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The Sterrhinae moth fauna of Fenglin Nature Reserve, North-East China

(Insecta, Lepidoptera, Geometridae)

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The Sterrhinae moth fauna (Lepidoptera, Geometridae) of the Fenglin Nature Reserve – a Biosphere Reserve of UNESCO's Man and the Biosphere Programme – in North-East China was studied in the summer of 2000. Altogether 25 species and 340 specimens were observed. The following 10 species are reported for the first time from China: *Idaea terpnaria* (Prout), *Idaea aversata* (Linnaeus), *Idaea effusaria* (Christoph), *Idaea pallidata* (D. & S.), *Cyclophora albipunctata* ssp. *griseolata* (Staudinger), *Problepsis plagiata* (Butler), *Problepsis phoebearia* Erschov, *Scopula nemoraria* (Hübner), *Scopula tenuisocius* Inoue and *Scopula asthena* Inoue. Adults of these are illustrated. Additionally, adults and genitalia of two species-pairs are illustrated and diagnosed that may prove difficult to be identified, i.e. *Scopula floslactata* (Haworth) – *S. tenuisocius* Inoue and *Scopula subpunctaria* (Herrich-Schäffer) – *S. prouti* Djakonov. Over 60 % of the observed Sterrhinae species were noticed to have a distribution area that is restricted to the eastern Palaearctic area.

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Introduction

The Geometridae moth fauna of Korea is relatively well-known (Shin 1996) as is the fauna of the Russian Far East, the Primorye territory and the Amur region (e.g. Viidalepp 1975, 1996). However, the Geometridae fauna of the adjoining areas on the Chinese side of the border, the Mantschuria, are virtually uninvestigated. In addition, a lack of national checklists, databases or identification guides [except for subfamily Larentiinae (Xue & Zhu 1999)] made it difficult to produce this kind of data for basic research as well as for applied studies such as nature conservation.

Moths of the geometrid subfamily Sterrhinae are often rather inconspicuous, relatively small with a wingspan normally between 20-30 mm, night-active and in many cases difficult to identify. They are often gray or brown in colour, but a few pink or bright yellow species are known, especially in the tropics. The species prefer to inhabit open or semi-open areas and of the known world diversity (approximately 2800 species) most are known from the tropics. Caterpillars often feed on low plants and on dry litter. As a result of the things mentioned above, the Sterrhinae are easily overlooked in basic faunal surveys.

There is one previous study on the lepidopteran fauna of the Fenglin Nature Reserve (Wang 1982). In that study, 15 Geometridae species were reported, two of which were Sterrhinae: *Problepsis superans* Butler and *Scopula (Somatina) indicataria* Walker.

In this paper I present the results of two Finnish expeditions, which in part studied the Sterrhinae moth fauna (Lepidoptera: Geometridae) of the Fenglin Nature Reserve, located at NE-China.

The project, study area and methods

The decision to study Sterrhinae moths at the Fenglin Nature Reserve resulted from the fact that there is an ongoing cooperation project 'Biodiversity in boreal forests' between the Division of Population Ecology at the University of Helsinki (FIBRE), the Division of Entomology at the Finnish Museum of Natural History, the Chinese Forestry Academy and The State Natural Reserve Management Bureau of Fenglin. These moths are studied extensively at the Finnish Museum of Natural History under the program "Diversity and systematics of Scopulini moths".

The Fenglin Nature Reserve is situated in a hemiboreal vegetation zone with mixed forests in the Heilongjiang district, NE-China (48°01' to 48°09'N; 128°39' to 129°15'E). It is the last virgin forest in the area, mainly covered by Korean pine *(Pinus koraiensis)* with a size of 18 000 hectares. Other trees include for example *Quercus mongolica*, *Acer mono*, *Tilia amurensis*, *Corylus manchurica* and *Abies nephrolepis*. The nature reserve is located at the Lesser Xingan Mountains and the altitude varies from 300 meters to over 700 meters above sea level.

In 1997 the Fenglin Nature Reserve was designated a Biosphere Reserve status and it is nowadays part of the World Network under UNESCO's Programme on Man and the Biosphere (MAB). As such its objectives are to promote solutions to reconcile the conservation of biodiversity with its sustainable use.

The moth fauna was studied during two separate expeditions: 2.-12.6.2000 (Jaakko Kullberg) and 28.6.-10.7.2000 (Pasi Sihvonen). Specimens were collected with generator powered lights and automatic light traps (model Jalas 160 W light, 2 × 20 W UV-light), Malaise traps and netting. Emphasis was placed on net collecting at dusk and at dawn when many species are active.

The majority of the specimens are deposited at the Finnish Museum of Natural History (Helsinki), and a few specimens are deposited at Institute of Zoology, Academia Sinica, (Beijing). Species were initially identified from the external characters, but in many cases the genitalia were prepared following the general procedures (Hardwick 1950).

The analysis of the distribution areas is based on literature records and museum collections of the Finnish

Tab. 1. Known distribution areas of the Sterrhinae moths found from the Fenglin Nature Reserve, North-East China, in 2000. First records from China are marked with an asterisk. 1 = Amur region and surrounding areas (Primorye, Sakhalin, Corea, Japan), 2 = trans-Palaearctic, a separate subspecies in Amur region and surrounding areas, 3 = Amur region, 4 = Japan, Korea, South Kuriles, 5 = trans-Palaearctic, mainly southern, 6 = Palaearctic, central and eastern.

	Species	Known distribution					
	Idaea muricata ssp. *minor* (Sterneck)		2				
	Idaea biselata ssp. *extincta* (Staudinger)		2				
	Idaea auricruda (Butler)	1					
*	*Idaea pallidata* ([Denis & Schiffermüller])					5	
*	*Idaea effusaria* (Christoph)	1					
	Idaea nitidata (Herrich-Schäffer)					5	
	Idaea promiscuaria (Leech)	1					
*	*Idaea aversata* (Linnaeus)					5	
*	*Idaea terpnaria* (Prout)	1					
*	*Scopula nemoraria* (Hübner)					5	
	Scopula modicaria (Leech)	1					
	Scopula umbelaria ssp. *graeseri* Prout		2				
	Scopula nigropunctata ssp. *subcandidata* (Walker)		2				
	Scopula prouti Djakonov	1					
*	*Scopula tenuisocius* Inoue	1					
	Scopula floslactata (Prout)					5	
	Scopula pudicaria (Motschulsky)	1					
*	*Scopula asthena* Inoue	1					
	Scopula subpunctaria (Herrich-Schäffer)					5	
	Scopula indicataria ssp. *sufflava* Prout	1					
*	*Problepsis phoebearia* Erschov			3			
*	*Problepsis plagiata* (Butler)				4		
*	*Cyclophora albipunctata* ssp. *griseolata* (Staudinger)		2				
	Timandra recompta ssp. *recompta* (Prout)						6
	Timandra comptaria (Walker)	1					
	Total	11	5	1	1	6	1
	Percentage	44	20	4	4	24	4

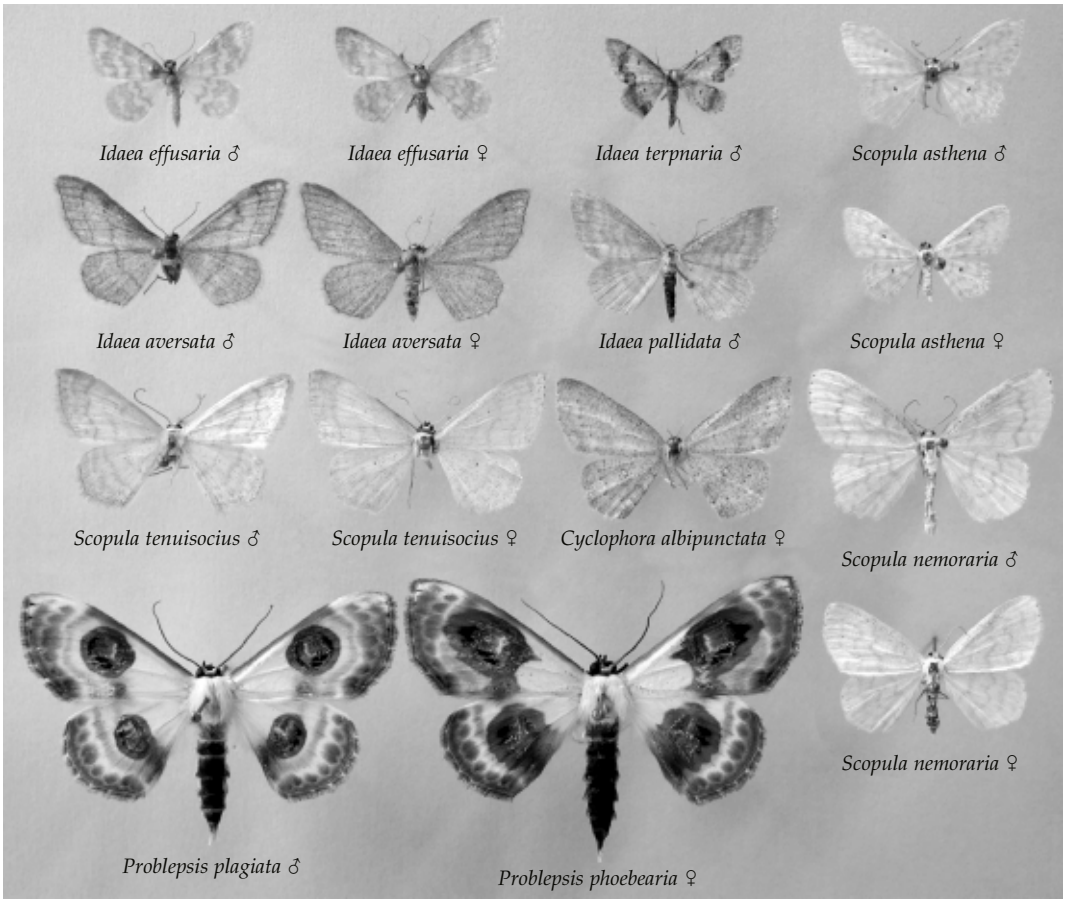


Fig. 1. Sterrhinae species, which are recorded for the first time from China. Specimens were collected from the Heilongjiang district, Fenglin Nature Reserve, 48°05'N 129°85'E, c. 200-500 m above sea level, between 2.-12.6.2000 and 28.6.-10.7.2000.

Museum of Natural History, Helsinki (ZMH), the Institute of Zoology, Academia Sinica, Beijing (IZAS) and The Natural History Museum, London (BMNH). Literature records include monographs and checklists (Ebert et al. 2001, Fajcik & Slamka 1996, Inoue 1977, Inoue et al. 1982a,b, Müller 1996, Shin 1996, Viidalepp 1996, Wang 1997, Hausmann 2004) as well as faunistic notes (Viidalepp 1975, Vojnits 1977).

List of species

Altogether 25 species and 340 specimens were observed. 10 species (40 % of all species) were recorded for the first time from China (Tab. 1). Species that are recorded for the first time from China are marked with an asterisk.

Idaea muricata ssp. *minor* (Sterneck, 1927)

2♂♂. N China – Mongolia, Korea, Japan, SE Russia (Inoue 1977, Inoue et al. 1982a,b, Shin 1996, Viidalepp 1996).

The western Palaearctic nominate subspecies inhabits open moors in the northern areas of its distribution (Mikkola et al. 1985), whereas in the more southern areas it is found on a variety of habitats from wet meadows to moors, gardens and forest edges (Ebert et al. 2001). The Fenglin specimens were caught with a Malaise trap from a closed deciduous forest.

Idaea biselata ssp. *extincta* (Staudinger, 1897)

13♂♂, 2♀♀. N China – Korea, Japan, SE Russia (Inoue 1977, Inoue et al. 1982a,b, Viidalepp 1996).

Nominate subspecies from Europe to Mongolia in the Palaearctic region.

Figs 2, 3. Diagnostic adult characters (indicated) of Chinese *Scopula* species. **2.** *S. floslactata* (Haworth). **3.** *S. tenuisocius* Inoue (abdomen removed).

Idaea auricruda (Butler, 1879)

1♂. NE China – Korea, Japan, SE Russia (Inoue et al. 1982ab, Shin 1996, Viidalepp 1996).

**Idaea pallidata* ([Denis & Schiffermüller], 1775)

1♂. (Fig. 1). NE China – from N and C Europe to SE Russia.

Forewing fasciae are straight, ground colour is light yellow-brown in males, white in females. In western parts of its distribution area it may be confused with *I. subsericeata* (Haworth) (for identification see Ebert et al. 2001, Hausmann 2004). Also *I. nitidata* is similar but males of *I. pallidata* can be separated by the absence of hair-pencil on the hind tibia. The larva feeds on dry leaves of *Taraxacum*, *Hieracium* and *Achillea* (Ebert et al. 2001).

**Idaea effusaria* (Christoph, 1881)

27♂♂, 15♀♀ (Fig. 1). NE China – Korea, Japan, SE Russia (Inoue 1977, Shin 1996, Viidalepp 1996).

Sugi et al. (1987) illustrate the caterpillar of *I. effusaria*.

Idaea nitidata (Herrich-Schäffer, 1861)

26♂♂, 8♀♀. N China – from S Europe to Korea and Japan (Shin 1996, Viidalepp 1996, Inoue et al. 1982a,b). See *I. pallidata*.

Idaea promiscuaria (Leech, 1897)

34♂♂, 7♀♀. N China – Korea, Japan, SE Russia (Inoue et al. 1982a,b, Shin 1996, Viidalepp 1996).

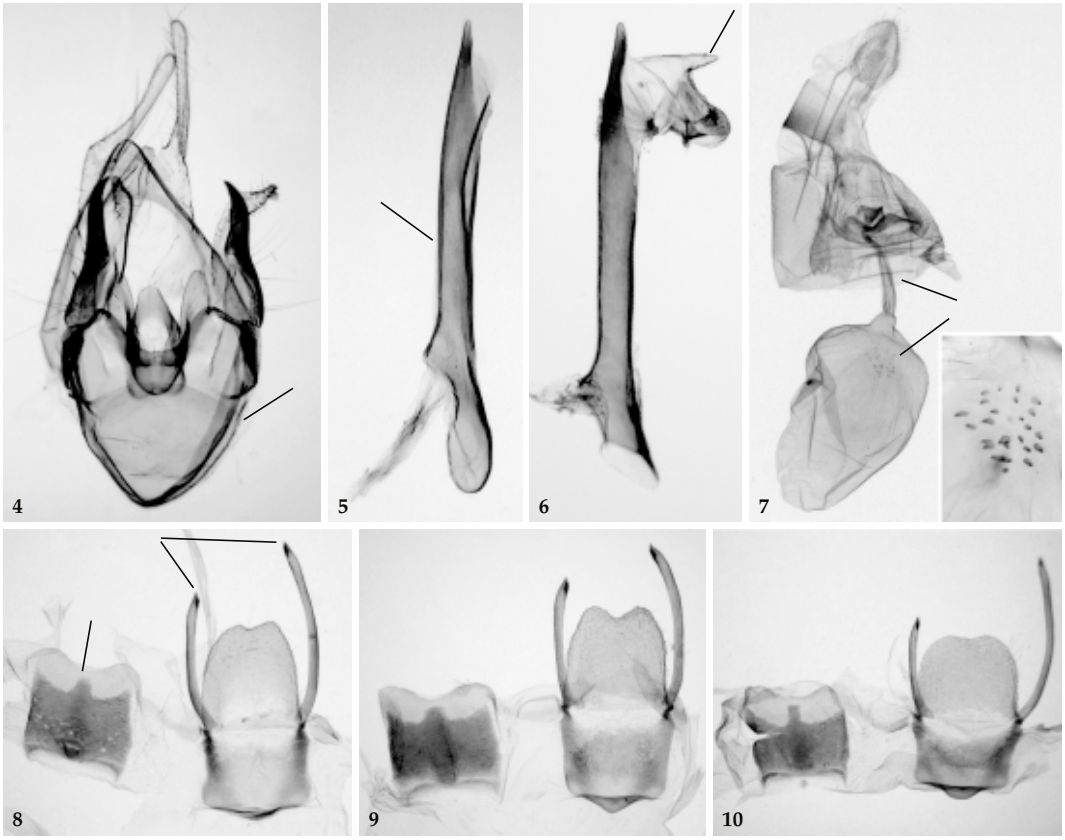
**Idaea aversata* (Linnaeus, 1758)

26♂♂, 8♀♀ (Figs 1, 30-32). NE China – Europe, Russia, Japan (Viidalepp 1996).

The external appearance of the Chinese *I. aversata* resembles Japanese populations, described as ssp. *japonica* (Inoue, 1955) (Inoue et al. 1982b). The Chinese specimens are reddish-brown and heavily suffused with black scales. The terminal line is distinct and the black dots at vein ends are obscure. Both male and female genitalia (Figs 30-32) match well with European specimens (Skou 1984, Hausmann 2004). The cucullus of the valva of the male genitalia bears a few sclerotized spines, the gnathos is heavily serrated with spines, the aedeagus is short, straight, with about 8 cornuti (Figs 30-31). The ductus bursae of the female genitalia is strongly spinose for about ⅓ of its length, it turns to the left along its axis and the ductus seminalis is bare (Fig. 32).

**Idaea terpnaria* (Prout, 1913)

2♂♂ (Fig. 1). NE China – SE Russia, Japan (Viidalepp 1996, Inoue et al. 1982a,b).



Figs 4-10. Diagnostic genitalia characters (indicated) of *Scopula floslactata* (Haworth). **4.** ♂ genitalia (PS653). **5.** ♂ aedeagus (PS653). **6.** ♂ aedegus, vesica everted (PS865). **7.** ♀ genitalia and signum (PS662). **8-10.** ♂ 8th segment of abdomen (PS669, PS670, PS653). Compare with closely related species *S. tenuisocius* (Figs 11-17).

**Scopula nemoraria* (Hübner, [1799])

11♂♂, 13♀♀ (Fig. 1). NE China – Palaearctic: S Europe to SE Russia (Viidalepp 1996).

The species is often found in deciduous forests. Possible foodplants include *Impatiens noli-tangere*, *Hypericum* spp. and grasses (Ebert et al. 2001).

Scopula modicaria (Leech, 1897)

2♂♂. NE and E China – Russia: Primorye; Japan, Korea (Inoue et al. 1982, Shin 1996, Viidalepp 1996).

Scopula umbelaria ssp. *graeseri* Prout, 1935

5♂♂, 2♀♀. NE China – Mongolia, Korea, Japan, SE Russia. Nominal subspecies from S Europe to NW China (Inoue et al. 1982, Viidalepp 1996).

Ebert et al. (2001) give *Vincetoxicum hirundinaria* as a possible food-plant of the larvae.

Scopula nigropunctata ssp. *subcandidata* (Walker, [1863])

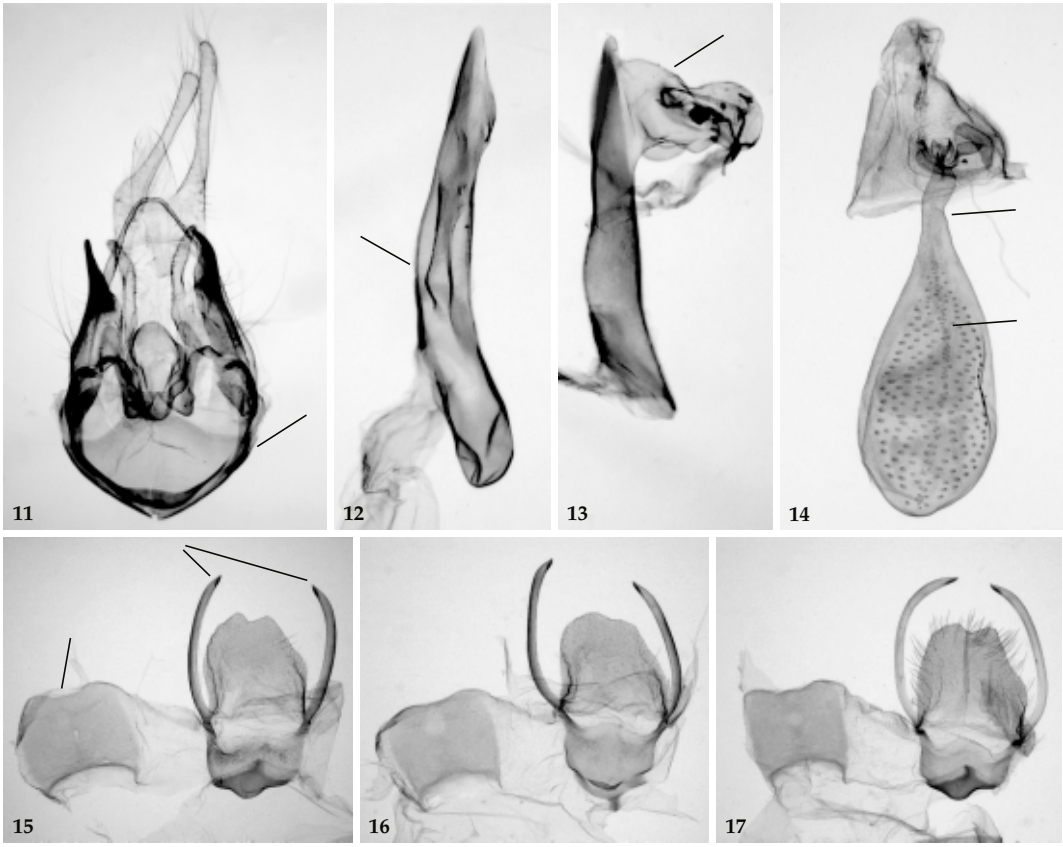
4♂♂. N, NE and E China – Korea, SE Russia, Mongolia. Nominal subspecies from Europe to Russia: Urals and Iran. Separate subspecies in Japan and Korea (Viidalepp 1996, Inoue 1977, Inoue et al. 1982a,b, Shin 1996, Viidalepp 1996, Scoble 1999).

**Scopula tenuisocius* Inoue, 1942

16♂♂, 4♀♀ (Figs 1, 3, 11-17). NE China – SE Russia, S Kuriles, Japan (Inoue et al. 1982a,b, Viidalepp 1996).

Similar to *S. duplinupta* Inoue, 1982, but the latter is currently known from Japan only (Inoue 1982b), and also to *S. floslactata* (Haworth), from which it can be separated as follows.

The wings of *S. tenuisocius* are sparsely serrated with black scales, especially in the forewing costa (more heavily serrated with black scales in *S. floslactata*) (Figs 2, 3). The terminal line is darker than the ground colour (terminal line concolorous with



Figs 11-17. Diagnostic genitalia characters (indicated) of *Scopula tenuisocius* Inoue. **11.** ♂ genitalia (PS861). **12.** ♂ aedeagus (PS861). **13.** ♂ aedegus, vesica everted (PS650). **14.** ♀ genitalia (PS663). **15-17.** ♂ 8th segment of abdomen (PS650, PS651, PS861). Compare with closely related species *S. floslactata* (Figs 4-10).

ground colour in *S. floslactata*), and there is a distinct black spot between the vein endings near the forewing apex (spot absent in *S. floslactata*). The costa of the vinculum of the male genitalia capsule is wide in *S. tenuisocius* (narrow in *S. floslactata*) (Figs 4, 11), the aedeagus is wide, curved ventrally (narrow, straight in *S. floslactata*) (Figs 5, 12), the vesica is without a distal diverticulum (present in *S. floslactata*) (Figs 6, 13), the cerata of 8th abdominal sternite are approximately of equal length or the left is longer (right ceras is longer in *S. floslactata*) (Figs 8-10, 15-17), the distal margin of 8th abdominal tergite is without a medial extension (with medial extension in *S. floslactata*) (Figs 8-10, 15-17). The ductus bursae of female genitalia is wide in *S. tenuisocius* (narrow in *S. floslactata*) and the signum is large, covering most of the corpus bursae (signum is small in *S. floslactata*) (Figs 7, 14).

In North-East China adults of *S. floslactata* fly from the end of May to the middle of July, whereas adults of *S. tenuisocius* fly from the end of June to the end of July.

Scopula floslactata (Haworth, 1809)

5♂♂, 5♀♀ (Figs 2, 4-10). NE China – Palaearctic: Europe to Korea and Japan (Shin 1996, Viidalepp 1996). Externally similar to *S. tenuisocius* Inoue, see that species.

Prout has described *S. floslactata* ssp. *claudata* Prout, 1913 from Japan and there are no reports of this taxon outside that country (Inoue 1977), apart from Viidalepp (1996), who considers *S. claudata* valid at the species level and reports the taxon from China, Korea, Japan and Russia: Primorye and South Kuriles whereas he has omitted records of *S. floslactata* from those areas. I have compared material from North-East China to European specimens, where the identity of *S. floslactata* is well established, and to Russian specimens from Novosibirskaja oblast, and found no difference in the structures. Therefore I

Figs 18-19. Diagnostic imago characters (indicated) of Chinese *Scopula* species. **18.** *S. subpunctaria* (Herrich-Schäffer) (abdomen removed). **19.** *S. prouti* Djakonov (abdomen removed).

consider the Chinese specimens to belong to *S. floslactata*.

Scopula pudicaria (Motschulsky, 1861)

14♂♂, 3♀♀. NE China – SE Russia, Korea, Japan (Inoue et al. 1982a, b, Shin 1996, Viidalepp 1996).

Antennae are dorsally suffused with black scales thus making the species easy to identify.

**Scopula asthena* Inoue, 1943

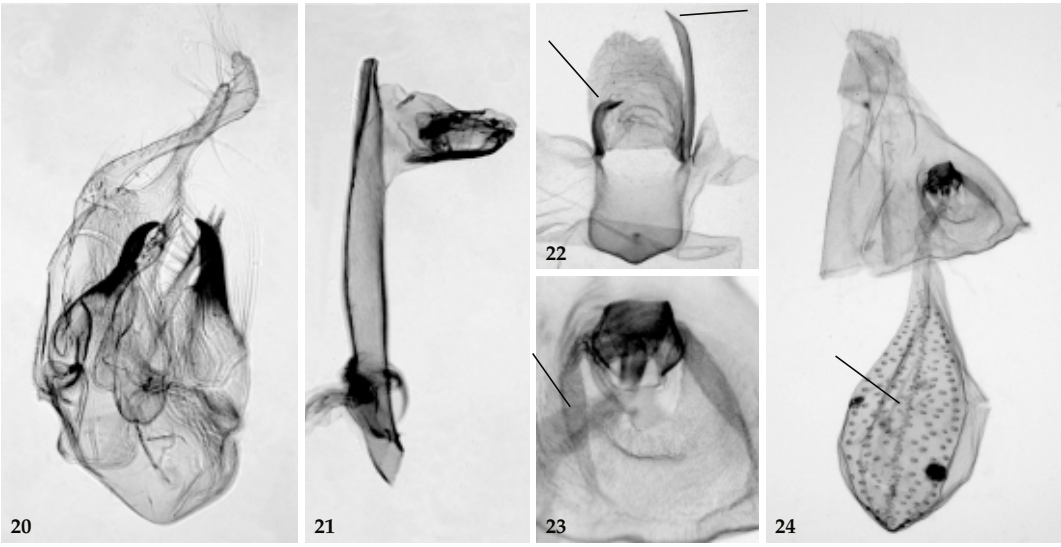
2♂♂, 1♀ (Fig. 1). NE China – SE Russia, Japan (Inoue et al. 1982a,b, Viidalepp 1996).

Scopula subpunctaria (Herrich-Schäffer, 1847)

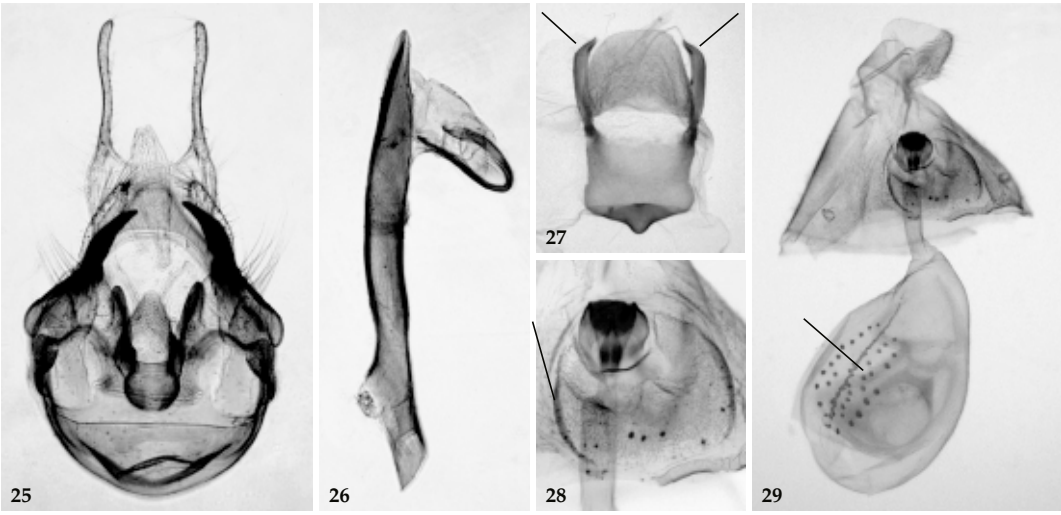
1♂, 9♀ (Figs 18, 20-24). N and NE China – S Palaearctic region (Shin 1996, Viidalepp 1996).

Similar to *S. prouti* Djakonov, from which it can be separated as follows. The terminal line of the wings has a distinct black spot between the vein endings, these are more pronounced near the forewing apex (spots usually absent in *S. prouti*) and the discal spots are often distinct (discal spots are often weak or absent in *S. prouti*) (Figs 18-19). The left ceras of the male 8th abdominal sternite is curved inwards strongly, being in length about half of the mappa, the right ceras exceeds in length the outer margin of the mappa (the cerata are about equal in length in *S. prouti*, barely reaching the outer margin of the mappa) (Figs 22, 27). The signum of the female genitalia is large, the spines are in multiple rows, covering almost the entire length of the corpus bursae (the signum is smaller, and the spines are in a few rows, covering only a small portion of corpus bursae in *S. prouti*) (Figs 24, 29), the sclerotisation cephalad of the ostium bursae (lamella antevaginalis) is slightly folded inwards laterally (the sclerotisation is weak, appearing as a weak ridge in *S. prouti*) (Figs 23, 28).

In many *Scopula* species the structures of the male 8th sternite are a region of great intraspecific polymorphism, especially the length of the cerata (lateral processi) varies, and therefore their usage in species-level diagnoses requires careful interpretation (Hausmann 1999). In that study Hausmann noted also that if there is a closely related species pair, the one species often exhibits polymorphic genitalia, whereas the genitalia of the other does not show such pattern. In Europe, the variation in the length of the cerata in *S. subpunctaria* is dimorphic: either both cerata are long and symmetrical or the left ceras is shortened to half length and strongly curved inwards. On average 35 % of specimens have symmetrical cerata, but regional differences in the morph ratios are considerable (Hausmann 2004). The only Chinese specimen that was available for study has the left ceras shortened and curved inwards (Fig. 22), agreeing with European material (Hausmann 2004). The length of the cerata does not seem to vary in the closely related species *S. prouti* (see below), based on the examined Chinese (n = 8) and South Ussuri (n = 4) specimens (in ZMH). Therefore, despite to which morph the *S. subpunctaria*



Figs 20-24. Diagnostic genitalia characters (indicated) of *Scopula subpunctaria* (Herrich-Schäffer). **20.** ♂ genitalia (PS659). **21.** ♂ aedeagus, vesica everted (PS659). **22.** ♂ 8th sternite of abdomen (PS659). **23.** Ostium bursae and sterigma of ♀ genitalia (PS675). **24.** ♀ genitalia (PS675). Compare with closely related species *S. prouti* (Figs 25-29).



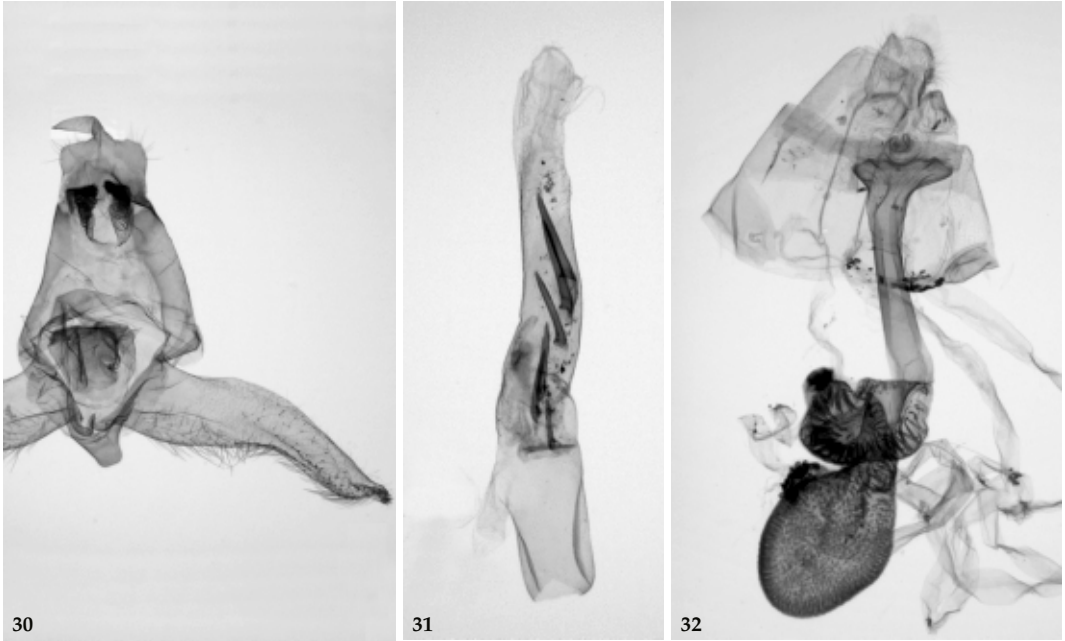
Figs 25-29. Diagnostic genitalia characters (indicated) of *Scopula prouti* Djakonov. **25.** ♂ genitalia (PS673). **26.** ♂ aedeagus, vesica everted (PS673). **27.** ♂ 8th sternite of abdomen (PS673). **28.** Ostium bursae and sterigma of ♀ genitalia (PS676). **29.** ♀ genitalia (PS676). Compare with closely related species *S. subpunctaria* (Figs 20-24).

specimen in question belongs, the right ceras is always considerably longer than the outer margin of the mappa (Fig. 22), whereas in *S. prouti* symmetrical cerata reach barely the outer margin of the mappa (Fig. 27).

Scopula prouti Djakonov, 1935

8♂♂, 1♀ (Figs 19, 25-29). NE China – Korea, Japan, SE Russia (Inoue et al. 1982a,b, Shin 1996, Viidalepp 1996).

Similar to *S. subpunctaria* (Herrich-Schäffer), see that species.



Figs 30-32. Genitalia of *Idaea aversata* (Linnaeus). **30.** ♂ genitalia (PS964) (only right valva is shown). **31.** ♂ aedeagus (PS875). **32.** ♀ genitalia (PS876).

Scopula indicataria ssp. *sufflava* (Prout, 1938)

39♂♂, 3♀♀. N and NE China – Korea, Japan, Russia: Amur, Primorye (Wang 1982, Shin 1996, Viidalepp 1996).

Nominal subspecies from East and South China, in addition there is yet another ssp. from Japan (Prout 1934-39, Inoue et al. 1982a,b). *Argyris indicataria* Walker was transferred from *Somatina* to *Scopula* by Sihvonen (2005).

**Problepsis phoebearia* Erschov, 1870

9♂♂ (Fig. 1). NE China – SE Russia (Viidalepp 1996).

All host-plant records of this genus are from Oleaceae (Holloway 1997).

**Problepsis plagiata* (Butler, 1881)

1♂ (Fig. 1). NE China – Japan, Korea, SE Russia (Inoue et al. 1982a,b, Shin 1996, Viidalepp 1996).

**Cyclophora albipunctata* ssp. *griseolata* (Staudinger, 1897)

1♂, 2♀♀ (Fig. 1). NE China – Korea, Japan, SE Russia. Nominal subspecies from Europe to Mongolia (Viidalepp).

The larva feeds on *Betula* (Mikkola et al. 1985, Ebert et al. 2001).

Timandra recompta ssp. *recompta* (Prout, 1930)

3♂♂. N China – from Central Asia (Kasakhstan) to Mongolia and SE Russia (Shin 1996, Viidalepp 1996, Kaila & Albrecht 1994). Two further subspecies have been described from Japan (Inoue et al. 1982a,b).

Timandra comptaria (Walker, [1863])

3♂♂, 1♀. NE China – Korea, Japan, SE Russia (Inoue 1977, Inoue et al. 1982a,b, Shin 1996, Viidalepp 1996).

Analysis of distribution areas

The distribution areas of many sterrhine moths are rather poorly known and only general conclusions can be drawn. The majority of the observed species (11 species, 44 %) have rather restricted distribution areas, i.e. they are known from the Amur region and the surrounding areas only (Tab. 1). These include species from the genera *Idaea* Treitschke, *Scopula* Schrank (including *Somatina* Guenée, see Sihvonen 2005), *Cyclophora* Hübner and *Timandra* Duponchel. In addition to that, five of the observed species (20 %) have a trans-Palaearctic distribution but a separate subspecies has been described from the Amur region. Considering these together, 64 % of the material have a restricted eastern Palaearctic distribution. Six of

the observed species are found throughout the (southern) Palaearctic region: *Idaea pallidata*, *I. aversata*, *I. nitidata*, *Scopula nemoraria*, *S. floslactata* and *Scopula subpunctaria*.

Both observed *Problepsis* species have rather restricted distribution areas also: earlier *P. phoebearia* was known from the Amur basin and Primorye only and *P. plagiata* from Japan and Corea only (Viidalepp 1996). The only species of the Fenglin Nature Reserve that is found in central and eastern parts of the Palaeartic region is *Timandra recompta*.

Discussion

The occurrence of all of the observed species was predictable because they were known earlier from the adjoining areas outside of China. Based on the material collected, the Sterrhinae species diversity of the Fenglin Nature Reserve is at present rather well documented although the field work was done during two short visits. This claim can be justified for several reasons. First, when the number of observed Sterrhinae species is compared to the latest Russian checklist that is based on extensive field work over years, and which reports 44 Sterrhinae species from the neighbouring Primorye territory and Amur basin (Viidalepp 1996), it is seen that over 50 % of all potential species were observed during these short trips. When taken into account that the Fenglin Nature Reserve, which is geographically much smaller in area, doesn't have suitable habitats for many of the missed species, it is likely that only a few new Sterrhinae species can be found. The most likely candidates to be found are from the genera *Idaea* Treitschke, *Scopula* Schrank and *Timandra* Duponchel. Second, by focusing collecting activity towards a pre-selected group, it was possible to make the special effort that was needed to observe these moths. For example, it is well-known that many of the Sterrhinae are diurnal and/or active at dusk and at dawn. Usage of sweep netting at those times resulted in good samples, which might have been missed if different collecting methods were used.

When the distribution areas of the observed species are viewed, it is striking that over 60 % of the species have a rather restricted eastern Palaearctic distribution. This may be artificial, at least in part, because for many species we do not have detailed distributional data available yet and a few may eventually turn out to be more widespread. The material does not allow for the prediction of what could be the cause behind the observed general pattern.

The observation that Hausmann (1999) made in European material in the genus *Scopula*, namely that if there exists a closely related species-pair, the one species often has polymorphic male 8th sternite, whereas the other species does not exhibit such variation in this structure. In this study a closely related species-pair was examined, *S. subpunctaria* and *S. prouti*, which occur sympatrically in the study area. Polymorphism has been reported to occur in *S. subpunctaria* (Hausmann 1999, 2004), and now it was found that in its close relative *S. prouti*, the relationship being judged from the overall similarity, no such variation was found. It remains unknown whether this phenomenon of species-pairs exists globally in *Scopula* or whether it is confined to the Palaearctic region only.

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Buchbesprechungen

20 Grimaldi, D. & M. S. Engel: Evolution of the Insects. – Cambridge University Press, New York, 2005. 755 S. ISBN 0-521-82149-5.

Die Insekten sind die artenreichste Organismengruppe der Welt. Das vorliegende Buch von David Grimaldi und Michael S. Engel umfaßt alle Aspekte ihrer Entstehungsgeschichte, von den frühesten, fossil belegten Anfängen, bis hin zur jetzigen Vielfalt. Klar formuliert, angenehm zu lesen, reich und brilliant illustriert, hat es in kurzer Zeit hohen Bekanntheitsgrad erlangt und wird mit Sicherheit zu einem der großen neuen Lehrbücher der Entomologie avancieren. Neben der vermittelten Informationsfülle, die modernste Methoden und neueste Ergebnisse berücksichtigt, ist insbesondere auch die Ästhetik der unzähligen Fotos und Illustrationen hervorzuheben. Ganz offensichtlich haben sich die Autoren hinsichtlich der Qualität ihres Produktes auf keinerlei Kompromisse eingelassen, und man wundert sich fast über den durchaus akzeptablen Preis.

Die ersten Kapitel bieten eine generelle Einführung in die Evolutionsforschung. Gut verständlich wird das erforderliche Allgemeinwissen über die wichtigsten historischen Stationen, zur Anwendung kommende Methoden und die entsprechende Terminologie vermittelt. Andere Kapitel befassen sich mit dem Reich der Fossilien, mit dem Wandel der Zeiten und den damit verbundenen großen Evolutionsereignissen. Die Entstehung der Formenvielfalt des Insektenreiches wird systematisch abgehandelt. Dabei werden für jede Großgruppe und Ordnung die charakteristischen Merkmale angeführt, gefolgt von einer ausführlichen Zusammenfassung der jeweiligen Diversität und Biologie. Immer wieder sind generellere Exkurse über biologische Besonderheiten eingestreut, z.B. Themen wie Biolumineszenz, Sozialverhalten, oder Parasitismus. Hypothesen zur Phylogenie der jeweiligen Gruppen werden vorgestellt und durch Zitate belegt, die zugrundeliegenden Argumente diskutiert, wobei die Autoren oft auch selbst sehr konkret Stellung beziehen. Die übersichtlichen Phylogramme stellen oft neben der Stammesgeschichte auch die Evolution von Schlüsselmerkmalen oder biologischen Anpassungen dar. Hinweise auf weiterführende Literatur sind reichlich vorhanden (allein die Literaturzitate nehmen 70 Seiten ein).

Überaus lobenswert ist die Qualität der Abbildungen. Für jede Gruppe gibt es Fototafeln, die sowohl typische als auch außerordentliche Vertreter darstellen. Die Lebend-Fotos heben die besondere Ästhetik der Insekten hervor und zeigen oft gleichzeitig biologische Besonderheiten aus Larvalentwicklung, Verhalten, etc. Details der Körperstruktur und -ornamentierung werden durch erstklassige rasterelektronenmikroskopische Aufnahmen dargestellt. Die größte Herausforderung dürften aber die Fotos der fossilen Belege geboten haben. Wer selbst einmal ein Bernsteinexemplar fotografiert hat, weiß, daß die immer korrekte Orientierung und Ausleuchtung größte Kunstfertigkeit und auch eine hervorragende Bearbeitung der Steine belegt. Für seine exzellenten Zeichnungen ist Grimaldi berühmt, und das Buch ist reich damit ausgestattet. Viele der fotografierten Fossilien sind zum besseren Verständnis zusätzlich auch als Zeichnung wiedergegeben. Andere Zeichnungen erklären übersichtlich Homologien, die Terminologie von Strukturen und ähnliches.

Dieses Buch ist ein "Muß" für jeden Entomologen und interessierten Laien. Ein wunderbares Geschenk zu jedem Anlaß. Sein einziger Nachteil – es ist etwas zu unhandlich, um es als Gute-Nacht-Lektüre mit ins Bett zu nehmen. M. Kotrba

21. Kreuels, M. & S. Buchholz: Ökologie, Verbreitung und Gefährdungsstatus der Webspinnen Nordrhein-Westfalens. Erste überarbeitete Fassung der Roten Liste der Webspinnen (Arachnida: Araneae). – Verlag Wolf & Kreuels, Havixbeck-Hohenholte, 2006. 116 S. ISBN 3-937455-07-8.

Rote Listen sind, wie sich für fast alle Tiergruppen gezeigt hat, eine wesentliche Grundlage für Arten- und Biotopschutz, daneben auch für die Landschaftsplanung allgemein. Neben Artenlisten und Einschätzungen der Gefährdungskategorien sind zudem Angaben über die geographische Verbreitung sowie die Habitatbindung der jeweiligen Arten unabdingbar für effiziente Naturschutzarbeit. Die hier von Martin Kreuels und Sascha Buchholz vorgelegte Überarbeitung der "Roten Liste" der Webspinnen entspricht diesen Anforderungen in idealer Weise.

Die Autoren stellen das Untersuchungsgebiet (Naturräumliche Gliederung, potentielle natürliche Vegetation), die zur Datenerfassung angewendeten Methoden (Fundortangaben aus über 38 000 Datensätzen) sowie den Aufbau bzw. die eingearbeiteten Informationskategorien ihrer Rote-Liste-Tabelle knapp, aber nachvollziehbar und gut gegliedert dar. Darüber hinaus wird die Problematik von Roten Listen, die immer nur begrenztes Wissen wiedergeben können, angemessen diskutiert. Eine vollständige Bibliographie rundet die vorliegende Studie ab.

Es ergibt sich ein Bestand von 677 Webspinnenarten aus 37 Familien für Nordrhein-Westfahlen, von denen 133 zumindest gefährdet sind. Davon gelten 9 als ausgestorben. Neben diesen Grunddaten finden sich in der Tabelle natürlich Angaben zum Gefährdungsstatus, zur aktuellen Bestandssituation und zur Verbreitung, daneben aber auch Angaben zur Ökologie (Habitat, Abhängigkeit von der Vegetationsschichtung, zusätzlich abiotische Faktoren wie Feuchte und Licht).

Die Autoren haben meines Erachtens eine sehr gelungene und nach dem derzeitigen Stand umfassende Überarbeitung der Roten Liste für die Webspinnen Nordrhein-Westfalens vorgelegt, die ich als Grundlage für Naturschutz und Landschaftsplanung uneingeschränkt empfehlen kann. R. Melzer