliability for the taxonomic judgment. Generally, adequate species identification information is easily accessible and problematic taxonomical cases, which need further study, are clearly mentioned. However, there are a few, admittedly minor things, which deserve a note here. The author has decided not to evert vesicae, even though it is a standard procedure in Lepidoptera systematics nowadays, and these structures have already been shown to be of additional diagnostic value in Sterrhinae systematics. The exclusion of this possible source of information *a priori* is unfortunate. Perhaps it could have given more solid evidence for taxonomic decisions in the difficult species groups, such as the Mediterranean *Rhodostrophia calabra*-group, where other diagnostic features are vague. In this genus the vesica characters have already been shown to offer further taxonomical information by others. Regarding genitalia plates, certain female genital structures have systematically been omitted in figures. Taxonomically important structures around the ostium bursae are omitted or weakly shown and position of the ductus bursae in the abdominal sternite

is unknown because the latter has been removed from it. Further, the ductus seminalis is not shown in a number of species and in several instances only parts of the genitalia are shown, perhaps as a result of unsuccessful dissection. Also, it would have been useful to reader if the diagnostic features were pointed out in the plates. Another issue is that immature stages are dealt with rather superficially. For a majority of species these are unknown, but descriptions like 'Pupa short, abdomen slender.', as for *Oar*, to cite one example, can barely be considered an improvement when compared with 'Immature stages unknown.' Finally, the book contains several citations to internet pages that offer additional information on taxonomy and biology of the dealt taxa, but when writing this the data were not available. No doubt, when the pages are functional they will offer wealth of further information.

The other part of book, i.e. systematic treatment of taxa, is variable in quality. The taxa are mostly classified according to recent findings, or in the lack recent research, after the traditionally held views. In other instances the author has chosen to favour his own taxonomical expertise. To cite an example, for the generic classification of the Scopulini the author explains well what the recent findings made by other researchers suggest, yet he has chosen not to follow them. The adopted, traditional approach is justified from the point of view of nomenclatoric stability. However, elsewhere, as in the case of *Apostates*, the author proposes novel taxonomic changes with little written justification. In another example the author has failed to make the presented taxonomical decisions easily accessible. Several new species combinations or synonyms are mentioned in the abstract, e.g. synonymy of *Rhodostrophia oxyntis* Prout with *R. xesta* Prout. These non-European taxa are not found in the index because they are not treated in this monograph. By browsing through the book I found the relevant part but there was no additional evidence that could be used to evaluate the conclusion drawn. If the presented taxonomical decisions are not based on transparent evidence, it unfortunately makes results appear suspect even if they are correct.

Despite the comments made above, I wish to emphasise that overall impression of the book is very positive and the author has produced an excellent monograph that is likely to become a standard reference in the field. The book contains a huge amount of taxonomic and biological data and I consider it a must for anyone who is interested in the European Sterrhinae fauna.

PASI SIHVONEN



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 paiements 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 bancaire 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 paiements, 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.





