Records of larentiine moths (Lepidoptera: Geometridae) collected at the Station Linné in Sweden

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Abstract

Background

The island of Öland, at the southeast of Sweden, has unique geological and environmental features. The Station Linné is a well-known Öland research station which provides facilities for effective studies and attracts researchers from all over the world. Moreover, the station remains a center for ecotourism due to extraordinary biodiversity of the area. The present paper is aimed to support popular science activities carried out on the island and to shed light on diverse geometrid moth fauna of the Station Linné.

New information

As an outcome of several research projects, including the Swedish Malaise Trap Project (SMTP) and the Swedish Taxonomy Initiative (STI) conducted at the Station Linné, a list of larentiine moths (Lepidoptera: Geometridae) collected on the territory of the station is presented. Images of moths from above and underside are shown. Of the totally 192 species registered for Sweden, 41 species (more than 21%) were collected in close

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proximity to the main building of the Station Linné. Malaise trap sampling of Lepidoptera is discussed.

**Keywords**

Alvar, checklist, diversity, faunistics, geometrid moths, Larentiinae, malaise trap sampling, Öland, Skogsby

**Introduction**

The island of Öland, at the southeast of Sweden, is famous for its dominant environmental feature, an Ordovician limestone pavement, which is called the Stora Alvaret (= the Great Alvar). Alvars are semi-natural grasslands which have been formed and developed due to long periods of human influence, including grazing (Rosén 1982). The Stora Alvaret has been designated as a World Heritage Site by UNESCO due to its unusual biodiversity and prehistory. Station Linné is situated on the island of Öland being a center for research, popular science activities, and ecotourism. The research station is named after Carl von Linné who visited Öland in 1741.

The Swedish Malaise Trap Project (SMTP), funded by the Swedish Species Information Centre (ArtDatabanken), is based at the Station Linné. The project aims to provide species determinations for the specimens obtained from Malaise traps sampling at a wide range of landscapes and habitats. For many groups, including geometrid moths, the final data release is still awaited. The present paper is aimed to present a first list of the larentiine moths collected at the Station Linné.

**Materials and methods**

Material for study was mainly collected using a UV light trap (UV), a mercury vapor light trap (MV) and net sweeping (NS) by O. Schmidt in 2014 (June 24-29, July 1-4) and 2015 (July 20-31) in the Mörbylånga kommun, Skogsby, Station Linné (56.6186 N, 16.4989 E). The UV light trap was placed between the tree and shrub rows along a walking path, with a meadow on one side and a swampy area on the other side (Fig. 1). The mercury vapor light trap was situated nearby, at the edge of the swamp (Fig. 2). The two light traps were separated by a row of trees and shrubs.

Furthermore, material collected as part of the SMTP in 2007 and 2008 using a Malaise trap (MF) located close to the main building of the Station Linné (see [http://www.stationlinne.se/sv/forskning/the-swedish-malaise-trap-project-smtp/traps/trap-id-2006-skogs](http://www.stationlinne.se/sv/forskning/the-swedish-malaise-trap-project-smtp/traps/trap-id-2006-skogs), Trap ID 2006) was checked and the larentiine moths identified. This Malaise trap was placed on a lawn, about 100 m north of the Alvar edge (56.6190 N, 16.4973 E) and was running from
April 2007 until November 2008. A note is given for the species recorded from Malaise trap samples only.

Figure 1.
UV light trap

Figure 2.
MV light trap
Additional material has been collected in the following locations: Borgholms kommun, Ismantorp; Borgholms kommun, Petgårdeträsk; Mörbylånga kommun, near Arontorp; Mörbylånga kommun, Gårdsby; Mörbylånga kommun, Gillsättra_wet, Gillsättra_dry; Mörbylånga kommun, Jordtorpsåsen_wet, Jordtorpsåsen_dry; Mörbylånga kommun, Kalkstad; Mörbylånga kommun, Södra Sandby (Suppl. material 1). Specimens collected by net sweeping on Öland outside the station are marked with asterisk (NS*).

The genitalia of all small-sized moths were studied to correctly identify the species. The material was identified using the Lepidoptera collection of the Zoologische Staatssammlung München (ZSM, Germany) and publications by Mironov (2003), Elmquist et al. (2011) and Hausmann and Viidalepp (2012).

List of larentiine moth species collected at the Station Linné

**Phibalapteryx virgata** (Hufnagel, 1767)

- [http://eol.org/pages/4031647/overview](http://eol.org/pages/4031647/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Phibalapteryx_virgata](http://www.lepiforum.de/lepiwiki.pl?Phibalapteryx_virgata)

**Notes:** Figs 3, 4
Cidaria fulvata (Forster, 1771)

- http://eol.org/pages/283762/overview
- http://www.lepiforum.de/lepiwiki.pl?Cidaria_Fulvata

Notes: Figs 5, 6
Colostygia olivata (Denis & Schiffermüller, 1775)

- [http://eol.org/pages/277279/overview](http://eol.org/pages/277279/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Colostygia_olivata](http://www.lepiforum.de/lepiwiki.pl?Colostygia_olivata)

Notes: Figs 7, 8

Figure 6.
*Cidaria fulvata*, underneath

Figure 7.
*Colostygia olivata*, above
Colostygia pectinataria (Knoch, 1781)

- [http://eol.org/pages/278481/overview](http://eol.org/pages/278481/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Colostygia_Pectinataria](http://www.lepiforum.de/lepiwiki.pl?Colostygia_Pectinataria)

**Notes:** Figs 9, 10
Cosmorhoe ocellata (Linnaeus, 1758)

- [http://eol.org/pages/270324/overview](http://eol.org/pages/270324/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Cosmorhoe_Ocellata](http://www.lepiforum.de/lepiwiki.pl?Cosmorhoe_Ocellata)

Notes: Figs 11, 12
**Eulithis prunata** (Linnaeus, 1758)

- [http://eol.org/pages/281849/overview](http://eol.org/pages/281849/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eulithis_Prunata](http://www.lepiforum.de/lepiwiki.pl?Eulithis_Prunata)

**Notes:** Figs 13, 14

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**Figure 12.**
*Cosmorhoe ocellata*, underneath

**Figure 13.**
*Eulithis prunata*, above
Eulithis mellinata (Fabricius, 1787)

- [http://eol.org/pages/284564/overview](http://eol.org/pages/284564/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eulithis_Mellinata](http://www.lepiforum.de/lepiwiki.pl?Eulithis_Mellinata)

**Notes:** Figs 15, 16
Eulithis testata (Linnaeus, 1761)

- http://eol.org/pages/286201/overview
- http://www.lepiforum.de/lepiwiki.pl?Eulithis_Testata

Notes: Figs 17, 18
Gandaritis pyraliata (Denis & Schiffermüller, 1775)

- [http://eol.org/pages/4017307/overview](http://eol.org/pages/4017307/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Gandaritis_Pyraliata](http://www.lepiforum.de/lepiwiki.pl?Gandaritis_Pyraliata)

Notes: Figs 19, 20
Figure 20.
*Gandaritis pyraliata*, underneath

**Plemyria rubiginata** (Denis & Schiffermüller, 1775)

- [http://eol.org/search?q=Plemyria+rubiginata&search=Go](http://eol.org/search?q=Plemyria+rubiginata&search=Go)
- [http://www.lepiforum.de/lepiwiki.pl?Plemyria_Rubiginata](http://www.lepiforum.de/lepiwiki.pl?Plemyria_Rubiginata)

**Notes:** Figs 21, 22

Figure 21.
*Plemyria rubiginata*, above
Thera cognata (Thunberg, 1792)

- [http://eol.org/pages/298019/overview](http://eol.org/pages/298019/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Thera_cognata](http://www.lepiforum.de/lepiwiki.pl?Thera_cognata)

**Notes:** Figs 23, 24

Figure 22.
*Plemyria rubiginata*, underneath

Figure 23.
*Thera cognata*, above
Figure 24.

*Thera cognata*, underneath

**Eupithecia absinthiata** (Clerck, 1759)

- [http://eol.org/pages/285123/overview](http://eol.org/pages/285123/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_absinthiata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_absinthiata)
- [http://mothphotographersgroup.msstate.edu/species.php?hodges=7586.1](http://mothphotographersgroup.msstate.edu/species.php?hodges=7586.1)

**Notes:** Figs 25, 26

Figure 25.

*Eupithecia absinthiata*, above
Eupithecia denotata (Hübner, 1813)

- [http://eol.org/search?q=Eupithecia+denotata&search=Go](http://eol.org/search?q=Eupithecia+denotata&search=Go)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_denotata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_denotata)
- [http://www.euroleps.ch/seiten/s_art.php?art=geo_denotata](http://www.euroleps.ch/seiten/s_art.php?art=geo_denotata)

**Notes:** Figs 27, 28

Figure 26.
Eupithecia absinthiata, underneath

Figure 27.
Eupithecia denotata, above
**Eupithecia exiguata** (Hübner, 1813)

- [http://eol.org/pages/284131/overview](http://eol.org/pages/284131/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_exiguata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_exiguata)

**Notes:** Figs 29, 30
Eupithecia icterata (de Villers, 1789)

- [http://eol.org/pages/281026/overview](http://eol.org/pages/281026/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_icterata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_icterata)

**Notes:** Figs 31, 32
Eupithecia linariata (Denis & Schiffermüller, 1775)

- [http://eol.org/pages/283937/overview](http://eol.org/pages/283937/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Linariata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Linariata)

Notes: Figs 33, 34
**Eupithecia nanata** (Hübner, 1813)

- [http://eol.org/pages/287885/overview](http://eol.org/pages/287885/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_nanata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_nanata)

**Notes:** Figs 35, 36

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**Eupithecia linariata**, underneath

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**Figure 34.**

**Eupithecia linariata**, underneath

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**Figure 35.**

**Eupithecia nanata**, above, abdomen missing
Eupithecia pusillata (Denis & Schiffermüller, 1775)

- [http://eol.org/search?q=Eupithecia+pusillata&search=Go](http://eol.org/search?q=Eupithecia+pusillata&search=Go)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Pusillata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Pusillata)

**Notes:** Figs 37, 38

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Figure 36.
*Eupithecia nanata*, underneath, abdomen missing

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Figure 37.
*Eupithecia pusillata*, above
Eupithecia satyrata (Hübner, 1813)

- [http://eol.org/pages/292707/overview](http://eol.org/pages/292707/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_satyrata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_satyrata)

Notes: Figs 39, 40

**Figure 38.**
Eupithecia pusillata, underneath

**Figure 39.**
Eupithecia satyrata, above
Eupithecia subfuscata (Haworth, 1809)

- [http://eol.org/pages/286559/overview](http://eol.org/pages/286559/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Subfuscata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Subfuscata)

**Notes:** Figs 41, 42
Eupithecia subumbrata (Denis & Schiffermüller, 1775)

•  [http://eol.org/pages/287281/overview](http://eol.org/pages/287281/overview)
•  [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_subumbrata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_subumbrata)

**Notes:** Figs 43, 44

Figure 42.
*Eupithecia subfuscata*, underneath

Figure 43.
*Eupithecia subumbrata*, above, abdomen missing
Eupithecia succenturiata (Linnaeus, 1758)

- [http://eol.org/pages/292925/overview](http://eol.org/pages/292925/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_succenturiata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_succenturiata)

**Notes:** Figs 45, 46
**Eupithecia tenuiata** (Hübner, 1813)

- [http://eol.org/pages/285093/overview](http://eol.org/pages/285093/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Eupithecia_tenuiata](http://www.lepiforum.de/lepiwiki.pl?Eupithecia_tenuiata)

**Notes:** Figs 47, 48
Eupithecia valerianata (Hübner, 1813)

- https://en.wikipedia.org/wiki/Eupithecia_valerianata
- http://www.lepiforum.de/lepiwiki.pl?Eupithecia_Valerianata

Notes: Figs 49, 50

Figure 48.
Eupithecia tenuiata, underneath

Figure 49.
Eupithecia valerianata, above
**Pasiphila chloerata** (Mabille, 1870)

- [http://eol.org/pages/4031644/overview](http://eol.org/pages/4031644/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Pasiphila_Chloerata](http://www.lepiforum.de/lepiwiki.pl?Pasiphila_Chloerata)

**Notes:** Figs 51, 52
Pasiphila rectangulata (Linnaeus, 1758)

- [http://eol.org/pages/277386/overview](http://eol.org/pages/277386/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Pasiphila_Rectangulata](http://www.lepiforum.de/lepiwiki.pl?Pasiphila_Rectangulata)

Notes: Figs 53, 54
Hydriomena furcata (Thunberg, 1784)

- [http://eol.org/pages/286763/overview](http://eol.org/pages/286763/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Hydriomena_furcata](http://www.lepiforum.de/lepiwiki.pl?Hydriomena_furcata)

**Notes:** Figs 55, 56
**Pelurga comitata** (Linnaeus, 1758)

- [http://eol.org/pages/284799/overview](http://eol.org/pages/284799/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Pelurga_Comitata](http://www.lepiforum.de/lepiwiki.pl?Pelurga_Comitata)

**Notes:** Figs 57, 58
Mesotype didymata (Linnaeus, 1758)

- [http://eol.org/pages/4012784/overview](http://eol.org/pages/4012784/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Mesotype_Didymata](http://www.lepiforum.de/lepiwiki.pl?Mesotype_Didymata)

Notes: Figs 59, 60

Figure 58.
*Pelurga comitata*, underneath

Figure 59.
*Mesotype didymata*, above
**Perizoma alchemillata** (Linnaeus, 1758)

- [http://eol.org/pages/295004/overview](http://eol.org/pages/295004/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Perizoma_Alchemillata](http://www.lepiforum.de/lepiwiki.pl?Perizoma_Alchemillata)

**Notes:** Figs 61, 62
Philereme transversata (Hufnagel, 1767)

- [http://eol.org/pages/296282/overview](http://eol.org/pages/296282/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Philereme_transversata](http://www.lepiforum.de/lepiwiki.pl?Philereme_transversata)

**Notes:** Figs 63, 64
Philereme vetulata (Denis & Schiffermüller, 1775)

- http://eol.org/search?q=Philereme+vetulata&search=Go
- http://www.lepiforum.de/lepiwiki.pl?Philereme_vetulata

Notes: Figs 65, 66
Scotopteryx chenopodiata (Linnaeus, 1758)

- [http://eol.org/pages/295986/overview](http://eol.org/pages/295986/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Scotopteryx_Chenopodiata](http://www.lepiforum.de/lepiwiki.pl?Scotopteryx_Chenopodiata)

**Notes:** Figs 67, 68

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Figure 66.
*Philereme vetulata*, underneath

Figure 67.
*Scotopteryx chenopodiata*, above
**Pterapherapteryx sexalata** (Retzius, 1783)

- [http://eol.org/pages/297593/overview](http://eol.org/pages/297593/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Pterapherapteryx_sexalata](http://www.lepiforum.de/lepiwiki.pl?Pterapherapteryx_sexalata)

**Notes:** Figs 69, 70

Figure 68.
*Scotopteryx chenopodiata*, underneath

Figure 69.
*Pterapherapteryx sexalata*, above
Camptogramma bilineata (Linnaeus, 1758)

- [http://eol.org/search?q=Camptogramma+bilineata&search=Go](http://eol.org/search?q=Camptogramma+bilineata&search=Go)
- [http://www.lepiforum.de/lepiwiki.pl?Camptogramma_Bilineata](http://www.lepiforum.de/lepiwiki.pl?Camptogramma_Bilineata)

Notes: Figs 71, 72
Catarhoe cuculata (Hufnagel, 1767)

- [http://eol.org/pages/276073/overview](http://eol.org/pages/276073/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Catarhoe_cuculata](http://www.lepiforum.de/lepiwiki.pl?Catarhoe_cuculata)

**Notes:** Figs 73, 74
Figure 74.
Catarhoe cuculata, underneath

Catarhoe rubidata (Denis & Schiffermüller, 1775)

- http://eol.org/pages/279041/overview
- http://www.lepiforum.de/lepiwiki.pl?Catarhoe_Rubidata

Notes: Figs 75, 76

Figure 75.
Catarhoe rubidata, above
**Epirrhoe alternata** (Müller, 1764)

- [eol.org/search?q=Epirrhoe+alternata&search=Go](http://eol.org/search?q=Epirrhoe+alternata&search=Go)
- [http://www.lepiforum.de/lepiwiki.pl?Epirrhoe_Alternata](http://www.lepiforum.de/lepiwiki.pl?Epirrhoe_Alternata)

**Notes:** Figs 77, 78
Epirrhoe hastulata (Hübner, 1790)

- [http://eol.org/pages/285918/overview](http://eol.org/pages/285918/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Epirrhoe_Hastulata](http://www.lepiforum.de/lepiwiki.pl?Epirrhoe_Hastulata)

**Notes:** Figs 79, 80

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**Figure 78.**
_Epirrhoe alternata_, underneath

**Figure 79.**
_Epirrhoe hastulata_, above
Epirrhoe tristata (Linnaeus, 1758)

- [http://eol.org/pages/285474/overview](http://eol.org/pages/285474/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Epirrhoe_Tristata](http://www.lepiforum.de/lepiwiki.pl?Epirrhoe_Tristata)

**Notes:** Figs 81, 82
**Xanthorhoe ferrugata** (Clerck, 1759)

- [http://eol.org/pages/288630/overview](http://eol.org/pages/288630/overview)
- [http://www.lepiforum.de/lepiwiki.pl?Xanthorhoe_ferrugata](http://www.lepiforum.de/lepiwiki.pl?Xanthorhoe_ferrugata)

**Notes:** Figs 83, 84

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**Figure 82.**
*Epirrhoe tristata*, underneath

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**Figure 83.**
*Xanthorhoe ferrugata*, above
Results and discussion

Totally, 192 species of Larentiinae are recorded for Sweden (Elmquist et al. 2011, http://www2.nrm.se/en/svenska_fjarilar/svenska_fjarilar.html). Bert Gustafsson listed 156 species occurring on Öland (http://www2.nrm.se/en/catalogus.html.se). Currently, 41 species are recorded for the territory of the Station Linné, which comprises 26.3% of the Öland species and more than 21% of the Swedish larentiine fauna. Interestingly, 37 species were sampled during 22 nights of light trapping in summer 2014 and 2015, when the weather was not quite favorable for collecting. For comparison, a recent rapid biotic survey at a 365 hectare Charitable Research Reserve in Ontario (Canada) revealed only nine larentiine species (Telfer et al. 2015). An unusual biodiversity registered for a small collecting site on Öland can be explained by use of effective sampling methods.

Most of the larentiine species were collected using a UV light trap. The exceptions are as follows: one specimen of *Eulithis testata* and one specimen of *Catarchoe cuculata* were attracted only to the Mercury vapor lamp. The efficiency of different types of traps in this study should be compared with caution. The Mercury vapor trap and the surrounding vegetation was checked once at night between 11 p.m. and 12 p.m. and emptied in the morning, after completion of light trapping, whereas the UV trap has been checked continuously and the geometrid moths flying near the trap and sitting on the leaves of trees and bushes were collected permanently. *Epirrhoe hastulata*, *E. tristata*, *Eupithecia exigua* and *E. satyrata* were recorded only in Malaise trap samples collected during July 24 – August 12, 2008, May 12 – June 5, 2008, June 5-21, 2008, and June 1-15, 2007 respectively.

Figure 84.
*Xanthorhoe ferrugata*, underneath
Morphological differences within *Gandaritis pyraliata* (Denis & Schiffermüller)

A series of specimens presumably belonging to the species *Gandaritis pyraliata* have been collected. The specimens display variation in the wing pattern above and underneath, in the male genitalia (the shape of the saccus) and in the female genitalia (the length of the ductus bursae and the shape of the signum). The specimens require more detailed study.

Malaise trap sampling of Lepidoptera

Malaise traps are effectively used for collecting small flying insects for many decades, after the trap has been described by Malaise (1937). Although butterflies and moths are sometimes target groups of large-scale malaise trap sampling for ecological and conservation studies (e.g. Basset et al. 2007, Campbell and Hanula 2007, Lamarre et al. 2012), collecting Lepidoptera by means of malaise traps is a challenging method. Designed for Diptera and Hymenoptera, a malaise trap indeed effectively samples Lepidoptera, as they get trapped within the malaise tent, flying upward towards either the sun (during the day) or the moon (at night) (see Lamarre et al. 2012). However, the specimens fall into a collecting jar filled with Ethanol, whereby the wing scales rub off easily. Generally, only specimens with distinct wing pattern can be reliably identified from the samples in Ethanol. The older the samples are, the more difficult it is to get a correct identification of Lepidoptera. For small moths it is necessary to study the genitalia or to perform a molecular analysis. Considering the results of present study, using only malaise traps for sampling Lepidoptera is advisable for well-studied faunas. Traditional methods, like net sweeping, light trapping or bait-traps deliver more suitable results.

Acknowledgements

The study has been conducted at the Station Linné (Öland, Sweden) and at the Zoologische Staatssammlung München (ZSM, Germany). Dave Karlsson, Pelle Magnusson and other participants of the Swedish Malaise Trap Project made additional material available for study. Axel Hausmann (ZSM) is thanked for providing access to the ZSM material and for acting as an academic editor of the manuscript. Jaan Viidalepp and Vladimir Mironov are kindly acknowledged for valuable comments on the manuscript. The present paper is a side product of research dealing with recording the fauna of Microhymenoptera related to the Swedish Taxonomy Initiative (STI) and conducted on the Station Linné. Christer Hansson (Lunds Universitet, Sweden) is thanked for discussions on the flora and fauna of Öland and assistance during field work. Stefan Schmidt (ZSM) is acknowledged for providing images of light traps and for advice and support.
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Supplementary material

Suppl. material 1: List of laretiine moth species (Lepidoptera: Geometridae) of the Station Linné

Authors: Schmidt, O.
Data type: occurrences
Filename: List_Taxon_Template-LarOLAND_Sweden.xls - Download file (177.00 kb)