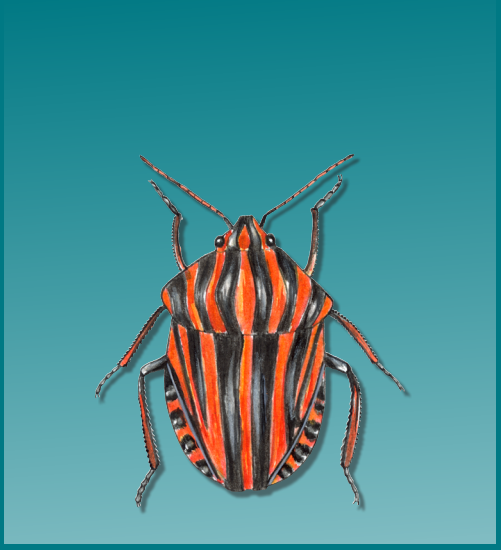

SELECTED ABSTRACTS & PAPERS
OF THE FIRST BALTIC INTERNATIONAL CONFERENCE

ON

FIELD ENTOMOLOGY AND FAUNISTICS

3–9 June 2014, Vilnius, Lithuania



Edukologija Publishers, 2014

Layout by **Rasa Labutienė**

Stonis, Jonas Rimantas [editor in chief]; **Hill, Simon Richard; Diškus, Arūnas; Auškalnis, Tomas** [editorial board].
Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics – Edukologija, Vilnius, 2014. – 124 p.

The Conference emphasizes the importance of faunistic research and provides selected or extended abstracts, short communications or full papers from 26 presentations by professors, scientific researchers, graduate, master or doctoral students from nine countries: Italy, Czech Republic, Poland, Lithuania, Latvia, Russia, Canada, USA, Ecuador.

Key words: aphidology, biodiversity, Bucculatricidae, Carabidae, Coleoptera, Cossidae, Crysomellidae, Curculionoidea, guava, *Hylobius*, Gracillariidae, fauna, faunistics, field methods, entomology, Kurtuvėnai Regional Park, leaf-mines, leaf-mining insects, Lepidoptera, Lepidoptera phylogeny, Lithuanian Entomological Society, micro-mounts, Nepticulidae, Tischeriidae, Tortricidae.

Published on 18 September 2014

© Edukologija Publishers

ISBN 978-9955-20-953-9

Urgent need for increased faunistic research

Recent decades have been characterized by faunistics and systematics regaining their significance and now these disciplines are becoming an important area of biological research. One of the most fundamental challenges for mankind of the 21st century is to document the extent and distribution of global biodiversity as well as understand the ecological processes that generate and maintain it. Such information will be essential for informing and guiding efforts to safeguard the natural ecosystems that provide the Earth's life support systems. Without the baseline data of faunistic and taxonomic diversity providing means for the identification of the species in a region, no one can move forward in properly planning their conservation or their control in case of invasive species.

Fast development of modern research techniques, which flourished at the end of 20th century, slightly diminished interest in faunistic research. On the other hand, the negative impact on ecosystems, including threats from human activity that causes habitat destruction and modification in the face of the global biodiversity crisis and climate change, led to an urgent need for significant intensification of biodiversity studies.

The Conference emphasizes the importance of faunistic research that includes studies into the nature of insect fauna: from sampling, species identification and regional biodiversity inventory, evaluation of species abundance, documentation of described species (morphology incl. variability, bionomics incl. life cycles and habitats) and description of new taxa to taxonomic, phylogenetic, trophic, chorolological and other analyses of regional and global faunas.

The research postulated in the Conference involves a large-scale investigation of various groups of insects, which, in spite of their tremendous economic importance, constitute one of the world's least known faunas and for which there has been a disturbing decline of qualified specialists.

Professor Jonas Rimantas Stonis,
Conference Chairman

HONOUR CHAIR

Acad. Algirdas Gaižutis (Rector of the Lithuanian University of Educational Sciences, Vilnius, Lithuania)

Dr. Donald R. Davis (Leading Scientist in the field of insect taxonomy, NMNH, Smithsonian Institution, Washington, D.C., USA)

GENERAL CHAIR

Prof. Habil. Dr. Jonas Rimantas Stonis (Chairman, LEU, Vilnius, Lithuania)

INTERNATIONAL SCIENTIFIC COMMITTEE

Prof. Dr. Virginijus Sruoga (Dean of the Faculty of Science and Technology, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

Prof. Habil. Dr. Vincas Būda (Director of the Nature Research Centre, Vilnius, Lithuania)

Prof. Habil. Dr. Rimantas Rakauskas (Head of the Zoology Department, Vilnius University, Vilnius, Lithuania)

Prof. Dr. Sigitas Podėnas (Leading Research Scientist, Nature Recearch Centre, Vilnius, Lithuania)

Dr. M. Alma Solis (Leading Research Scientist, USDA, NMNH, Smithsonian Institution / formerly Head of Systematic Entomology Laboratory, United States Department of Agriculture, Washington, D.C., USA)

Dr. Svetlana V. Baryshnikova (Leading Research Scientist, Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia)

Dr. Aleksandr L. Lvovsky (Leading Research Scientist, Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia)

Dr. David C. Lees (Postdoctoral Research Associate, Skylab, Department of Zoology, Cambridge University, Cambridge, United Kingdom)

Dr. Blanca Huertas (Curator of the Lepidoptera Collection, Natural History Museum, London, United Kingdom)

Dr. Jean-François Landry (Leading Research Scientist and Curator, and Editor of an international zoological taxonomy journal – Zootaxa, Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Canada)

Assoc. Prof. Dr. Arūnas Diškus (Senior Researcher, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

Assoc. Prof. Dr. Andrius Petrašiūnas (Vilnius University and President of the Lithuanian Entomological Society)

Assoc. Prof. Dr. Romualda Lazauskaitė (Vice-Dean of the Faculty of Science and Technology, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

Assoc. Prof. Dr. Jurga Turčinavičienė (Vice-Dean of the Faculty of Natural Sciences, Vilnius University, Vilnius, Lithuania)

Dr. Brigita Tamutė (Vytautas Magnus University and Tadas Ivanauskas Zoological Museum, Kaunas, Lithuania)

Prof. Dr. Remigijus Noreika (Head of the Biology Department, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

Assoc. Prof. Dr. Regimantas Bareikis (Head of the Institute for Scientific Research, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

Assoc. Prof. Dr. John B. Heppner (Curator of Florida State Collection of Arthropods and the Founder of the International Association for Tropical Lepidoptera, Editor of Lepidopterorum Catalogus (new series) and Lepidoptera Novae, McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Gainesville, USA)

EXECUTIVE COMMITTEE

Prof. Habil. Dr. Jonas Rimantas Stonis (Chairman, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

Prof. Dr. Virginijus Sruoga (Dean, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

Dr. Uldis Valainis (Director of Institute of Systematic Biology, Daugavpils University, Latvia)

Assoc. Prof. Dr. Romualda Lazauskaitė (Vice-Dean, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

Assoc. Prof. Dr. Arūnas Diškus (Senior Researcher, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

PhD Fellow Andrius Remeikis (Nature Recearch Centre, Vilnius, Lithuania)

Prof. Dr. Remigijus Noreika (Head of Biology Department, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

EDITORIAL BOARD

Prof. Habil. Dr. Jonas Rimantas Stonis (Editor-in-chief) (Lithuanian University of Educational Sciences, Lithuania)

Simon R. Hill (London School of Economics and Political Science)

Assoc. Prof. Dr. Arūnas Diškus (Lithuanian University of Educational Sciences, Lithuania)

Tomas Auškalnis (National Martynas Mažvydas Library, Lithuania)

The Conference brought together international academics
from the Baltic countries and Poland (speakers from other countries were also welcomed),
including professors and graduate, master or postgraduate (doctoral/PhD) students,
which presented methodological novelties and faunistic research in their respective fields.

The first aim of the Conference was to provide opportunities for academics
from various countries representing a range of disciplines in entomology to share their research
by means of the conference podium.

The Conference's second aim was to provide opportunities for academics to receive informal
in-depth feedback through discussions and enable them to establish contact with professionals
from other countries and institutions.

Number of given presentations:

Italy – 2, Czech Republic – 1, Poland – 6, Lithuania – 15, Latvia – 6, Russia – 1, Canada – 2, USA – 4; Ecuador – 1.

Number of participants who provided presentations:

Italy – 2, Czech Republic – 2, Poland – 8, Lithuania – 18, Latvia – 8, Russia – 1, Canada – 4, USA – 3; Ecuador – 1.

SELECTED

ABSTRACTS and PAPERS



(PEER-REVIEWED)

CONTENTS

Aphid (Hemiptera, Sternorrhyncha: Aphidoidea) fauna of Lithuania: current state of knowledge. By Rimantas Rakauskas (*Vilnius University, Vilnius, Lithuania*) / **9**

The first record of *Stigmella malella* (Lepidoptera, Nepticulidae), an apple tree pest in Kurtuvėnai (NW Lithuania). By Anna Karlsone, Janis Strautinš (*Daugavpils University, Latvia*), Justyna Patrycja Rudak, Kornelia Cypryjanska (*Wrocław University of Environmental and Life Sciences, Wrocław, Poland*), Romualdas Šopoka (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*) / **11**

Evolution of the weevil rostrum (Coleoptera: Curculionoidea): internal structure and evolutionary trends. By Steve R. Davis (*Natural History Museum, University of Kansas, USA*) / **13**

Global issues of biodiversity. By Greta Pastorino, Alex Borrini (*Genoa University, Italy*) / **18**

The first discovery of the rare species *Enteucha acetosae* (Lepidoptera, Nepticulidae) in the Kurtuvėnai Regional Park. By Anna Patrycja Chrachol (*Wrocław University of Environmental and Life Sciences, Wrocław, Poland*), Tatjana Makėvič (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*), Agata Malecka (*Wrocław University of Environmental and Life Sciences, Wrocław, Poland*), Tautvydas Kirtiklis (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*), Jekaterina Voskresenska (*Daugavpils University, Daugavpils, Latvia*) / **21**

Recent faunistic and taxonomic studies of mining moths from the Bucculatricidae and Gracillariidae families (Lepidoptera) in Russia. By Svetlana Baryshnikova (*Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia*) / **23**

First discovery of leaf-mining Nepticulidae and Tischeriidae (Lepidoptera) associated with the Chilean endemic genus *Podanthus* Lag. (Asteraceae) as a host-plant. By Arūnas Diškus, Jonas R. Stonis (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*) & Nixon Cumbicus Torres (*Universidad Técnica Particular de Loja, Ecuador*) / **30**

Study methods of Nepticulidae: micro-mounts of genitalia structures. By Jonas Rimantas Stonis, Arūnas Diškus (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*), Andrius Remeikis (*Nature Research Centre, Vilnius, Lithuania*), Asta Navickaitė (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*) / **32**

Short review of sampling methods used in applied entomology. By Jacek Jackowski & Jacek Twardowski (*Wrocław University of Environmental and Life Sciences, Wrocław, Poland*) / **36**

***Fomoria weaveri* (Lepidoptera, Nepticulidae), an interesting Nepticulidae species in the Kurtuvėnai Regional Park (Lithuania).** By Juris Pikelis (*Daugavpils University, Daugavpils, Latvia*), Ligita Šlapelytė, Dovilė Masalskaitė (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*), Marcin Cierpisz (*Wrocław University of Environmental and Life Sciences, Wrocław, Poland*) / **41**

Some data on Macrolepidoptera from the Kurtuvėnai Regional Park. By Dalius Dapkus, Tatjana Makevič (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*) / **43**

Systematics of carpenter moths (Lepidoptera: Cossidae) and the discovery of new lepidopteran glands. By Steve R. Davis (*Snow Hall University of Kansas, USA*) / **45**

Study methods of beetles of the genus *Hylobius* and related mycobiota. By Donatas Stanionis (*Lithuanian Research Centre for Agriculture and Forestry, Institute of Forestry, Kaunas, Lithuania*) / **48**

Revised fauna of the Nepticulidae (Lepidoptera) of continental East Asia: lots of effort to elucidate the little-known diversity of pygmy moths. By Agnė Rocienė & Jonas Rimantas Stonis (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*) / **51**

How good are the ground beetles (Coleoptera, Carabidae) as indicators of biodiversity in the example of the Kurtuvėnai Regional Park, Lithuania. By Jacek Twardowski, Jacek Jackowski (*Wrocław University of Environmental and Life Sciences, Wrocław, Poland*) & Raimonds Cibuļskis (*Daugavpils University, Daugavpils, Latvia*) / **63**

The first photographic documentation and new data on *Enteucha guajavae* (Lepidoptera, Nepticulidae), a pest of guava from equatorial America. By Andrius Remeikis (*Nature Research Centre, Vilnius, Lithuania*), Jonas R. Stonis, Arūnas Diškus (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*) & Donald R. Davis (*National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA*) / **65**

Lithuanian Entomological Society: activities, challenges and prospects. By Andrius Petrašiūnas (*Lithuanian Entomological Society and Vilnius University, Vilnius, Lithuania*) / **75**

Genetic polymorphism at the cytochrome oxidase I gene: application in biosystematics of aphids. By Jurga Turčinavičienė (*Vilnius University, Vilnius, Lithuania*) / **77**

The leaf-mining Lepidoptera of Central Asia: 18-year anniversary of the first revised checklist. By Nurgozel Saparmamedova (*Toronto, Canada / formerly Institute of Zoology, Turkmenian Academy of Sciences, Asghabat, Turkmenistan*), Jonas Rimantas Stonis, Arūnas Diškus, Remigijus Noreika & Virginijus Sruoga (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*) / **78**

Fauna and biogeography of Chrysomelidae *sensu lato* (Insecta: Coleoptera) of Latvia. By Andris Bukejs (*Formerly Daugavpils University, Daugavpils, Latvia*) / **82**

Lepidopteran diversity and phylogeny: 15 years ago and now. By M. Alma Solis (*Smithsonian Institution / United States Department of Agriculture, Washington, D.C., USA*) / **85**

***Paralobesia cypripediana* (Lepidoptera, Tortricidae): a stealthy micromoth attacking *Cypripedium reginae* (Orchidaceae).** By Jean-François Landry (*Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Canada*), Marilyn H. S. Light & Michael MacConaill (*Gatineau, Québec, Canada*) / **90**

First faunistic data of the Nepticulidae fauna (Lepidoptera) of northwestern Lithuania. By Justine Zaberga, Liva Legzdina (*Daugavpils University, Daugavpils, Latvia*), Wojciech Otfinowski (*Wrocław University of Environmental and Life Sciences, Wrocław, Poland*) & Žygimantas Obelevičius (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*) / **92**

What is new and most interesting about the Nepticulidae of the Crimea and Lithuania. By Asta Navickaitė, Arūnas Diškus & Jonas Rimantas Stonis (*Lithuanian University of Educational Sciences, Vilnius, Lithuania*) / **96**

Checklist of moths and butterflies of the Czech Republic (Insecta: Lepidoptera). By Zdeněk Laštůvka & Jan Liška (*Mendel University, Brno, Czech Republic*) / **118**

The wetlands of Zeri: flora, vegetation and amphibian population of Peloso Lake (Toscany, Italy). By Alex Borrini (*Genoa University, Genoa, Italy*) / **121**

APHID (HEMIPTERA, STERNORRHYNCHA: APHIDOIDEA) FAUNA OF LITHUANIA: CURRENT STATE OF KNOWLEDGE

Rimantas Rakauskas

Vilnius University, Vilnius, Lithuania

Presently, the only comprehensive reference on the aphid fauna of Lithuania is the checklist of Lithuanian aphid species (Rakauskas *et al.,* 1992). Based on the references from 1916–1990, three hundred aphid species of ninety nine genera were listed in the checklist. Subsequent research efforts added a total of 42 species and one subspecies (Rakauskas, 2011, also references therein), enlarging the list of aphid species in Lithuania to 343 taxa. In the same year, *Aphis (Protaphis) carlinae* (Börner, 1940) was added to the list (Rakauskas *et al*., 2011). J. Danilov (2013), when carrying out his Biology Bachelor research project on root aphids, reported 19 aphid species new to Lithuanian aphid fauna: *Acaudinum* (*Acaudinum*) *centaureae* (Koch, 1854), *Anoecia (Anoecia) major* Börner, 1950, *Anoecia (Anoecia) zirnitsi* Mordvilko, 1931, *Aphis* (*Aphis*) *etiolata* Stroyan, 1952, *Aphis* (*Aphis*) *jacobaeae* Schrank, 1801, *Aphis* (*Aphis*) *longini* Huculak, 1968, *Aphis* (*Aphis*) *pilosellae* (Börner, 1952), *Aphis* (*Aphis*) *subviridis* (Börner, 1940), *Aphis* (*Pseudoprotaphis*) *picridicola* Holman, 1966, *Aphis (Protaphis) terricola* Rondani, 1847, *Dysaphis (Cotoneasteria) microsiphon* (Nevsky, 1929), *Forda formicaria* von Heyden, 1837, *Forda marginata* Koch, 1857, *Forda pawlowae* Mordvilko, 1901, *Protrama radicis* (Kaltenbach, 1843), *Protrama ranunculi* (del Guercio, 1909), *Tetraneura* (*Tetraneura*) *longisetosa* (Dahl, 1912), *Trama centaureae* Börner, 1940, *Trama (Neotrama) maritima* (Eastop, 1953). Due to the research projects concerning alien and invasive aphid species (supported by the Research Council of Lithuania, grants: No. LEK-10001, LEK-04/2012), *Aphis* (*Aphis*) *spiraecola* Patch was added to the list of Lithuanian fauna (Rakauskas *et al*., unpublished). In 2013, *Tuberolachnus* (*Tuberolachnus*) *salignus* (Gmelin, 1790) was collected in Lithuania for the first time (Gedminas & Rakauskas, unpublished). In conclusion, 365 aphid taxa (364 species and 1 subspecies) are to be listed presently in the aphid fauna of Lithuania. In comparison, 757 aphid species are reported in the fauna of Poland (Osiadacz & Hałaj, 2012), 382 in the fauna of Latvia (Rupais, 1989).

REFERENCES

Danilov, J. 2013. *Root aphids (Hemiptera, Sternorrhyncha: Aphidoidea) of Lithuania* (in Lithuanian). Master in Zoology Thesis. Vilnius University, Vilnius. 84 pp.

Osiadacz, B. & Hałaj, R. 2012. The Update of "Systematic Review of Aphids (Hemiptera: Sternorrhyncha: Aphidomorpha) of Poland with host plant index". *Wiadomości entomologiczne*, 31 (4): 230–241.

Rakauskas, R. 2011. Aphid species (Hemiptera, Sternorrhyncha: Aphididae) alien and invasive to Lithuania. *Aphids and other hemipterous insects*, 17: 21–27.

Rakauskas, R., Turčinavičienė, J. & Bašilova, J. 2011. How many species are there in the subgenus *Bursaphis* McVicar Baker, 1934 (Hemiptera, Sternorrhyncha: Aphididae): CO-I evidence. *European Journal of Entomology*, 108 (3): 469–479.

Rakauskas, R., Rupais, A. & Juronis, V. 1992. The Check-list of Lithuanian Aphidoidea. *New and rare for Lithuania insect species. Records and descriptions of 1992*: 83–100.

Rupais, A. 1989. *The aphids (Aphidodea) of Latvia* (in Russian). Zinatne, Rīga. 331 pp.

Rakauskas, R. 2014. Aphid (Hemiptera, Sternorrhyncha: Aphidoidea) fauna of Lithuania: current state of knowledge. *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics*. Edukologija Publishers, Vilnius. 9–10 p.

THE FIRST RECORD OF *STIGMELLA MALELLA* (LEPIDOPTERA, NEPTICULIDAE), AN APPLE TREE PEST IN KURTUVĖNAI (NW LITHUANIA)

Anna Karlsone[1], Janis Strautiņš[1], Justyna Patrycja Rudak[2], Kornelia Cypryjanska[2] & Romualdas Šopoka[3]

[1] *Daugavpils University, Latvia*

[2] *Wrocław University of Environmental and Life Sciences, Wrocław, Poland*

[3] *Lithuanian University of Educational Sciences, Vilnius, Lithuania*

INTRODUCTION

Stigmella malella (Stainton) has been included in the list of pests of cultivated plants (Kuznetzov & Puplesis, 1994). It has been determined that Nepticulidae species mine host-plants from 35 genera and 15 families (Navickaitė *et al*., *unpublished*), including Rosaceae, Salicaceae, Fagaceae and Betulaceae. Eleven species of the Lithuanian Nepticulidae mine fruit trees, including 7 species from 3 genera (*Stigmella*, *Bohemannia* and *Ectoedemia*), which in different seasons mine the leaves of domestic apple trees (*Malus domestica*) (Navickaitė *et al*., *unpublished*). Some Nepticulidae species (*Stigmella oxyacanthella*, *S. plagicolella* and *S. prunetorum*) are oligophagous leaf-miners on a few fruit tree species (Diškus & Stonis, 2012).

METHODS

Collecting methods and protocols for species identification and description are outlined in Puplesis & Diškus (2003) and Diškus & Stonis (2012).

TREATMENT

In Lithuania, *Stigmella malella* (Stainton) is a monophagous species on apple trees (*Malus domestica* Borkh.) (Fig. 1A). It is bivoltine in the Baltic States and Poland (at least in the northern regions of Poland) (Diškus & Stonis 2012). Larvae of the first generation can be found in June; larvae of the second generation mine from mid-July to September (however, according to Diškus *et al*., 2012, in September only a few larvae can be found).

The species belongs to the Euro-Submediteranean chorological group (Diškus *et al*., 2012; Navickaitė & Stonis, 2012) and is widespread almost everywhere in Europe (except some southern regions); it also occurs

in the Caucasus, though (according to Diškus & Stonis, 2012) the data on distribution of this species need to be verified.

Although the species was recorded in numerous districts of Lithuania (Klaipėda, Šilutė, Tauragė, Akmenė, Joniškis, Jurbarkas, Šakiai, Vilkaviškis, Kaunas, Kaišiadoriai, Alytus, Varėna, Trakai, Šalčininkai, Vilnius, Švenčionys and Zarasai) (Diškus *et al.*, 2012), it has never been detected in northwest Lithuania, i.e. the Šiauliai Region) (Fig. 1B).

Within the investigated region (the Kurtuvėnai Regional Park), the species is widespread. The mining was detected as very abundant (more than 40 leaf-mines on a site). Therefore, following the 'Method of Evaluation of Species Occurrence' (Diškus & Stonis, 2012; Stonis *et al., unpublished*), it could be stated that *S. malella* is a common species in the Kurtuvėnai Regional Park, a pest of *Malus domestica* (cultivated and growing in the wild).

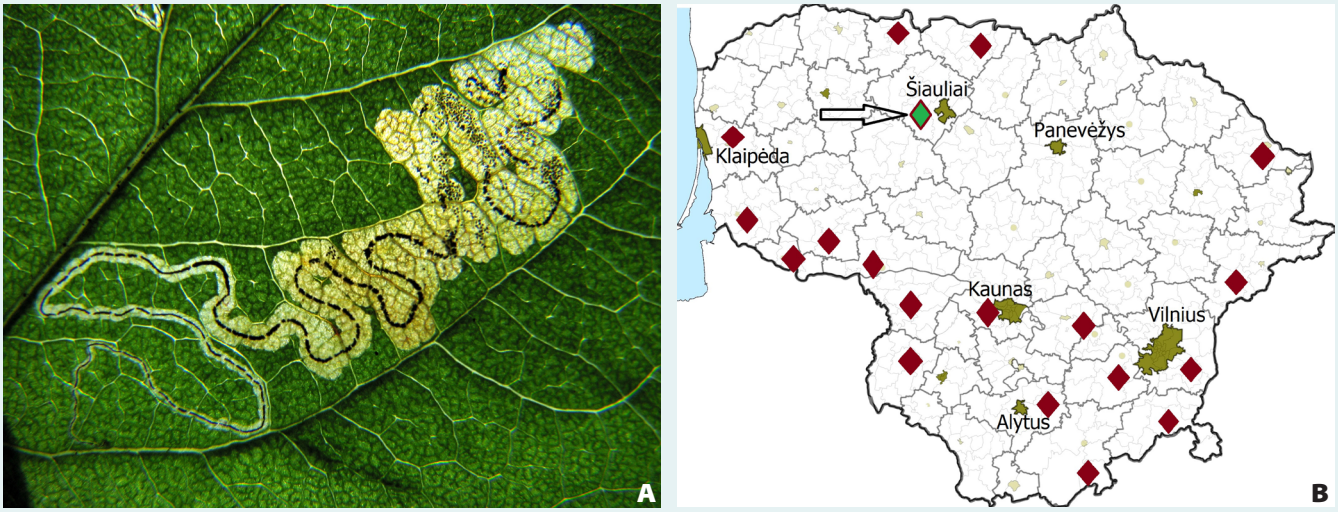

Figure 1. *Stigmella malella*: A – leaf mine on *Malus domestica* found in the Kurtuvėnai Regional Park; B – distribution in Lithuania, with a new record in the Kurtuvėnai RP, Šiauliai Region.

REFERENCES

Diškus, A. & Stonis, J. R. 2012. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 220 pp.

Diškus, A., Navickaitė, A. & Stonis, J. R. 2012. Taksonominė Lietuvos Nepticulidae sudėtis ir papildytas faunos sąvadas. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships* [in Lithuanian]. Lututė Publishers, Kaunas. 73–100 p.

Kuznetzov, V. I. & Puplesis, R. K. 1994. Sem. Nepticulidae (Stigmellidae) – moli-malyutki (in Russian). *In*: Kuznetzov, V. I. (ed.). *Nasekomye i kleshchi – vrediteli sel'skokhozyaistvennykh kul'tur.* Cheshuekrylye [*Insects and mites – pests of agricultural plants*. Lepidoptera, in Russian], 3 (1): 12–23. Nauka Publishers, St. Petersburg.

Navickaitė, A. & Stonis, J. R. 2012. Chorologinis Lietuvos Nepticulidae faunos įvertinimas. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships* [in Lithuanian]. Lututė Publishers, Kaunas. 101–111 p.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp., figs 612.

EVOLUTION OF THE WEEVIL ROSTRUM (COLEOPTERA: CURCULIONOIDEA): INTERNAL STRUCTURE AND EVOLUTIONARY TRENDS

Steve R. Davis

Department of Ecology and Evolutionary Biology, Division of Entomology, Natural History Museum, University of Kansas, USA

INTRODUCTION

Weevils (Coleoptera: Curculionoidea) are one of the most diverse groups of extant organisms, with approximately 60,000 described species. They are extremely important economically, being of great agricultural significance because they are associated with all major groups of plants and plant parts. The current classification of weevils, despite having witnessed numerous hypotheses, is still quite unstable at the higher levels and even more so at the lower levels. In order to develop a more robust morphological character system for cladistics analysis of the higher lineages and to gain a comprehensive understanding of rostrum structure prior to developmental studies examining its formation, a comparative study was conducted of rostrum structure throughout Curculionoidea. Thin sections were made of the rostra of exemplar taxa representing most of the weevil families, as well as several subfamilies within the largest family, Curculionidae, and internal structures were examined for useful characters. While the morphological diversity of rostral forms is rather astounding, general morphological trends are apparent. Internal rostral morphology also represents a valuable set of previously unexplored characters; similar to traditional external morphology, these features provide new insight into rostral morphology and have implications for settling current incongruence in the higher classification.

METHODS

Heads were placed in gelatin capsules and embedded in LR White (Electron Microscopy Sciences) following thermal curing in an oven for ~ 24 hours at 60°C, embedded heads were removed from the capsules and sectioned using a Leica EM UC6 ultratome and diamond knife, producing semi-thin sections ~ 5000–6000 nm thick. Sections were transferred to glass slides, stained in toluidine blue, and digitally photographed with a Canon EOS-1 camera mounted on an Olympus BX51 compound microscope. Regarding most photomicrographs, a z-stack was acquired of several images, combined using the software CombineZ, and edited in

Adobe Photoshop CS3. Scanning Electron Microscope (SEM) images were captured using a LEO 1550 FES-EM (Field Emission Scanning Electron Microscope). Heads were mounted on SEM stubs using Leit-C-Plast adhesive and an isopropanol-based colloidal graphite, and coating was performed using gold.

Semi-thin sections were produced for 12 of the 20 currently recognized, extant families within Curculionoidea, and 11 of the 16 recognized subfamilies within Curculionidae (sensu Alonso-Zarazaga & Lyal, 1999).

Preliminary phylogenetic results, displayed as a strict consensus of 126 most-parsimonious trees (fig. 3), were obtained by analyzing 196 morphological characters from 151 extant taxa in TNT (Tree analysis using new Technology; Goloboff *et al*., 2003).

RESULTS

In most extant Curculionoidea, in which the rostrum is fairly curved, most mouthpart tendons are situated in cuticular canals that guide and facilitate their sliding action (Figs 1, 2). The canals for the larger mandibular tendons, naturally, are quite deep, and constitute apodemes formed by the occipital sulci. In weevils that possess distinct subgenal sulci, separate phragma are present for supporting the maxillary tendons. In most higher weevils, such as Curculionidae, the occipital sulci have merged with the subgenal sulci, and the apodemes of the subgenal sulci apparently have formed a bridge connecting the apodemes of the occipital sulci (which support the mandibular tendons). The tendons of the maxilla, then, rest in canals on this bridge. Nearing attachment to the mouthparts, as was the case at the base of the rostrum, the tendons take a more central position in the rostral cavity, eventually arriving adjacent to and partially enclosed by the pharyngeal bracons. Also at the apex, the pharynx widens, the pharyngeal bracons become more visible, and the posterior extensions of the mentum, which facilitate in guiding the mandibular tendons, are visible.

DISCUSSION

Aside from differences in the basal gular region of the head, the most notable changes in rostrum evolution within Curculionoidea appear to lie in orientation of the ventral sulci (occipital and subgenal) and location and degree of development of the internal apodemes/canals that usually are denoted by these sulci (Fig. 3). Apically, most Curculionoidea (excluding Scolytidae and Platypodidae) possess an internal, X-shaped scaffold extending from the postmentum that supports the mandibular adductor tendons and the beginning of the pharynx. In all weevils, the occipital sulcus is present apico-laterally, supporting the abductor tendons. In the lower weevils (all families except Curculionidae), the occipital sulcus is positioned more laterally on the rostrum, which is apparent from the lateral apodemes that support the mandibular adductor and abductor tendons. In the higher Curculionoidea (Curculionidae *s. l.*), the occipital sulci have migrated ventrally and the subgenal sulci appear largely internalized and invisible externally, often forming a bridge between the apodemes of the occipital sulci.

Due to the absence of a rostrum in Scolytidae and Platypodidae, any evidence of internal apodemes seems to have also disappeared. Examination of the internal, pre-ocular region of the head in these groups, therefore, although appearing little informative in elucidating their phylogenetic placements, requires further study in different taxa. Despite these problems, internal rostrum structure does seem to provide

further support for Curculionidae *s. l.* Following further sampling, the structural differences seen in the internal rostral phragma may be informative of classificatory groupings within Curculionidae.

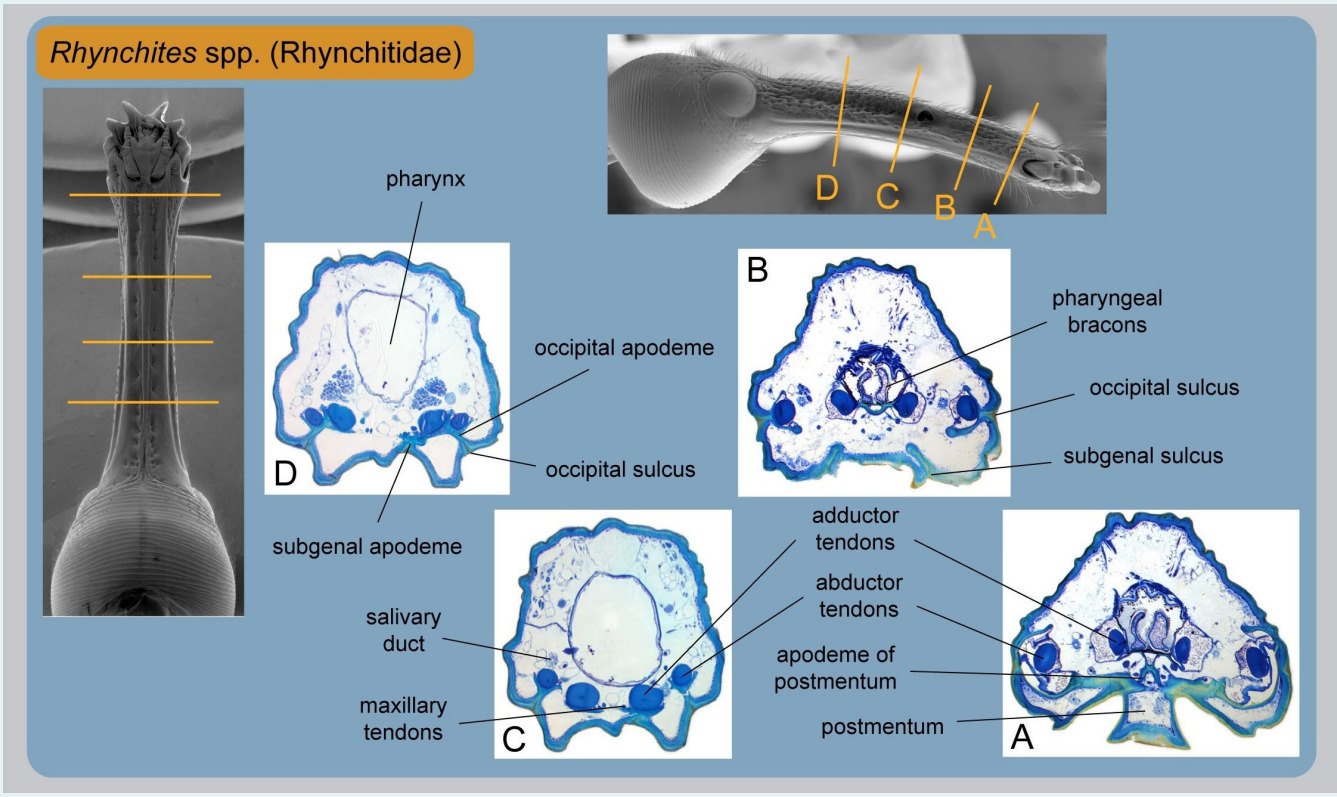

Figure 1. Rostrum of Rhynchitidae.

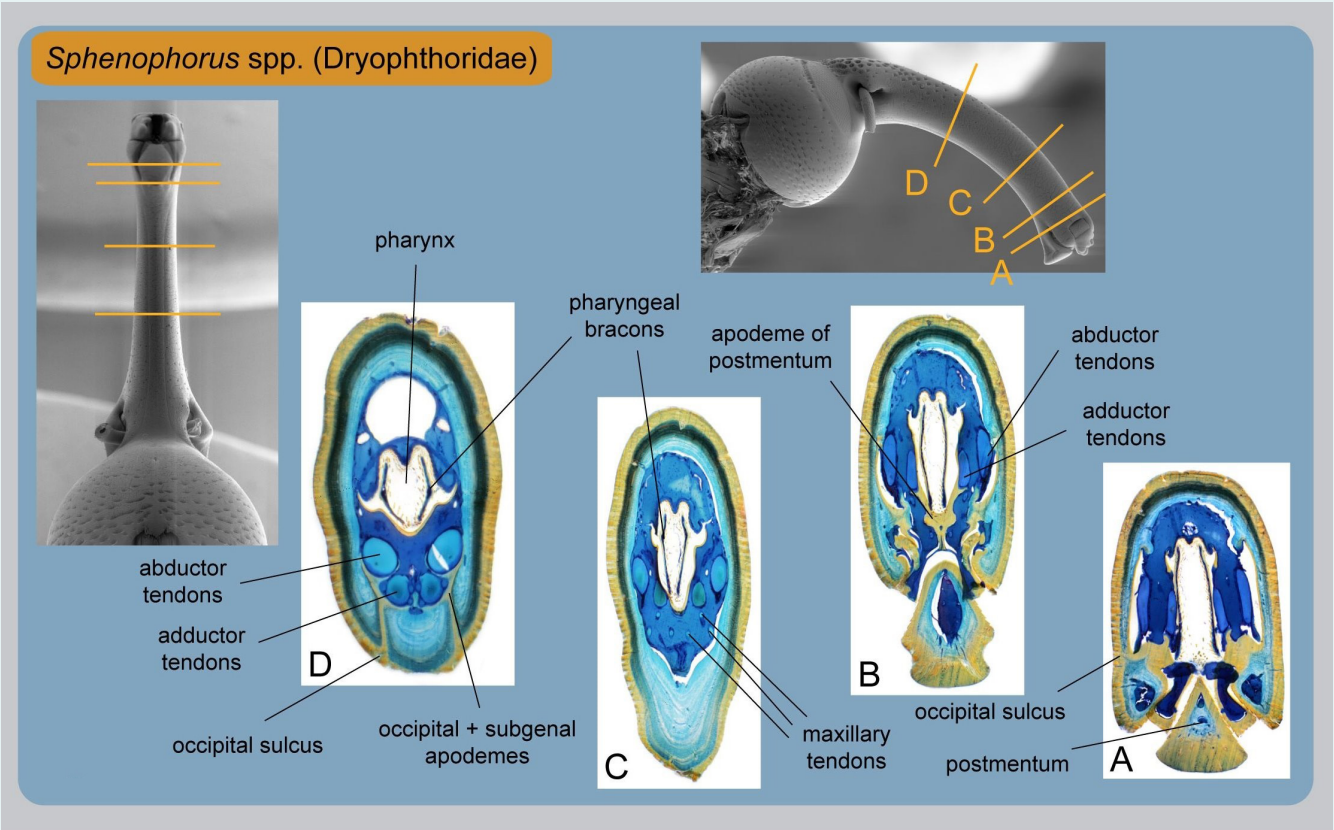

Figure 2. Rostrum of Dryophthoridae.

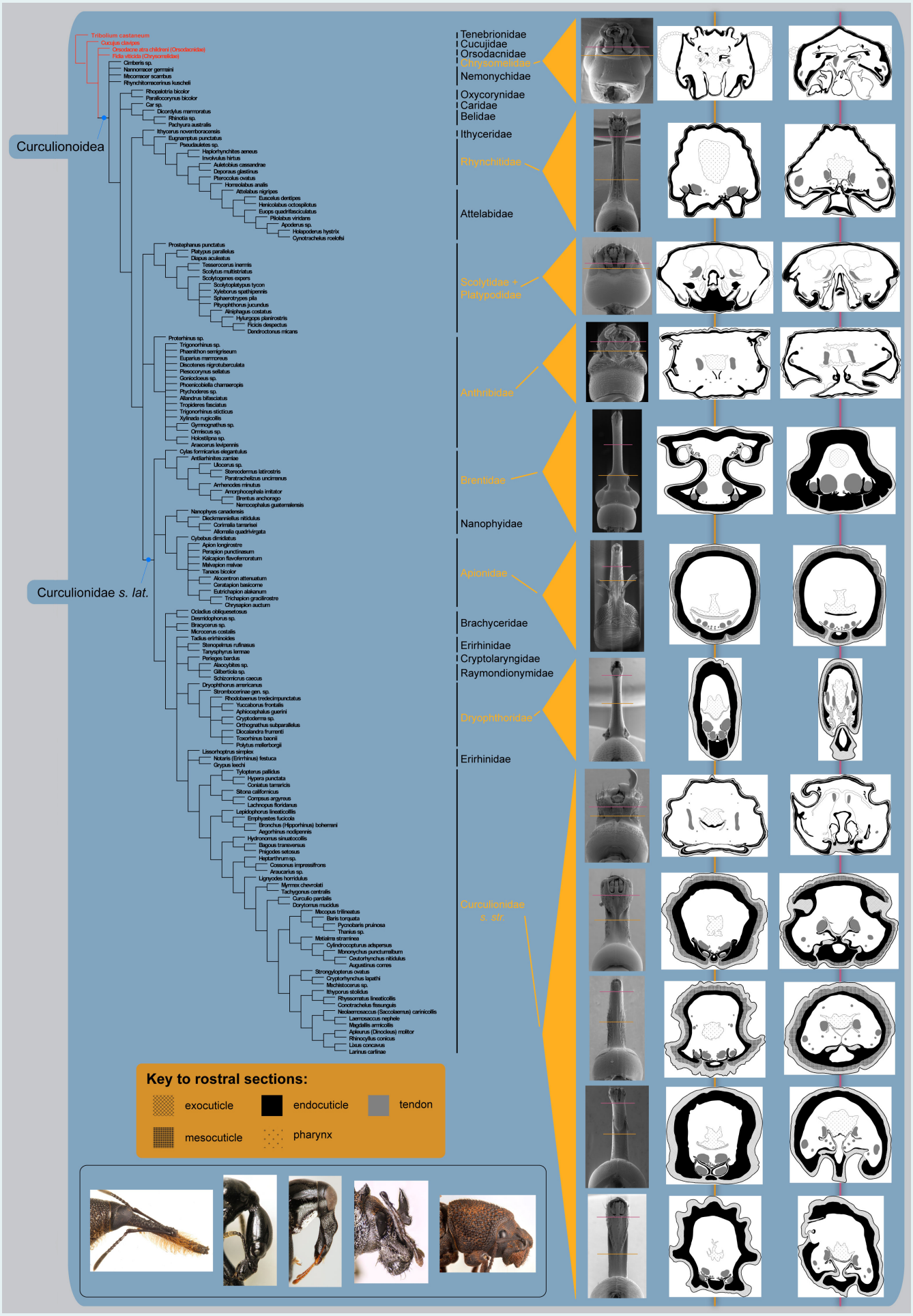

Figure 3. Preliminary phylogenetic results, displayed as a strict consensus of 126 most-parsimonious trees, were obtained by analyzing 196 morphological characters from 151 extant taxa in TNT.

ACKNOWLEDGEMENTS

Much appreciation is given to the assistance and support of the staff at the University of Kansas of Kansas Microscopy and Analytical Imaging Laboratory throughout much of this project and particularly during thin sectioning, staining, and all types of imaging. Partial funding for microscopy was supplied by a Panorama Grant from the KU Biodiversity Institute and a Sigma Xi Grant-In-Aid of Research (Grant ID#G200810150607), and NSF DEB-1110590 (to M. S. Engel, P. Cartwright, and S. R. Davis). Grants from the KU EEB Department and KU Entomology Endowment assisted in financing travel. I am grateful to my advisor, Dr. M. S. Engel, for all of his support and guidance at every step.

REFERENCES

Alonso-Zarazaga, M. A. & Lyal, C. H. C. 1999. *A world catalogue of families and genera of Curculionoidea (Insecta: Coleoptera) (Excepting Scolytidae and Platypodidae)*. Entomopraxis, Barcelona. 315 pp.

Goloboff, P., Farris, J., Källersjö, M., Oxelmann, B., Ramírez, M. & Szumik, C. 2003. Improvements to resampling measures of group support. *Cladistics*, 19 (4): 324–332.

GLOBAL ISSUES OF BIODIVERSITY

Greta Pastorino & Alex Borrini

Genoa University, Italy

Definition of global biodiversity: 1) The variety of organisms on Earth, including the variety within and between species, within and between ecosystems and genetic variation of different organisms; 2) The current and overall result of biological evolution on Earth.

Importance of biodiversity. Biodiversity is important for environment and humans through ecosystem services and goods (de Groot *et al.*, 2002). Ecosystem services include: regulating services such as air and water purification; providing services (goods) such as fuel and food; cultural services such as natural parks, reserves; supporting services such as pollination and nutrient cycling, etc.

Extent of global biodiversity. Currently around 1.9 million extant species are believed to have been described (Chapman, 2009) (Table 1). However the total number of species for some taxa may be much higher: 10 million of insects, 5 million of bacteria, 1.5 million of fungi, ~1 million of mites (Hawksworth, 2001). In 1982 T. Erwin published an estimate of global species richness of 30 million by extrapolating from the number of beetles species found on a single tropical tree (Erwin, 1982). On one species of tree, Erwin identified 1,200 beetle species, of which he estimated 163 were found only on that species of tree. Given the 50,000 described tropical tree species, Erwin (1982) suggested that there are almost 10 million beetle species in the tropics.

Global biodiversity is affected by speciation and extinction. The background extinction rate varies among taxa but it is estimated that there is approximately one extinction per million species years. Biodiversity has grown and decreased in Earth's past due to (presumably) abiotic factors such as geologically rapid changes in climate. Climate change 299 million years ago was one such event. A cooling and drying resulted in catastrophic rainforest collapse and subsequently a great loss of diversity, especially of amphibians (Sahney *et al.*, 2010).

Measuring biodiversity. Biodiversity is usually described as the richness of a geographic area, with some reference to a temporal scale. Types of biodiversity include: taxonomic diversity, species diversity, ecological diversity, morphological diversity and genetic diversity.

Evaluation of biodiversity. Some methods to evaluate biodiversity: remote sensing; Geographic Information Systems (GIS); local ecological knowledge; transect and point sampling, etc.

Table 1. Described and estimated species number (after Chapman, 2009).

GROUP	DESCRIBED	GLOBAL ESTIMATE
Mammals	5,487	5,500
Birds	9,990	>10,000
Reptiles	8,734	10,000
Amphibians	6,515	15,000
Fish	31,153	40,000
Agnatha	116	unknown
Cephalochordata	33	unknown
Tunicata	2,760	unknown
Invertebrates	1,359,365	6,755,830
Plants	310,129	390,800
Fungi/Lichens	99,998	1,500,000
Others	66,307	2,600,500
TOTAL (including taxa not listed in the Table 1)	1,899,587	11,327,630

The variability of biodiversity on Earth. Latitude: with the same water sources, biodiversity is higher where solar radiation is more intensive. Ecological factors: the oldest biological communities are generally more diversified; diversity is lower in historically less-stable environments, higher in the oldest and most stable environments. Climatic factors: a stable climate promotes diversity. Productivity: greater productivity brings greater diversity. Spatial heterogeneity: the more complex the environment, the more diverse is the biological community. Predation and competition: competition for ecological niches between nearby species can affect biodiversity. Insularity and distance: islands' diversity is generally lower and tends to decrease with increasing distance from the mainland.

Biodiversity hotspots. The 34 hotspots identified by Conservation International cover 2.3% of the Earth's land surface, yet more than 50% of the world's plant species and 42% of all terrestrial vertebrate species are endemic to these areas (Mittermeier *et al.*, 2004). All these hotspots are threatened by human activities.

Functional biodiversity. Not all species occuring in an ecosystem have equal importance in the sense that the presence of some of them can have an ecological significance far superior to those of others ('Key-species' hypothesis, i.e. some species are more important than the other; 'Uniqueness of the species' hypothesis).

Biodiversity decline. The current rate and magnitude of extinctions is much higher than background estimates. This, considered by some to be leading to the sixth mass extinction (Barnosky *et al*., 2011), is a result of human impacts on the environment. Causes: habitat change, over-exploitation, pollution; invasive species, climate change, genetic manipulations, etc.

Solutions. Establishment of a system of protected areas. The Protocol 'Specially Protected Areas and Biological Diversity in the Mediterranean' (Barcelona, 1995) states that parties shall take the necessary measures to protect, preserve and manage in a sustainable manner and in environmentally compatible areas of special natural and cultural value, particularly by means of specially protected areas. It also states that they should draw up lists of flora and fauna reliable and useful for the analysis of biodiversity *in situ* and for comparisons with other protected areas. Other solutions include education and information for teaching purposes and scientific management, environmental protection, monitoring, impact assessment and scientific communication.

REFERENCES

Barnosky, A. D., Matzke, N., Tomiya, S., Wogan, G. O. U., Swartz, B., Quental, T. B., Marshall, C., McGuire, J. L., Lindsey, E. L., Maguire, K. C., Mersey, B. & Ferrer, E. A. 2011. Has the Earth's sixth mass extinction already arrived? *Nature*, 471 (7336): 51–57. doi:10.1038/nature09678.

Chapman, A. D. 2009. *Numbers of Living Species in Australia and the World* (PDF) (2nd ed.). Canberra: Australian Biological Resources Study. 80 pp.

Erwin, T. L. 1982. Tropical forests: their richness in Coleoptera and other Arthropod species. *The Coleopterists Bulletin*, 36 (1): 74–75.

Groot de, R. S., Wilson, M. A. & Boumans, R. M. J. 2002. A typology for the classification, and description and valuation of ecosystem functions, goods and services. *Ecological Economics*, 41 (3): 393–408. doi:10.1016/s0921-8009(02)00089-7.

Hawksworth, D. L. 2001. The magnitude of fungal diversity: the 1.5 million species estimate revisited. *Mycological Research*, 105: 1422–1432.

Mittermeier, R. A., Robles-Gil, P., Hoffmann, M., Pilgrim, J. D., Brooks, T., Mittermeier, C. G., Lamoreux, J. & da Fonseca, G. A. B. 2004. *Hotspots revisited: Earth's biological rischest and most endangered terrestrial ecoregions*. CEMEX, Monterrey; Conservation International, Washington D.C.; Agrupación Sierra Madre, Mexico.

Sahney, S., Benton, M. J. & Falcon-Lang, H. J. 2010. Rainforest collapse triggered Pennsylvanian tetrapod diversification in Euramerica. *Geology*, 38 (12): 1079–1082. doi:10.1130/G31182.1.

THE FIRST DISCOVERY OF THE RARE SPECIES *ENTEUCHA ACETOSAE* (LEPIDOPTERA, NEPTICULIDAE) IN THE KURTUVĖNAI REGIONAL PARK

Anna Patrycja Chrachol[1], Tatjana Makėvič[2], Agata Malecka[1], Tautvydas Kirtiklis[2], Jekaterina Voskresenska[3]

[1] *Wrocław University of Environmental and Life Sciences, Wrocław, Poland*

[2] *Lithuanian University of Educational Sciences, Vilnius, Lithuania*

[3] *Daugavpils University, Daugavpils, Latvia*

INTRODUCTION

The object of our research is one of the most important taxonomic groups of micro-moths, whose larvae are greatly specialized plant-miners (Ivinskis *et al*., 1985). Because of stenophagy, sedentary lifestyle and a high rate of endemism, Nepticulidae (or pygmy moths) occur in almost all terrestrial ecosystems and could serve as a perfect tool for characterizing the richness of biotas under investigation (Diškus & Stonis, 2012; Stonis, 2014). However, research data concerning these insects, which are both of practical and theoretical importance, are insufficient (Puplesis & Diškus, 2003; Stonis, 2014; Diškus, 2014).

METHODS

Collecting methods and protocols for species identification and description are outlined in Puplesis & Diškus (2003) and Diškus & Stonis (2012).

TREATMENT

The *Enteucha acetosae* (Stainton, 1854) is a strict oligophagous species. Larvae feed (mine) on leaves of common sorrel (or garden) sorrel (*Rumex acetosa* L. and *R. acetosella* L.) (Fig. 1A). On the basis of the knowledge of European fauna (Johansson *et al*., 1990), it was considered that *R. acetosella* L. is the main host-plant of *E. acetosae*, but studies in Lithuania showed that this species usually chooses *R. acetosa* instead of *R. acetosella* (Diškus *et al*., 2012).

Previously *E. acetosae* was treated as a bivoltine species (Ivinskis *et al*., 1985), but later studies suggested about three generations of *E. acetosae* in Lithuania (Diškus & Stonis, 2012). In the recent monograph on the Lithuanian Nepticulidae (Diškus & Stonis, 2012), it was stated that larvae of the second generation

could be found in the beginning of June, and then mining could be observed in the first half of October (the third generation). The generations are probably overlapping.

Our first finding of *E. acetosae* in the Kurtuvėnai Regional Park provided new data about early mining of this species in late May.

Larvae collected in late summer are ready for hibernation and will hatch from pupae only next year, but some may hatch in August of the same year.

The species is very rare in the Kurtuvėnai Regional Park. According to the 'Method of Evaluation of Species Occurrence' (Diškus & Stonis, 2012; Stonis *et al., unpublished*), not abundant mining and almost solitary finding is charateristic for *Enteucha acetosae* in the Kurtuvėnai Regional Park. Previously the species was known from the Šilutė, Šakiai, Vilkaviškis, Ukmergė, Kaišiadoriai, Trakai, Varėna, Vilnius, Švenčionys, and Zarasai Districts (Fig. 1B). In all these localtities the species is rare (Diškus *et al*., 2012). The causes of this highly restricted distribution remains unknown.

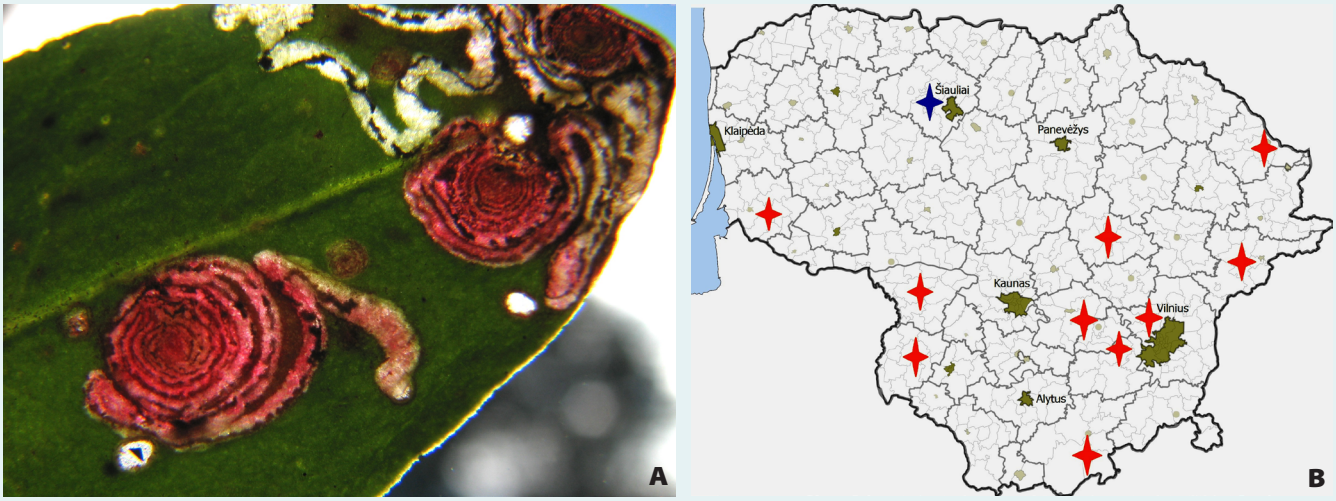

Figure 1. *Enteucha acetosae*: A – sample of leaf-mines collected in the Kurtuvėnai Regional Park; B – currently known distribution of *Enteucha acetosae* in Lithuania, with new a record in the Kurtuvėnai RP, Šiauliai Region.

REFERENCES

Diškus, A. 2014. Small insects, global issues. *Taxonomy for understanding biodiversity.* http://www.biotaxa.info/index.php (accessed on January 25, 2014)

Diškus, A. & Stonis, J. R. 2012. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 220 pp.

Diškus, A., Navickaitė, A. & Stonis, J. R. 2012. Taksonominė Lietuvos Nepticulidae sudėtis ir papildytas faunos sąvadas. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships* [in Lithuanian]. Lututė Publishers, Kaunas. 73–100 p.

Ivinskis, P., Pakalniškis, S. & Puplesis, R. 1985. *Augalus minuojantys vabzdžiai.* Mokslas, Vilnius. 240 pp.

Johansson, R., Nielsen, E. S., Nieukerken, E. J. van & Gustafsson, B. 1990. The Nepticulidae and Opostegidae (Lepidoptera) of north west Europe. *Fauna Entomologica Scandinavica*, 23 (1/2), 1–739.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp., figs 612.

Stainton, H. T. 1854. *Insecta Britannica. Lepidoptera: Tineina.* Lovell Reeve, London. i–viii + 313 pp., pls 10.

Stonis, J. R. 2014. Small insects, global issues. *Taxonomy for understanding biodiversity.* http://biotaxonomy.eu/index.php (accessed on January 25, 2014)

RECENT FAUNISTIC AND TAXONOMIC STUDIES OF MINING MOTHS FROM THE BUCCULATRICIDAE AND GRACILLARIIDAE FAMILIES (LEPIDOPTERA) IN RUSSIA

Svetlana Baryshnikova

Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia

ABSTRACT

The results of long-term faunistic and taxonomic studies of mining moths from families Bucculatricidae and Gracillariidae with special emphasis on data new to the Baltic Region are presented.

INTRODUCTION

Investigation of biodiversity and elaboration of methods for its assessment and ways for its maintenance are basic scientific tasks. Studies within the framework of the solution of this problem run in several main directions, including the inventory of local and regional faunas and compilation of taxonomical catalogues as well as generation of taxonomic revisions and identification keys of living organisms. This is especially true regarding the extremely numerous and diversified groups of smaller animals and, in particular, for lepidopterans. Faunistic and taxonomic studies developed by the author mainly concern tineoid and gracillarioid microlepidopterans.

RESULTS

The data on the fauna of Lepidoptera of Russia, including those for the families Bucculatricidae (1 genus, 49 species) and Gracillariidae (29 genera, 233 species) have been summarized for 40 regions in the Catalogue of the Lepidoptera of Russia (ed. S. Yu. Sinev) published in 2008 (Baryshnikova, 2008a, 2008b). As a result, many Russian regions were provided with faunistic lists for the first time.

The author's recent activity on the identification of collections by many entomologists as well as examination of published sources, including those on the applied entomology, markedly supplemented the data contained in the Catalogue. In addition, several new species have been described. It should be mentioned that the principal contribution to the knowledge of moths of the Baltic Region has come from new findings by zoologist A. P Shapoval (ZIN, St. Petersburg) collecting lepidopterans in the Russian part of Curonian

Spit. Most of his material has been recently included in a list of Microlepidoptera species of the Curonian Spit (Sinev & Shapoval, 2013).

THE LIST OF NEW FINDINGS FOR RUSSIA

(taxonomy and designations of geographical regions follow the aforementioned Catalogue)

Species new to science

Fam. Bucculatricidae

Bucculatrix pectinifera Baryshnikova, 2007, described from the Jewish Autonomus Province in the Far East of Russia (Fig. 1A), being closely related to *B. pectinella* Deschka, 1981 and belonging to the same taxonomic group.

Bucculatrix malivorella Baryshnikova, 2007, described from Middle Asia and Kazakhstan (Fig. 1B, C), and, most probably, expected to be found in Russia. This species is closely related to *Bucculatrix bechsteinella* (Bechstein & Scharfenberg, 1805), revealing more difference in female characters.

Bucculatrix lovtsovae Baryshnikova, 2013, described from Primorskii Territory (Baryshnikova, 2013b) (Fig. 1D). This unique species of the genus is characterized by asymmetrical male genitalia and exhibits morphological relationships with *Bucculatrix rhamniella* Herich-Schäffer, 1855 and *B. albedinella* (Zeller, 1839).

Fam. Gracillariidae

Caloptilia dubatolovi Baryshnikova, 2007, described from Bolshekhekhtsyrskii Nature Reserve in environs of Khabarovsk in the Far East of Russia (Fig. 1E), which was tentatively referred to the genus *Caloptilia*.

Species new to the fauna of Russia

Bucculatrix tsurubamella Kobayashi, Hirowatari & Kuroko, 2010. Primorskii Territory.

Bucculatrix muraseae Kobayashi, Hirowatari & Kuroko, 2010. Primorskii Territory.

Parectopa robiniella Clemens, 1863. Krasnodar, West-Caucasian region (reported in the Internet publication by Gninenko *et al*., 2010).

Macrosaccus robiniella (Clemens, 1859). Krasnodar, West-Caucasian region (reported in the Internet publication by Gninenko *et al*., 2010).

Phyllocnistis citrella Stainton, 1856. Sochi, West-Caucasian region (Ignatova, 2009).

Species new to Russian regions (including the records from the Russian part of the Curonian Spit in the Kaliningrad Province and from St. Petersburg)

Fam. Bucculatricidae

Bucculatrix artemisiella Herrich-Schäffer, 1855. Omsk Province, South West-Siberian region.

Bucculatrix bechsteinella (Bechstein et Scharfenberg, 1805), Sverdlovskaya Province, Middle Ural region.

Bucculatrix humiliella Herrich-Schäffer, 1855. Buryatia, Baikal region.

Bucculatrix maritima Stainton, 1851. Omsk Province, South West-Siberian region.

Fam. Gracillariidae

Subfam. Gracillariinae

Parectopa ononidis (Zeller, 1839). Curonian Spit, Kaliningrad region.

Micrurapteryx gradatella (Herrich-Schäffer, 1855) Sverdlovskaya Province, Middle Ural region.

Micrurapteryx gerasimovi Ermolaev, 1989. Buryatia, Baikal region.

Caloptilia aceris Kumata, 1966. Amur Province, Middle-Amur region.

Caloptilia betulicola (M. Hering, 1928). Kemerovo Province, Cis-Altai region.

Caloptilia elongella (Linnaeus, 1761). Curonian Spit, Kaliningrad region, Omsk Province, South West-Siberian region.

Caloptilia hemidactylella (Denis et Schiffermüller, [1775]). St. Petersburg, European Northwestern region.

Caloptilia schisandrae Kumata, 1966. Amur Province, Middle-Amur region.

Caloptilia stigmatella (Fabricius, 1781). Curonian Spit, Kaliningrad region, Kemerovo Province, Cis-Altai region.

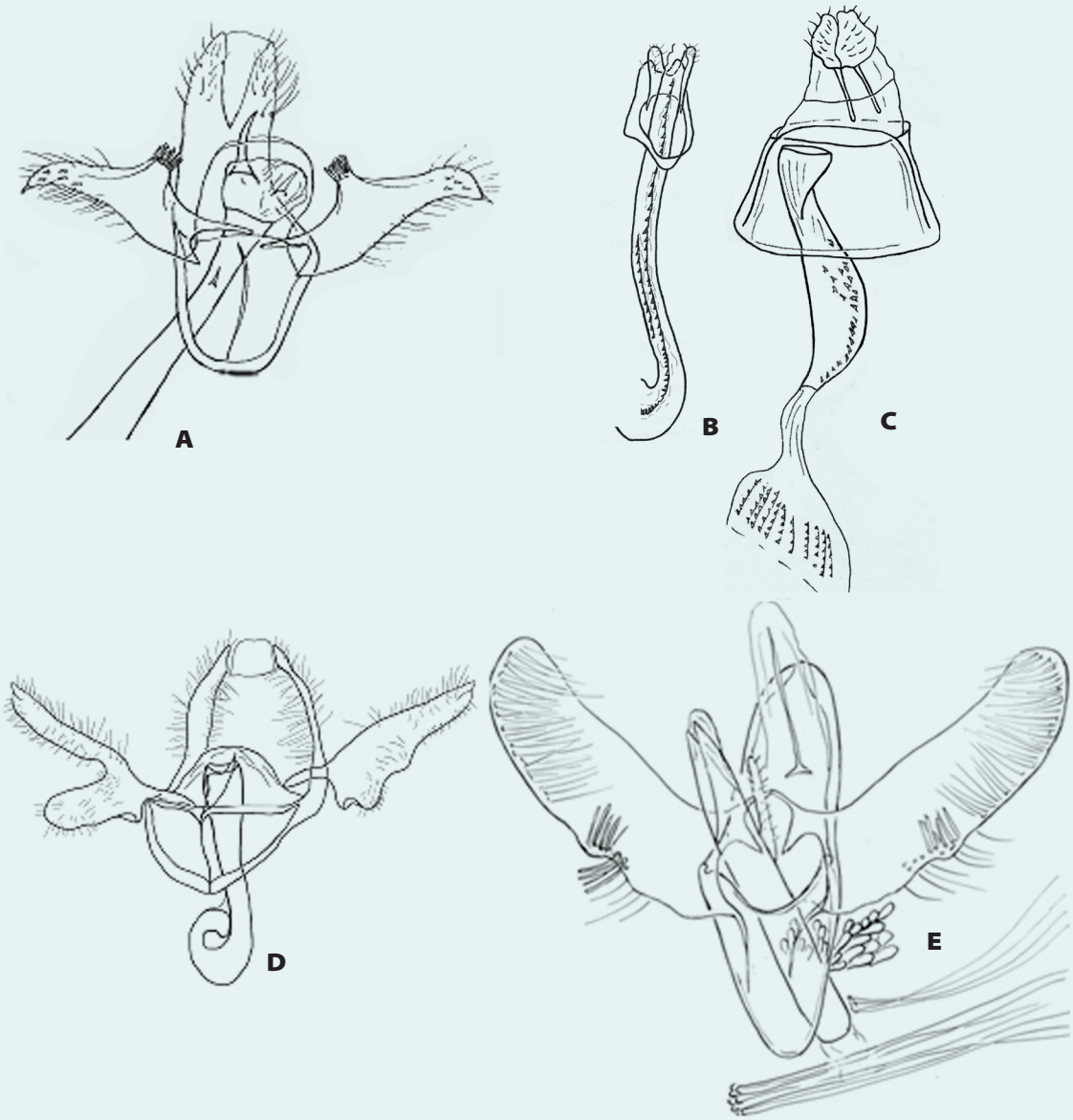

Figure 1. Bucculatricidae and Gracillariidae, genitalia of recently described species: A – *Bucculatrix pectinifera* Baryshnikova, 2007, male; B – *B. malivorella*, Baryshnikova, 2007, male; C – *B. malivorella*, Baryshnikova, 2007, female; D – *B. lovtsovae* Baryshnikova, 2013, male; E – *Caloptilia dubatolovi*, Baryshnikova, 2007, male.

Gracillaria syringella (Fabricius, 1794). Omsk Province, South West-Siberian region.
Calybites phasianipennella (Hübner, [1813]). Curonian Spit, Kaliningrad region, Omsk Province, South West-Siberian region, Buryatia, Baikal region.
Euspilapteryx auroguttella (Stephens, 1835). Curonian Spit, Kaliningrad region, Bashkir Republic, Orenburg province, Southern Ural region.
Acrocercops brongniardella (Fabricius, 1798). Curonian Spit, Kaliningrad region, Bashkir Republic, Southern Ural region.
Dialectica imperialella (Zeller, 1847). Kemerovo Province, Cis-Altai region.
Subfam. Ornixolinae
Ornixola caudulatella (Zeller, 1839). Omsk Province, South West-Siberian region.
Subfam. Orniginae
Callisto coffeella (Zetterstedt, 1835). Khanty-Mansi Autonomous District, Northern Ural region.
Parornix devoniella Stainton, 1850. Curonian Spit, Kaliningrad region, Omsk, South West-Siberian region.
Parornix scoticella (Stainton, 1850). Curonian Spit, Kaliningrad region.
Subfam. Lithocolletinae
Cameraria ochridella Deschka et Dimič, 1986. Curonian Spit, Kaliningrad region, St. Petersburg, European Northwestern region, Krasnodar, West-Caucasian region (reported in Internet publication by Gninenko *et al*., 2010).
Phyllonorycter apparella (Herrich-Schäffer, 1855). Curonian Spit, Kaliningrad region, Sverdlovskaya Province, Middle Ural region.

The results of long-term studies of taxonomy, phylogeny, biology and distribution of Bucculatricidae were represented in 2013, in the survey 'Bucculatricid moths (Lepidoptera Bucculatricidae) of the fauna of Russia and adjacent territories' which appeared in the series 'Keys to the fauna of Russia' published by the Zoological Institute of the Russian Academy of Sciences (Baryshnikova, 2013a). The identification key involves 56 species. Some species reveal a great morphological similarity, forming pairs or even the groups of hardly distinguishable (cryptic) species. Notably, females frequently provide more pronounced characters for the species segregation (Figs 2, 3).

As a result of a study of taxonomic structure of subfamily Lithocolletinae, a review of *Phyllonoryter* species associated with oaks has been published (Baryshnikova, 2012), involving a new determination key for 20 species of the Russian fauna as well as characteristics and composition of 13 species-groups proposed on the basis of comparative morphological analysis of male genitalia in Palaearctic species. The necessity of compiling the new determination key was generated by the impossibility to determine all species from the territory of Russia using the keys available for the faunas of the European part of the former USSR (Kuznetzov, 1981) and the Far East (Noreika, 1997). The first consists of a number of identification keys for species belonging to certain ecological groups and the second, in spite of representing the united key, embraces only regional fauna. At the same time, many species of the genus *Phyllonorycter* reveal economical importance; this shows that a need often arises to identify moths from various regions.

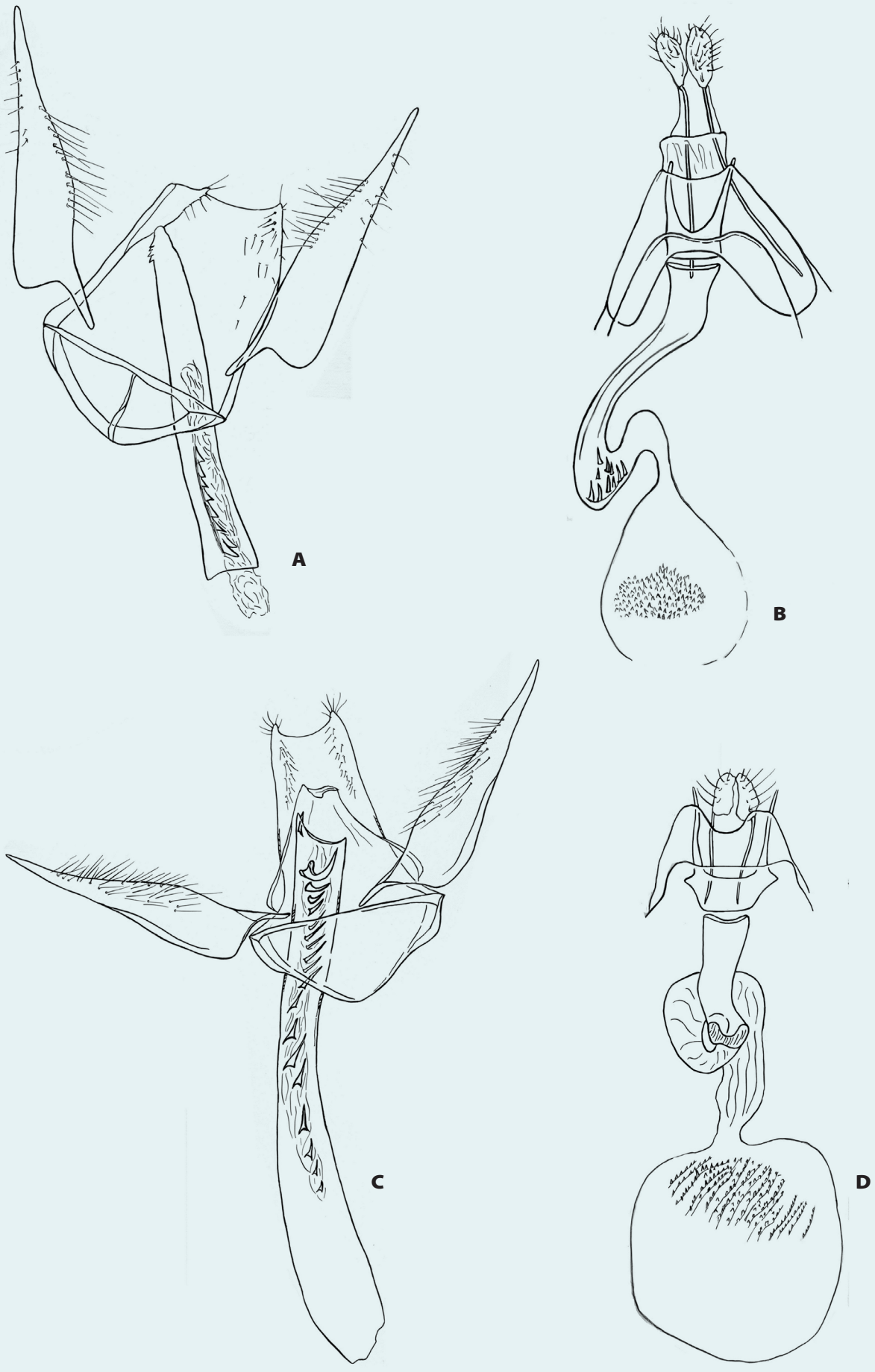

Figure 2. *Bucculatrix* Z. (Bucculatricidae), male and female genitalia: A – *B. albedinella* (Z.), male; B – *albedinella* (Z.), female; C – B. *altera* Seksjaeva, male; D – *B. altera* Seksjaeva, female.

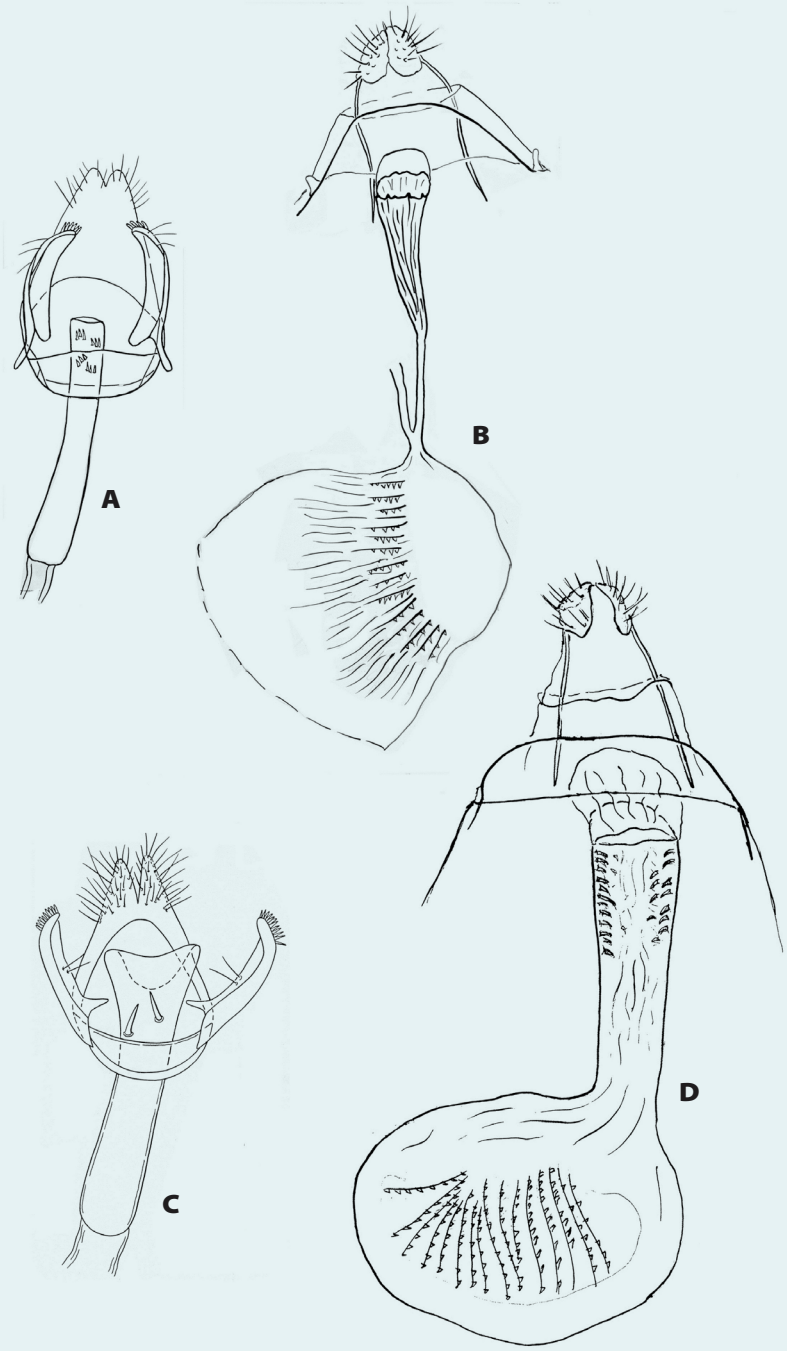

Figure 3. *Bucculatrix Z.*, male and female genitalia: A – *B. citima* Seksjaeva, male; B – *B. citima* Seksjaeva, female; C – *B. frangutella* (Goeze), male; D – *B. frangutella* (Goeze), female.

CONCLUSION

A contribution to the taxonomical research and to the identification of the representatives of poorly investigated regional faunas has been provided for mining moths from families Bucculatricidae and Gracillariidae (Lepidoptera).

ACKNOWLEDGMENTS

The study was financially supported by the Russian Foundation for Basic Research (project no. 14-04-00770) and the program of the Presidium of Russian Academy of Sciences 'Living nature: present-day state and problems of development'.

REFERENCES

Baryshnikova, S. V. 2007a. New species of bucculatricid moths (Lepidoptera, Bucculatricidae) from Eastern Palaearctic. *Zoosystematica Rossica*, 16 (2): 285–288.

Baryshnikova, S. V. 2007b. *Caloptilia dubatolovi* sp. n. from the Russian Far East (Lepidoptera, Gracillariidae). *Zoosystematica Rosica*, 16 (1): 125–126.

Baryshnikova, S. V. 2008a. Fam. Bucculatricidae. *In*: Sinev S. Yu. (ed.). *Catalogue of the Lepidoptera of Russia*. KMK Scientific Press Ltd., St. Petersburg-Moscow. 37–38 p.

Baryshnikova, S. V. 2008b. Fam. Gracillariidae. *In*: Sinev S. Yu. (ed.). *Catalogue of the Lepidoptera of Russia*. KMK Scientific Press Ltd., St. Petersburg-Moscow. 38–45 p.

Baryshnikova, S. V. 2012. A review of the ecological grouping of species of the genus *Phyllonorycter* Hübner, [1822] (Lepidoptera, Gracillariidae: Lithocolletinae), associated with Fagaceae [in Russian]. *Entomologicheskoe Obozrenie,* 91 (1): 106–130.

Baryshnikova, S. V. 2013a. *Buculatricid moths (Lepidoptera Bucculatricidae) of the fauna of Russia and adjacent territories*, in *Keys to the fauna of Russia published by the Zoological Institute of the Russian Academy of Sciences,* 175 [in Russian]. KMK Scientific Press Ltd., St. Petersburg-Moscow.

Baryshnikova, S. V. 2013b. A new remarkable species of the genus *Bucculatrix* (Lepidoptera: Bucculatricidae) from the Primorsky Territory (Russian Far East). *Zoosystematica Rossica*, 22 (1): 111–113.

Ignatova, E. A. 2009. The citrus leafminer in subtropics of Russian federation, Nauchnye trudy [in Russian]. *Vserossiiskii nauchno-issledovatel'skii institut tsvetovodstva i subtropicheskikh kultur*, 42 (2): 260–265.

Kuznetzov, V. I. 1981. Gracillariidae – moli-pestryanki, Opredelitel' nasekomykh Evropeiskoi chasti SSSR [in Russian], 4 (2): 149–311. Nauka, Leningrad.

Noreika, R. V. 1997. Sem. Gracillariidae– moli-pestryanki [in Russian]. *In*: Ler, P. A. (ed.). *Key to the insects of Russian Far East*. Trichoptera and Lepidoptera, 5 (1): 373–429. Dal'nauka Publishers, Vladivostok.

Sinev, S. Yu. & Shapoval, A. P. 2013. To the knowledge of Microlepidoptera of the "Curonian Spit" National Park I [in Russian]. *Entomologicheskoe Obozrenie*, 92 (4): 802–822.

FIRST DISCOVERY OF LEAF-MINING NEPTICULIDAE AND TISCHERIIDAE (LEPIDOPTERA) ASSOCIATED WITH THE CHILEAN ENDEMIC GENUS *PODANTHUS* LAG. (ASTERACEAE) AS A HOST-PLANT

Arūnas Diškus[1], Jonas R. Stonis[1] & Nixon Cumbicus Torres[2]

[1] *Lithuanian University of Educational Sciences, Vilnius, Lithuania*

[2] *Departamento de Sciences Naturales, Universidad Técnica Particular de Loja, Ecuador*

In total, 121 genera and 863 species of Asteraceae are native to Chile (Moreira-Muñoz & Muñoz-Schick, 2007; Moreira-Muñoz, 2011). *Podanthus* Lag. is an endemic genus of Asteraceae (Asteroideae, Heliantheae) occurring in central Mediterranean Chile. No leaf-mining Nepticulidae or Tischeriidae have ever been recorded on *Podanthus* (Puplesis & Robinson, 2000; Stonis, 2014). Studies of reared material collected by the first author from Chile (Region Metropolitana de Santiago, Rio Clarillo) resulted in the discovery of one new species of *Stigmella* (Nepticulidae) and one previously poorly-known species *Astrotischeria chilei* Puplesis & Diškus, 2003 (Tischeriidae) (Fig. 1).

The new nepticulid species belongs to the *Stigmella salicis* group and clearly differs from all other species of the group by shape and number of cornuti in the phallus. The new species is a leaf-miner on *Podanthus ovatifolius* Lag. After the 'Formula of Evaluation of Abundance and Occurrence of Leaf-miners' (see Stonis *et al*., 2012: 52–54; Stonis *et al*., unpublished), the new leaf-miner on *Podanthus ovatifolius* is not rare in central Chile: limited in distribution but abundant (more than 20 leaf-mines recorded at a single site).

In the original description of *A. chilei* (see Puplesis & Diškus, 2003) the ink drawings and photographs of the male genitalia are very accurate but neither females nor trophical relationships of the species were known or described. New material allowed a redescription of *A. chilei*, with the first photographic documentation of the leaf-mines and female genitalia (Stonis *et al*., *in prep.*). *Astrotischeria chilei* differs from all other known *Astrotischeria* in the dorsal lobe of the valva which is narrowed in distal half but in the ventral view always appears broad; the host-plant (*Podanthus ovatifolius*) also makes this species distinctive. Larvae mine leaves in April producing specific blotch mines. After the 'Formula of Evaluation of Abundance and Occurrence of Leaf-miners' (Stonis *et al*., 2012; Stonis *et al*., unpublished), *A. chilei* is common in central Chile: limited in distribution, but extremely abundant mining.



Figure 1. Studies of leaf-mines on *Podanthus* Lag. (Asteraceae) in central Chile yielded in the discovery of one new species of *Stigmella* (Nepticulidae) and one previously poorly known species *Astrotischeria chilei* (Tischeriidae): A – leaf-mines on *Podanthus*; B – habitat in central Mediterranean Chile.

REFERENCES

Moreira-Muñoz, A. 2011. *Plant Geography of Chile*. Springer Publishers, Dordrecht, Heidelberg, London, New York. 368 pp.

Moreira-Muñoz, A. & Muñoz-Schick, M. 2007. Classification, diversity, and distribution of Chilean Asteraceae: implications for biogeography and conservation. *Diversity and Distributions*, 13: 818–828.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp.

Puplesis, R. & Robinson, G. S. 2000. A review of the Central and South American Nepticulidae (Lepidoptera) with special reference to Belize. *Bulletin of the Natural History Museum* (*Entomology*), 69 (1): 3–114.

Stonis, J. R. 2014. Small insects, global issues. *Taxonomy for understanding biodiversity*. Available from: http://biotaxonomy.eu/index.php (accessed on August 1, 2014).

Stonis, J. R., Diškus, A. & Navickaitė, A. 2012. Nepticulidae tyrimų metodai. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 38–59 p.

STUDY METHODS OF NEPTICULIDAE: MICRO-MOUNTS OF GENITALIA STRUCTURES

Jonas Rimantas Stonis[1], Arūnas Diškus[1], Andrius Remeikis[2], Asta Navickaitė[1]

[1] *Lithuanian University of Educational Sciences, Vilnius, Lithuania*

[2] *Nature Research Centre, Vilnius, Lithuania*

INTRODUCTION

In the studies on Lepidoptera, in particular Nepticulidae, description of external characters is often insufficient and mounts of genitalia have to be prepared. Nepticulidae species diagnostics most often relies on the characters of male (sometimes on the characters of female) genitalia (Fig. 2), which compared with other morphological structures are distinguished by high specificity (Puplesis & Robinson, 2000; Puplesis & Diškus, 2003). Reliable species identification and descriptions of Nepticulidae are impossible without the examination of genital structures (Diškus & Stonis, 2012). It was noticed that the male genitalia characters of Nepticulidae vary little and specific at the level of both species or higher taxonomic rank (Šimkevičiūtė *et al*., 2010; Navickaitė *et al*., 2011; Stonis *et al*., 2012b). The shape of valva, transtilla, vinculum, uncus, gnathos, phallus (especially including cornuti on vesica) are essential diagnostic characters of Nepticulidae species.

DESCRIPTION OF THE METHODS

Temporary micro-mounts of genital structures in glycerine. The stages of preparing temporary micro-mounts of genital structures are as follows. 1. Under a stereoscopic microscope with an attached background of sticky white plastic plate, using a handled minutien pin, the abdomen of the insect is snapped off by gentle movements up and down. 2. The snapped off abdomen is transferred into a test tube with a handled minutien pin steeped in glycerine; about 1 ml of potassium hydroxide (10% KOH) is dripped into the test tube using a pipette (Fig. 1B). 3. The test tube is heated on an open flame (e.g. spirit lamp) or in boiling water; the abdomen is boiled until it becomes transparent. During the boiling, the test tube should be jolted to prevent air bubbles squirting out together with the abdomen. 4. The content of the test tube is poured out into a clean small Petri dish and then, using a preparation needle, transported to an other dish with distilled or boiled water. 5. Gently moving the handled minutien pin, the abdomen is rinsed. 6. A drop of glycerine is dripped onto a clean cavity slide (with shallow depression) which is covered with a cover

slip in such a way as to leave part of the glycerine drop uncovered. 7. The rinsed mount is transported into the glycerine drop and carefully squeezed under the cover slip with the handled minutien pin; the mount should be thrust between the slide and cover slip ventral part upside; for this purpose, a stereoscopic binocular microscope with magnification of 28–56 times is used; the temporary micro-mount is examined using a study microscope with higher magnification. 8. The temporary micro-mount is stored in a supersaturated sugar solution (i.e. in sugar crystal) or in a glycerine drop (in a minute test tube or pit of plastic strip which is covered with another strip of the same kind of plastic (Puplesis, 1994).

Temporary slides in glycerine, contrary to permanent slides in Euparal, are less suitable for detailed documentation of overlapping sclerites and comparison of morphological structures. Therefore permanent mounts (slides) are necessary (Stonis *et al*., 2012a).

Permanent micro-mounts (slides) of genital structures in Euparal. The stages of preparing permanent micro-mounts of genital structures are as follows (Fig. 1A, C, D). 1. The genital armature stored in glycerine is rinsed with distilled or boiled water then transferred with a handled minutien pin into a pit (depression) of a clean cavity slide with a 30% ethanol (ethyl alcohol) solution and, under a stereoscopic microscope, separated from the abdomen. 2. After the dissection, the genital armature and the abdomen pelt are transferred into a depression of a clean cavity slide with 70% ethanol and the mount is carefully

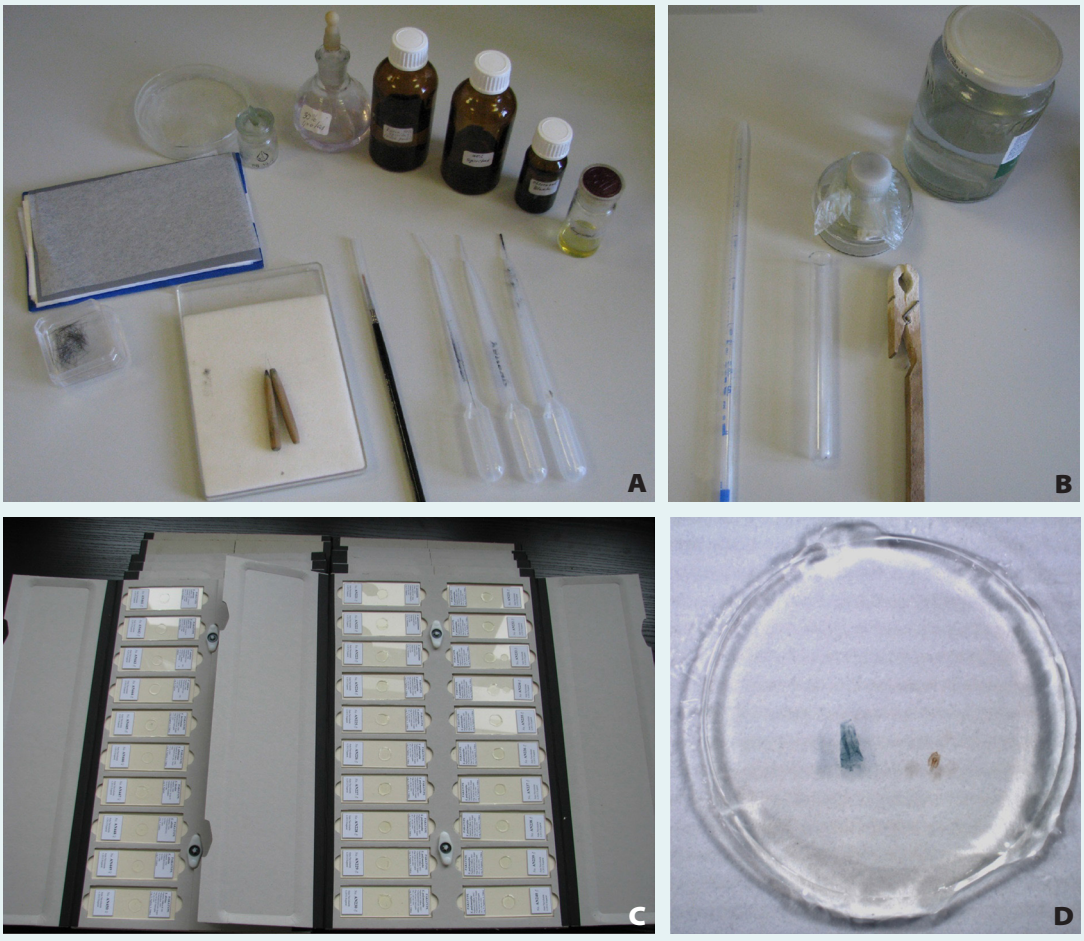

Figure 1. Preparing micro-mounts of Nepticulidae: A, B – tools and chemicals; C – slide trays with labelled permanent genitalia mounts; D – genitalia and stained abdomen pelt under cover slip in Euparal.

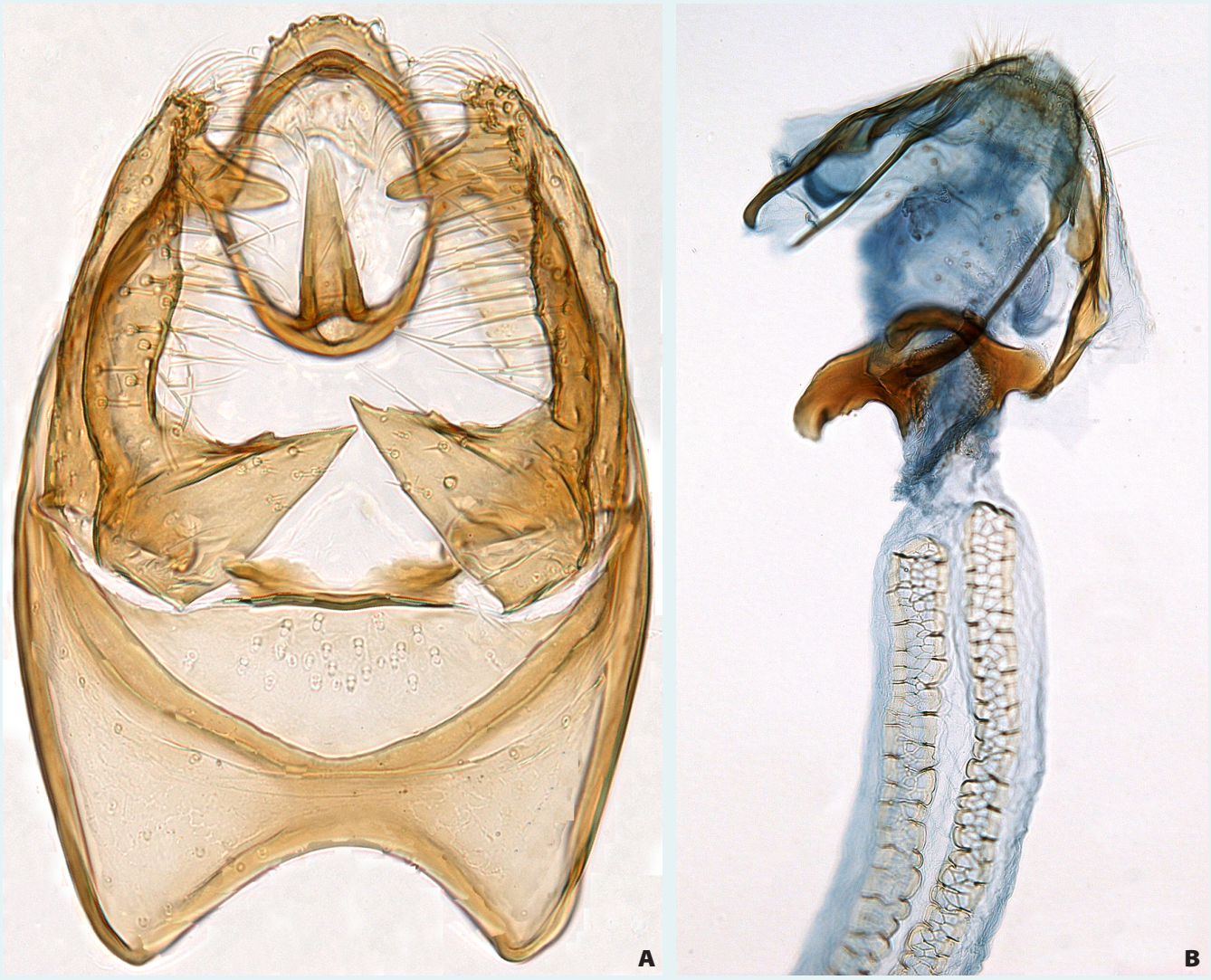

Figure 2. Permanent mounts in Euparal: A – male genitalia of *Acalyptris platani* (phallus dissected from the capsule), slide no. RA239; B – female genitalia of *A. platani,* stained with spirit solution of Chlorazol Black, slide no. RA243.

rinsed; the scales adhering to the abdomen pelt are cleaned using a very small, thin brush or(and) a very thin, sharp-pointed handled minutien pin. 3. After this partial dehydration, the genital armature and the abdomen pelt are stained with spirit solution of *Chlorazol Black*. 4. The final dehydration of the genitalia and abdomen pelt is performed: pure ethanol is dripped over the mount which then is carefully rinsed using a handled minutien pin. 5. A small drop of Euparal (if thicker than fresh honey it should be diluted with Euparal essence) is dripped on a clean slide. 6. Using a stereoscopic microscope, the genitalia and abdomen pelt are transferred into the Euparal drop and covered with a very small cover slip (Fig. 1D). The genital armature is fixed ventral part upside whereas the separate sclerites can be spread or even separated (dissected); sometimes the abdomen pelt or separated sclerites of genital apparatus (e.g. phallus dissected from the capsule) are fixed under a separate cover slip but on the same slide. 7. The mount is labelled (a paper label is tagged on the slide); each prepared permanent micro-mount must be numbered. 8. It is recommended to photograph the permanent genital mounts right after the preparation (in our study, the

genital micro-mounts were examined using *Leica DM2500* microscope and *Leica DFC420* digital camera connected with the microscope and computer); the photographs of the genital structures must be supplied with the slide numbers and species identification data. 9. Mounts (slides) are placed onto a special card or plastic slide tray (Fig. 1C) and dried for 2–3 months at room temperature or for 20 days in a heating oven (at +50°–60°) (Diškus & Stonis, 2012).

DISCUSSION

Only the temporary mount provides the possibility to observe (and photograph) the morphological structures laterally or to image morphologically interesting or diagnostically important sclerites from all sides whereas it is impossible to roll and observe or photograph laterally the permanent mount. But as the examined temporary mounts are stored in glycerine their structures are not as clearly visible as those of transparent permanent mounts (the quality of their photographs also are worse than those of permanent and highly transparent micro-mounts). Some time ago, drawings or photographs of temporary mounts alone sufficed for documentation of newly discovered species. Nowdays, all Nepticulidae species are mainly described and compared based only on permanent mounts. However, the preparation of temporary mounts preserves the natural structure of spatial genitalia of Nepticulidae, i.e. it changes little or does not change at all. Moreover, temporary mounts offer a possibility of repeated examination and documentation of the spatial characters of structures and sclerite links. For this reason, it is recommended that the initial observation and documentation of little-known (or exotic) fauna is conducted using glycerine as a mounting medium; Euparal should be used during further examination.

REFERENCES

Diškus, A. & Stonis, J. R. 2012. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships.* Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 220 pp.

Navickaitė, A., Diškus, A., Stonis, J. R. & Dobrynina, V. 2011. Taxonomic catalogue of the world Nepticuloidea and Tischerioidea (Lepidoptera) described by members of the Biosystematics Research Group (Lithuania) up to 2009. *Acta Zoologica Lituanica*, 21 (2): 113–132.

Puplesis, R. 1994. *The Nepticulidae of Eastern Europe and Asia: western, central and eastern parts*. Backhuys Publishers, Leiden. 552 pp., figs 840.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp., figs 612.

Puplesis, R. & Robinson, G. S. 2000. A review of the Central and South American Nepticulidae (Lepidoptera) with special reference to Belize. *Bulletin of the Natural History Museum* (*Entomology*), 69 (1): 3–114.

Šimkevičiūtė, A., Stonis, J. R. & Sruoga, V. 2010. Male genitalia characters and their diagnostic value in taxonomy of Nepticulidae (Insecta, Lepidoptera). *V International Conference of Naturalists 'From Biotechnology to Environment Protection'*: 44 p. University of Zielona Gora Publishers, Zielona Gora.

Stonis, J. R., Diškus, A. & Navickaitė, A. 2012a. Nepticulidae tyrimų metodai. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships.* Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 38–59 p.

Stonis, J. R., Diškus, A., Navickaitė, A., Remeikis, A. & Rocienė, A. 2012b. Morfologiniai Nepticulidae požymiai, naudojami identifikuojant taksonus ir paremiantys šiuolaikinę šeimos sistemą. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships.* Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 60–72 p.

SHORT REVIEW OF SAMPLING METHODS USED IN APPLIED ENTOMOLOGY

Jacek Jackowski & Jacek Twardowski

Department of Plant Protection (Entomology), Wrocław University of Environmental and Life Sciences, Wrocław, Poland

INTRODUCTION

When taking part in the Erasmus intensive programme 'Intensive observational course in the protected area: analysis of Lepidoptera insects in the Kurtuvėnai Regional Park' (Project No. LLP-ERA-IP-2013-LT-0911, 1st – 14th June 2014), the authors were invited to contribute with their lectures to the programme of the First Baltic International Conference on Field Entomology and Faunistics. The original purpose of these lectures were to instruct biology course students, participants of the aforementioned project, on the field techniques of insect collection relevant to their planned work in the Kurtuvėnai Regional Park. As the background of both the authors is that of applied entomology, the lectures attempted to shed light on the applicative value of entomological research within an agricultural context where herbivore species are considered pests and where their density and not only incidence is the most critical parameter.

As an introduction, some general distinction between observational *versus* factorial experiment is necessary. The former only recording certain current state of population or an assemblage of species, the latter – involving some alteration of the levels of experimental factors, coupled with the observation of the response of the investigated organisms. The distinction is not always very precise: the applied entomological research often adopts factorial experiments with an array of easily-manipulated anthropogenic factors, but on the other hand, faunistic observations may frequently be classified as non-manipulative factorial experiments too because they use the existing levels of environmental variables as factors that enable habitat comparison, ranking or validation. Thus both observational and factorial experiments most often involve, apart from recording or collecting insect specimens, recording an assemblage of environmental data that are useful, if not essential, in the process of interpretation of the collected faunistic information (Lepš & Šmilauer, 2003).

Sampling methods used in applied entomology research depend on the target sampled organism and its bionomy, on type of habitat and on the aim of a study. In general, insect sampling methods can be divided into the following categories: 1) direct visual observation methods that include or do not include

collection of the observed specimens, the latter called '*in situ* counting', 2) different methods of habitat sampling, all of which definitely involve specimen collection, 3) different methods of trapping that use a variety of mechanical and mechanical-biotechnological devices in order to collect insects over longer periods of time without continuous attention from the investigator. Particular attention should be paid to the fact that different sampling methods may or may not reveal not only particular species, but in specific situations, may be restricted in their results to only particular developmental instars of the specific insect taxa. Species that feed on plant foliage and in fruit when being respectively *imagines* and larvae, but that descend to soil prior to pupation make good examples of creatures not easily sampled by one method if all the instars need to be collected. The fact that the majority of sampling methods, also including different trapping techniques, present considerable local disturbance to the investigated habitat and affect the sampling process itself, must be taken into account while interpreting the collected data.

Objectives of research in the applied entomology were outlined and explained in the context of crop plants and herbivore pests. The emphasis in the crop protection research and pest management research is on the density of insects and on their rate of plant infestation, as these two measures are directly related to potential damage to the plants and as such they affect decisions on application of chemical pest control. Apart from density and infestation level, finding out the time of insect emergence in spring is, in the majority of cases, critical to the decision on early control treatment.

INSECT SAMPLING METHODS

(1) Direct visual observation is a general term that refers to a number of different techniques including the estimation of herbivore numbers on individual plants instead of precision counting. Estimation is most often applied to aphids, where the detailed number of individuals is unimportant after the pest has exceeded some generally recognized threshold of density or percentage of plant infestation beyond which a control treatment is justified. Another approach is systematic sampling on a number of series of plants within the analysed area, commonly applicable in field crop situations. The term 'systematic sampling' may refer to soil sampling, mentioned later, or whole plant sampling for laboratory dissection. The common feature of the two approaches is not the type of organism sampled or counted but the spatial arrangement of the individual sampling (counting) sites, which should reflect and represent equally well all parts of the sampled habitat (field, orchard, greenhouse, etc.). A technique based on browsing only selected portions of individual plants is often used with shrubs or trees, in which case the pre-determined length of branches is taken from the plant or the insects present on them are counted *in situ*.

(2) Habitat sampling. Sweep netting (1) is the most commonly known technique of vegetation sampling and yields both qualitative and quantitative data. The latter kind of data may be compared between different sampling sites and habitats – provided equal number of net strokes on each site – as all the net catch is collected and may be taxonomically determined and counted. Sweep netting non-selectively collects all the arthropods present within the canopy, from true herbivores that feed and breed on the plants, to the occasional feeders and to the sporadical visitors that do not even forage on the sampled vegetation.

Alternatively, the use of D-VAC vacuum insect collector (2) in similar situations results in a different kind of catch. D-VAC, being a modified leaf blower with reversed thrust, enables collection of the taxa that are more closely associated with the investigated type of vegetation compared to the catch provided by the entomological net. In particular, the D-VAC device is useful for homopterans, where frequent collection of aphids with their rostrum torn off testifies to the fact that the sampled specimens represent taxa indeed feeding on the plant. On the other hand, D-VAC seems to be an effective tool for sampling guilds of predatory insects, among them not only the species climbing up the vegetation in their search for prey but also those searching the ground surface (Elliott *et al.* 2006). (3) Johnson`s aspirator is the tool for long-term aphid migration monitoring and forecasting, but also the one used for faunistic studies, employed in a network of stations for nearly 30 years now ('Euraphid' network, 1990). (4) Plant dissection had been used widely in pest management contexts for its usefulness in finding out the extent of plant infestation by cryptophagous species or instars, such as oilseed rape weevils (Coleoptera, Curculionidae). (5) Entomological sieve enables sifting forest litter and superficial soil strata and is often used in research aimed at forecasting and monitoring forestry pests that hibernate in soil. At the same time, soil and litter sifting in forest cultures and natural habitats helps to detect juvenile and imaginal instars of rare species of such groups as rove beetles (Coleoptera, Staphylinidae) and many other soil-dwelling taxa that are useful for habitat evaluation. (6) Systematic soil sampling for pest incidence and density may be carried out using very simple techniques such as digging with a shovel, in order to take and inspect a precisely determined volume of soil sample from a particular depth. An example is density assessment of grubs and wireworms (Coleoptera: Scarabaeidae and Elateridae respectively). In this instance the sampling is usually carried out based on a pre-designed spatial scheme, so that the data collected indeed represents the extent of soil infestation within the area in question and may become a solid foundation for an informed decision on chemical soil treatment. (7) The use of a cylindrical soil core sampler allows for collection of soil mesofauna (size 0.2–2 mm, e.g. springtails, mites, enchytraeids, etc.) for faunistic research or pest management investigation (Alford, 2000). It is in fact the one version of soil sampling, mentioned above, contrary to grubs, wireworms, etc., that is focused on the fraction of fauna that cannot be counted (not to mention determined taxonomically) *in situ*. The samples are therefore taken to the lab where they are processed using Tullgren apparatus. The working principle of this device is that of driving soil-dwelling mesofauna out of the soil sample by lighting and heating it over a metal sieve. As the soil desiccates and crumbles, the animals migrate out of it and drop down through the sieve to a vessel filled with preserving fluid. Typically, the procedure is run for a period of 12–24 hours and the efficacy of the analyses simply depends on the number of samples that may be processed at a time.

(3) Trapping. Traps of different design may collect flying and epigeal fauna, as well as particular instars of a species in question such as larvae on their way to soil to pupate. (1) Yellow water traps (Moericke traps) are equally well known as is the net sweeping. They are commonly recognized and used tools for collecting hymenopteran, dipteran and homopteran species. Their working principle involves colour attraction coupled with their ability to drawn arriving insects in water filling the trap as the result of surfactant being

added to it. (2) Sticky traps of a relevant attractive colour are used for attraction of particular insect groups, among them Homoptera (yellow traps) and Thysanoptera (blue traps). These are most often used in protected cultures as the diagnostic tool of mostly applicative importance, in order to monitor pest density dynamics in time. (3) Pheromone traps (or traps based on synthetic analogues of insect pheromones) were introduced during the lectures within the forestry and fruit production context. Yet, they have in fact much broader application range. They are key tools for pest monitoring and forecasting, either within a current season or in the long-term perspective. The examples of field-use of pheromone traps in monitoring arable field pests include the European Corn Borer (*Ostrinia nubilalis* Hübner) and *Diabrotica virgifera* Le Conte (Western Corn Rootworm). In the latter case the pheromone is used for detection of the pest species over a region where it had not been recorded before. Pheromone traps (or just pheromone lures in dispensers) are also often used as a direct control measure in crop protection and in forestry, but this topic goes beyond the scope of the present article.

(4) So called 'fall traps' are usually designed to collect insect larvae that migrate from a host plant on which they feed into the soil where they pupate. They can be used as a species-specific measure of the migration process, e.g. that of the pod weevil (*Ceutorhynchus assimilis* Paykull, Coleoptera: Curculionidae), an important pest of oilseed rape cultures. At the same time they detect the dynamics of involuntary migration of other fauna, resulting from their dropping from the plant. In this sense, such traps deliver approximate information on the supply of prey for those species of epigeal fauna which do not climb plants. Fall traps are most often designed in a such way that the ground fauna is excluded from them.

(5) Emergence traps (Williams, 2006) measure dynamics of adult insect emergence from the soil after pupation has ended. Their mode of action relies on the fact that they cover and enclose an area over a patch of soil from which the pupating insects are expected to emerge. The emerging adults are attracted to a kairomone and trapped in some kind of mechanical device which may be a sticky trap or a one-way entrance container.

The majority of traps mentioned so far (1–5) must be inspected on a regular basis if the data collected by them is intended to produce time-related results such as density prognosis for control decision.

(6) Light trapping, typically applied as a tool for the collection of nocturnal lepidopteran taxa, is often considered an alternative or auxiliary measure to be interpreted along with the pheromone trap catches of the investigated species. These two tools do not work in the same way, and it is often the case that only the light trap catch confirms the incidence of a species within a region, while in the pheromone traps the same taxon is found only occasionally, despite the same trapping period. Light traps may vary in design from simple screen traps that require the individual, manual catching of every single specimen, to the devices that work with no human assistance, attracting, killing and collecting the insects over long periods of time.

(7) The Barber or pitfall-trap is essentially a plastic or glass cup or jar that is filled with preserving fluid and placed open in the soil with its rim level with the ground. Pitfall-traps may be accompanied by simple 'roof' arranged over them, so that the rain water does not get into the cup in excess, diluting the preservative and making the trapped specimens flow out of the trap. The traps are intended to collect epigeal arthropod fauna, mostly coleopteran species and spiders. Data collected by them need to be interpreted with caution, as the data result from both the number and activity (movement) of the trapped individuals. Less-mobile species are trapped less frequently and vice versa. Moreover, although the movement of insects is apparently affected by temperature, different species respond to temperature changes to a different degree which may also influence the results. Therefore the information obtained from pitfall-traps should not be considered as a straightforward measure of a species density over the investigated area, but rather as an estimate of the number of active individuals. The installation of a pitfall-trap alone presents a local disturbance to the habitat and as such may bias the collected data. This and some other facts are commonly known (and accepted) shortcomings of pitfall-traps. Some of these shortcomings may be compensated for by clever mechanical design (Chapman & Armstrong, 1997; Winder *et al.*, 2001; Porter, 2005), or by using mathematical models that enable approximation to the 'true' density (Raworth & Choi, 2001) and some may not. Nevertheless, pitfall-traps are still considered one of the most powerful instruments in ground fauna research.

REFERENCES

Alford, D. V. (ed.) 2000. Pest and disease management handbook. Blackwell Science: 6–18, 131–136.

Chapman, P. A. & Armstrong, G. 1997. Design and use of time-sorting pitfall trap for predatory arthropods. *Agriculture, Ecosystems and Environment*, 65: 15–21.

Elliott, N. C., Tao, F. L., Fuentes-Granados, R., Giles, K. L., Elliott, D. T., Greenstone, M. H., Shufran, K. A. & Royer, T. A. 2006. D-vac sampling for predatory arthropods in winter wheat. *Biological Control*, 38: 325–330.

'Euraphid' network: Trapping and aphid prognosis. 1990. *Proceedings of a meeting of the EC-Experts' Group,* Catania, Italy 7 to 9 November 1988. Luxembourg: Office for Official Publications of the European Communities, 1990. ISBN 92-826-0944-8, Catalogue number: CD-NA-11559-2A-C.

Lepš, J. & Šmilauer, P. 2003. Multivariate Analysis of Ecological Data using CANOCO. Cambridge University Press. 1–15.

Porter, S. D. 2005. A simple design for a rain-resistant pitfall-trap. Insectes Sociaux, 52: 201–203.

Raworth, D. A. & Choi M.-Y. 2001. Determining numbers of active carabid beetles per unit area from pitfall-trap data. *Entomologia Experimentalis et Applicata*, 98: 95–108.

Williams, I. H. 2006. Integrating parasitoids into management of pollen beetle on oilseed rape. *Agronomy Research*, 4 (Special issue): 465–470.

Winder, L., Holland, J. M., Perry, J. N., Woolley, C. & Alexander, C. J. 2001. The use of barrier-connected pitfall trapping for sampling predatory beetles and spiders. *Entomologia Experimentalis et Applicata*, 98: 249–258.

FOMORIA WEAVERI (LEPIDOPTERA, NEPTICULIDAE), AN INTERESTING NEPTICULIDAE SPECIES IN THE KURTUVĖNAI REGIONAL PARK (LITHUANIA)

Juris Pikelis[1], Ligita Šlapelytė[2], Dovilė Masalskaitė[2] & Marcin Cierpisz[3]

[1] *Daugavpils University, Daugavpils, Latvia*

[2] *Lithuanian University of Educational Sciences, Vilnius, Lithuania*

[3] *Wrocław University of Environmental and Life Sciences, Wrocław, Poland*

INTRODUCTION

There are only two species of the genus *Fomoria* Beirne that occur in Lithuania. One of them, *F. septembrella* (Stainton, 1849), is trophically associated with *Hypericum perforatum* L.; the other, *F. weaveri* (Stainton, 1855), with *Vaccinium vitis-idaea* L. (Diškus *et al*., 2012).

METHODS

Collecting methods and protocols for species identification and description are outlined in Puplesis & Diškus (2003) and Diškus & Stonis (2012).

TREATMENT

Fomoria weaveri is an monophagous and univoltine species (Diškus & Stonis, 2012). Larvae start to mine leaves of *Vaccinium vitis-idaea* from mid-September and continue to feed until mid-November (Johansson *et al*., 1990); however, they are difficult to find. After hibernation, larvae continue feeding in spring and can be easily detected by the large combine leaf-mines (Fig. 1A) in May.

In contrast to the previously recorded data (see Diškus *et al*., 2012), the feeding larvae were found in early June in the Kurtuvėnai Regional Park.

The species belongs to the Trans-Palaearctic chorological group (Diškus *et al*., 2012; Navickaitė & Stonis, 2012); it is widespread in Europe (except the southern regions), Siberia (Buryatia, Yacutia, Magadan) and East Asia (Japan) (Diškus & Stonis, 2012). It was noticed that *F. weaveri* is presumably a post-glacial relict and occurs in dark taiga habitats (Fig. 1B), especially in the taiga pine forest and damp fir groves as well as being often found near waterlogged sites (Diškus & Stonis, 2012). In Lithuania, it has been recorded from almost all regions (Diškus *et al*., 2012); however, it is not known from the Curonian Spit (Navickaitė *et al*., 2011), and previously was not known from northwestern Lithuania (the Šiauliai area).

The first discovery of *F. weaveri* in northwestern Lithuania (the Kurtuvėnai Regional Park, the Šiauliai area) revealed that the species is highly limited in distribution and its mining is not abundant. Therefore, contrary to what was expected, according to the 'Method of Evaluation of Species Occurrence' (Stonis *et al*., 2012; Stonis *et al*., *unpublished*), the species is rare in the Kurtuvėnai Regional Park. The causes for the rarity of *F. weaveri* in the region with 'suitable habitats' remain unknown.



Figure 1. *Fomoria weaveri*: A – leaf-mine; B – habitat of *Fomoria weaveri* in the Kutuvėnai Regional Park.

REFERENCES

Diškus, A. & Stonis, J. R. 2012. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 220 pp.

Diškus, A., Navickaitė, A. & Stonis, J. R. 2012. Taksonominė Lietuvos Nepticulidae sudėtis ir papildytas faunos sąvadas. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships* [in Lithuanian]. Lututė Publishers, Kaunas. 73–100 p.

Johansson, R., Nielsen, E. S., Nieukerken, E. J. van & Gustafsson, B. 1990. The Nepticulidae and Opostegidae (Lepidoptera) of north west Europe. *Fauna Entomologica Scandinavica*, 23 (1/2): 1–739.

Navickaitė, A. & Stonis, J. R. 2012. Chorologinis Lietuvos Nepticulidae faunos įvertinimas. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships* [in Lithuanian]. Lututė Publishers, Kaunas. 101–111 p.

Navickaitė, A., Diškus, A. & Stonis, J. R. 2011. Review of Nepticulidae (Insecta: Lepidoptera) occurring in the Curonian Spit (Baltic Coast of Lithuania). *Acta Zoologica Lituanica*, 21 (3): 221–231.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp., figs 612.

Stainton, H. T. 1849. *An attempt at a systematic catalogue of the British Tineidae & Pterophoridae*. John van Voorst, London. i–iv + 32 pp.

Stainton, H. T. 1855. Lepidoptera. The new British species in 1854. *The Entomologist's Annual*, 1855: 40–50.

Stonis, J. R., Diškus, A. & Navickaitė, A. 2012. Nepticulidae tyrimų metodai. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 38–59 p.

SOME DATA ON MACROLEPIDOPTERA FROM THE KURTUVĖNAI REGIONAL PARK

Dalius Dapkus & Tatjana Makėvič

Lithuanian University of Educational Sciences, Vilnius, Lithuania

INTRODUCTION

The Kurtuvėnai Regional Park was established in 1992, with the aim of protecting the hilly landscape of Kurtuvėnai and its forested and laky surroundings. Therefore, Lepidoptera fauna of the park is still insufficiently known as only episodic studies were carried out (Ivinskis, 2004; Ivinskis & Augustauskas, 2004; Kazlauskas, 1984).

METHODS

The research of Macrolepidoptera in the Kurtuvėnai Regional Park was carried out from 5th to 11th of June, 2014. Day-flying butterflies and moths were registered during field trips in Valatkiai, Burkšai, Dirvonai, Galvidiškės, Jurgoniškiai, Juškaičiai II, Pašvinės and Vainagiai environs. Nocturnal moths were studied using the Jalas model automatic light trap with a 160 W blended lamp bulb (Fig. 1) in Valatkiai and Pašvinės environs.

RESULTS

In total, 140 Macrolepidoptera species were registered during the studies. Of these, 67 species belonged to Geometridae, 23 – to Noctuidae family while other families were represented by smaller number of species. New records of some rare and protected species were revealed. Three species recorded are included in the Lithuanian Red Data Book (Rašomavičius, 2007): *Lopinga achine* (Nymphalidae) was registered in Galvidiškės, Dirvonai and Pašvinės, *Melitaea diamina* (Nymphalidae) in Valatkiai, Burkšai, Dirvonai, Galvidiškės, Jurgoniškiai, Juškaičiai II, and Vainagiai, while *Lycaena dispar* (Lycaenidae) in Juškaičiai II and Pašvinės environs. One specimen of a sphingid *Macroglossum stellatarum* was registered close to Pašvinio Ežeras Lake. The species is a rare migrant dispersing to Lithuania from the southern latitudes. A population of *Cabera leptographa* was found in a fen close to Galvidiškės and more than 10 specimens were registered. There are only some finding localities of the latter species in Lithuania.



Figure 1. The Jalas model automatic light trap with a 160 W blended lamp bulb.

REFERENCES

Ivinskis, P. 2004. *Lepidoptera of Lithuania.* Vilniaus universiteto Ekologijos instituto leidykla, Vilnius. 380 pp.

Ivinskis, P. & Augustauskas, J. 2004. *Lietuvos dieniniai drugiai* [*Butterflies of Lithuania*] [in Lithuanian]. Lututė Publishers, Kaunas. 248 pp.

Kazlauskas, R. 1984. *Lietuvos drugiai* [*Butterflies and Moths of Lithuania*] [in Lithuanian]. Mokslas, Vilnius. 192 pp.

Rašomavičius, V. (ed.) 2007. *Lietuvos raudonoji knyga* [*Red Data Book of Lithuania*] [in Lithuanian]. Lututė Publishers, Kaunas. 800 pp.

SYSTEMATICS OF CARPENTER MOTHS (LEPIDOPTERA: COSSIDAE) AND THE DISCOVERY OF NEW LEPIDOPTERAN GLANDS

Steve R. Davis

Department of Ecology and Evolutionary Biology, Division of Entomology, Snow Hall University of Kansas, USA

INTRODUCTION

The family Cossidae is a moderately large, cosmopolitan family of ditrysian moths, which, together with the paleotropical family Dudgeoneidae, comprise the superfamily Cossoidea. Of the approximately 700 species known, about 40% occur within the Neotropical Region (Edwards *et al.*, 1999). Currently the family consists of the following six subfamilies: Cossinae, Cossulinae, Hypoptinae, Metarbelinae, Ratardinae, and Zeuzerinae. Relatively little is known about the biology of Cossoidea, with most of the pertinent literature being restricted to original species descriptions and family reviews, such as most recently by Common (1990), Scoble (1992), and Edwards *et al.* (1999). Adult Cossidae and Dudgeoneidae, with the exception of day-flying Ratardinae, are nocturnal in activity (Edwards *et al.*, 1999). Oviposition usually occurs in decaying wood or under tree bark, with the larvae boring in the branches and trunks of a wide range of trees and shrubs. Many species are considered agricultural pests, particularly on coffee, pecan, apple, plum, and peach trees. Other than important works by Gentili (1989) and Schoorl (1990), little revisionary work has been done within Cossoidea.

The primary purpose of this research is to contribute to the understanding of cossid systematics by revising the classification of the New World subfamily Cossulinae. In the course of a review of the Costa Rican species it became clear that the current generic classification conflicted with many of the characters examined. Therefore, a phylogenetic study of all the available species of Cossulinae was conducted, to confirm the monophyly of the subfamily and to define monophyletic genera.

The Cossulinae are endemic to the New World, and consist of approximately 60 species, which previously were classified into 6 genera (Edwards *et al.,* 1999). Loss of the saccus is an apparent synapomorphy for Cossulinae, and all Cossulinae possess bipectinate antennae (Edwards *et al.*, 1999). The present revision recognizes 5 genera within the Cossulinae, including 4 new genera. For Costa Rica, 18 species are recognized, including 8 endemic species, and 9 new species. One specific synonomy, 2 generic synonomies, and 29 new combinations are proposed within the New World Cossulinae.

TREATMENT (PHYLOGENETIC ANALYSIS)

Taxon and character sampling. It was intended in this study to obtain as comprehensive taxon sampling as possible within the Cossulinae. A total of 83 taxa were examined. Monophyly of Cossidae was assumed (Edwards *et al*., 1999) and the Dudgeoneidae (genus *Dudgeonea*) were used as the outgroup. Eight exemplar species representing all of the other five subfamilies in Cossidae were included in the ingroup. These were: Ratardinae: *Ratarde tertia*; Metarbelinae: *Paralebeda carnescens*, unidentified metarbelid species 1, unidentified metarbelid species 2; Cossinae: *Prionoxystus robiniae*; Zeuzerinae: *Morpheis pyracmon*; Hypoptinae: *Hypopta vassilia*, *Givira modisma*. Also included in the ingroup were 75 cossuline species, which comprise all of the species within the subfamily, excluding five species that were not obtained. Forty-two adult morphological characters, 22 of them multistate, were analyzed, including 3 head, 11 thoracic, 2 abdominal, 22 male genitalia, and 4 female genitalia characters.

Data analysis. All analyses were performed using WinClada (Nixon, 2002), which incorporates the Nona tree search program of Goloboff (1993). All characters were treated as equally weighted and unordered (Fitch optimization). Tree search used the parsimony ratchet function of WinClada (Nixon, 1999), using the default parameters. A strict consensus tree was calculated from the resulting most-parsimonious trees. The characters were optimized using accelerated transformation (ACCTRAN), which favors reversal over parallelism when multiple equally-parsimonious ancestral state assignments exist (Goloboff, 1993).

RESULTS

Our cladogram depicts the strict consensus of the 23 most parsimonious trees found; it has a length of 220, a consistency index (CI) of 32, and a retention index (RI) of 78. While all of the individual MP trees are fully resolved, 38 nodes are unresolved in the strict consensus tree.

All exemplar species from the five other subfamilies fall outside of the Cossulinae, thereby supporting the monophyly of the subfamily. The other two multiple-sampled subfamilies, Metarbelinae and Hypoptinae, were also monophyletic in the strict consensus tree.

Within Cossulinae there are a number of deep nodes supported by numerous synapomorphies; these form the basis of the generic re-classification proposed in the following section. The unresolved parts of the consensus tree seem to consist mostly of closely-related species.

NEW LEPIDOPTERAN GLANDS

In the course of revising the cossid moth subfamily Cossulinae, adult moths throughout the superfamily Cossoidea (Cossidae + Dudgeoneidae) were found to possess paired tuberculate evaginations on abdominal tergites 2–8. These organs apparently have not been observed previously in any insect, including Lepidoptera. In addition to Cossoidea, abdominal tubercles were observed in all representatives examined from Andesianidae, Acrolophidae, Arrhenophanidae, Brachodidae, Carposinidae, and Pyralidae. These tubercles are similar in size to those in Dudgeoneidae, but differ in apparently lacking the terminal pore seen in Cossoidea.

In the Cossidae, the tubercles occur in both sexes but are slightly less developed in females. The tubercles increase in size caudally, with the first pair reduced to a small pore leading to an apparent internal gland, and the caudal-most pair suberect and digitiform. The anterior-most tubercles are minute, the more caudal pairs range up to approximately 0.1 mm in length, clearly visible under a dissecting microscope. In the representative of Cossulinae examined by SEM, an asymmetrical flap of tissue, possessing a fimbriate tip, extends from the apex of the tubercle.

The function of the abdominal tubercles is unknown, but several observations suggest that, at least in Cossidae, they may be glandular. First, the tubercles in cossids possess an internal canal which opens to the outside through a terminal pore. Second, at the base of the tubercle there appears to be an enclosed chamber, plausibly interpreted as a gland. Third, the fimbriate tip of the tubercle seen under SEM is suggestive of an evaporative surface. Because the tubercles in Cossidae are so small, and occur in both sexes, it is unlikely that they are associated with long-range pheromone production. It seems more plausible that they could be involved in production of a close range pheromone, or a defensive chemical (Hallberg & Poppy, 2003). Clearly, histological, physiological, and behavioral studies will be required to test these hypotheses.

ACKNOWLEDGEMENTS

I would like to thank Don Davis (Smithsonian Institution, Washington, D.C.), Patricia Gentili-Poole (Smithsonian Institution), and Charles Mitter (Department of Entomology, University of Maryland, College Park) for graciously assisting me in all aspects of systematic teaching. Partial support for this research was provided by grants from the Howard Hughes Medical Institute through the Undergraduate Biological Sciences Education Program of the University of Maryland.

REFERENCES

Common, I. F. B. 1990. *Moths of Australia*. Melbourne University Press, Carlton. vi+535 pp., 32 pls.

Edwards, E. D., Gentili, P., Horak, M., Kristensen, N. P. & Nielsen, E. S. 1999. The Cossoid/Sessoid assemblage, 181–197 p. *In*: N. P. Kristensen (ed.). Lepidoptera, Moths and Butterflies. Vol. 1: Evolution, systematics, and biogeography. *Handbuch der Zoologie*, Bd. IV Arthropoda: Insecta. Walter de Gruyter, Hawthorne, New York.

Gentili, P. 1989. Revision sistematica de los Cossidae (Lepidoptera) de la Patagonia. *Reviste de la Sociedad Entomologica Argentina*, 45 (1–6): 1–75.

Goloboff, P. 1993. Estimating character weights during tree search. *Cladistics*, 9: 83–91.

Hallberg, E. & Poppy, G. 2003. Exocrine glands: Chemical communcation and chemical defense, 361–375 p. *In:* Kristensen, N. P. (ed.). Lepidoptera, moths and butterflies. Vol. 2: Morphology, physiology and development. *Handbook of Zoology*, Bd. IV Arthropoda: Insecta. Walter de Gruyter GmbH & Co, KG, Berlin.

Nixon, K. C. 1999. The parsimony ratchet, a new method for rapid parsimony analysis. *Cladistics*, 15: 407–414.

Nixon, K. C. 2002. WinClada ver. 1.00.08. Published by the author, Ithaca, NY.

Schoorl, J. W. Jr. 1990. A phylogenetic study on Cossidae (Lepidoptera: Ditrysia) Based on external Adult Morphology. *Zoologische Verhandelingen*, 263: 1–295.

Scoble, M. J. 1992. *The Lepidoptera: form, function and diversity*. Oxford University Press, Oxford. xi+404 pp.

STUDY METHODS OF BEETLES OF THE GENUS *HYLOBIUS* AND RELATED MYCOBIOTA

Donatas Stanionis

Lithuanian Research Centre for Agriculture and Forestry, Institute of Forestry, Kaunas, Lithuania

INTRODUCTION

In Lithuania pine weevil, together with cockchafer, is the major pest of forest saplings. Because of them, forest enterprises lose a lot of money annually.

The large pine weevil is little studied in Lithuania and inadequately researched abroad as a host of tree pathogenic fungi (Жerac, 1976). So far pine weevil mycobiota complex is unknown, ways of pathogens transfer from infected to healthy seedlings stump remain unclear, still little research on the large pine weevil entomophatogenic fungi is done, new and effective methods of protection forest against weevils are necessary.

Pine weevil infestations in Lithuanian forest plantations, which are up to 15 years old, are calculated in hundreds of hectares in area every year. The most common infestation occurs on planted pine seedlings. Weevils damage young trees and often completely kill them. The trees then need to re-grow and it sharply increases deforestation rates.

In order to start the protection of forests against weevils it is necessary to explore the weevils first.

Study methods of genus *Hylobius* use classical entomological research methods: weevil beetle collecting by interceptor holes (Pitfall traps) and attractive traps (Pitfall traps with pheromone) methods; weevil larvae collecting by peeling stump root bark.

WEEVIL BEETLE COLLECTING WITH INTERCEPTOR HOLES (PITFALL TRAPS)

Traps work effectively in light soil. If, in the selected forest peat soil dominates or the soil is moist, trap will not work because any weevils will escape from the trap. In the forest study we focus on finding out the amount of weevils in a certain forest area. Therefore, in the area of the forest, we strip-mine these traps (usually 15–50). They are strip-mined in planned transects to cover the entire area. Traps are made in a cube shape ranging from 20x20x20 cm to 40x40x40 cm in size.



Figure 1. The author checks the pitfall trap.

As pine weevils hardly fly at all, they crawl on the ground, drop into the pitfall trap and can not get out.

When we have determined trap area (such as 1600 cm^2), we can calculate the area of all the traps and derive the relationship between the forest area. In this way, during the season, we check these traps: execute weevils registration and at the end of the season, we can provide a relative abundance of weevils in a forest area. The traps serve as means of reducing pests in the forest, because every weevil which drops into one, is destroyed (but only if it is a pest).

WEEVIL BEETLE COLLECTING WITH AN ATTRACTIVE TRAP

This method is very similar to the one previously mentioned. The only difference is that seductive material, such as a pheromone is placed in the traps. In our study, weevils pheromones we often replace with other materials which naturally attract weevils.

The most common place to this trap is on young shoots of pine trees with resin. It well attracts weevils. Results are usually pretty close as the use of pheromones. The advantage of this method is seen in cost savings as the purchase of expensive pheromones is not required.

WEEVIL LARVAE COLLECTING BY PEELING STUMP ROOT BARK METHOD

The methods that have been mentioned above are suitable only for research on adult weevils. If you want to collect larvae for study, you should use another method called the root bark peeling method because the weevils larvae live under the pine trees (and other coniferous) root bark.

To collect weevil larvae, you should select approximately 1-year-old pine stumps in a forest. You will need to find where the roots begin at the base of the stump (preferably from several different angles). These roots need to be dug up (approximately 0.5 m in length) and then have the bark carefully peeled. This way you will find pine weevil larvae. This method is only suitable for the larvae collecting for further study, as for abundance estimations it can not be used.

DISCUSSION

In the study we aim to investigate micobiota inside the weevil's body. It is expected that weevils carry various fungal rot of conifers and distributes these fungal diseases. After this study we could focus specifically on reduction of carriers of these diseases in number. We plan to use the latest DNA research methodologies for mycobiota. It is also possible that we can find and entomophatogenic fungi, which would be disastrous for weevils. In such case, it probably would be possible to use these entomophatogenic fungi as natural weapons for regulation the pests in our forests.

REFERENCE

Жегас, А. 1976. *Изучение новых инсектицидов для борьбы с важнейшими вредителями сосновых молодняков Литовской СССР* [in Russian]. Каунас. 249 pp.

REVISED FAUNA OF THE NEPTICULIDAE (LEPIDOPTERA) OF CONTINENTAL EAST ASIA: LOTS OF EFFORT TO ELUCIDATE THE LITTLE-KNOWN DIVERSITY OF PYGMY MOTHS

Agnė Rocienė & Jonas Rimantas Stonis

Lithuanian University of Educational Sciences, Vilnius, Lithuania

INTRODUCTION

In order to understand the extent of global biodiversity and processes that maintain it, researchers are encouraged to more intensively inventory the biological diversity of the Earth's biomes and ecosystems as well as provide taxonomic reviews, revisions and identification tools (Stonis, 2010). Our research, focused on leaf-mining (endobiontic) insects, relates to important topics today's taxonomy, evolution and ecology. The family Nepticulidae comprises stenophagous (mostly monophagous) species whose larvae, during the whole of the larval stage, feed and develop within green (assimilatory) tissues of plants (Diškus & Stonis, 2012). Such a lifestyle is called mining and the cavities (tunnels) that larvae make in assimilatory tissues are called 'leaf-mines' (or simply 'mines' if the cavities are in the green tissue of another plant organ other than a leaf) (Diškus & Stonis, 2012). Nepticulids are important from an economical viewpoint as these organisms can be recognized as pest or potential pests (dozens of species have been included in the list of pests of cultivated plants, see Kuznetzov & Puplesis, 1994). Better knowledge of the diversity of pygmy moths fauna is essential for establishing various plant protection measures.

On the other hand, Nepticulidae (as is the case with some other endobiontic organisms) are rather sedentary and can be detected in nearly all terrestrial ecosystems, though with uneven distribution (Puplesis, 1994; Stonis, 2010). Studying Nepticulidae enables better understanding of evolutionary tendencies and biogeographical peculiarities. The taxonomic inventory of the East Asiatic fauna carried out in this project presents data which contributes to a better understanding of Nepticulidae worldwide and provides a better knowledge of the fauna of East Asia or zoogeographical links, including those with the related Euro-Nemoral fauna.

Prior to this research, the fauna of Nepticulidae of continental East Asia had not been sufficiently studied (see Rocienė & Stonis, 2013 and Stonis & Rocienė, 2013). Most of the earlier data had been based on inaccurate descriptions of adult genitalia, and type specimens had been studied and documented relying

merely on temporary micro-slides of genitalia (Rocienė & Stonis, 2013). Temporary slides in glycerine, contrary to permanent slides in Euparal, are less suitable for detailed documentation of overlapping sclerites and comparison of morphological structures (Stonis *et al*., 2012a, 2014).

The type series of all 56 Nepticulidae species described earlier in the Russian Far East were examined: permanent morphological micro-slides of the holotypes of all species were made for the first time and the species descriptions were supplemented with new data and documented according to up-to-date scientific standards (see Rocienė & Stonis, 2013). The unidentified Nepticulidae material deposited at the Institute of Zoology of the Russian Academy of Sciences was dissected, examined and described for the first time (see Rocienė & Stonis, 2013). The *Stigmella regina* (Pupl.) was synonymized with *S. sashai* (Pupl.), and *Ectoedemia laura* (Pupl.) with *E. sivickisi* (Pupl.). A taxonomic checklist of the East Asiatic Nepticulidae was updated and supplemented with new species and peculiarities of trophic relationships and geographical distribution of the East Asiatic species were reviewed (see Rocienė & Stonis, 2013).

The use of permanent slides in this research not only helped discover new species for science or for the fauna of East Asia but also describe more accurately the distribution ranges of many previously known nepticulids and performs the first chorological analysis of the East Asiatic Nepticulidae.

STUDY METHODS

One of the most effective ways of collecting Nepticulidae is light trapping (Puplesis & Diškus, 2003) (Fig. 1 D, E). During our research, adults of pygmy moths were collected at light using a 1.5 x 2.5 m white fabric screen (Fig. 1D), the upper edge of which was folded over by 2 cm and sewn so that a strong rope could be threaded along the upper edge of the screen. The rope length used was about 20–30 m so that the screen could be stretched between trees. A lamp was fastened by a trident holder to the upper edge of the screen (in the centre) above eye level. DRL or LRF type UV lamps or their analogues were the most suitable for collecting Nepticulidae. The bottom edge of the screen was turned forward on the ground so that fallen moths could be collected. The screen was stretched tightly so as not to be disturbed by wind (windy places were avoided). It is easier to collect insects from a tightly stretched fabric than from a badly tensed one where folds make it difficult to notice and collect minute moths. Nepticulidae were taken from the screen by small (about 3.5–5.5 mm in diameter and 30–50 mm in length) glass test tubes then plugged with cotton wool. Each specimen was put into a separate test tube so that the moths could retain as many scales as possible. The plug of a test tube had to be tight enough for a moth not to escape and permeable enough to permit the insect-killing chemical (acetyl acetate) to pass through it. The test tube containing a moth was immediately placed into a killing jar – a tightly and easily-closed container (usually made of glass) with a 3–5 cm high cotton wool liner on the bottom. So that specimens could be preserved fresh, the collected material was pinned either immediately after a light collecting session or no later than the afternoon of the next day. Before pinning, in line with the method described in Puplesis (1994), material was kept in a dark and cool place (e.g. a fridge).

Alongside light trapping, adult moths were collected by brushing with a small (15 cm diameter) entomological net over Nepticulidae host-plants. Another important and time and effort consuming way of

collecting Nepticulidae material, namely rearing of adults from mining larvae was also used. This method enabled getting not only the highest quality material (i.e. specimens in the best condition, not rubbed) but also important additional data on host-plants, leaf-mines and cocoons (colour and size) as well as the life-cycles (Diškus & Stonis, 2012).

In the studies on insects, in particular micro-moths, description of external characters is often insufficient, and slides of morphological structures have to be prepared. Species diagnostics most often relies on the characters of male genitalia (genital apparatus/armature), which, compared with other morphological structures, are distinguished by high specificity (Stonis *et al*., 2012b). Reliable identification and species description of pygmy moths (in particular new species) is impossible without the examination of genital structures (Diškus & Stonis, 2012; Stonis *et al*., 2014). It was noticed that the male genitalia characters of Nepticulidae are little variable and specific at the level of both species or higher taxonomic rank (Šimkevičiūtė *et al*., 2010; Stonis *et al*., 2012b).

In line with the methods described by Diškus & Puplesis (2003), Stonis *et al.* (2012a, 2014), temporary and permanent micro-slides were prepared. The study of genitalia mounts (micro-slides) was performed by using high magnification microscopes. Genital structures were measured and photographed, and sclerites were described. All micro-slides were recorded in a special register, providing the slide number, name of the species, dissection date, institution to which the dissected specimen belongs, and other information.

The genital structures important for diagnostics were studied, measured and documented by a Leica DM 2500 stereoscopic microscope, Leica DFC 420 digital camera, and the LeicaApplicationSuite V3.0.0 software. Adults were measured by a MBS-10 stereoscopic microscope with an ocular measuring ruler, and their exterior was photographed by a Leica S6D stereoscopic microscope, DFC 290 camera, and the LeicaImageManager IM50 software.

The distribution ranges of species were thoroughly mapped and chorologically analysed. Taxa distinguished for the same or similar distribution range were joined into groups which, in their turn, were named indicating the type of the range.

MATERIALS

Scientific material was collected by the first author A. Rocienė in 2011 and 2013 during the fieldwork in Russian Far East (mainly at Gornotayezhnoe Station of the Far East Division of the Russian Academy of Sciences (Ussuriysk District, 2011) (Fig. 1A–C), and the cognitive trip to northeastern China (2013). The types of 56 East Asiatic species and a sizeable unidentified Nepticulidae material for our scientific studies was temporary borrowed from the Institute of Zoology of the Russian Academy of Sciences.

RESULTS OF THE STUDY OF THE TYPE SERIES OF THE NEPTICULIDAE SPECIES DESCRIBED FROM CONTINENTAL EAST ASIA AND THE UNIDENTIFIED MATERIAL DEPOSITED AT THE RUSSIAN ACADEMY OF SCIENCES

The current diagnostics of the East Asiatic Nepticulidae species is mostly based on male genital structures, which are little variable and are species-specific (Stonis *et al*., 2012b); therefore, a detailed study and precise representation of such structures is very important for reliable species diagnostics. Before our studies,

East Asia was known to comprise 103 Nepticulidae species. Most of them (63 species) were described from continental East Asia, i.e. Primorskiy Kray, Russian Far East. All these Nepticulidae species were described exclusively on the basis of temporary mounts (slides) of genital structures in glycerine. Most of such slides not always precisely demonstrated the main diagnostic characters of the species, and the element of subjectivity often occurred (also because of the poor quality of microscopes). The drawings of genital structures were not sufficiently precise and sometimes even confusing. For the first time and by using up-to-date entomological methods, we dissected, re-examined, and documented the type material of the earlier described Nepticulidae species from East Asia, mainly from Primorskiy Kray (also from a few adjacent territories) and provided the first photographic documentation of the types of 56 species described by R. Puplesis (Stonis & Rocienė, 2013).

Before the studies, in 1974–1990, sizeable matherial was collected in the Russian Far East (mainly Primorskiy Kray, also from adjacent territories) by S. Yu. Sinev, S. V. Seksyaeva (Baryshnikova), R. Puplesis, M. M. Omelko and others in: Andreevka, 42°38′ N, 131°07′ E, Barabash Levada, 44°45′ N, 131°25′ E, Kedrovaya Pad' Nature Reserve, 43°11′ N, 131°24′ E, Kamenushka, 44°10′ N, 131°22′ E, Ryazanovka, 42°47′ N, 131°14′ E, Zanadvorovka, 43°18′ N, 131°37′ E, and a few other localities (see Rocienė & Stonis, 2013). The material was deposited at the Institute of Zoology of the Russian Academy of Sciences and was transferred to us for the purpose of this project. The earlier analysis of the type series of the previously described species provided grounds for the identification and taxonomic analysis of this unstudied material. A total of 1000 specimens were dissected, analysed and identified. The result of the taxonomic analysis has yielded 35 species (including two species new to science: *Ectoedemia ortiva* Rocienė & Stonis and *E.* species 219).

The examination of the material showed that two species which earlier had been regarded as separate (*Stigmella regina*, *Ectoedemia laura*) must not be longer recognized as independent taxa; therefore, *S. regina* was synonymized with *S. sashai*, and *E. laura* with *E. sivickisi* (Rocienė & Stonis, 2013). The synonymity of these names was supported by other researchers as well (van Nieukerken, *pers. comm.*). In addition, a few species that were new to science were discovered and described; a detailed morphological analysis of all examined species was performed, and new (not described earlier) morphological characters significant for taxonomy and diagnostics were determined (see Rocienė & Stonis, 2013). This taxonomic re-examination of sizeable material provided the foundation for updating the taxonomic checklist of the East Asiatic Nepticulidae (given in Rocienė & Stonis, 2013).

The fieldwork by the first author A. Rocienė in Primorskiy Kray as well as the dissection and examination of the collected material provided new data on Nepticulidae of this region, their distribution and morphological characters. In addition, three species new to science were identified – two of the *Stigmella* genus and one *Ectoedemia* Busck. In addition, *Stigmella thuringiaca* (Petry) was identified for the fauna of East Asia for the first time (Stonis & Rocienė, 2014). In Europe, larvae of *S. thuringiaca* are leaf-miners of various herbaceous Rosaceae: *Agrimonia*, *Filipendula*, *Fragaria*, *Potentilla* and *Sanguisorba*. These plants also occur in the East Asiatic flora, but feeding preferences of *S. thuringiaca* in East Asia are still unknown. Formerly the species was known only from Europe (widespread from Spain to Central European Russia, and from Belgium to Italy and Ukraine; now it is recorded in deciduous, predominantly broad-leaf forest of

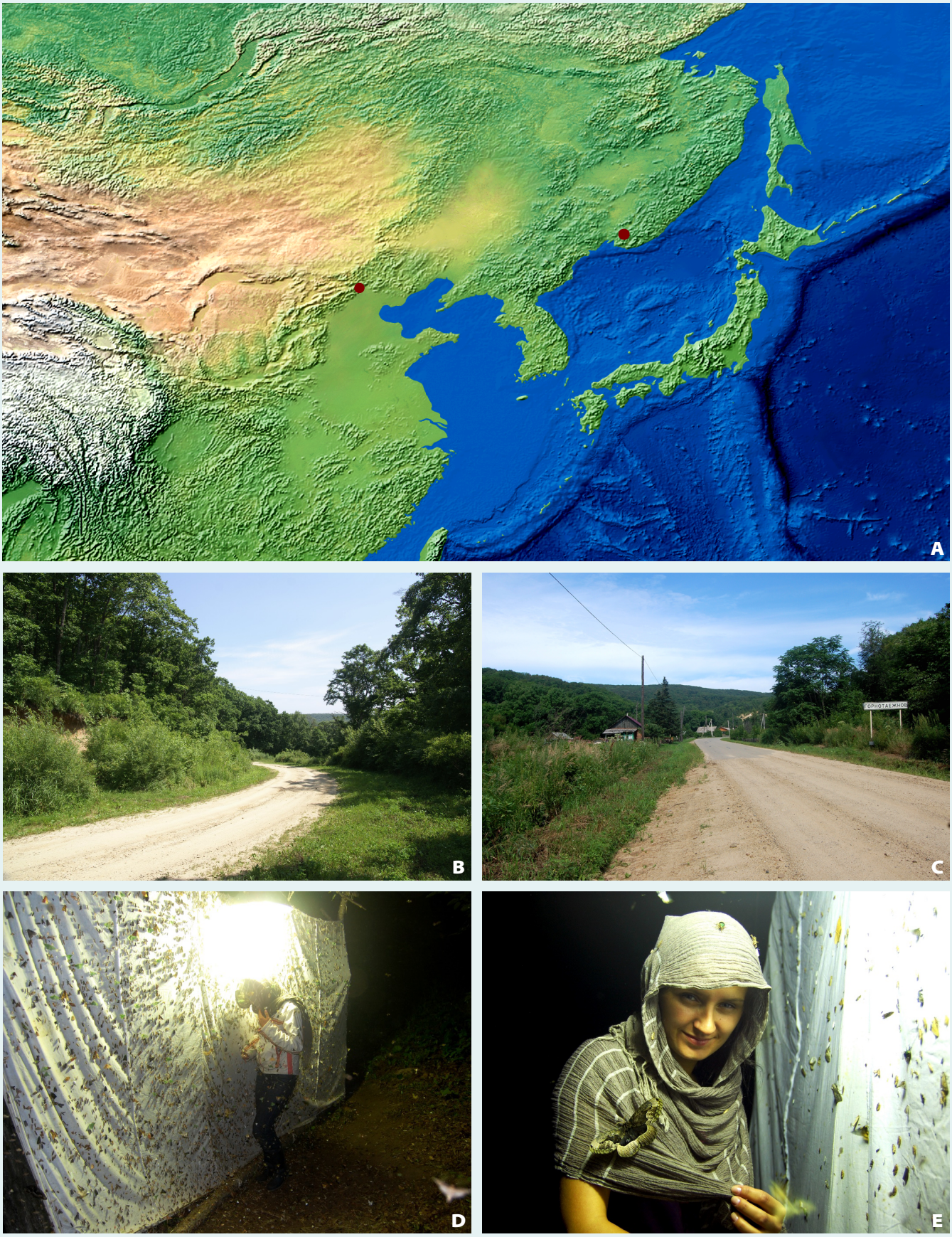

Figure 1. Collecting in continental East Asia: A – map of the region (courtesy of T. Patterson, USA) showing the collection localities by the first author A. Rocienė; in addition, a sizeable material was studied and incorporated into our study from various other sites (not shown on the map): Andreevka, 42°38′ N, 131°07′ E; Barabash Levada, 44°45′N, 131°25′ E; Kedrovaya Pad′ Nature Reserve, 43°11′ N, 131°24′ E; Kamenushka, 44°10′ N, 131°22′ E; Ryazanovka, 42°47′ N, 131°14′ E; Zanadvorovka, 43°18′ N, 131°37′ E, and a few other localities; B, C – habitat in Gornotayezhnoe (deciduous, predominantly broad-leaf forest), Ussuriysk District, Russian Far East; D, E – collecting site at the Gornotayezhnoe Station of the Far East Division of the Russian Academy of Sciences (July–August, 2011).

the southern Primorye (Primorskiy Kray, Far East Russia) (Stonis & Rocienė, 2014). In addition, new data on poorly investigated species, namely *Stigmella gimmonella* (Matsumura), *S. tranocrossa* Kemperman & Wilkinson, and *Ectoedemia philipi* Puplesis, were disclosed (see Stonis & Rocienė, 2014).

During our studies 6 new species were discovered (recently published by Rocienė & Stonis, 2013, Stonis *et al*., 2013, and Stonis & Rocienė, 2014). Most of the newly discovered and described species are trophically associated with plants of the *Quercus* genus. One of them, *Stigmella cornuta* Rocienė & Stonis (Stonis *et al*., 2013), is distributed in China and belongs to a newly designated species group (the *S. cornuta*), which is trophically associated with *Quercus dentata*. Another recently published new species, *Stigmella multispicata* Rocienė & Stonis (see Stonis & Rocienė, 2014) is described from the Russian Far East and belongs to the *S. malella* group; its host-plant remains unknown. Other 4 newly described species are: *Stigmella sexcornuta* Rocienė & Stonis (see Stonis & Rocienė, 2014) belonging to the *S. salicis* species group (the host-plant unknown); *Ectoedemia ortiva* Rocienė & Stonis (see Rocienė & Stonis, 2013) and *E. paraortiva* Rocienė & Stonis (see Stonis & Rocienė, 2014) belonging to the *E. suberis* group (the species of this group are *Quercus*-miners); and *Ectoedemia* species 219 (see Rocienė & Stonis, 2013), which was also discovered and described but left unnamed (this species belongs to the *subbimaculella* group, which is trophically associated with *Quercus*).

After the addition to the East Asiatic fauna and taxonomical changes, in total the current checklist of the Nepticulidae of East Asia comprises 110 described and named species, and one described but unnamed species (*Ectoedemia* species AG219 documented by Rocienė & Stonis 2013). Seventy-one species occur in the Russian Far East and 53 in Japan (20 species of which occur both in Japan and Russia). Of the 53 species currently known from Japan, six species (approximately 11%) also occur in Europe. For 12 species (about 17%) known from the continental Russian Far East (Primorskiy Kray), the Euro-East Asiatic distribution is characteristic. All species identified in East Asia belong to five genera: *Stigmella* Schrank, *Bohemannia* Stainton, *Ectoedemia* Busck, *Fomoria* Beirne, and *Etainia* Beirne (the classification follows Puplesis, 1994; Puplesis & Robinson, 2000; and Puplesis & Diškus, 2003). The *Stigmella* genus comprises the largest number of species (69); 27 species belong to *Ectoedemia*, 6 to *Bohemannia*, 5 to *Etainia*, and 3 to *Fomoria* (Fig. 2).

CHOROLOGICAL ANALYSIS

All currently known East Asiatic Nepticulidae species were mapped (with global distribution indicated) and grouped according to the similarity of ranges (species with similar or identical ranges were merged into one chorological group). The analysis of distribution ranges showed that chorologically the East Asiatic fauna of Nepticulidae is not homogeneous. Four chorological groups of Nepticulidae can be distinguished: East-Palaearctic (we further divide it into continental, insular, and broad), Amphi-Palaearctic, Holarctic, and Trans-Palaearctic.

East Asiatic Nepticulidae species are characterized by both very broad (Holarctic or Palaearctic) distribution ranges and geographically more limited ranges. The smallest chorological groups of East Asiatic fauna were found to be groups with the broadest distribution ranges, i.e. Holarctic and Amphi-Palaearctic chorological groups comprising 1–2 species each. The most abundant chorological group of the East Asiatic

fauna is the Continental East-Palaearctic subgroup but not the Broad East-Palaearctic as predicted earlier (Fig. 3). It is interesting that most of the Trans-Palaearctic species were recorded in the fauna of Japan.

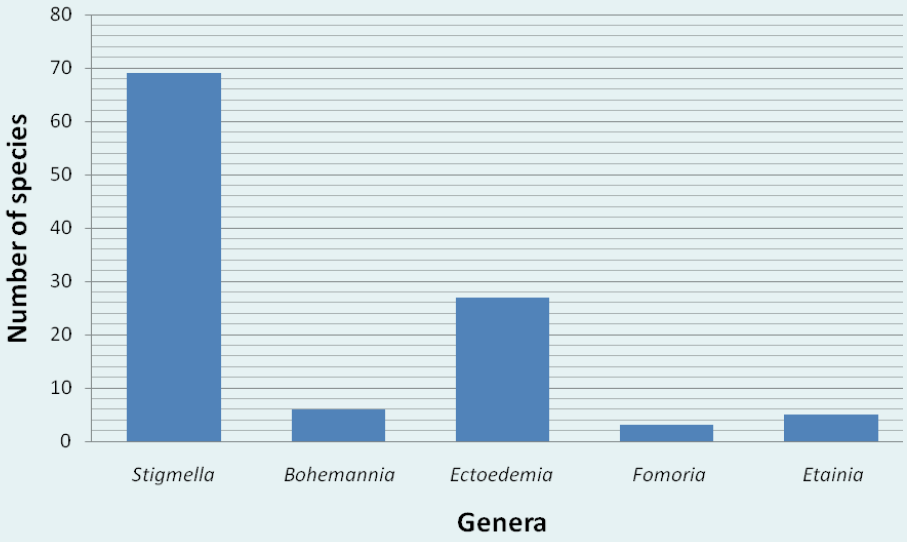

Figure 2. Taxonomic composition of the Nepticulidae of East Asia.

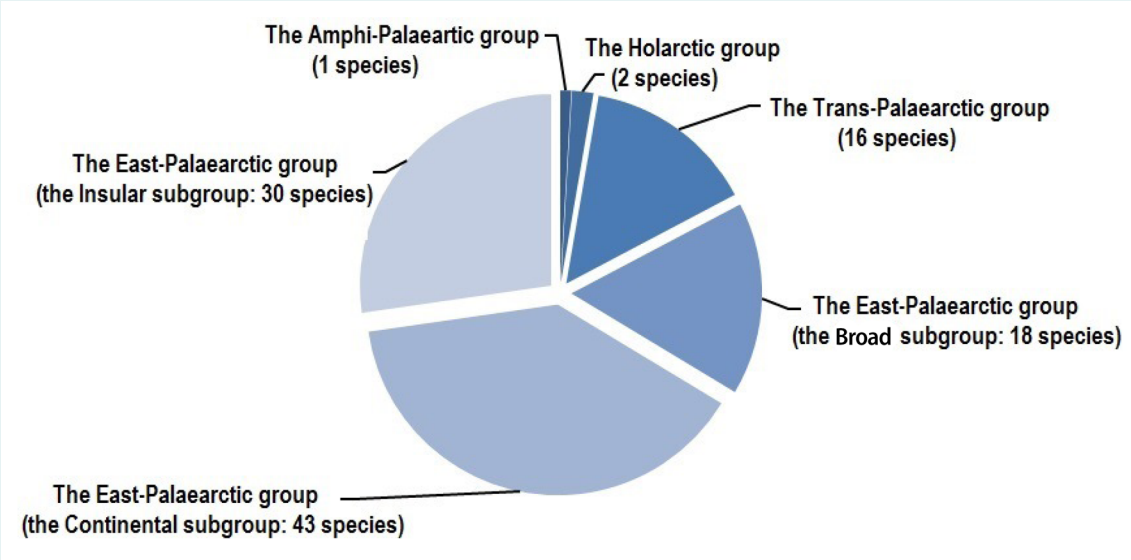

Figure 3. Chorological composition of the East Asiatic fauna of Nepticulidae.

The East-Palaearctic chorological group. The species of this group are distributed in East Asia: their distribution ranges extend from the northeastern provinces of China, Primorskiy Kray, Sakhalin, North Korea and South Korea up to Japan (most often Hokkaido Island). In the East Asiatic fauna, this chorological group comprises 91 Nepticulidae species (83%). According to the species distribution, the East Palaearctic chorological group can be further subdivided into the Continental (continental part of Asia), Insular (Japan and the neighbouring islands) and Broad (i.e. the continental part of East Asia and Japan together) chorological subgroups.

The Continental East-Palaearctic chorological subgroup. The greatest species diversity is registered (the subgroup comprises 43 Nepticulidae species): *Stigmella mirabella* (Pupl.), *S. sashai* Pupl., *S. attenuata* Pupl., *S. ultima* Pupl., *S. tegmentosella* Pupl., *S. kozlovi* Pupl., *S. nostrata* Pupl., *S. micromelis* Pupl., *S. crataegivora* Pupl., *S. taigae* Pupl., *S. palionisi* Pupl., *S. amuriella* Pupl., *S. alisa* Pupl., *S. auricularia* Pupl., Diškus & Juchn., *S. sexcornuta* Rocienė & Stonis, *S. palmatae* Pupl., *S. monticulella* Pupl., *S. fervida* Pupl., *S. multispicata* Rocienė & Stonis, *S. cornuta* Rocienė & Stonis, *Bohemannia suiphunella* Pupl., *B. piotra* Pupl., *Ectoedemia admiranda* Pupl., *E. sivickisi* Pupl., *E. arisi* Pupl., *E. christopheri* Pupl., *E. philipi* Pupl., *E. chasanella* Pupl., *E. ortiva* Rocienė & Stonis, *E. paraortiva* Rocienė & Stonis, *E. aligera* Pupl., *E. ermolaevi* Pupl., *E. maculata* Pupl., *E.* species 219, *E. ornatella* Pupl., *E. ivinskisi* Pupl., *E. picturata* Pupl., *E. sinevi* Pupl., *Fomoria permira* Pupl., *Etainia capesella* (Pupl.), *E. tigrinella* (Pupl.), *E. peterseni* (Pupl.), and *E. sabina* (Pupl.). The species of this subgroup have a wide spectrum of host-plants, but mainly they are trophically associated with plants of the genera *Acer*, *Quercus*, and *Betula*.

The Insular East-Palaearctic subgroup comprises 30 species: *Stigmella caesurifasciella* Kemp. & Wilk., *S. kurilensis* Pupl., *S. conchyliata* Kemp. & Wilk., *S. oplismeniella* Kemp. & Wilk., *S. populnea* Kemp. & Wilk., *S. titivillitia* Kemp. & Wilk., *S. orientalis* Kemp. & Wilk., *S. alaurulenta* Kemp. & Wilk., *S. chaenomelae* Kemp. & Wilk., *S. honshui* Kemp. & Wilk., *S. sorbivora* Kemp. & Wilk., *S. zumii* Kemp. & Wilk., *S. kurotsubarai* Kemp. & Wilk., *S. nakamurai* Kemp. & Wilk., *S. nireae* Kemp. & Wilk., *S. azusa* Hirano, *S. zelkoviella* Kemp. & Wilk., *S. acrochaetia* Kemp. & Wilk., *S. alikurokoi* Kemp. & Wilk., *S. ichigoiella* Kemp. & Wilk., *S. sesplicata* Kemp. & Wilk., *S. spiculifera* Kemp. & Wilk., *S. oa* Kemp. & Wilk., *S. crenatiella* Hirano, *S. azuminoensis* Hirano, *S. hisakoae* Hirano, *Bohemannia nipponicella* Hirano, *Ectoedemia cerviparadisicola* Sato, *E. insularis* Pupl., and *Etainia trifasciata* (Mats.). In terms of trophic relationships, the larvae of this group mine plants belonging to 15 genera: *Acer*, *Alnus*, *Quercus*, *Populus*, *Malus*, *Sorbus*, *Rhamnus*, *Ulmus*, *Salix*, *Rubus*, *Rhododendron*, *Castanea*, *Oplismenus*, *Zelkova*, and *Chaenomeles*.

The Broad East-Palaearctic chorological subgroup includes 18 Nepticulidae species: *Stigmella cathepostis* Kemp. & Wilk., *S. monella* Pupl., *S. tranocrossa* Kemp. & Wilk., *S. gimmonella* (Mats.), *S. dentatae* Pupl., *S. aladina* Pupl., *S. omelkoi* Pupl., *S. fumida* Kemp. & Wilk., *S. clisiotophora* Kemp. & Wilk., *S. castanopsiella* (Kuroko), *S. kurokoi* Pupl., *Bohemannia manschurella* Pupl., *B. ussuriella* Pupl., *B. nubila* Pupl., *Ectoedemia scoblei* Pupl., *E. olvina* Pupl., *E. pilosae* Pupl., and *Fomoria hypericifolia* Kuroko. The species of this group have a wide spectrum of host-plants, yet they are mostly trophically associated with plants of *Quercus* and *Acer* genera (Fig. 4).

The Amphi-Palaearctic chorological group. The species of this group are characterized by a disjunct distribution range, one part of which is in the southern or south-eastern part of Europe, including Italy, Slovakia, Czech Republic, Austria, Hungary, and Greece; the other is in East Asia (Russian Far East, north-eastern China, and Korea). The fauna of East Asia has one species belonging to this chorological group, namely *Ectoedemia preisseckeri* (Klim.), which is trophically associated only with the *Ulmus* genus.

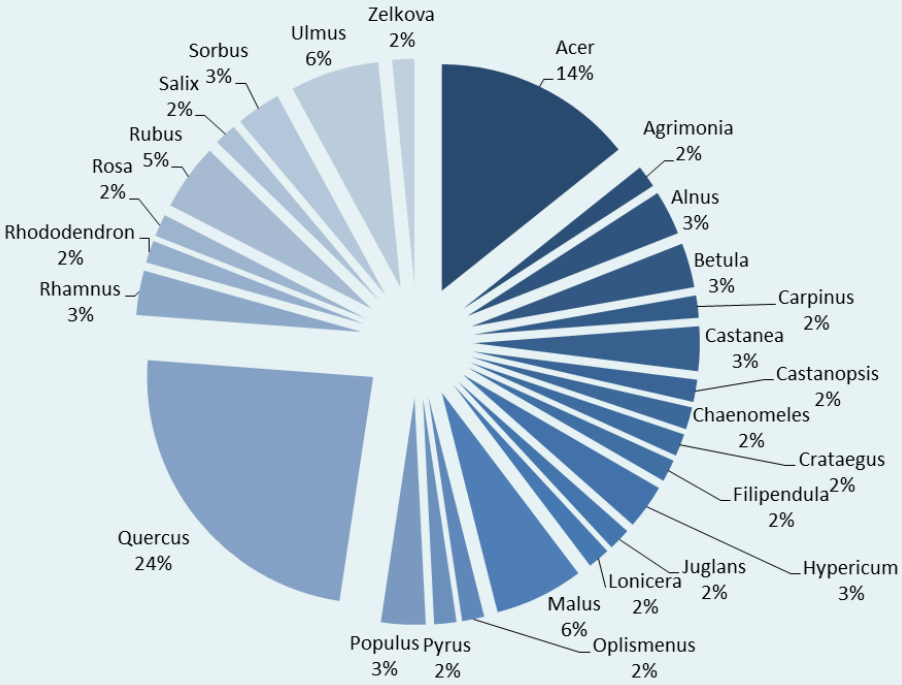

Figure 4. Trophic relationships of the species of the Broad East-Palaearctic chorological subgroup in the fauna of East Asia.

The Trans-Palaearctic chorological group. This group encompasses species with the ranges extending from Europe (through southern Siberia) to East Asia: Russian Far East (Sakhalin and Primorskiy Kray), northern provinces of China and (or) Japan (most often Hokkaido Island). Though we still have no sufficient evidence on the continuous range of the so-called Trans-Palaearctic species, the host-plants of these species do have such distribution ranges. This could be one of the main arguments allowing these species to be called Trans-Palaearctic but not Amphi-Palaearctic (which are characterized by a large gap of the range in the centre of the continent). Currently the Trans-Palaearctic group includes 16 Nepticulidae species of the East Asiatic fauna. The majority of species are trophically associated with Betulaceae: *Stigmella naturnella* (Klim.), *S. betulicola* (Stt.), *S. lutella* (Stt.), *S. sakhalinella* Pupl., *S. continuella* (Stt.); and Salicaceae: *S. assimilella* (Z.), *S. salicis* (Stt.), *S. abliquella* (Hein.), *E. intimella* (Z.), E. *hannoverella* (Glitz); other species are associated with plants of Rosaceae (*S. aurora* Pupl., *S. anomalella* (Göze), *S. thuringiaca* (Petry)), Ericaceae (*S. lediella* (Schl.), *Fomoria weaveri* (Stt.)), and Ulmaceae (*Ectoedemia amani* (Svenss.)) (Fig. 5). Chorologically, *Stigmella anomalella* is one of the most typical species of this group, which has a very broad distribution from the Russian Far East to Europe: Great Britain, Portugal, Finland, France, and the Canary Islands. Probably the most peculiar is the range of *Stigmella lediella*. It covers only the northeastern part of Europe and, most likely, continuously extends through Siberia up to the Russian Far East. In Europe this species is mining only *Ledum*, and in East Asia only various *Rhododendron* plants (Rocienė & Stonis, 2014). Earlier this *Rhododendron*-feeding East Asiatic population was described as two species differing from the European *S. lediella* (Puplesis, 1985); however, later it was proved that their genital structures are identical, and thus the names of both Asiatic species were recognized to be junior synonyms of *S. lediella* (Puplesis & Diškus, 2003).

The Holarctic chorological group. This chorological group encompasses species that have the broadest geographical distribution. The ranges of species extend from Europe to East Asia and North America. The

fauna of East Asia has two species belonging to this chorological group: *Ectoedemia argyropeza* (Z.) and *E. occultella* (L.). The first is trophically associated with plants of the genus *Betula*, the other with *Populus*. Though the leaf-mining *Ectoedemia argyropeza* may have been introduced into North America accidentally (with host-plants), we have no evidence to confirm or deny this assumption so far.

The highest diversity of the Nepticulidae species (and endemism) was recorded in the Russian Primorskiy Kray, which is characterized by exceptional biodiversity. Primorskiy Kray is recorded to be inhabited by 69 Nepticulidae species, 57 of which (82%) currently are known as endemic in Primorskiy Kray (Stonis & Rocienė, 2014). Though the overall level of endemism is rather high, 16 species (15%) detected in continental East Asia are distinguished by very broad ranges. *Ectoedemia occultella* (L.) and *E. argyropeza* (Z.) are characterized by Holarctic distribution, and the ranges of other 14 species extend up to Europe. Disclosing the fauna of Siberia might reduce the number of endemic species; however, this enormous region of Asia is still insufficiently studied as regards Nepticulidae.

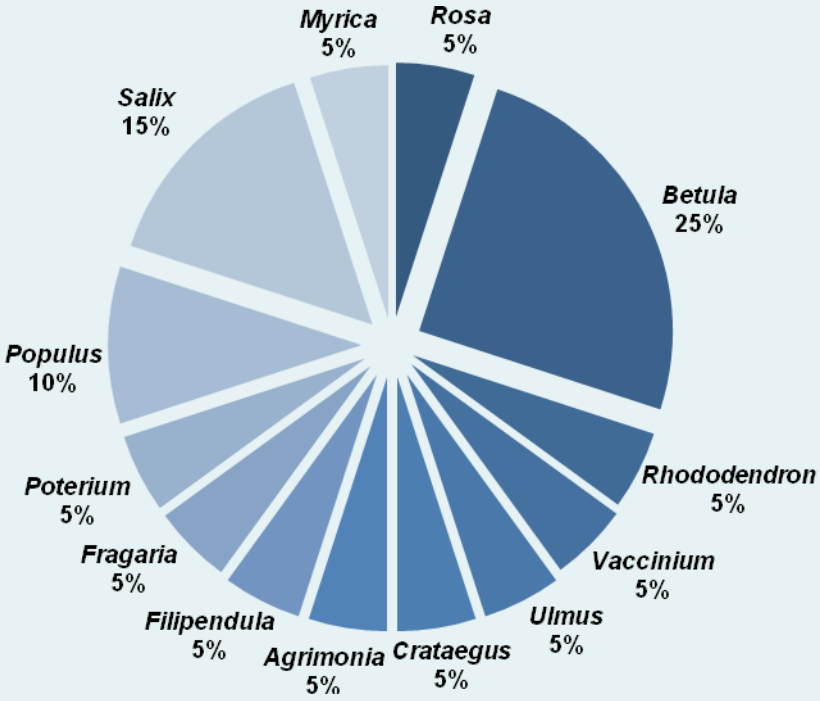

Figure 5. Trophic relationships of the species of the Trans-Palaearctic chorological group in the fauna of East Asia.

The chorological analysis revealed 7 possible vicariants: *Stigmella sexcornuta* Rocienė & Stonis (Primorskiy Kray) is probably a vicariant with *S. azusa* Hirano (Japan), *S. fervida* Pupl. (Primorskiy Kray) with *S. hisakoae* Hirano (Japan), *S. nostrata* Pupl. (Primorskiy Kray) with *S. zumii* Kemp. & Wilk. (Japan), *S. palionisi* Pupl. (Primorskiy Kray) with *S. nakamurai* Kemp. & Wilk. (Japan), *S. palmatae* Pupl. (Primorskiy Kray) with *S. filipendulae* (Wocke) (Europe), *Bohemannia ussuriella* Pupl. (Primorskiy Kray) with *B. nipponicella* Hirano (Japan), and *B. piotra* Pupl. (Primorskiy Kray) with *Bohemannia pulverosella* (Stt.) (Europe).

Recent designation of the *cornuta* species group (Stonis *et al.*, 2013) is based on *Stigmella cornuta*, a species that we recently discovered in China. In the male genitalia, the *cornuta* group exibit some similarity

to the non *Quercus*-feeding *betulicola* group: the apically narrowed valva with a chitinized apical papilla, the interrupted transverse bar of transtilla, the broad lobate vinculum, and the weakly individualized lobes of uncus (Stonis *et al*., 2013). A cladistic analysis of the species of the *Stigmella betulicola* group and *S. cornuta* detected in East Asia showed that *S. cornuta* does not belong to the *S. betulicola* group but is a representative of a separate (independent) group of species, supported by at least 9 autapomorphic characters. The most important of them are the following: the development of very large cornuti in phallus, trophic specialization (Fagaceae: *Quercus* mining), and the mine type (combined leaf-mines).

CONCLUSIONS

1. After the addition to the East Asiatic fauna of the formerly European *Stigmella thuringiaca* (Petry), the synonymization of *Stigmella regina* and *Ectoedemia laura*, the description of six new species, a total of 110 Nepticulidae species belonging to 5 genera: *Stigmella* (69 species), *Bohemannia* (6), *Ectoedemia* (27), *Fomoria* (3), and *Etainia* (5), were discovered in East Asia.

2. Chorological analysis of the fauna showed that species detected in East Asia belong to 4 chorological groups. Most of them (91 species) belong to the East-Palaearctic group, yet on the basis of a more detailed analysis of distribution ranges this group can be split into three subgroups, the largest of which is the Continental East-Palaearctic subgroup (43 species).

3. The smallest chorological groups in East Asia include species with the broadest distribution ranges (the Holarctic and Amphi-Palaearctic).

4. A comparison of chorological analysis with trophic relationships of species revealed that species with East-Palaearctic distribution are mostly trophically associated with plants of *Quercus*, *Acer*, *Malus*, and *Ulmus*, whereas species with Trans-Palaearctic distribution are chiefly mining the *Betula, Salix*, and *Populus* plants.

5. The recently designated *cornuta* group has common characters with another *Stigmella* group (the *betulicola*), however, the newly designated group is a separate (independent) evolutionary clade supported by at least 9 autapomorphic characters (including the specific shape and very large size of cornuti, specific shape of gnathos with partly reduced caudal processes, unique leaf-mines with the final part widening into a large blotch; the combined leaf-mines are unique among all other species of the *Stigmella* genus trophically associated with the Fagaceae plants). In total, the species of *Stigmella* from East Asia can be assigned to 18 different species groups.

ACKNOWLEDGEMENTS

The authors acknowledge the hospitality, friendly cooperation and valuable advice of the Head of the Laboratory DSc. S. Yu. Sinev, Dr. A. L. Lvovsky, Dr. S. V. Baryshnikova and Dr. V. G. Mironov during Agnė Rocienė' visit at the Institute of Zoology of the Russian Academy of Sciences (St. Petersburg). The first author A. Rocienė is thankful to Prof. Dr. P. S. Zorikov, the Director of the Gornotayezhnoe Scientific Station of the Far Eastern Division of the Russian Academy of Sciences (Primorskiy Kray), for the possibility to carry out her research and for the technical equipment during the field and laboratory work in 2011. She also

thanks Dr. M. M. Omelko, the Head of the Laboratory of Insect Ecology of the Gornotayezhnoe Station, and his wife Dr. N. V. Omelko, for hospitality and help.

REFERENCES

Diškus, A. & Stonis, J. R. 2012. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships.* Monograph, [in Lithuanian]. Lututė Publishers, Kaunas. 220 pp.

Kuznetzov, V. I. & Puplesis, R. 1994. Sem. Nepticulidae (Stigmellidae) – moli-malyutki (in Russian). *In*: Kuznetzov, V. I. (ed.). *Nasekomye i kleshchi – vrediteli sel'skokhozyaistvennykh kul'tur.* Cheshuekrylye [*Insects and mites – pests of agricultural plants*. Lepidoptera], 3 (1): 12–23. Nauka Publishers, St. Petersburg.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp., figs 612.

Puplesis, R. & Robinson, G. S. 2000. A review of the Central and South American Nepticulidae (Lepidoptera) with special reference to Belize. *Bulletin of the Natural History Museum, London* (*Entomology*), 69 (1): 1–114.

Puplesis, R. 1994. *The Nepticulidae of Eastern Europe and Asia: western, central and eastern parts*. Backhuys Publishers, Leiden. 552 pp., figs 840.

Rocienė, A. & Stonis, J. R. 2013. Nepticulidae (Lepidoptera) of East Asia (2). Study of a collection sample deposited at the Russian Academy of Sciences, with descriptions of new species and a checklist. *Zootaxa*, 3652 (2): 75–116.

Šimkevičiūtė, A., Stonis, J. R. & Sruoga, V. 2010. Male genitalia characters and their diagnostic value in taxonomy of Nepticulidae (Insecta, Lepidoptera). *V International Conference of Naturalists 'From Biotechnology to Environment Protection'*: 44 p. University of Zielona Gora Publishers, Zielona Gora.

Stonis, J. R. & Rocienė, A. 2013. Nepticulidae (Lepidoptera) of East Asia (1). Re-examination of the male genitalia of types deposited at the Russian Academy of Sciences. *Zootaxa*, 3652 (1): 1–59.

Stonis, J. R. & Rocienė, A. 2014. Additions to the Nepticulidae (Lepidoptera) of East Asia, with descriptions of three new species from Primorskiy Kray. *Zootaxa*, 3846 (2): 204–220.

Stonis, J. R. 2010. Kodėl taksonominiai biologinės įvairovės tyrimai svarbūs Lietuvai? *Mokslo Lietuva*, 8: 1, 6.

Stonis, J. R., Diškus, A. & Navickaitė, A. 2012a. Nepticulidae tyrimų metodai. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships.* Monograph, [in Lithuanian]. Lututė Publishers, Kaunas. 38–59 p.

Stonis, J. R., Diškus, A., Navickaitė, A., Remeikis, A. & Rocienė, A. 2012b. Morfologiniai Nepticulidae požymiai, naudojami identifikuojant taksonus ir paremiantys šiuolaikinę šeimos sistemą. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships.* Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 60–72 p.

Stonis, J. R., Diškus, A., Remeikis, A. & Navickaitė, A. 2014. Study methods of Nepticulidae: micro-mounts of genitalia structures. *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics.* Edukologija Publishers, Vilnius. 32–35 p.

Stonis, J. R., Diškus, A., Remeikis, A., Navickaitė, A. & Rocienė, A. 2013. Description of new species of oak leaf-miners (Lepidoptera: Nepticulidae), with notes on the species groups of *Stigmella* Schrank associated with *Quercus* as a host-plant. *Zootaxa*, 3737 (3): 201–222.

HOW GOOD ARE THE GROUND BEETLES (COLEOPTERA, CARABIDAE) AS INDICATORS OF BIODIVERSITY IN THE EXAMPLE OF THE KURTUVĖNAI REGIONAL PARK, LITHUANIA

Jacek Twardowski[1], Jacek Jackowski[1] & Raimonds Cibuļskis[2]

[1]Wrocław University of Environmental and Life Sciences, Wrocław, Poland

[2]Daugavpils University, Daugavpils, Latvia

INTRODUCTION

Ground beetles are one of the key groups of organisms in different ecosystems, well reflecting the environmental conditions of their habitat. This coleopteran group is also thought to be an important component of both wild and cultivated areas, contributing to the regulation of prey species and to the biological control of pests and even playing a role in the improvement of physical soil conditions (Thiele, 1977). In arable fields they often act as generalist predators of many crop pests, with great potential to reduce their abundance (Holland, 2002). Ground beetles' contribution to biodiversity, as they are a species-rich arthropod family, also results from their relatively high biomass and, usually, high number of species collected in a particular area.

In Lithuania, 323 species from Carabidae family have been recorded until now, and a further 69 are expected (Tamutis *et al.*, 2011). They are also widely distributed and relatively abundant which means that they meet the criteria of a good bioindicator (Luff, 2002). This group of bioindicators constitutes measurable component of the environments, which provide a rapid, cost-effective and simplified system to gather complex information about the ecosystems in which they occur, and about human-environment interactions (Rainio & Niemelä, 2003). Thus soil-dwelling, adult Carabidae have been identified as good candidates for evaluating the potential differences amongst the habitats found in the Kurtuvėnai Regional Park.

STUDY LOCALITY AND METHODS

This very preliminary study was designed to examine the suitability of ground beetles as bioindicators. A trial was conducted in late spring 2014, in the protected area of the Kurtuvėnai Regional Park. The park was created in order to protect the hilly landscape of Kurtuvėnai and its forested and lakeside surroundings. The park area covers 17.252 ha and ca. 80% of this territory is covered with forest. Rivers and lakes cover

2.8% of the land area. The territory of the park is divided into several zones, where different limitations are applicable: conservation (nature reserves), ecological priority (preservation), recreation, economic (forestry, agriculture) and living zones. For our analysis four habitats were taken: dry meadow (created by xerothermophile flora, mainly perennial with predominant grasses), a semi-wetland meadow with high groundwater horizon throughout much of the year, coniferous forest, and riparian habitat stretching along a lake. Beetles were collected using plastic pitfall traps of 9 cm diameter, filled with ethylen glycol as a preservative. Five traps were arranged in each habitat. The ground beetle species collected by the traps were all identified to species level and their nomenclature in the present paper follows that used in the key of Hurka (1996).

RESULTS

It was shown that the forest habitat harboured a greater abundance and diversity of ground beetles. Analysis of species composition reflects the fact that this area is occupied by *Pterostichus oblongopunctatus* or *Carabus hortensis*, both species being typical in this case. In each of the habitat eurytopic species were identified as well, such as *Pterostichus melanarius*, *Bembidion lampros*, *B. properans*, *Pterostichus strenuus* or species representing the genus of *Amara*. In a small number *Pterostichus aethiops*, *Carabus granulatus*, *Cychrus caraboides*, *Leistus ferrugineus*, *Poecilus lepidus*, *P. versicolor* and *Dyschirius* spp. were noted. The riparian habitat was the poorest with respect to both number and species richness.

DISCUSSION

Although one of the primary goals undertaken in research on bioindicators, namely the identification of taxonomic units, has therefore already been accomplished, in order to take a real picture of these briefly scanned habitats, considerably longer study should be performed. We conclude that ground beetles are useful bioindicators but, as crucial understanding of their relationship with other species is incomplete, they should be used in that role with caution.

REFERENCES

Holland, J. M. 2002. Carabid beetles: their ecology, survival and use in agroecosystems. *In:* Holland J. M. (ed.). *The agroecology of carabid beetles*. Intercept, Andover. 1–40 p.

Hůrka, K. 1996. *Carabidae of the Czech and Slovak Republics*. Kabourek, Zlin. 565 pp.

Luff, M. 2002. Carabid assemblage organization and species composition. *In:* Holland J. M. (ed.). *The agroecology of carabid beetles*. Intercept, Andover. 41–80 p.

Rainio, J. & Niemelä, J. 2003. Ground beetles (Coleoptera: Carabidae) as bioindicators. *Biodiversity and Conservation*, 12: 487–506.

Tamutis, V., Tamutė, B. & Ferenca, R. 2011. A catalogue of Lithuanian beetles (Insecta, Coleoptera). *ZooKeys*, 121: 1–494.

Thiele, H. U. 1977. *Carabid beetles and their environments*. Springer-Verlag, Berlin. 369 pp.

THE FIRST PHOTOGRAPHIC DOCUMENTATION AND NEW DATA ON *ENTEUCHA GUAJAVAE* (LEPIDOPTERA, NEPTICULIDAE), A PEST OF GUAVA FROM EQUATORIAL AMERICA

Andrius Remeikis[1], Jonas R. Stonis[2], Arūnas Diškus[2] & Donald R. Davis[3]

[1] *Nature Research Centre, Vilnius, Lithuania*

[2] *Lithuanian University of Educational Sciences, Vilnius, Lithuania*

[3] *National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA*

INTRODUCTION

Pygmy moths (Nepticulidae) are economically important because these insects are often recognized as pests or potential pests (dozens of species have been listed as pests of cultivated plants, see Kuznetzov & Puplesis, 1994). This article deals with a previously poorly known leaf-miner of *Enteucha* Meyrick, a pest of guava.

The common guava (*Psidium guajava,* Myrtaceae) (or *guayaba* in Spanish) is one of the most popular fruit trees (particularly in Latin America). The guava is widely cultivated in tropical and subtropical regions around the world, although it is native to the Neotropics (Central America and probably more widespread). It is an evergreen small tree or shrub, which florishes in a moist tropical environment but can tolerate drought conditions.

The small genus *Enteucha*, belonging to the plant-mining (predominantly leaf-mining) family Nepticulidae, includes several described species, the majority of which are known from the Neotropics: *E. cyanochlora* Meyrick, 1915; *E. gilvafascia* (Davis, 1978); *E. hilli* Puplesis & Robinson, 2000; *E. contracolorea* Puplesis & Robinson, 2000; *E. terricula* Puplesis & Robinson, 2000; *E. snaddoni* Puplesis & Robinson, 2000; *E. acuta* Puplesis & Diškus, 2002; and *E. guajavae* Puplesis & Diškus, 2002 (Puplesis & Robinson, 2000; Puplesis *et al*., 2002b). Although the biology and host-plants of most of the species are still unknown, the latter species – *E. guajavae* – was described from reared material as a monophagous leaf-miner on *Psidium guajava* (Puplesis *et al*., 2002a). To date this is only guava-feeding species among Nepticulidae; however, after the species first discovery in 2001, no more data on *E. guajavae* have been published or collected. Our recent searches for plant-mining larvae on *Psidium guajava* in Bucay (a type locality of *E. guajavae*) and other localities of central Ecuador, Colombia, Guatemala, and Mexico have brought no results (except for a few empty old leaf-mines observed at the type locality in March–April 2005 and 2007). This could be because our searches were either too sporadic (seldom and unfocused) , or because of the restricted distributions of the species.

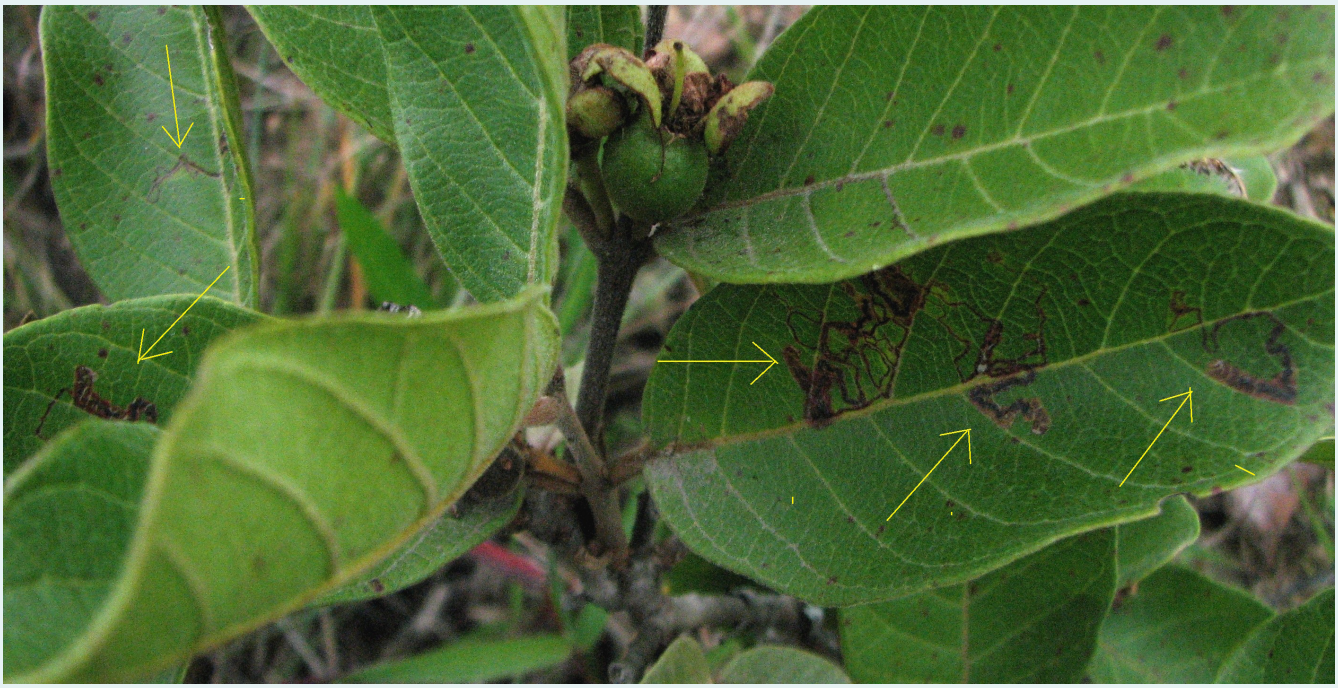

Figure 1. Leaf-mines on common guava (Loja province, southern Ecuador, 2014).

A recent business trip to *La Universidad Técnica Particular de Loja* (southern Ecuador), undertaken in February 2014 by the first two authors, has resulted in the rediscovery of *E. guajavae* and revealed new data on the species biology, distribution and female morphology.

In the original description of the species (see Puplesis *et al.*, 2002a), the ink drawings of the genitalia are quite accurate but they did not show all details of the female genitalia or leaf-mines. Here, on the basis of new material, we present a re-description of *E. guajavae*, with the first photographic documentation of the leaf-mines, adults, and genitalia.

METHODS

Collecting methods and protocols for species identification and description are outlined in Puplesis & Diškus (2003), Diškus & Stonis (2012), and Stonis *et al.*, 2014. After maceration of the abdomen in 10% KOH and subsequent cleaning, male genital capsules were removed from the abdomen and mounted ventral side uppermost. The phallus was removed and mounted alongside the genital armature. Female genitalia were removed entirely from the abdomen, cleaned and mounted ventral side uppermost. Genitalia and abdominal pelts of both sexes were stained with Chlorazol Black (Direct Black 38/Azo Black), and mounted in Euparal.

Permanent slides were photographed and studied using a Leica DM2500 microscope and Leica DFC420 digital camera. The descriptive terminology of morphological structures follows Puplesis & Robinson (2000), except for the term 'aedeagus', which is refered here as 'phallus'. For an evaluation of occurence of the species, the 'Formula of Evaluation of Abundance of Leaf-miners' was followed (see Stonis *et al.*, 2012: 52–54; Stonis *et al.*, unpublished).

Abbreviation for specimen depository: LEU – Lithuanian University of Educational Sciences (formerly VPU), Vilnius, Lithuania; ZMUC – Zoological Museum, University of Copenhagen, Denmark.

RE-DESCRIPTION OF *ENTEUCHA GUAJAVAE* PUPLESIS & DIŠKUS, 2002

Diagnosis. Very distinctive species; from other species of *Enteucha* it differs strongly by the presence of two distinctive forewing fasciae. In the male genitalia, this species is easily distinguishable by the shape of the gnathos (an inverted 'V'). In the female genitalia, it differs from other known *Enteucha* by the oval signum formed by a group of numerous, large, blunt pectinations. The host-plant (*Psidium guajava*) may also make this species distinctive, but as very little is known about the biology of other *Enteucha* it is uncertain how atypical the utilisation of Myrtaceae might be (Puplesis *et al*., 2002a).

Male (Fig. 2). Forewing length: 1.4–1.6 mm. Wingspan: 3.1–3.6 mm. Head: palpi brownish cream or cream; frontal tuft ochreous orange or orrange; collar cream; eye-caps cream and glossy; flagellum of antenna fuscous dorsally and grey ventrally, comprising of about 21–24 segments (Puplesis *et al*., 2002a). Thorax and tegulae fuscous with some purple iridescence; forewing of same colour, with two striking shiny silvery (or golden glossy) fasciae: basal fascia almost half the width of postmedial. Cilia greyish with distinct dark cilia-line. Venter of forewing fuscous. Venation with Sc, four radials, one medial, but no cubital vein (see Puplesis *et al*., 2002a: fig. 2). Hindwing lanceolate, covered with brownish cream or beige androconial scales (especially dense on venter of wing, making the hindwing the same colour as the venter of the abdomen); cilia of hindwing grey. Legs brownish cream, darkened with fuscous brown dorsally. Abdomen fuscous dorsally but ochreous cream ventrally (Puplesis *et al*., 2002a).

Female. Hindwing grey. Otherwise as in male.

Male genitalia (Fig. 3). Capsule 320–285 µm long. Tegumen band-like, distally broadly rounded. Uncus with two short but broad, weakly papillated sublateral lobes. Gnathos very slender, in shape of inverted 'V'; caudally directed portion weakly sclerotized and rounded; lateral arms long and slender. Valva 140–155 µm long; slender (except the base), curved inwardly, with long, slender, strongly chitinized apical process (Fig. 3D). Transtilla with a weakly chitinized transverse bar and short, slender, strongly chitinized sublateral processes (Fig. 3C); in type series specimens (Puplesis *et al*., 2002a: fig. 21), valva additionally connected ventrally by ventral sclerite which is fused with vinculum plate. Juxta weakly developed and without clearly defined shape (or indistinct). Ventral plate of vinculum very long and broad, widely rounded distally; no anterior excavation nor lateral lobes; caudally directed lateral arms of vinculum usually strongly chitinized and therefore distinct (in contrast to many other nepticulids but not *Enteucha*). Phallus slightly longer than vinculum plate, 195–230 µm long, with one small acute lateral extension at the caudal end (see Puplesis *et al*., 2002a: figs 22–25) or two lateral extensions at the caudal end (Fig. 3B), and with a few (4–5) compactly arranged cornuti; cornuti resemble the 'usual' spine-like ones common in many nepticulids; however, in this species they are weakly defined, sometimes with unsclerotized apices (see Puplesis *et al*., 2002a: figs 22–25) or form a very large horn-like sclerite (Fig. 3B).

Female genitalia (Fig. 4). Total length about 305–365 µm. Abdominal apex very broadly rounded, anal papillae sometimes indistinct. Apophyses anteriores distally with short slender lateral process and large blunt inner lobe (see Puplesis *et al*., 2002a: fig. 90). Apophyses posteriores slender and greatly exceeding apophyses anteriores. Ductus spermathecae originating from a heavily sclerotized and wrinkled area between apophyses posteriores (not visible in Fig. 4A), narrow and long, with 3–3.5 chitinized convolutions;

extending into very large utriculus (Fig. 4A) (possibly broken off and lost in Puplesis *et al.*, 2002a: figs 89, 90). Caudal part of corpus bursae narrow and weakly folded, main body relatively very small, distinctly globular, with an oval signum formed by a group of numerous, large, blunt pectinations (developed/presented in slide no. RA612 but not visible in fig. 4A; well illustrated in Puplesis *et al.*, 2002a: figs 22–25).

Bionomics (Figs 1, 6, 7). Host-plant: *Psidium guajava* L. (Myrtaceae) (Fig. 6B, C). Larva green (Fig. 7), found in January–February (and much earlier); mining leaves. Egg on underside of leaf. Mine slender or very slender, sinuous, from relatively short to long or very long; in dry tropical forest of southern Ecuador on thick-leaved guavas; it usually (but not always) begins on leaf underside (Fig. 7), then continues on upper side of leaf-blade. In the first half of the mine blackish frass can fill most of the width, with narrow but still distinct clear margins remaining; in the second half of the mine frass is deposited as a black narrow central line with broad clear margins remaining; sometimes the central line of frass can be interrupted, but in most examples it forms an uninterrupted line (Fig. 7). Larval exit slit on upper side of the leaf. Cocoon greyish ochreous to grey-brown, flattened, strongly narrowed to the posterior end; length 2.3–2.5 mm, maximal width 1.5 mm (n=19). Voltinism of the species is still unclear. In Bucay (moist premontane forest on western slopes of the Andes, at 700 m), 15 mining larvae in January were found together with a dozen old and very old mines from probably November–December, while in Vilcabamba (dry montane tropical forest in southern Ecuador, at 1800 m) 23 mining larvae (15 of them very young, perhaps of the second, overlapping generation) in February were found together with 200–230 moderately old leaf-mines from probably January–December. Adults from larvae collected in January emerged after 20–25 days (in February) (Puplesis *et al.*, 2002a); adults from larvae collected in February emerged in March.

Distribution (Fig. 5). The type locality is in Bucay area (80 km E of Guayaquil), in western foothills of the Andes (Ecuador) (Fig. 5C – a), but now it has also been discovered in southern Ecuador (near to border of Peru (Figs 5C – b, D, 6A).

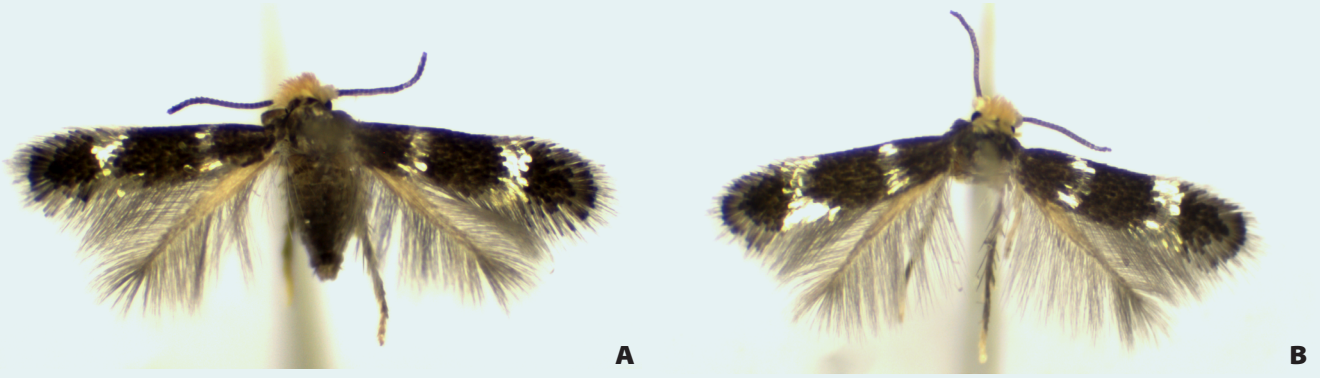

Figure 2. Male adults of *Enteucha guajavae*, wingspan: 3.2–3.5 mm (Loja province, southern Ecuador).

Material examined. ECUADOR: 2♂, 1♀, Loja province, 45 km S of Loja, Vilcabamba, 4°15‘44“S, 79°13‘53“W, elevation ca. 1800 m, mining larvae on *Psidium guajava*, 16–18.ii.2014, leg. A. Remeikis & J. R. Stonis, genitalia slide nos RA611♂, RA 612♀ (LEU, with further re-deposition at ZMUC); 6♂, 2♀ (holotype and paratypes), 80 km E of Guayaquil, Bucay, western foothills of the Andes, elevation ca. 700 m, moist premontane tropical forest and orchards, 16–19.i.2001, leg. R. Puplesis & S. R. Hill, genitalia slide nos AD0340♂ (holotype), AD0341♂ (paratype), AD0342♂ (paratype), AD0343♀ (paratype), AD0344♀ (paratype); forewing venation slide AD0346 (paratype) (LEU, with re-deposition at ZMUC).

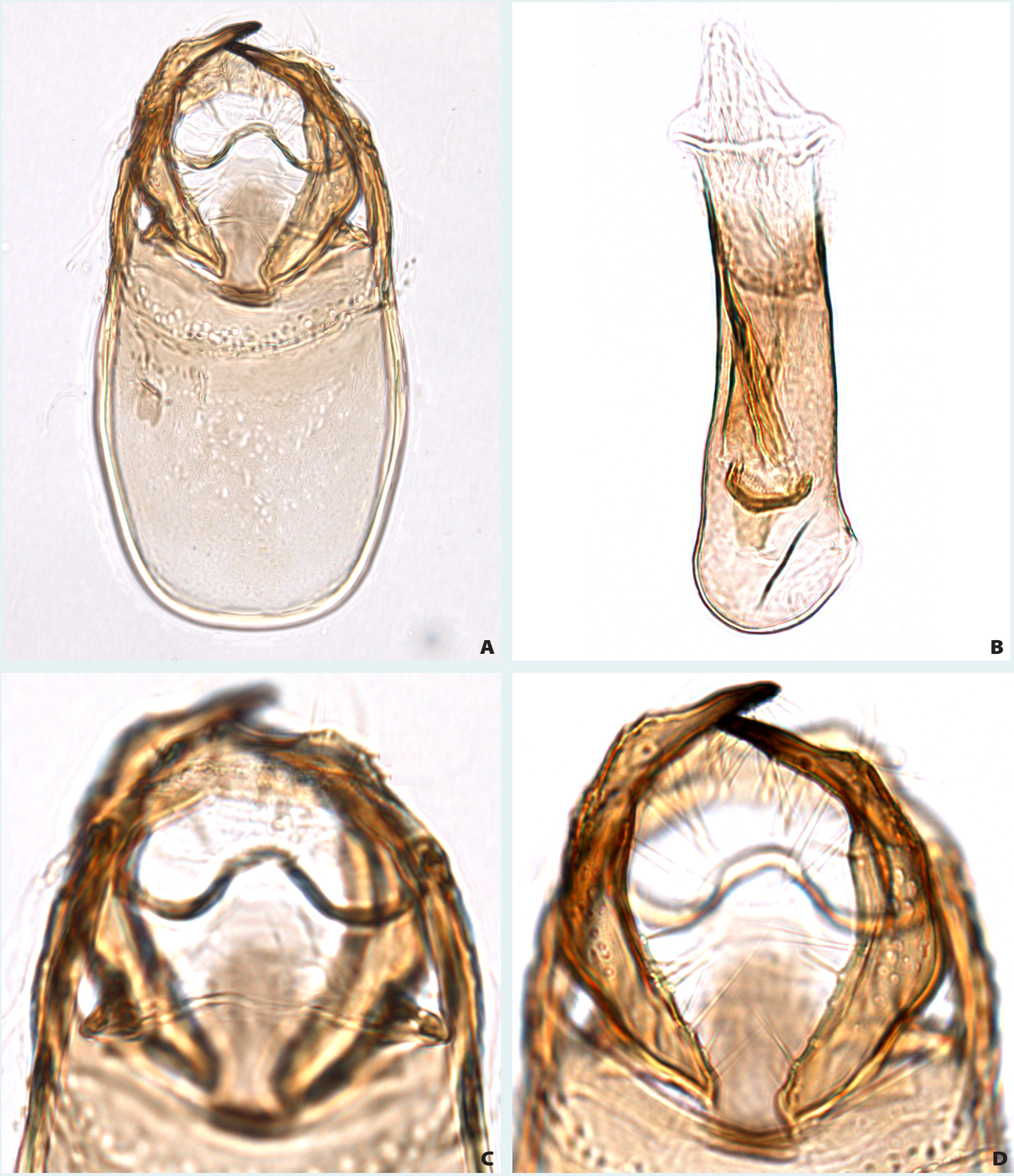

Figure 3. Male genitalia of *Enteucha guajavae*, Loja province, southern Ecuador, genitalia slide no. RA611 (LEU, with further re-deposition at ZMUC): A – capsule (250 µm long); B – phallus; C, D – caudal part of capsule, dorsal (C) and ventral view (D).

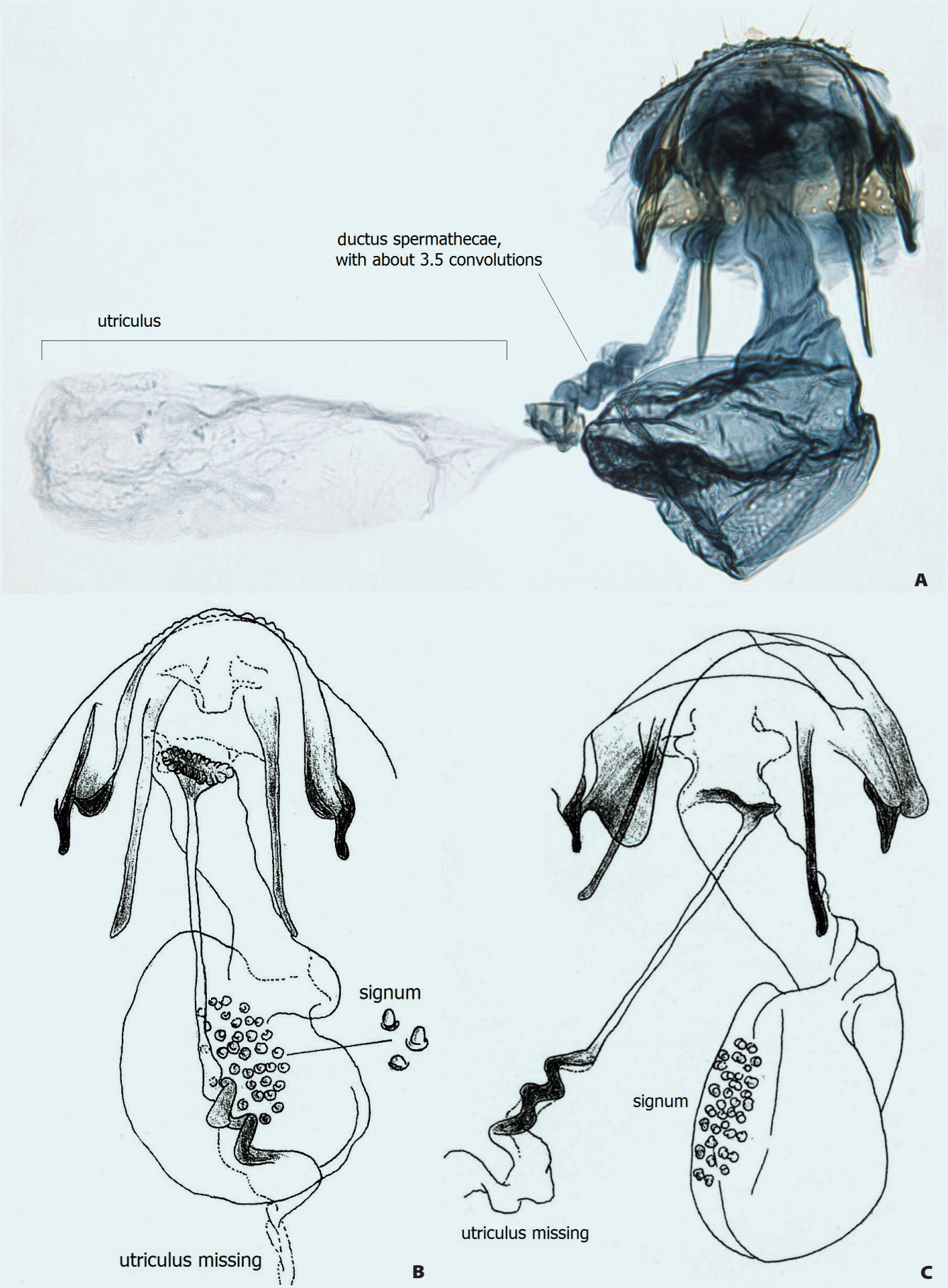

Figure 4. Female genitalia of *Enteucha guajavae* (LEU, with further re-deposition at ZMUC): A – photographic image, Loja province, southern Ecuador, genitalia slide no. RA612; B, C – drawings in ink (after Puplesis *et al.*, 2002a), Bucay area, central Ecuador.

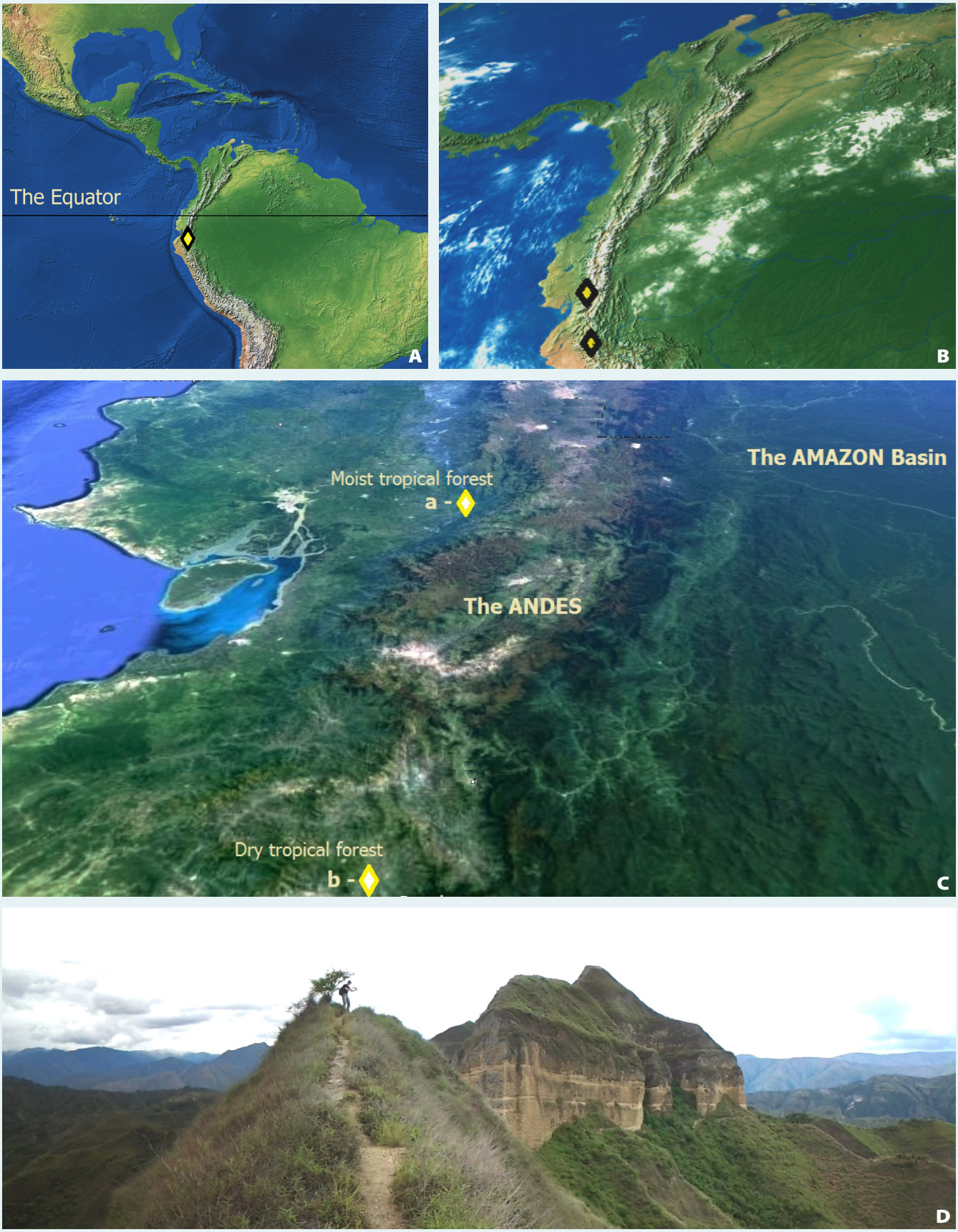

Figure 5. Maps and locality: A, B – general maps (courtesy of T. Patterson, USA), with indication of distribution of *Enteucha guajavae*; C – observation and collecting sites (courtesy of Google Maps) (a – Bucay area, 80 km E of Guayaquil, Ecuador, 2°11'39"S, 79°10'18"W, elevation ca. 700 m, moist tropical premontane forest; b – Vilcabamba, 45 km S of Loja, Ecuador, 4°15'44"S, 79°13'53"W, elevation ca. 1800 m, dry or semi dry tropical montane forest); D – western slopes of Vilcabamba valley and Mount Mandango overgrown with *Psidium guajava* L., 45 km S of Loja, Ecuador.



Figure 6. Habitat and host-plant of *Enteucha guajavae* : A – dry tropical montane forest on western slopes of Vilcabamba valley (south-eastern exposition), elevation 1800 m, 45 km S of Loja, Ecuador; B, C – host-plant *Psidium guajava* L. (Myrtaceae).

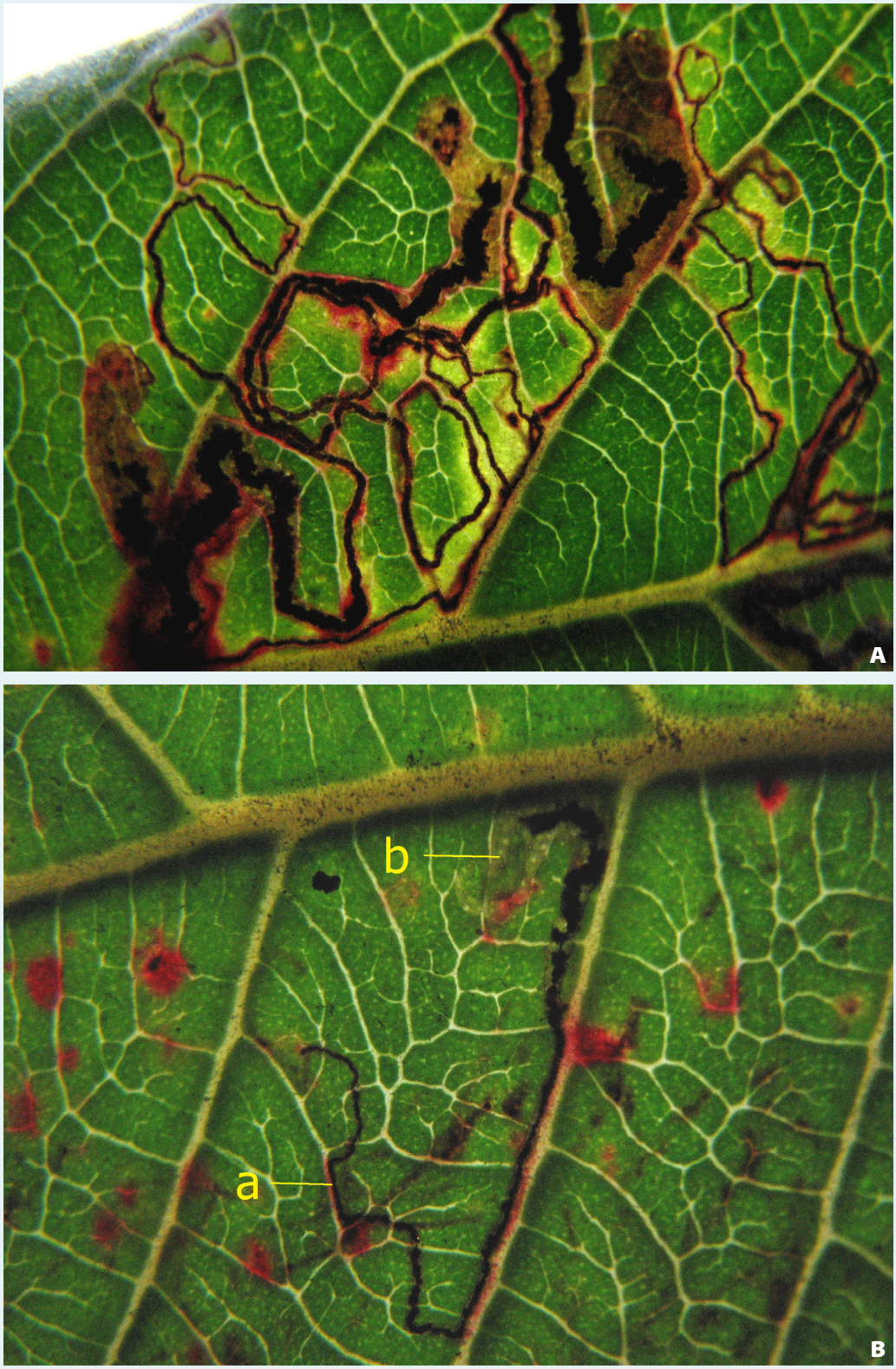

Figure 7. Leaf-mines of *Enteucha guajavae* on *Psidium guajava*, Vilcabamba, 45 km S of Loja, southern Ecuador (a – initial part of leaf-mine on underside of leaf-blade; b – bright green feeding larvae).

DISCUSSION

The species occurs both in moist tropical premontane (Fig. 5C-a; also see Puplesis *et al*., 2002a: fig. 101) and dry tropical montane forest (Figs 5C-a, D, 6A), and orchards. Earlier it was supposed (Puplesis *et al*., 2002a) that *E. guajavae* might be quite common on cultivated guava in Ecuador; however, most of our unfocused,

limited search for mining larvae on cultivated *Psidium guajava* in various localities of Ecuador, Colombia, Guatemala and Mexico has not yielded any results.

After the 'Formula of Evaluation of Abundance and Occurrence of Leaf-miners' (see Stonis *et al*., 2012: 52–54; Stonis *et al*., unpublished), *E. guajavae* is not rare in moist tropical premontane forest habitat (Bucay, fig. 12a): limited in distribution but abundant (more than 25 leaf-mines recorded at a single site); in dry tropical montane forest habitat (Vilcabamba, figs 5D, 6A) it is very common: widespread and extremely abundant (more than 200–250 leaf-mines recorded at a single site).

Among the most interesting observations in this re-discovery of *E. guajavae* are: 1) the species occurrence in both moist and dry tropical habitats; 2) peculiar mining: the leaf-mine on thick-leaved guavas usually starts on underside of leaf-blade; 3) well-developed utriculus in female genitalia, similar or homologous to the structure presented in females of all species of a new *Stigmella* group from Patagonia (Stonis *et al*., in press).

REFERENCES

Diškus, A. & Stonis, J. R. 2012. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 220 pp.

Kuznetzov, V. I. & Puplesis, R. K. 1994. Sem. Nepticulidae (Stigmellidae) – moli-malyutki (in Russian). *In*: Kuznetzov, V. I. (ed.). *Nasekomye i kleshchi – vrediteli sel'skokhozyaistvennykh kul'tur*. Cheshuekrylye [*Insects and mites – pests of agricultural plants*. Lepidoptera, in Russian], 3 (1): 12–23. Nauka Publishers, St. Petersburg.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp., figs 612.

Puplesis, R., Diškus, A. & Robinson, G. S. 2002a. New Neotropical Nepticulidae (Lepidoptera) from the western Amazonian rainforest and the Andes of Ecuador. *Bulletin of the Natural History Museum, London* (Entomology), 71 (1): 19–58.

Puplesis, R., Diškus, A., Robinson, G. S. & Onore, G. 2002b. A review and checklist of the Neotropical Nepticulidae (Lepidoptera). *Bulletin of the Natural History Museum, London* (Entomology), 71 (1): 59–76. http://dx.doi.org/10.1017/S0968045402000032

Puplesis, R. & Robinson, G. S. 2000. A review of the Central and South American Nepticulidae (Lepidoptera) with special reference to Belize. *Bulletin of the Natural History Museum, London* (*Entomology*), 69 (1): 1–114.

Stonis, J. R., Diškus, A. & Navickaitė, A. 2012. Nepticulidae tyrimų metodai. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships.* Monograph, [in Lithuanian]. Lututė Publishers, Kaunas. 38–59 p.

Stonis, J. R., Diškus, A., Remeikis, A. & Navickaitė, A., 2014. Study methods of Nepticulidae: micro-mounts of genitalia structures. *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics*. Edukologija Publishers, Vilnius. 32–35 p.

LITHUANIAN ENTOMOLOGICAL SOCIETY: ACTIVITIES, CHALLENGES AND PROSPECTS

Andrius Petrašiūnas

Lithuanian Entomological Society and Vilnius University, Vilnius, Lithuania

The Lithuanian Entomological Society was established on November 3rd 1965 and initially had 38 members. Only people with a scientific degree, equal to that of a PhD, were accepted for membership. For thirty years after its establishment the Society was chaired by Dr. P. Zajančkauskas (1965–1995), followed by several terms by prof. A. Skirkevičius (1995–2001), Dr. D. Dapkus (2001–2011) and has been chaired by Dr. A. Petrašiūnas since 2011.

Currently the Society consists of 78 members with 15 of them being honorary members (older than 70). Forty seven members have a PhD or higher degree and 31 are amateurs enthusiasts.

The biggest group of people, based on object of their research, is the group of those interested in Lepidoptera (16 members) followed by the group of those who work in different areas of applied entomology – agricultural, forest or medical entomology (13 members) and people interested in beetles (11 members). The biggest of the smaller teams are those working on Diptera (4 members) and Hymenoptera (4 members) while all other members are specialists of Hemiptera, Odonata, Trichoptera and other insect orders with two members working on Mollusca, two on spiders and several more being photographers.

The Lithuanian Entomological Society has bi-annual meetings. One in June being a two-day expedition to a regional, national park or other interesting place and the other one in November or December in indoors somewhere, such as a museum or university.

The Society, together with the Institute of Zoology and Parasitology (Later – Institute of Ecology, Nature Research Center), published 14 volumes of 'New and Rare for Lithuania Insect Species. Records and Descriptions' in 1982–1995. The journal was renewed in 2003 continuing with volume 15. It is since published yearly and is referred to by the Zoological Record database. The Lithuanian Entomological Society also published 12 volumes of 'Acta Entomologica Lituanica' during the period of 1970 to 1994 until it was incorporated into 'Acta Zoologica Lituanica' in 1994, which became 'Zoology and Ecology' in 2012.

Other activities of the Society are diverted towards education of the public about different aspects of entomology. One of the traditional activities is the 'Insect of the Year campaign' that was started in 2002. General society is asked to observe their closest surroundings and look for particular insects or arthropods. The first object of interest in 2002 was the old world swallowtail (*Papilio machaon*). Later other rare or

otherwise notable arthropods followed: stag beetle *Lucanus cervus* (2003), wasp spider *Argiope bruennichi* (2005), band winged grasshoppers *Oedipoda* (2008), blister beetles *Meloe* (2009), green shield bug *Palomena prasina* (2010), paper wasps *Polistes* (2011), robber flies *Laphria* (2012), chaffer beetle *Oxythyrea funesta* (2013) and Arran brown *Erebia ligea* (2014).

Other educational activities include a 'Grant for young researchers' that is awarded to students doing research in the area of entomology and 'School of young entomologists' that was organized in 2008–2010 for young people interested in entomology.

The Society is a member of the Coalition of NGO's for Nature Protection and takes part in discussions on new laws or other questions of nature protection.

The main challenges that the Lithuanian Entomological Society face these years are interrelated with the situation in secondary education where the number of lessons on biodiversity is diminishing and so younger generations often lack the basic knowledge of their surroundings. Hence the general interest in entomology is also lower. However, as modern mobile technologies allow the documenting of almost everything that is observed around, entomologists are now more often asked for help in identifying those crawling mysterious creatures. This it is an opportunity for spreading the knowledge of the members of the Society. New specialists of understudied insect groups might appear from such an amateur interest that comes from a genuine curiosity in this wonderful micro-world, if properly guided. All said, the prospects of the Lithuanian Entomological Society are rather good, if emphasis is made on citizen science.

Petrašiūnas, A. 2014. Lithuanian Entomological Society: activities, challenges and prospects. *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics*. Edukologija Publishers, Vilnius. 75–76 p.

GENETIC POLYMORPHISM AT THE CYTOCHROME OXIDASE I GENE: APPLICATION IN BIOSYSTEMATICS OF APHIDS

Jurga Turčinavičienė,

Vilnius University, Vilnius, Lithuania

The idea of biosystematics assumes that evolutionary entities in nature are recognizable equally as well from DNA sequences as from any other evidence in traditional taxonomy. Generally, classifications of aphids have been carried out on the basis of morphology and host plants. In recent years technological advances in molecular biology have greatly impacted the field of taxonomy. For example, mitochondrial genome is an excellent target for genetic analysis because of its lack of introns, limited recombination and haploid mode of inheritance. Application of DNA barcoding is based on the fact that short pieces of mitochondrial DNA cytochrome oxidase I gene can vary a very minor degree within species and variation is much less than between species (Footit *et al*., 2010). Identification of aphid species by this method is very useful but this is not only method employed in taxonomy. DNA taxonomy examples highlight the need to obtain voucher specimens with a known life cycle and host specificity (Turčinavičienė & Rakauskas, 2009). Aphids are phytophagous insects showing divergent evolution through adaptation to different host plants and different life cycles, so morphological characters often vary owing to adaptations to different host plants and geographic isolations, etc. In this case, using DNA characters in a diagnostic context would be entirely compatible with the process of current taxonomic research. Corroboration from more than one line of evidence would serve as a bridge between morphological, ecological and molecular approaches.

Information on mitochondrial DNA could be relevant for inferring phylogenetic relationships of species, genera and higher taxa as well (von Dohlen *et al*., 2006).

Phylogenetic relationships of genera within tribe Aphidini were inferred from partial DNA sequences of mitochondrial cytochrome oxidase I (COI). The intraspecific diversity was low; however genetic differentiation among genera was statistically significant when comparing with intraspecific differences. Analysis of partial sequences recovered well-supported phylogenetic relationships in tribe Aphidini but results would certainly benefit from more species of Aphidini included in the analysis and from the analysis of more genes.

REFERENCES

Dohlen, C. D. von, Rowe, C. A. & Heie, O. E. 2006. A test of morphological hypotheses for tribal and subtribal relationships of Aphidinae (Insecta: Hemiptera: Aphididae) using DNA sequences. *Molecular Phylogenetics and Evolution*, 38: 316–329.

Footit, R. G., Maw, H. E. L., Pike, K. S. & Miller, R. G. 2010. The identity of *Pentalonia nigronervosa* Coquerel and *P. caladii* van der Goot (Hemiptera. Aphididae) based on molecular and morphometric analysis. *Zootaxa*, 2358: 25–38.

Turčinavičienė, J. & Rakauskas, R. 2009. *Macrosiphum* on *Knautia* in Central Europe – molecular data support the synonymy of *M. silvaticum* and *M. knautiae* (Hemiptera Aphididae). *Redia*, 42: 105–116.

Turčinavičienė, J. 2014. Genetic polymorphism at the cytochrome oxidase I gene: application in biosystematics of aphids. *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics*. Edukologija Publishers, Vilnius. 77 p.

THE LEAF-MINING LEPIDOPTERA OF CENTRAL ASIA: 18-YEAR ANNIVERSARY OF THE FIRST REVISED CHECKLIST

Nurgozel Saparmamedova[1], Jonas Rimantas Stonis[2], Arūnas Diškus[2], Remigijus Noreika[2] & Virginijus Sruoga[2]

[1] Toronto, Canada / formerly Institute of Zoology, Turkmenian Academy of Sciences, Asghabat, Turkmenistan

[2] Lithuanian University of Educational Sciences, Vilnius, Lithuania



Figure 1. Major collecting site in western Kopet-Dag (Turkmenistan).

INTRODUCTION

For a long time the fauna of mining Lepidoptera of Central Asia (including Nepticulidae, Opostegidae, Bucculatricidae, Gracillariidae, Elachistidae, etc.) was almost completely unknown. On the other hand, Central Asia represents a huge geographical region, the core region of the Asian continent, with highly specific biomes (Figs 1, 3A, B). The region occupies the territory from Caspia to the Gobi desert. Politically most of this land belongs to Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, Kirgyziya, partially to Armenia and Azerbaijan (i.e. the former states of the Soviet Union) and most of Mongolia & North-West China & Tibet. The remaining territory is divided between eastern Turkey, Iran (except the southernmost parts), northern and central Afghanistan and northernmost Pakistan (Fig. 2A).

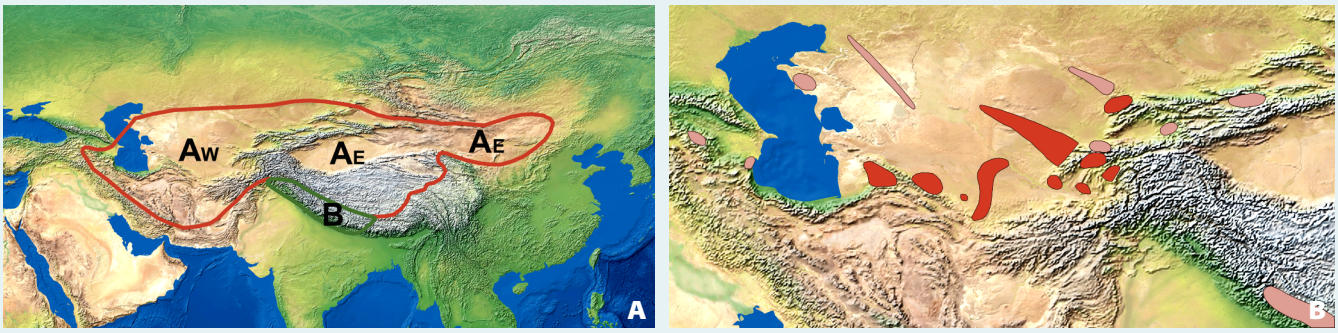

Figure 2. Central Asia: A – the region occupies the territory from Caspia to the Gobi desert; A – collecting sites (dark red; pink – collecting sites of other researchers, including in the adjacent western Himalaya).

REVIEWING THE LEAF-MINING FAUNA OF CENTRAL ASIA

The study of mining Lepidoptera of Central Asia was started by Russian entomologists Filipjev and Gerasimov (see Gerasimov, 1930) and was continued by I. M. Falkovitch, V. I. Kuznetzov, R. Sherniyazova, G. Krasilnikova, S. Yu. Sinev and a few others. The largest increase in the number of Nepticulidae species from Central Asia was provided by the Lithuanian entomological expeditions organized by J. R. Stonis (formerly R. Puplesis) (Puplesis & Diškus, 2003). These expeditions were often fraught with many difficulties, especially in remote areas (Figs 2B, 3C–E).

The first checklist of the leaf-mining Lepidoptera was published in 1996 (Puplesis *et al.*, 1996). This checklist included 194 species belonging to Opostegidae (4 species), Nepticulidae (87), Tischeriidae (6), Gracillariidae (76) and Bucculatricidae (21 species).

During the last 10 years studies of some additional unidentified material from Tajikistan and Turkmenistan have yielded numerous data on the fauna of leaf-mining Lepidoptera of Central Asia, including new host-plant data, new regional records, and even new species (Stonis *et al.*, in prep.).

Unfortunately all species previously published (including those published during the period 1984–1996) were described and illustrated from temporary glycerol slides and using poor quality microscopes. In the original descriptions of these species (even in the later review by Puplesis, 1994) ink drawings of genitalia usually do not show details of genital armature or sometimes are confusing. Therefore we made permanent mounts in Euparal and photographed genitalia slides of the holotypes for the first time. This study is rather significant because without the baseline data providing morphology of genital armature of type material it is impossible to continue studies on the Central Asiatic fauna of leaf-mining Lepidoptera.



Figure 3. Collecting in Central Asia: A – the famous Varzob canyon in Tadzhikistan; B – the Kugitang; C – A. Diškus at long term field work in western Kopetdag in 1992; D, E – R. Noreika and V. Sruoga during motocycle raids in Turkmenistan and Tajikistan.

Among species known as restricted in distribution ranges within Central Asia, 12 distribution groups were recognized (listed according to the number of species):

1) species know from the Turkestan province only (supposed Turkestan endemics);

2) species know from the Persian province only (supposed Persian endemics);

3) species know from the Turan province only (supposed Turan endemics);

4) species of disjunctive Persian-Turkestan distribution (the range being interrupted in Turan);

5) species known from the Tyanshan province only (supposed Tyanshanian endemics);

6) species of broad Persian-Turkestan distribution (i.e. southern Centralasasiatic with obligatory occurrence in Turan);

7) species of Turkestanian-Tyanshanian distribution;

8) species of Persian-Turanian distribution;

9) species of Turanian-Turkestanian distribution;

10) species of Turanian-Gobian (arid Centralasiatic) distribution;

11) species of Persian-Gobian (broadly Centralasiatic) distribution;

12) species of steppe distribution.

These distribution types can be united into a few more generalized groups: Turkestanian distribution (about 22%), Persian distribution (about 14%), Turanian (about 5%), broadly Centralasiatic (about 8%), broadly Turkestanian (about 4%), Tyanshanian (about 3%), and broadly Turanian (about 3%). The remaining species (41%) are more widely distributed than in Central Asia alone.

REFERENCES

Gerasimov, A. M. 1930. Zur Lepidopteren-Fauna Mittel-Asiens. I. Microheterocera aus dem Distrikt Kaschka-Darja (SO-Buchara). *Annuaire du Musée Zoologique de l'Académie des Sciences de l'URSS*, 31 (1): 21–48, pl. 17.

Puplesis, R. 1994. *The Nepticulidae of Eastern Europe and Asia: western, central and eastern parts*. Backhuys Publishers, Leiden. 552 pp., figs 840.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp., figs 612.

Puplesis, R., Diškus, A., Noreika, R. & Saparmamedova, N. 1996. Revised check-list of mining Lepidoptera (Nepticuloidea, Tischerioidea and Gracillarioidea) from Central Asia. *Tijdschrift voor Entomologie*, 139 (2): 191–200.

FAUNA AND BIOGEOGRAPHY OF CHRYSOMELIDAE *sensu lato* (INSECTA: COLEOPTERA) OF LATVIA

Andris Bukejs

Formerly Daugavpils University, Daugavpils, Latvia

Leaf-beetles, represented by 30,000–50,000 species, are one of the largest families of the order Coleoptera worldwide (Bieńkowski, 2004; Jolivet, 1988; Mohr, 1966). The family is also abundant and rich in species in the fauna of Latvia and in the other Baltic States. They are phytophagous: adults mostly occur on leaves and flowers, larvae mostly feed on leaves and roots, occasionally larvae are saprophagous or carpophagous. Some species of leaf-beetles are considered to be serious pests in agriculture and forestry.

The research history of Latvian Chrysomelidae is more than 220 years old (Bukejs, 2008). The first information on leaf-beetles of Latvian fauna was published in the second half of the 18th century in the monograph describing nature of Livland (Fischer, 1778) where three species are mentioned. More than 170 works were published in Latvia subsequently.

The Latvian fauna of leaf-beetles includes 326 species (Bukejs, 2013) belonging to 3 families (Megalopodidae, Orsodacnidae and Chrysomelidae) and 13 subfamilies (Zeugophorinae, Orsodacninae, Bruchinae, Donaciinae, Criocerinae, Cassidinae, Chrysomelinae, Galerucinae, Alticinae, Lamprosomatinae, Cryptocephalinae (incl. Clytrini and Cryptocephalini), Eumolpinae, Synetinae). In Latvian fauna, Megalopodidae and Orsodacnidae contain a small number of species – 5 and 1 respectively, but Chrysomelidae is one of the largest in number of species families of Coleoptera and contains 320 species. The subfamilies Alticinae (125 species), Chrysomelinae (57 species), Cryptocephalinae (incl. Clytrini and Cryptocephalini; 42 species) and Donaciinae (27 species) are predominate.

The Latvian fauna of leaf-beetles is represented by 17 chorotypes (Bukejs, 2012): Cosmopolitan – 4 species (1.23%), Holarctic-Oriental – 1 species (0.31%), Palaearctic-Oriental – 2 species (0.61%), Holarctic – 15 species (4.60%), Palaearctic – 45 species (13.80%), West-Palaearctic – 11 species (3.37%), Asiatic-European – 65 species (19.94%), Siberian-European – 74 species (22.70%), Centralasiatic-Euro-Mediterranean – 23 species (7.06%), Centralasiatic-European – 17 species (5.21%), Turanian-Euro-Mediterranean – 3 species (0.92%), Turanian-European – 13 species (3.99%), European-Mediterranean – 9 species (2.76%), European – 28 species (8.59%), Central-European – 14 species (4.29%), North-European – 1 species (0.31%), and East-European – 1 species (0.31%).



Figure 1. Leaf-beetles: A – *Cassida nebulosa* Linnaeus; B – *Donacia semicuprea* Panzer; C – *Cryptocephalus sericeus* (Linnaeus).

REFERENCES

Bieńkowski, A. O. 2004. *Leaf-beetles (Coleoptera: Chrysomelidae) of the Eastern Europe. New key to subfamilies, genera and species*. Mikron-print, Moscow. 278 pp.

Bukejs, A. 2008. The history of investigations of *Chrysomelidae* sensu lato (Coleoptera) in Latvian fauna. *Acta Biologica Universitatis Daugavpiliensis*, 8 (2): 259–272.

Bukejs, A. 2012. Taxonomical structure and biogeography of leaf-beetles (Coleoptera: Chrysomelidae s. l.) of the Latvian fauna. *Acta Biologica Universitatis Daugavpiliensis*, 12 (3): 25–34.

Bukejs, A. 2013. Catalogue of Latvian leaf-beetles (Coleoptera: Megalopodidae, Orsodacnidae & Chrysomelidae). *Latvijas Entomologs*, 52: 3–57.

Jolivet, P. 1988. Food habits and food selection of Chrysomelidae. Bionomic and Evolutionary Perspectives. *In:* Jolivet, P., Petitpierre, E. & Hsiao, T. H. (eds). *Biology of Chrysomelidae*. Kluwer Academic Publishers. 1–24.

Mohr, K. H. 1966. 88 Familie: Chrysomelidae. *In:* Freude, H., Harde, K. W. & Lohse, G. A. (eds). *Die Käfer Mitteleuropas. Band 9, Cerambycidae, Chrysomelidae*. Goecke & Evers, Krefeld. 1–299.



Figure 2. Leaf-beetles: A – *Gonioctena viminalis* (Linnaeus); B – *Galerucella nymphaeae* (Linnaeus); C – *Chrysomela populi* Linnaeus; D – *Leptinotarsa decemlineata* (Say).

LEPIDOPTERAN DIVERSITY AND PHYLOGENY: 15 YEARS AGO AND NOW

M. Alma Solis

Smithsonian Institution / United States Department of Agriculture, Washington, D.C., USA

In 1999, Solis & Pogue wrote a paper entitled 'Lepidopteran Biodiversity: Patterns and Estimators'. They pointed out that the relationships in the lower Lepidopteran taxa and species numbers (around 2,035 species) were well known (Fig. 1 of Solis & Pogue, 1999) in comparison to rest of the Lepidopteran tree. But as you go up the evolutionary tree of moths and butterflies relationships and species richness became less clear. In the Ditrysia (Figs 2 and 3) relationships between very large lepidopteran taxa were almost unknown and the number of species were broad estimates or guesses by one or two lepidopterists that ranged from 140,465 species to 480,465 species.

Recently, phylogenetic analyses at higher levels, and therefore knowledge about relationships between families of Lepidoptera, have made great strides using molecular characters in research programs by Regier *et al.* (2009, 2013) and Mutanen *et al.* (2010). In addition, Erik J. van Nieukerken (2011) and others spearheaded a grand effort to come to a more precise number of species in the Lepidoptera. The phylogenies in Figures 4–6 are based on Regier *et al.* (2013) and the species numbers superimposed are from van Nieukerken *et al.* (2011).

In the lower Lepidoptera there has been an increase of about 600 species discovered and the molecular phylogenetic work has resolved the relationships between Nepticulidae, Incruvariidae, Tischeriidae and Palaephatidae (Fig. 4). In the lower Ditrysia the Tineoidea remains basal, but the position and relationships of major groups such as the Tortricoidea are now resolved (Fig. 5) and the species numbers are 27,246 (not including the Gelechioidea). The Gelechioidea (18,489 species) is the sister group of the Obtectomera (109,049 species) or the higher Lepidoptera (Fig. 6). So instead of a range (140,465 to 480,465) of hypothesized species number, currently there are 154,780 species in the Ditrysia. Relationships between speciose taxa are more resolved. This is much closer to the lower estimates of previous authors.

The number of species in the order Lepidoptera is currently about 157,000 (van Nieukerken *et al.*, 2011). But much more work remains in the Lepidoptera because it has been estimated that there could be over half a million species in Lepidoptera (Gaston, 1991; Kristensen *et al.*, 2007).

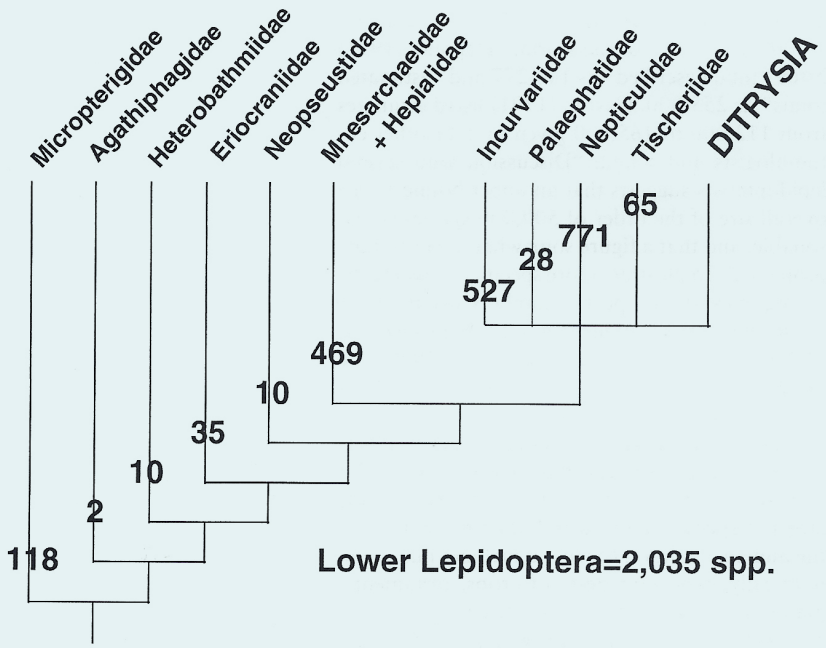

Figure 1. Numbers of species for each family in phylogeny of lower Lepidoptera (from Scoble, 1992, but also see Kristensen, 1984); phylogeny of Ditrysia continued on Figs 2 and 3.

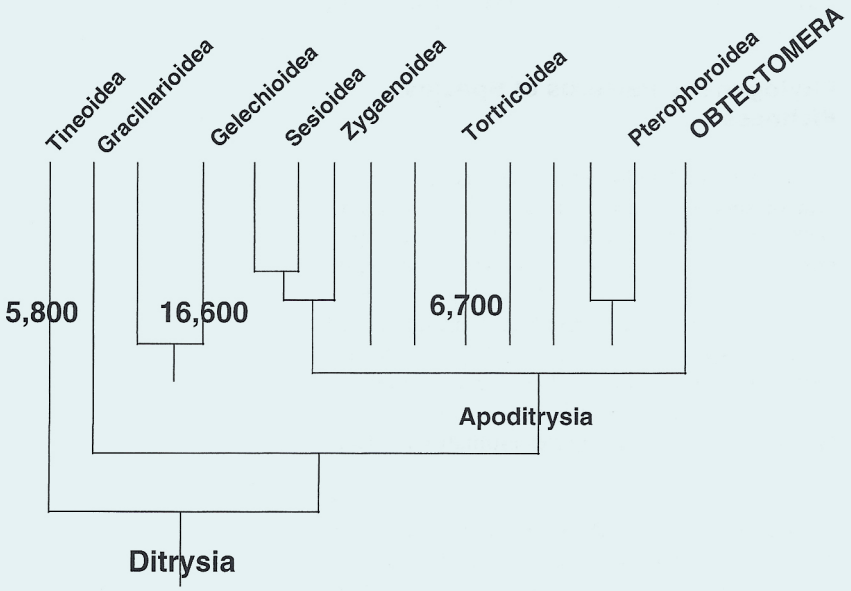

Figure 2. Numbers of species for selected superfamily groups in phylogeny of lower Ditrysia (from Minet, 1991); phylogeny of Obtectomera or higher Ditrysia continued on Fig. 3.

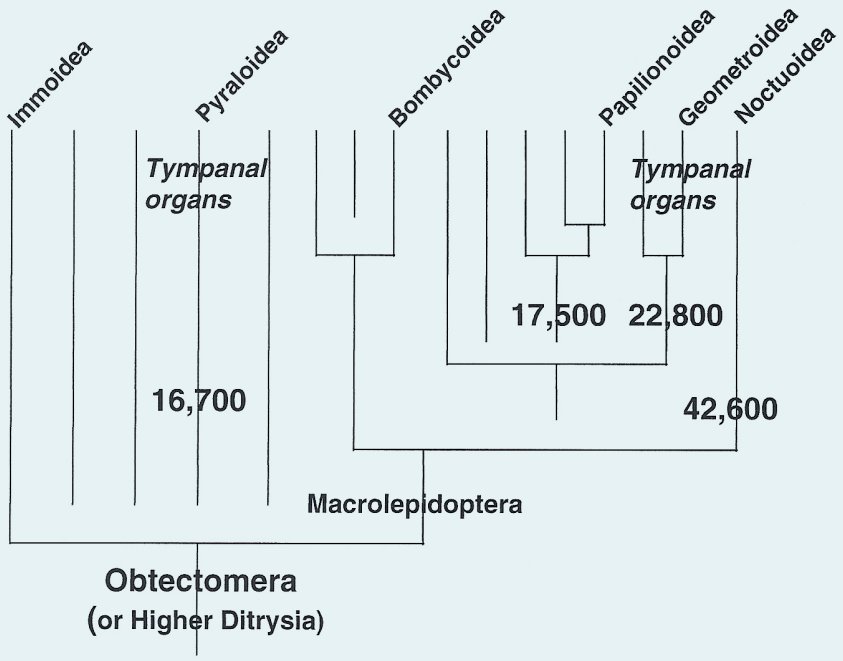

Figure 3. Numbers of species for selected superfamily groups in phylogeny of higher Ditrysia (from Minet, 1991).

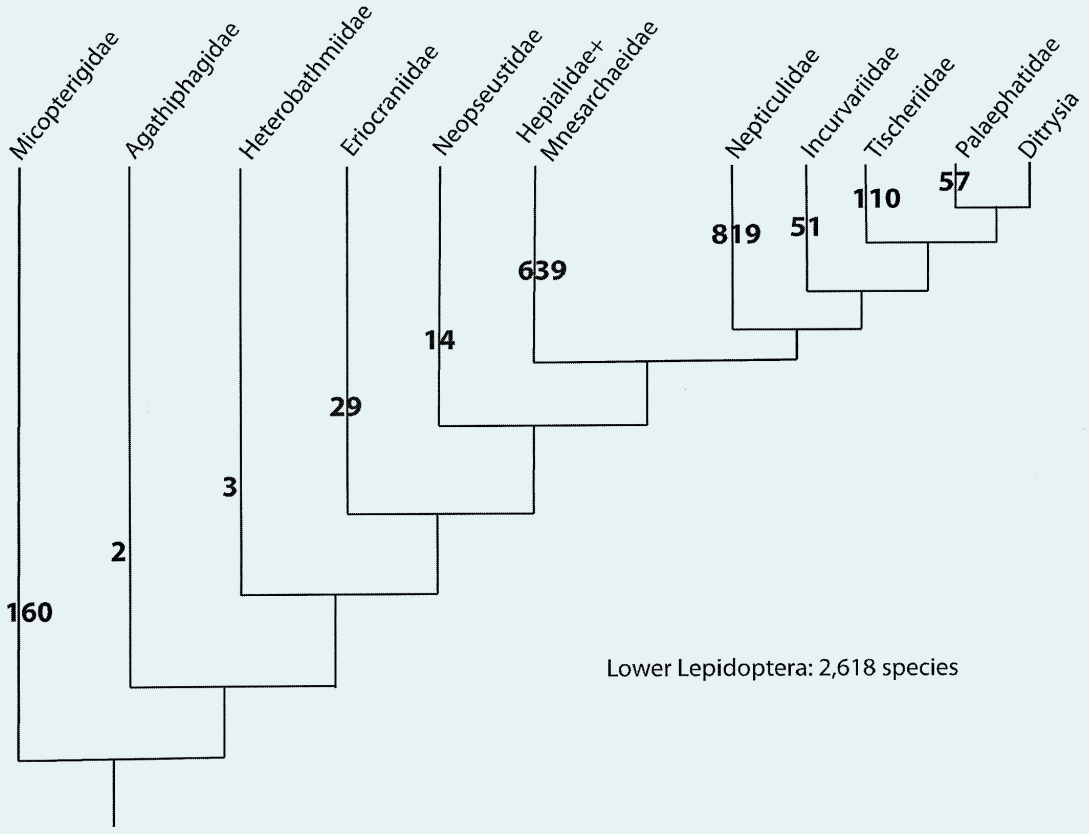

Figure 4. Relationships between Nepticulidae, Incruvariidae, Tischeriidae and Palaephatidae. Phylogenies in figures 4–6 are based on Regier (2013) and the species numbers superimposed are from van Nieukerken *et al.* (2011).

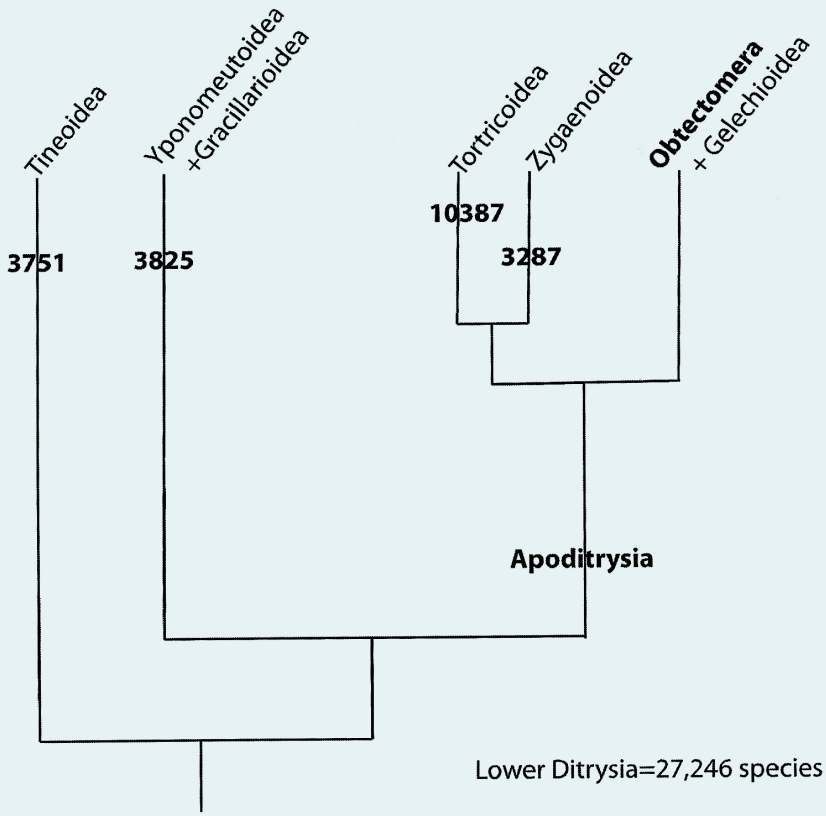

Figure 5. In the lower Ditrysia the Tineoidea remains basal, but the position and relationships of major groups such as the Tortricoidea are now resolved. Phylogenies in figures 4–6 are based on Regier (2013) and the species numbers superimposed are from van Nieukerken *et al.* (2011).

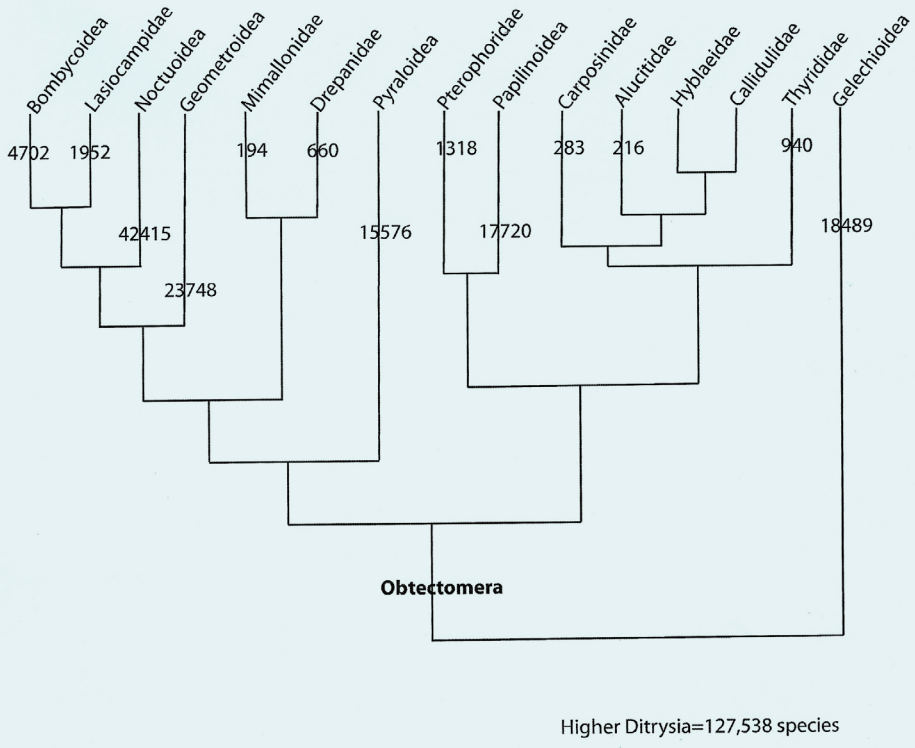

Figure 6. The Gelechioidea is the sister group of the Obtectomera or the higher Lepidoptera. Phylogenies in figures 4–6 are based on Regier *et al.* (2013) and the species numbers superimposed are from van Nieukerken *et al.* (2011).

MAIN REFERENCES

Gaston, K. J. 1991. The magnitude of global insect species richness. *Conservation Biology*, 5: 283–296.

Kristensen, N. P., Scoble, M. J. & Karsholt, O. 2007. Lepidoptera phylogeny and systematic: the state of inventorying moth and butterfly diversity. *Zootaxa*, 1668: 699–747.

Mutanen, M., Wahlberg, N. & Kaila, L. 2010. Comprehensive gene and taxon coverage elucidates radiation patterns in moths and butterflies. *Proceedings of the Royal Society B Biological Sciences*, 277: 2839–2848.

Nieukerken, E. J. van, Kaila, L., Kitching, I. J., Kristensen, N. P., Lees, D. C., Minet, J., Mitter, C., Mutanen, M., Regier, J. C., Simonsen, T. J., Wahlberg, N., Yen, S.-H., Zahiri, R., Adamski, D., Baixeras, J., Bartsch, D., Bengtsson, B. Å., Brown, J. W., Bucheli, S. R., Davis, D. R., De Prins, J., Epstein, M. E., Gentili-Poole, P., Gielis, C., Hättenschwiler, P., Hausmann, A., Holloway, J. D., Kallies, A., Karsholt, O., Kawahara, A., Koster, S. (J. C.), Kozlov, M., Lafontaine, J. D., Lamas, G., Landry, J.-F., Lee, S., Nuss, M., Penz, C., Rota, J., Schmidt, B. C., Schintlmeister, A., Sohn, J. C., Solis, M. A., Tarmann, G., Warren, A. D., Weller, S., Yakovlev, R., Zolotuhin, V. & Zwick, A. 2011. Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness. *Zootaxa*, 3148: 212–221.

Regier, J. C., Mitter, C., Zwick, C., Basinet, A., Cummings, M. P., Kawahara, A. Y.,Sohn, J., Zwickl, D. J., Cho, S., Davis, D. R., Baixeras, J., Brown, J., Parr, C., Weller, S., Lees, D. C. & Mitter, K. T. 2013. A large-scale, higher-level, molecular phylogenetic study of the insect Order Lepidoptera (Moths and Butterflies). *PLoS ONE* 8(3): e58568.

Regier, J. C., Zwick, A., Cummings, M. P., Kawahara, A. Y., Cho, S., Weller, S., Roe, A., Baixeras, J., Brown, J. W., Parr, C., Davis, D. R., Epstein, M., Hallwachs, W., Hausmann, A., Janzen, D. H., Kitching, I. J., Solis, M. A., Yen, S.-H., Bazinet, A. L. & Mitter, C. 2009. Toward reconstructing the evolution of advanced moths and butterflies (Lepidoptera: Ditrysia): an initial molecular study. *BioMed Central Evolutionary Biology*, 9: 280–301.

Solis, M. A. & Pogue, M. G. 1999. Lepidopteran biodiversity: Patterns and estimators. *American Entomologist*, 45: 206–212.

PARALOBESIA CYPRIPEDIANA (LEPIDOPTERA, TORTRICIDAE): A STEALTHY MICROMOTH ATTACKING *CYPRIPEDIUM REGINAE* (ORCHIDACEAE)

Jean-François Landry[1], Marilyn H. S. Light[2] & Michael MacConaill[2]

[1] *Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Canada*

[2] *Gatineau, Québec, Canada*

Paralobesia cypripediana is a rare tortricid moth whose larvae feed exclusively on the equally rare orchid *Cypripedium reginae*. The host plant, arguably the largest and showiest of the North American orchids, has a wide historical range but its current populations are all narrowly restricted and many comprise very small number of plants. A study of the two largest populations of the orchid in the Ottawa region led to the discovery of tortricid larvae feeding on its seed capsules. The culprit allegedly was *Paralobesia cypripediana*, a species described 100 years ago from specimens found and reared from that host orchid in southern Manitoba. No other confirmed records of this tortricid seem to exist, so discovery of larvae in Ontario and Quebec (Fig. 1) was significant from a faunistic standpoint.

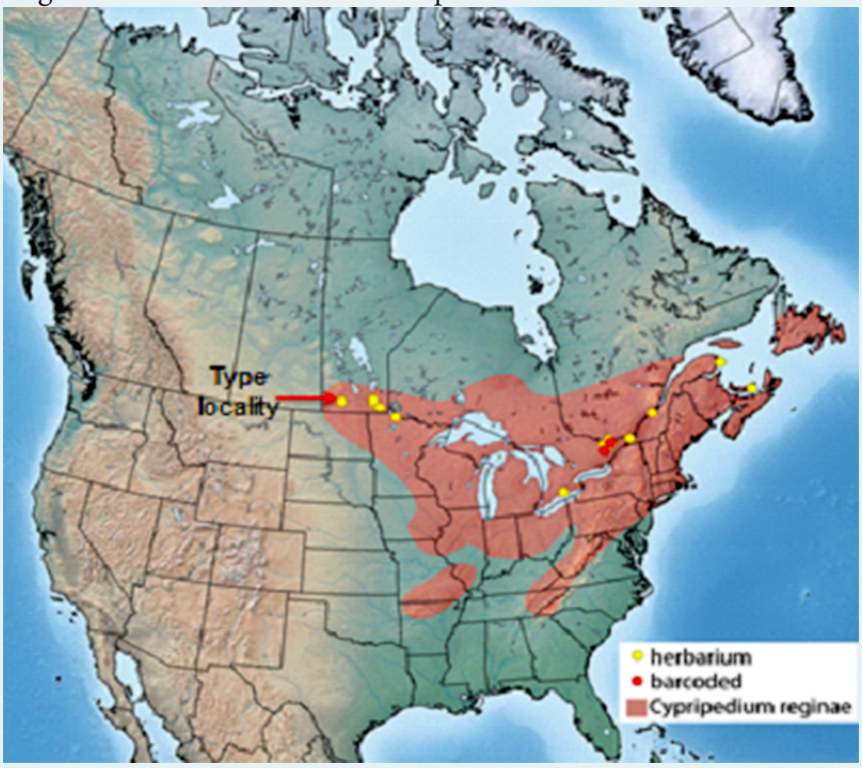

Figure 1. *Paralobesia cypripediana*: known records.

Old herbarium records of the orchid revealed the characteristic feeding damage by the tortricid as well as dried eggs on floral bracts.

The orchid is currently considered a species at risk in certain parts of its range due to habitat loss and thus attracts heightened conservation concerns. Immature stages of the tortricid (eggs, larvae, pupae) were readily found over the course of three field seasons. However, attempts to rear out the adults to confirm the species identity proved problematic and repeatedly failed, due to the special overwintering conditions required by the pupa, as the plant grows in wet or flooded fen habitat (At last one adult has successfully emerged past spring).

DNA barcoding was done with all three immature stages and showed that the species forms a cluster distinct from all other *Paralobesia* species. Barcoding also revealed that many of the sequenced *Paralobesia* specimens were misidentified. The taxonomy of *Paralobesia* species has historically relied on host plants for delineation but paradoxically some species have been deemed to feed on several different hosts. This genus of moths in need of a modern taxonomic study to re-assess species boundaries.

The case of *Paralobesia cypripediana* as a 'seed predator' of a rare orchid also raises interesting questions of evolutionary survival of a narrow specialist dependent on a rare host with a spotty distribution and a highly restricted habitat.

Landry, J.-F., Light, M. H. S. & MacConaill, M. 2014. *Paralobesia cypripediana* (Lepidoptera, Tortricidae): a stealthy micromoth attacking *Cypripedium reginae* (Orchidaceae). *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics*. Edukologija Publishers, Vilnius. 90–91 p.

FIRST FAUNISTIC DATA OF THE NEPTICULIDAE (LEPIDOPTERA) OF NORTHWESTERN LITHUANIA

Justine Zaberga[1], Liva Legzdina[1], Wojciech Otfinowski[2] & Žygimantas Obelevičius[3]

[1] *Daugavpils University, Daugavpils, Latvia*

[2] *Wrocław University of Environmental and Life Sciences, Wrocław, Poland*

[3] *Lithuanian University of Educational Sciences, Vilnius, Lithuania*

INTRODUCTION

Currently 76 species of Nepticulidae (pygmy moths) are known in the fauna of Lithuania (Diškus & Stonis, 2012; Ivinskis *et al*., 2012); they belong to 7 genera (mostly to *Stigmella*, 56 species, and *Ectoedemia*, 13 species). Eight regions of Lithuania were recognized (Diškus & Stonis, 2012). The greatest number of pygmy moth species have been discovered in the South-Eastern (63 species) and the South-Western (67 species) regions (Navickaitė & Stonis, 2012). Mapping of all seventy six species recorded in the Lithuanian regions and their chorological grouping showed that the Curonian Spit region has unique species diversity. So far, 24 species of pygmy moths, or 32% of the total Lithuanian Nepticulidae fauna, have been discovered in this region. Contrary to what had been expected, part of the pygmy moth fauna (from 26 to 31%) is represented by Euro-Submediterranean distribution group (Navickaitė & Stonis, 2012) almost in all Lithuanian regions. However, no data on Nepticulidae in Northerwestern Lithuania (the Šiauliai area) is known (Fig. 1B).

METHODS

Collecting methods and protocols for species identification and description are outlined in Puplesis & Diškus (2003) and Diškus & Stonis (2012).

TAXONOMIC TREATMENT OF NEWLY RECORDED SPECIES

During fieldwork in the Kurtuvėnai Regional Park and ajacent areas in early June 2014, eight Nepticulidae species were recorded for the region (Fig. 1 A, C, D).

Genus ***Enteucha*** Meyrick

Enteucha acetosae (Stainton)

For the host-plant and bionomics see Chrachol *et al.* (2014).

Newly recorded distribution in Lithuania: the Kurtuvėnai Regional Park (see Chrachol *et al*., 2014).

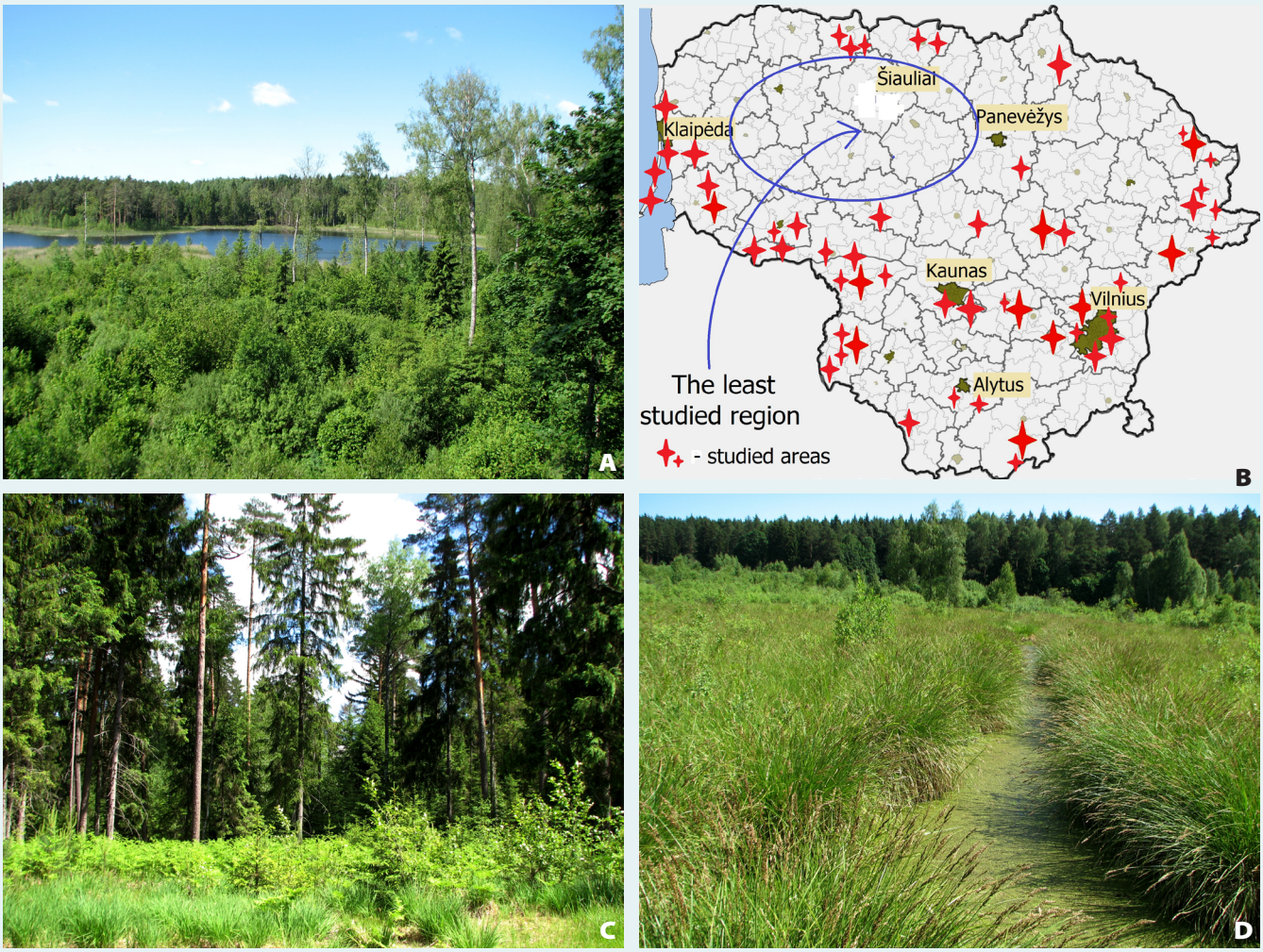

Figure 1. A – before our studies, there had been no Nepticulidae records for a large area in northwestern Lithuania; map of Lithuania with previous collecting localities (after Navickaitė, *unpublished*); B–D – habitats of the studied Kurtuvėnai Regional Park.

Genus ***Stigmella*** Schrank

Stigmella aceris (Frey)

Host-plants: *Acer platanoides* L. (in Šiauliai area); *A. campestre* L., *A. ginnala* Maxim., *A. tataricum* L. in other regions of Lithuania (Puplesis & Diškus, 2003; Diškus *et al*., 2012).

Not a rare species in Lithuania (Diškus *et al*., 2012); before our studies in the Šiauliai area, the species had been recorded from the Coronian Spit (Navickaitė *et al*., 2011) and the Akmenė, Joniškis, Raseiniai, Jurbarkas, Šakiai, Vilkaviškis, Kaunas, Kaišiadoriai, Alytus, Vilnius, Švenčionys, Ukmergė, Ignalina, and Zarasai Districts.

Newly recorded distribution in Lithuania: Šiauliai (city). Abundant mining was recorded.

Note. Contrary to what had been expected, the species was not observed in natural forested habitats of the investigated Kurtuvėnai Regional Park.

Stigmella magdalenae (Klimesch)

Host-plants: *Sorbus aucuparia* L., occasionaly *Malus domestica* Borkh. (Diškus *et al*., 2012).

Very common species in Lithuania (Diškus *et al*., 2012); before our studies in the Kurtuvėnai Regional Park, the species had been recorded from the Coronian Spit, Palanga town, the Šilutė, Akmenė, Joniškis, Šakiai, Vilkaviškis, Kaunas, Alytus, Varėna, Vilnius, Švenčionys, Ukmergė, and Zarasai Districts.

Newly recorded distribution in Lithuania: the Kurtuvėnai Regional Park. During the study investigation period in early June, higly limited distribution and sporadic mining were recorded (probably because of the early season); meanwhile, very abundant mining is charateristic in other/most regions of Lithuania (Diškus & Stonis, 2012).

Stigmella malella (Stainton)

For the host-plant and bionomics see Karlsone *et al*. (2014).

Newly recorded distribution in Lithuania: the Kurtuvėnai Regional Park (see Karlsone *et al*., 2014).

Stigmella floslactella (Haworth)

Host-plants: *Corylus avellana* L. and *Carpinus betulus* L. (Diškus *et al*., 2012).

Not rare species in Lithuania (Diškus *et al*., 2012); before our studies in the Kurtuvėnai Regional Park, the species had been recorded from the Klaipėda, Šilutė, Tauragė, Akmenė, Joniškis, Jurbarkas, Šakiai, Vilkaviškis, Kaunas, Kaišiadoriai, Alytus, Lazdijai, Varėna, Trakai, Šalčininkai, Vilnius, Švenčionys, Ukmergė, and Zarasai Districts.

Newly recorded distribution in Lithuania: the Kurtuvėnai Regional Park. During the investigation period in early June, higly limited distribution and sporadic mining were recorded (probably because the early season).

Stigmella sorbi (Stainton)

Host-plants: *Sorbus aucuparia* L., probably occassionally also *Malus domestica* Borkh. (Diškus *et al*., 2012).

A common species in Lithuania (Diškus *et al*., 2012); before our studies in the Kurtuvėnai Regional Park, the species had been recorded from the Curonian Spit and the Klaipėda, Šilutė, Tauragė, Akmenė, Joniškis, Vilkaviškis, Trakai, Šalčininkai, and Vilnius Districts.

Newly recorded distribution in Lithuania: the Kurtuvėnai Regional Park (wide distribution and abundant mining was recorded).

Genus ***Fomoria*** Beirne

Fomoria weaveri (Stainton)

For the host-plant and bionomics see Pikelis *et al*. (2014).

Newly recorded distribution in Lithuania: the Kurtuvėnai Regional Park (see Pikelis *et al*., 2014)

Genus ***Etainia*** Beirne

Etainia sericopeza (Zeller)

Host-plant: *Acer platanoides* L. (Diškus *et al*., 2012).

Common species in Lithuania (Diškus *et al*., 2012); before our studies in Šiauliai area, the species had been recorded from the Coronian Spit and the Klaipėda, Pagėgiai, Joniškis, Vilkaviškis, Kaunas, Trakai, and Vilnius Districts.

Newly recorded distribution in Lithuania: Šiauliai (town). Abundant mining was recorded.

Note. Contrary to what had been expected, the species was not observed in natural forested habitats of the investigated Kurtuvėnai Regional Park.

REFERENCES

Chrachol, A. P., Makėvič, T., Malecka, A., Kirtiklis, T. & Voskresenska, J. 2014. The first discovery of rare species *Enteucha acetosae* (Lepidoptera, Nepticulidae) in the Kurtuvėnai regional park. *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics*. Edukologija Publishers, Vilnius. 21–22 p.

Diškus, A. & Stonis, J. R. 2012. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 220 pp.

Diškus, A., Navickaitė, A. & Stonis, J. R. 2012. Taksonominė Lietuvos Nepticulidae sudėtis ir papildytas faunos sąvadas. *In*: Diškus, A., Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships* [in Lithuanian]. Lututė Publishers, Kaunas. 73–100 p.

Ivinskis, P., Nieukerken, E. J. van & Rimšaite, J. 2012. *Trifurcula* (*Glaucolepis*) *lituanica* sp. nov., an unexpected new stem-miner on *Salvia pratensis* occuring in easter Europe (Lepidoptera: Nepticulidae). *Zootaxa*, 3570: 41–55.

Karlsone, A., Strautinš, J., Rudak, J. P., Cypryjanska, K. & Šopoka, R. 2014. The first record of *Stigmella malella* (Lepidoptera, Nepticulidae), an apple tree pest in the Kurtuvėnai (NW Lithuania). *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics*. Edukologija Publishers, Vilnius. 11–12 p.

Navickaitė, A. & Stonis, J. R. 2012. Chorologinis Lietuvos Nepticulidae faunos įvertinimas. *In*: Diškus, A., Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships* [in Lithuanian]. Lututė Publishers, Kaunas. 101–111 p.

Navickaitė, A., Diškus, A. & Stonis, J. R. 2011. Review of Nepticulidae (Insecta: Lepidoptera) occurring in the Curonian Spit (Baltic coast of Lithuania). *Acta Zoologica Lituanica*, 21 (3): 221–231.

Pikelis, J., Šlapelytė, L., Masalskaitė, D. & Cierpisz, M. 2014. *Fomoria weaveri* (Lepidoptera, Nepticulidae), an interesting Nepticulidae species in the Kurtuvėnai regional park (Lithuania). *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics*. Edukologija Publishers, Vilnius. 41–42 p.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp., figs 612.

WHAT IS NEW AND MOST INTERESTING ABOUT THE NEPTICULIDAE OF THE CRIMEA AND LITHUANIA

Asta Navickaitė, Arūnas Diškus & Jonas Rimantas Stonis

Lithuanian University of Educational Sciences, Vilnius, Lithuania

INTRODUCTION

Due to the active destruction of landscapes as well as frequent fragmentation of habitats, global biodiversity is undergoing rapid decline. The increasing concern of the world's scientific community about the biodiversity crisis stimulated researchers to more actively inventorize the Earth's main biomes (Stonis, 2010; Navickaitė *et al*., 2011b).

The object of our research is one of the most primitive (and from this point of view, one of the most interesting) taxonomic groups of the Lepidoptera order (Nepticuloidea: Nepticulidae) comprising 850 species and 16 genera: *Pectinivalva*, *Roscidotoga*, *Simplimorpha*, *Enteucha*, *Mononeura*, *Areticulata*, *Stigmella*, *Bohemannia*, *Ectoedemia*, *Fomoria*, *Acalyptris*, *Parafomoria*, *Trifurcula*, *Glaucolepis*, *Etainia* and *Varius* (the classification of Nepticulidae follows Puplesis, 1994; Puplesis & Robinson, 2000, and Puplesis & Diškus, 2003). The majority of these genera are widely distributed throughout many continents; they include the world's smallest Microlepidoptera, which are characterized not only by their archaic morphology but also, as plant-miners, are greatly specialized. One of the most prominent characteristics of Nepticulidae, their mining within the green tissue of plants, presents an issue which is interesting and important for ecology (Stonis, 2010; Diškus & Stonis, 2012).

Because of stenophagy, sedentary lifestyle and a high rate of endemism, these small insects occur in almost all biomes (from tundra or deserts to tropical rainforests) and various terrestrial ecosystems and could serve as a perfect tool for characterizing the richness, origin and faunal relationships of biomes under investigation (Puplesis, 1994; Navickaitė *et al*., 2011a; Diškus & Stonis, 2012). However, research data concerning these insects, which is both of practical and theoretical importance, is insufficient. Prior to the investigation carried out by the first author and her colleagues, information on the fauna of Nepticulidae of the Crimea and Lithuania had been far from exhaustive. Climate change, intensive migration of the population and commercial projects pursuing economic benefits (in particular involving exotic territories) provide conditions for an incidental introduction of pest fauna (Diškus & Stonis, 2012). Because of

the life-style within assimilation tissues of leaves, buds, stems, young bark or fruits of plants, a number of Nepticulidae that we investigated could be considered as pests or potential pests; for that reason they are important from the economic point of view (Puplesis, 1994; Kuznetzov & Puplesis, 1994). It is considered that oligophagous endobiontic insects are capable adapt in new territories and establish trophic relationships with alien host-plants (Diškus & Stonis, 2012).

The investigation of life-cycles, trophic relationships or other biological characteristics of potential pests, as well as continuous cooperation with professionals of nature protection, could enable the preparation of effective measures preventing alien pests from infiltrating our fauna and also enable the implementation of a quarantine policy. The deficiency of investigation data, economical (practical) and theoretical (scientific) significance of the family Nepticulidae and increasing concern by the scientific community about the biodiversity crisis stimulated the studies of Nepticulidae of the Euro-Nemoral zone; the importance of such studies was also emphasized by the Convention on Biological Diversity of Rio de Janeiro.

MATERIALS

The first author A. Navickaitė, assisted by A. Diškus and other researchers (see Acknowledgements) conducted fieldwork over six years (2008–2013) and collected scientific material of Nepticulidae from different Lithuanian regions (Fig. 1). The integration of individual data (incl. Diškus *et al*., 2012) and data published by other researchers (e.g. Ivinskis, 2004; Ivinskis *et al*., 2012, etc.) offered the possibility for full-scale analysis of the Lithuanian Nepticulidae fauna. The collected and analysed material is stored in the collection of Biosystematics Research Group of the Lithuanian University of Educational Sciences (LEU).

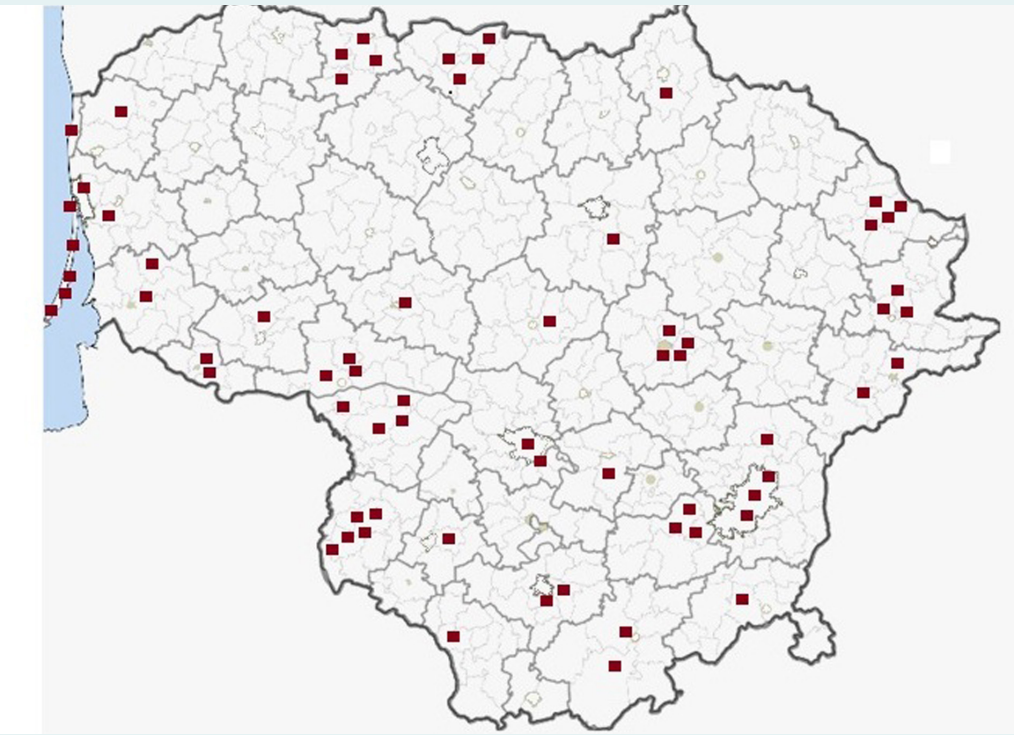

Figure 1. Localities of Nepticulidae investigations in Lithuania from which the data obtained served as a basis for the present study (after A. Navickaitė in Stonis *et al*., 2012a).

In 2011–2012, the first author A. Navickaitė, assisted by A. Diškus, J. R. Stonis, G. Varačinskas (LEU) and S. R. Hill from the UK carried out intensive long-term fieldwork in the Crimea: Karadag Nature Reserve (Fig. 2) and Yalta Forest Reserve, Angara Mountain Pass, Feodosia, Koktebel, Alushta and other localities. During the fieldwork, the authors and their assistants collected a large original scientific material. Also the authors, together with A. Remeikis and A. Rocienė (LEU), dissected and studied a sizeable amount of unidentified material collected in 1977–1989 in the Crimea by other researchers: S. Yu. Sinev (ZIN), Yu. I. Budashkin (KNURAS), I. Reznik (ZIN), and R. Puplesis (ZIN) (Stonis *et al*., 2013). Other, comparative material was collected during field trips to Naples (Campania, Italy, 2012) and Bergamo (Lombardy, Italy, 2013) (Fig. 2).

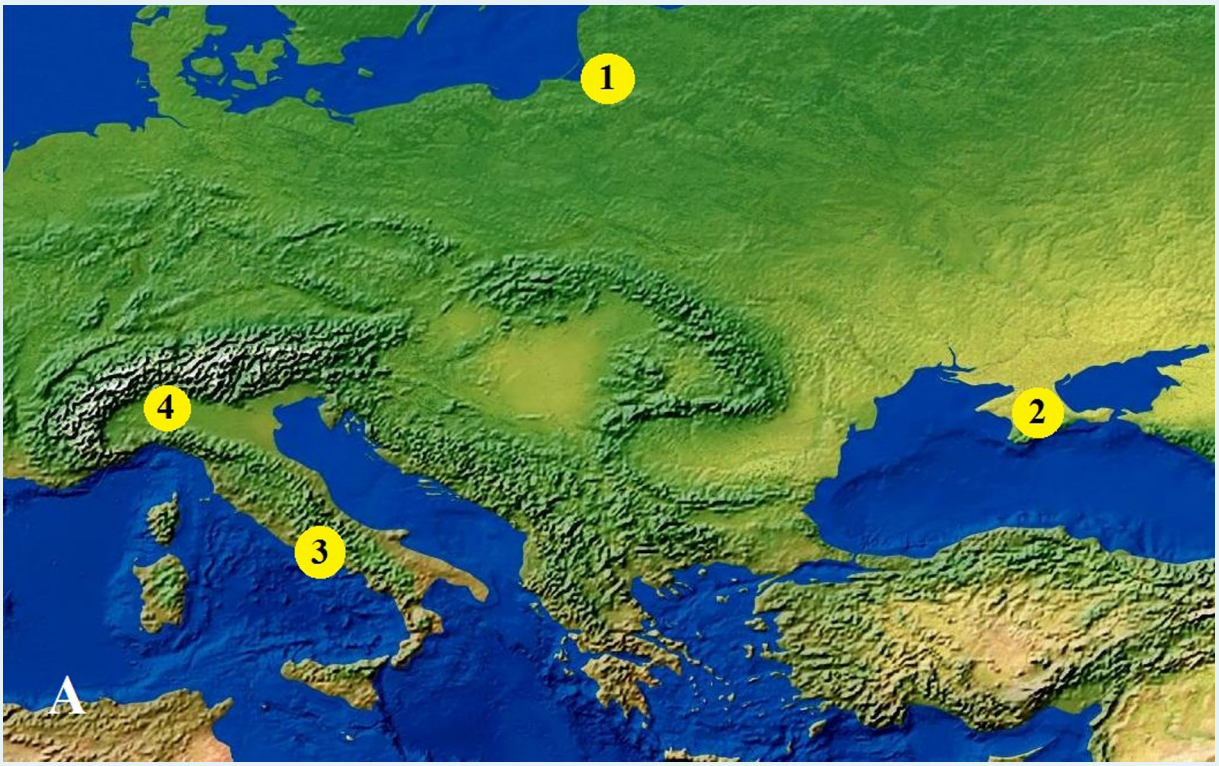

Figure 2. Localities where in 2008–2013 the first author A. Navickaitė, assisted by A. Diškus, J. R. Stonis, A. Remeikis and G. Varačinskas (LEU), collected the main material (1 – Lithuania; 2 – the Crimea) and comparative material (3, 4 – Italy).

REARING OF ADULTS FROM MINING LARVAE

Most of the treated species were reared from mining larvae using a standard method (Puplesis, 1994; Diškus & Stonis, 2012). Registration of the traces of larval activity (the mines or leaf-miners) was conducted by thorough inspection of damaged parts of host-plants or potential host-plants. Most of the Lithuanian Nepticulidae usually mine leaves, occassionally apple-tree/maple buds or maple samaras (e.g. *Etainia sericopeza*), or stems or young bark (e.g. *Ectoedemia atrifrontella*) (Puplesis, 1994; Puplesis, Diškus, 2003). For an evaluation of occurence of the species distributed in the Crimea and Lithuania, the 'Formula of Evaluation of Abundance of Leaf-miners' was followed (see Diškus & Stonis, 2012: 52–54). Species were evaluated in two ways: how widely they are distributed within the forested part of the Crimea; and how numerous (abundant) specimen samples were, including those attracted to light traps, in relation to the quantity of observed leaf-mines.

The following terminology for species mining abundance was used (Stonis *et al*., 2012b, Stonis *et al*., unpublished): 'Sporadic' was applied to species known from fewer than 4 leaf-mines in a locality of investigation; 'Not abundant' = known from 4–10 recorded leaf-mines; 'Abundant' = recorded from more than 10 but fewer than 40 leaf-mines; 'Very abundant' = species recorded from 40–100 leaf-mines; 'Extremely abundant' = recorded from more than 100 leaf-mines. Species with more numerous leaf-mines ('Epizootic') were not observed in the Crimea during the fieldwork of 2011 and 2012.

Following Stonis *et al.* (2012b) and Stonis *et al.* (unpublished), the terms 'Very widespread' or 'Widespread' were applied to species documented from numerous and disjunctive areas of the study region, including data from our observations on species traces (i.e. old/empty leaf-mines) in various localities during the fieldwork of 2011 and 2012, as well as unpublished records by R. Puplesis from the Crimea (1987–1988) and A. Diškus from Lithuania (1996–2003). 'Limited in distribution' or 'Highly limited in distribution' was applied to species collected (or leaf-mines observed) in very few localities; 'Solitary finding' designates species recorded from a single locality. Following Stonis *et al.* (2012b) and Stonis *et al.* (unpublished), the combination of these two evaluations (as given in the Table II.2 by Diškus & Stonis, 2012) determined which species should be regarded as 'very common', 'common', 'not rare', 'rare', or 'very rare'.

COLLECTION OF MATERIAL USING LIGHT TRAPS

This method is most relevant in countries like the Crimea with a hot climate when night temperatures are around +25°C – +28°C (Puplesis & Diškus, 2003). A sheet of white stiff cloth as a screen and ultraviolet spectrum bulbs (125 W and 250 W) were used for attracting insects. It was recommended that on windy nights with suitable temperature, the bulb should be hung lower in dense but low scrubs and the upper edge of the screen should be turned down by 90° to form a hood (Stonis & Remeikis, 2010) (Fig. 3C).

Nepticulidae specimens were collected using small glass test tubes (5 mm in diameter and 30–40 mm in depth) which were then plugged with a tight cotton wad, and, following Puplesis (1994) and Stonis *et al.* (unpublished), kept alive in a dark container with a few plant leaves added to preserve some moisture. It is best that the collected material is pinned and set (i.e., wings spread) outright or kept alive in a refrigerator at +10°C and prepared in the first half of the next day. Dead material (especially stored at higher temperatures and dry air conditions) looses elasticity in 2–4 hours and crumbles at pinning. For killing collected specimens, acetil acetate, chloroform or organophosphorus insecticides no longer were used, but each test tube with live specimen was placed individually in hot (just boiled) water for a one-two seconds. Some specimens were placed alive in individual sterile plastic test tubes with 70% alcohol and kept in a freezer for later molecular studies.



Figure 3. Long-term fieldwork in the Crimea: A, D – the Karadag Nature Reserve; B – leaf-mine collecting during the fieldwork in 2011; C – the screen turned down by 90° so as to form a hood (recommended and described by Stonis & Remeikis, 2010) during the fieldwork in 2009.

PREPARATION OF COLLECTED SPECIMENS

The reared under laboratory conditions or freshly collected specimens are pinned under a stereoscopic binocular microscope on a special elastic cushion using the finest 5–10 mm stainless minutien pins. The insect wings are fixed using narrow (1–1.2 mm wide and 8–10 mm long) transparent paper strips pinned with D1 and D2 minutien pins. The mounted material is left to dry for about 14 days. During fieldwork, a simpler technique for spreading wings was used: the wings of the fresh specimen were spread by air flow (blowing from the caudal end) and left to dry (there was no need to worry about the fixation or regularity

of wing setting). The correct wing setting of collected material is not always successful. It also depends on the correct pinning. For taxonomic analysis, this preparation stage can be dismissed (Puplesis & Diškus, 2003; Diškus & Stonis, 2012), however, when the wings of the examined specimen are spread it is easier to observe and describe the colour of the abdomen and arrangement of androconial scales on the hindwings and forewings; it is also easier to snap off the abdomen for genitalia preparation.

Under laboratory conditions, the specimens are mounted on small (1.5 mm wide and 7–10 mm long) white plastic strips and labelled. The labels contain information about the species, finding locality, habitat, date of finding, name of collector, information about the host-plant, fieldwork card number and, if applicable, and altitude above sea level; the labels of night-trapped adults may also contain the information about the light trap used. The collected material is stored in hermetically sealed boxes to prevent damage from pests, moisture and bright light. In regions of hot and humid climate the boxes also may be supplied with fungicide powder to prevent the from formation of mould.

In our study, the adults were measured using ocular micrometre and stereoscopic binocular microscope *MBS-10*. The length of the wingspan was measured from the end of the left wing cilia to the end of the right wing cilia. If the measured specimen is not straightened out the length of one of the forewings is indicated. The indicated length is multiplied by two and the thorax width is added. For depiction of the external coloured morphological patterns of adults Faber-Castell watercolour pencils can be used or specimens can be photographed using *Leica S6D* microscope and attached *DFC290* camera.

PREPARATION AND EXAMINATION OF MICRO-MOUNTS OF GENITALIA STRUCTURES

Techniques for genitalia preparation and protocols for description are outlined in Diškus & Stonis (2012) and Stonis *et al*., 2014. In our study, the genital micro-mounts were studied and photographed using a *Leica DM2500* microscope and *Leica DFC420* digital camera, respectively.

CHOROLOGICAL METHOD

The distribution ranges of all analysed species were thoroughly mapped. Taxa distinguished from the same or comparable distribution range were joined into groups which, in their turn, were named indicating the type of the range: Holarctic, Trans-Palaearctic, Euro-Siberian, West-Palaeartic, Euro-Mediterranean, Euro-Submediterranean, Sub-Mediterranean, Sub-Mediterranean-Mediterranean, Euro-Nemoral, and predominantly Sub-Baltic. The chorological analysis not only included congeneric species but also unrelated taxa. This type of species evaluation requires all available information about the species, including trophic relationships and other trophic specialization, distribution of host-plant and habitats. For the designation of European ecoregions we used the 'Map of the division of Europe in ecoregions' (by J. R. Stonis in Navickaitė *et al*., 2014: fig. 6), which is mostly based on recent research data on the Sub-Mediterranean by other authors (e.g., de Dios *et al*. 2009, Rueda *et al*. 2010) as well as our personal data (Fig. 4).



Figure 4. Division of Europe in ecoregions (provinces), where the Sub-Mediterranean ecoregion (province) can be treated as a transitional region between the whole nemoral, forested Europe (Euro-Boreal + Euro-Atlantic + Central European + Euro-Continental + Sub-Mediterranean) and the non-nemoral, Mediterranean ecoregion (after J. R. Stonis in Navickaitė *et al.*, 2014).

THE CRIMEAN NEPTICULIDAE FAUNA

The Crimean Nepticulidae within the contect of the European fauna. In total, 264 species of Nepticulidae belonging to 11 genera are known in the European fauna (Fig. 5).

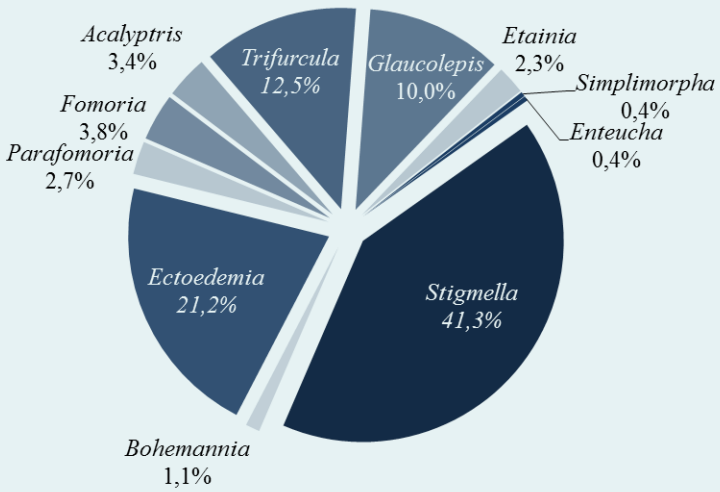

Figure 5. The revised taxonomic composition of the European Nepticulidae fauna.

Analysis of the European Nepticulidae fauna showed that trophic relationships had been established for 89% of the species (host-plants of 11% of European species remain unknown).

An analysis of host-plants revealed that the European Nepticulidae are trophically associated with 97 plant genera. The majority of Nepticulidae species mines on *Quercus* (42), *Betula* (11) and *Salix* (10). Yet 47% of plant genera are engaged by single mining Nepticulide species. Woody plants are dominant (66%) among the host-plants of the European pygmy moths whereas 34% of the known pygmy moths are trophically associated with herbaceous plants.

The majority of the pygmy moths of Europe mine plants of Rosaceae, Fagaceae, Fabaceae, Salicaeae and Betulaceae families. Rosacae is the dominant plant family with which 58 Nepticulidae species have trophic relationships; 17% of Nepticulidae species are trophically associated with Fagaceae family. However, 14 known host-plant families are mined only by one species of these leaf-miners. In total, we counted 31 host-plant families for the European Nepticulidae.

As shown in figure 4, the European Nemoral (forested) region includes the Euro-Boreal, Euro-Atlantic, Central European, Euro-Continental, and Sub-Mediterranean ecoregions. The European Nepticulidae fauna analysed in the current study was interpreted as 'Euro-Nemoral Nepticulidae fauna' (in spite that some Nepticulidae species mine woody plants and some other – the smaller part – mine grasses).

The Sub-Mediterranean ecoregion, on the basis of our studies conducted in the Crimea and Italy, is for the first represented as a transitory zone between the whole nemoral Europe and the Mediterranean ecoregion. As a rule, species (17) of the Sub-Mediterranean chorological group inhabit very limited areas. *Stigmella rhamnella*, *S. szoecsiella* and *Ectoedemia contorta,* which have trophic relationships either with *Rhamnus* (1 species) or with *Quercus* (2 species) host-plants, make an exception.

The fauna of the Euro-Atlantic province (ecoregion) comprises 123, Central European 141 and Euro-Mediterranean 164 Nepticulidae species. Meanwhile, 151 species of pygmy moths have been identified in the Sub-Mediterranean ecoregion.

The greatest number of the European Nepticulidae species is recorded in the Mediterranean province – 191 species. Yet the identified Nepticulidae fauna is unevenly distributed: some species occur in the area between the Iberian Peninsula and Greece or South-West Turkey (and Cyprus) whereas some of them are bound only to a certain part of the Mediterranean province. The number of Nepticulidae species identified in the western part of the Mediterranean province amounts to 109, in the central part 94 and in the eastern part 99.

From the taxonomical point of view, the unexpectedly high number of species identified in the Mediterranean ecoregion allows assuming that the distribution of some Nepticulidae genera is strongly restricted within the Mediterranean ecoregion as the number of species identified in this province accounts for 93% of the European fauna of *Glaucolepis* genus. A very strong bond to the Mediterranean province also is characteristic of *Acalyptris*, *Ectoedemia* and *Parafomoria* genera (respectively 89%, 86% and 85% of the total of the species of these genera identified in Europe). The largest Nepticulidae genus (*Stigmella*) represented in Europe by 109 species also is widely distributed in this province (73% of the European *Stigmella* fauna).

Based on chorological method for the first time applied for analysis of the European Nepticulidae fauna it was established that Nepticulidae species in this part of the world belong at least to 10 chorological groups: Euro-Nemoral *sensu lato* (incl. predominantly Sub-Baltic, see Navickaitė & Stonis, 2012), Euro-Submediterranean, Euro-Mediterranean, Sub-Mediterranean, Sub-Mediterranean–Mediterranean, West-Palaearctic, Euro-Siberian, Trans-Palaearctic, and Holarctic.

The largest groups in the European fauna are: Mediterranean (29%), Euro-Submediterranean (20%), and Euro-Mediterranean (12%); also many species belong to the Euro-Nemoral group (9%) (Fig. 6).

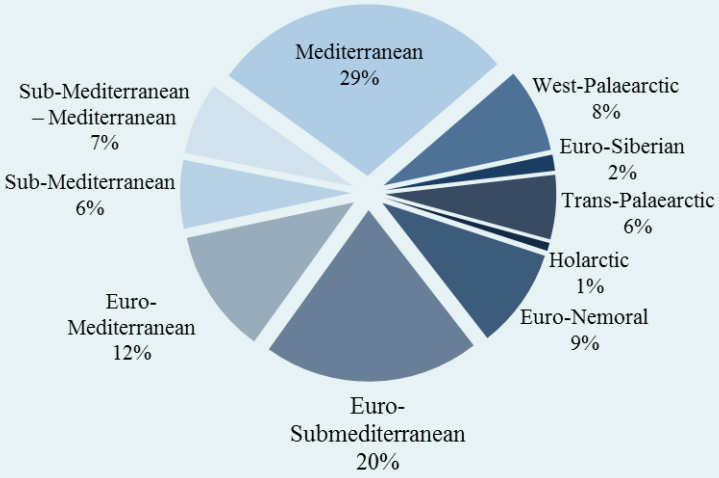

Figure 6. Chorological groups of the European Nepticulidae by size (relative percentage).

Among the 54 Nepticulidae species attributed to the Euro-Submediterranean chorological group, *Ectoedemia quinquella* and *Glaucolepis lituanica* are the most interesting ones. The latter has been recently published as a new species found in a few extremely remote and isolated European localities (including Lithuania) (Ivinskis *et al*., 2012). Presumably, this species should be considered as a relict rather than a species spreading from north to south due to the changing climate. Meanwhile, *E. quinquella* can serve as a typical example of a spreading species: the species is widely known in the Sub-Mediterranean ecoregion and, according to the data of our colleagues (van Nieukerken *et al*., 2010), has gradually spread in the Atlantic part of France, Benelux countries and, later, in the southern part of GB. The expansion of the distribution range of this species is possibly related to the climate change.

Taxonomy of Nepticulidae of the Crimea. The first material of Nepticulidae was collected in the Crimea in 1977; however, for a long time only a small number of attempts were reported to identify and publicize the fauna of this Lepidoptera family from the Crimea. In 2009–2010, under the 'Crimean Project', the authors identified 31 species of Nepticulidae, among which *Stigmella ulmiphaga*, *Ectoedemia rufifrontella* and Acalyptris platani were recorded for the first time from the Crimea; it was reported in our publication (Stonis & Remeikis, 2011; Stonis *et al*., 2013). Out of more than 600 examined specimens, only 3 were attributed to the *Trifurcula* genus: one to *T. subnitidella*, and two to *Trifurcula macedonica*, a new species within the fauna of the Crimea. *Stigmella szoecsiella*, *Ectoedemia albifasciella* and *E. pubescivora* were excluded

from the list of the Crimean species because of misidentification of these species or insufficient scope of previous research (Stonis *et al*., 2013).

The authors of the current paper, after having concluded fieldwork in Karadag, Yalta, Feodosia, Sudak, Alushta, Simferopol and other locations in 2011, succeeded in identifying 26 species of Nepticulidae which were new to the fauna of the Crimea (Navickaitė *et al*., 2014). The revised and updated taxonomic checklist of the Nepticulidae species of the Crimea includes comprehensive data about 20 species from the *Stigmella* genus, 1 species respectively from *Bohemannia*, *Ectoedemia* and *Fomoria* genera and 3 species from the *Trifurcula* genus, all of which are recorded for the first time for the fauna of the Crimea (i.e. 40% of the whole of the Crimean fauna) (Navickaitė *et al*., 2014). One species, *Ectoedemia spinosella*, was excluded from the list because of previous misidentifications having resulted from referring exclusively to leaf-mines (see van Nieukerken *et al*., 2004); our presumption is that *E. mahalebella* has been misidentified and mistaken as *E. spinosella* (Navickaitė *et al*., 2014).

At present the fauna of the Crimea includes 64 Nepticulidae species belonging to the *Simplimorpha* (1), *Stigmella* (41), *Bohemannia* (1), *Ectoedemia* (10), *Fomoria* (1), *Acalyptris* (1), *Trifurcula* (5), *Glaucolepis* (2) and *Etainia* (2) genera (Navickaitė *et al*., 2014). The *Bohemannia* and *Fomoria* genera were registered within the Crimean Nepticulidae fauna for the first time. *Trifurcula subnitidella* and *T. josefklimeschi* had been the only *Trifurcula* species in the Crimea. Additionally, we succeeded to document the distribution of the *T. silviae* and *T. eurema* in the Crimea. *T. macedonica* was identified during the study of the material collected in 1987. According to these data, 15% of Europe's species of the *Trifurcula* genus occur in the Crimean peninsula.

When analysing trophic relationships among Nepticulidae registered in the Karadag Nature Reserve and its surroundings, we identified that the majority of the newly identified species were related to the Rosaceae (35%) and Betulaceae (20%) host-plants.

We present *Trifurcula macedonica* and *Ectoedemia mahalebella* in the Crimean fauna without describing new subspecies, though the investigated material is of very distinctive nature.

Chorological analysis of Nepticulidae of the Crimea. The mapping and analysis of Nepticulidae distribution ranges taking into account the Crimean and general distribution showed that from the chorological point of view, Nepticulidae of the Crimea could be divided into 8 chorological groups. These groups could be aggregated into two larger distribution groups: the European (Euro-Submediterranean + Euro-Mediterranean + Sub-Mediterranean-Mediterranean + + Euro-Nemoral) and Palaearctic (West-Palaearctic + Euro-Siberian + Trans-Palaearctic) (Fig. 7).

There is a tendency that 72% of species from the Crimea belong to chorological groups that are more or less related to the Mediterranean ecoregion. It leads to a conclusion that these species could have originated in the South and later gradually spread all over the European continent.

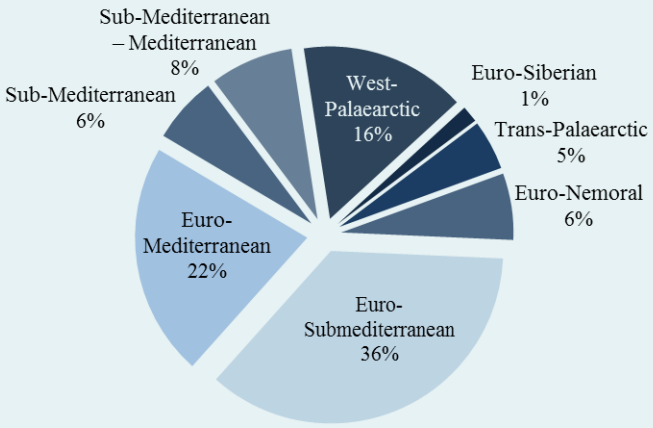

Figure 7. Chorological composition of the Crimean Nepticulidae fauna defined during the chorological analysis.

After having evaluated occurrence (data on geographical distribution and quantity/abundance, see Methods), we identified the common and rare species of the region. Rather a large number of species identified in the Crimea are characterized by wide distribution and moderately abundant mining (19%) or wide distribution and extremely abundant mining (17%). Among the Crimean fauna that has been analyzed, there are a number of species characterized by limited distribution and moderately abundant mining (12%), limited distribution and not abundant mining (12%) and local distribution and not abundant mining (12%). Common species can also be divided into common and very common; the latter are characterized by wide or very wide distribution and very abundant or abundant mining. Common species may be characterized by limited distribution if their mining has been identified as very abundant.

The common species identified within the Crimean fauna predominantly are of the Euro-Submediterranean chorological group (47%), whereas, contrary to our expectations, less numerous among the common species are those characterized by Sub-Mediterranean/Mediterranean ranges (18% of the common species of the Crimea).

The common Nepticulidae species of the Crimea are trophically associated with 13 plant genera, among which *Quercus*, *Sorbus*, *Crataegus* and *Prunus* are the most prolific (if estimated by the number of mining Nepticulidae species) (Fig. 8).

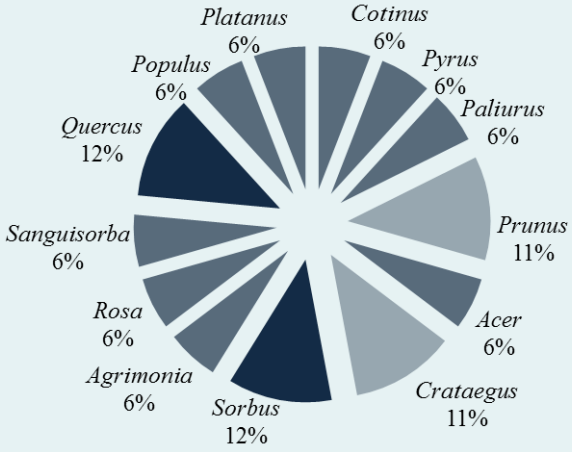

Figure 8. Identified trophic relationships of the common (common + very common) Nepticulidae species.

Rare species of the region are characterized by limited geographical distribution and not abundant or sporadic mining. However, in line with the applied methods, some of the widely distributed species were attributed to the rare category if their mining was sporadic; and, on the contrary, rare species may be characterized by abundant or very abundant mining if their geographical distribution has been identified as highly limited or based on solitary findings (according to Stonis *et al*., unpublished). Among the investigated Crimean fauna, there are species which are characterized by limited distribution and not abundant mining (5% of the entire fauna), solitary finding and not abundant mining (2%) and highly limited distribution and sporadic mining (2%). Rare species may also be divided into rare and very rare; the latter, according to Stonis *et al.* (unpublished), are characterized by only highly limited distribution or solitary finding and not abundant or sporadic mining.

The rare species of the Crimean fauna mainly belong to the Euro-Mediterranean chorological group; a number of rare species belong to the Euro-Submediterranean and Euro-Nemoral groups and the Sub-Mediterranean chorological group. As it could have been predicted, species which are characterized by wide ranges and Sub-Mediterranean/Mediterranean distribution are the fewest within the category of rare species.

Among the host-plants which are mined by rare species, the most prominent is the *Quercus* genus: about 1/5 of the total number of host-plants. The remaining rare species are associated with 14 other genera of host-plants (Fig. 9). To date, there are no known data about the *Trifurcula macedonica* host-plant.

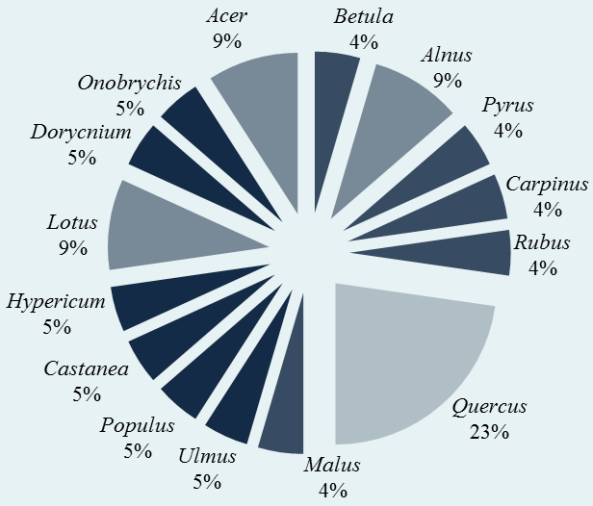

Figure 9. The identified trophical relationships among the rare (rare + very rare) Nepticulidae species of the Crimea.

Trophic analysis and features of the life cycle of the Crimean Nepticulidae. The majority of the Crimean Nepticulidae are related to the Rosaceae (18 species of Nepticulidae) and Fagaceae (12 species) plant families. It should be noted that as far as 54 species are adapted to mine woody plants and the remaining 10 species, herbaceous plants.

The analysis of the Crimean Nepticulidae showed that 7 species (11% of the identified fauna) mine cultivated plants: *Prunus spinosa*, *P. cerasifera*, *Malus domestica* and *Pyrus elaeagnifolia*.

During the investigation, we succeeded to record for the first time the host-plant of *Stigmella irregularis*, *Pyrus elaeagnifolia*, which widely occurs not only throughout the Karadag Reserve but also the whole of the mountainous Crimea.

During the present research, it has been observed that larval stage (and the whole life cycle) depends not only on the mined plant but also on the mining season, ambient temperature (sunshine or shade) and biological properties of Nepticulidae genus.

During our fieldwork, the mining seasonality of the Crimean species was analysed for the first time (Table 1).

The precise mining time was established for 39 (61%) known Crimean Nepticulidae species (most of adults of these species were reared). Meanwhile, such species as *Stigmella samiatella*, *S. atricapitella*, *Trifurcula silviae*, *Glaucolepis melanoptera*, *Ectoedemia atrifrontella* and *E. longicaudella* were recorded solely applying the light trap method. Thus, the seasonal cycles were established taking into consideration the flying time of adults and published literary data.

It can be maintained that almost 50% of Nepticulidae species found in Crimea have two generations in a year and about 30% have one generation. It has been reported that under favourable conditions some species may have even three generations in a year (e.g. *Simplimorpha promissa*, *Stigmella aceris*, and *Trifurcula eurema*). Comparison of the life cycles of Crimean species with the life cycles of the same species in other European countries show some mismatches which might be predetermined by the geographical position of the Crimean Peninsula and the favourable conditions of the coastal zone entailed by the Crimean mountains, which serve as a barrier for cold air masses.

Table 1. New revised data about mining time of Crimean Nepticulidae species. ◆ – reliably established (mines with mining larvae were collected); ● – established during fieldwork according to the empty mines); ○ – conjectural mining time of larvae (based on observations of old leaf-mines); I–III – month decades.

No.	Species	June			July			August			September			October		
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
1.	*Simplimorpha promissa*			●	●	●	◆	◆	◆	◆						
2.	*Stigmella confusella*					●	●									
3.	*Stigmella irregularis*					◆	◆	◆								
4.	*Stigmella freyella*				●	◆	◆									
5.	*Stigmella tiliae*				●	◆	◆									
6.	*Stigmella paliurella*		●	●				◆								
7.	*Stigmella microtheriella*				●	◆	◆									
8.	*Stigmella glutinosae*					●	○	◆								
9.	*Stigmella alnetella*		○	○		●	●	◆	◆							
10.	*Stigmella prunetorum*	●	●	●	●		◆									
11.	*Stigmella aceris*	●	●	○	●	◆	◆	◆								
12.	*Stigmella paradoxa*					◆	◆	◆	◆	◆						
13.	*Stigmella minusculella*				○	○	○	○	○			○	○	○		
14.	*Stigmella desperatella*				●	◆	◆	◆								

No.	Species	June			July			August			September			October		
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
15.	*Stigmella torminalis*						◆	◆								
16.	*Stigmella crataegella*			○	○	◆	◆									
17.	*Stigmella hahniella*			○	○		◆	◆								
18.	*Stigmella hybnerella*			○	○		○	○								
19.	*Stigmella catharticella*				●	◆	◆	◆								
20.	*Stigmella malella*				●	◆	◆	◆								
21.	*Stigmella rhamnella*				●	◆	◆	◆								
22.	*Stigmella viscerella*				●	●	◆									
23.	*Stigmella ulmivora*					○	●	◆								
24.	*Stigmella ulmiphaga*					○	●	◆								
25.	*Stigmella thuringiaca*				●	◆	◆									
26.	*Stigmella rolandi*			●	●	◆	◆	◆	◆							
27.	*Stigmella trimaculella*					●	◆									
28.	*Stigmella salicis*				○	●	◆									
29.	*Stigmella obliquella*					○	●	◆	◆							
30.	*Stigmella floslactella*				○	○					○	○				
31.	*Stigmella tityrella*			○	●	●	◆									
32.	*Stigmella carpinella*			○	●	◆	◆	◆			○	○	○			
33.	*Stigmella lemniscella*				●	●	◆									
34.	*Stigmella incognitella*				●	◆										
35.	*Stigmella perpygmaeella*			○	○						○	○				
36.	*Stigmella splendidissimella*					◆	◆									
37.	*Stigmella plagicolella*			○	●	◆	◆	◆	◆							
38.	*Stigmella atricapitella*					○	○					○	○	○		
39.	*Stigmella basiguttella*						●					○	○	○		
40.	*Stigmella dorsiguttella*			●	●			◆				○	○	○		
41.	*Stigmella samiatella*					○	○	○				○	○	○		
42.	*Stigmella roborella*					○	●	◆				○	○	○		
43.	*Bohemannia pulverosella*	○	○	●	●											
44.	*Ectoedemia atrifrontella*			○	○	○	○	○	○	○	○	○	○	○	○	○
45.	*Ectoedemia longicaudella*			○	○	○	○	○	○	○	○	○	○	○	○	○
46.	*Ectoedemia amani*								○	○	○	○	○	○	○	○
47.	*Ectoedemia similigena*									○	○	○	○	○	○	○
48.	*Ectoedemia turbidella*						○	○	○	○	○	○	○	○	○	○
49.	*Ectoedemia subbimaculella*											○	○	○	○	○
50.	*Ectoedemia rufifrontella*									○	○	○	○	○	○	○
51.	*Ectoedemia heringi*									○	○	○	○	○	○	○

No.	Species	June			July			August			September			October		
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
52.	*Ectoedemia contorta*									○	○	○	○			
53.	*Ectoedemia mahalebella*				●	◆	◆				○	○	○			
54.	*Fomoria septembrella*				○	○			○	○	○	○				
55.	*Acalyptris platani*			○	●	◆	◆			○	○	○				
56.	*Trifurcula subnitidella*									○	○	○	○	○		
57.	*Trifurcula josefklimeschi*						○	○	○	○						
58.	*Trifurcula silviae*							○	○	○						
59.	*Trifurcula eurema*					◆	◆			○	○	○				
60.	*Trifurcula macedonica*								○	○	○	○	○			
61.	*Glaucolepis melanoptera*									○	○	○	○			
62.	*Glaucolepis bleonella*										○	○	○			
63.	*Etainia sericopeza*				●	◆	◆									
64.	*Etainia louisella*					◆	◆									

THE LITHUANIAN NEPTICULIDAE FAUNA

Taxonomic composition of the Lithuanian Nepticulidae. Currently, 76 species of pygmy moths are known in the fauna of this country (for an annotated checklist containing new data about species distribution patterns, trophic specialization, host-plants, specified seasonal cycles, and occurrence, see Diškus *et al*., 2012; for an amazing addition to the Lithuanian fauna – *Glaucolepis lithuanica*, see Ivinskis *et al*., 2012). Most of the species belong to *Stigmella* (56) and *Ectoedemia* (13); the remaining species are divided among five other genera. Comparison of the taxonomic composition of the Lithuanian Nepticulidae fauna with the European one revealed no major differences or unique trends.

Chorological evaluation of the Lithuanian Nepticulidae fauna. Recent analysis of the Lithuanian Nepticulidae fauna indicated 8 chorological groups: the Holarctic, predominatly Sub-Baltic, Trans-Palaearctic, Euro-Mediterranean, Euro-Submediterranean, Euro-Siberian, West-Palaearctic and Euro-Nemoral (Fig. 10). The Lithuanian Nepticulidae species are distributed both in vast Holarctic and Palaearctic areas and in geographically restricted areas of Europe (Navickaitė & Stonis, 2012).

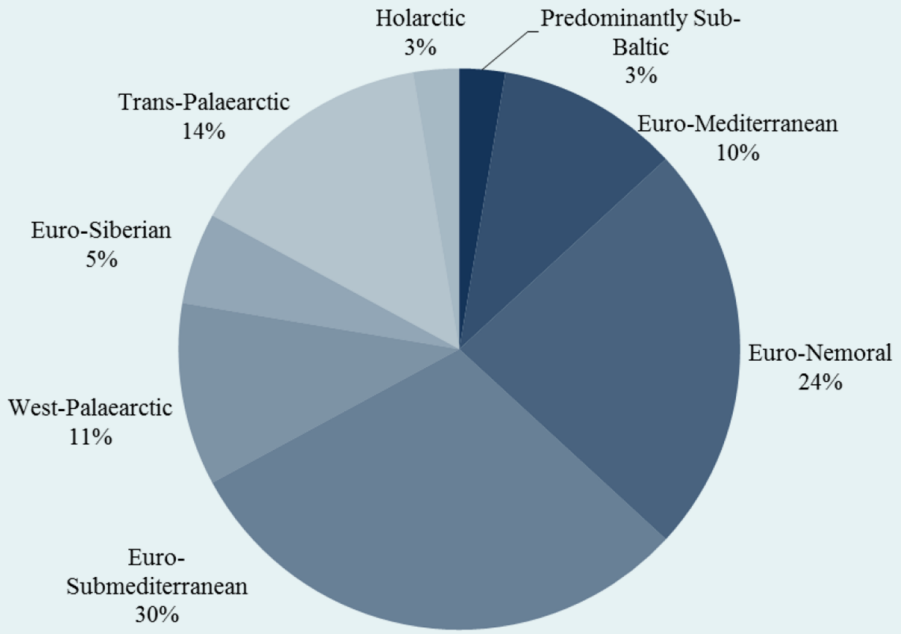

Figure 10. Chorological groups of the Lithuanian fauna of pygmy moth (updated).

The greatest number of pygmy moth species has been registered in the South-Eastern (63 species) and South-Western (67 species) regions of Lithuania. Mapping of all seventy six species recorded in the Lithuanian regions and their chorological grouping showed that the Curonian Spit region has unique species diversity (Navickaitė *et al*., 2011a; Ivinskis & Rimšaitė, 2013). As distinct from what had been expected, part of the pygmy moth fauna (from 26 to 31%) almost in every Lithuanian region is represented by Euro-Submediterranean distribution group (Navickaitė & Stonis, 2012). The best explored regions (the South-Eastern and South-Western) are predominated by Euro-Nemoral and Euro-Submediterranean species whereas the Coastal region stands out for abundance of species of Euro-Mediterranean group (Fig. 11).

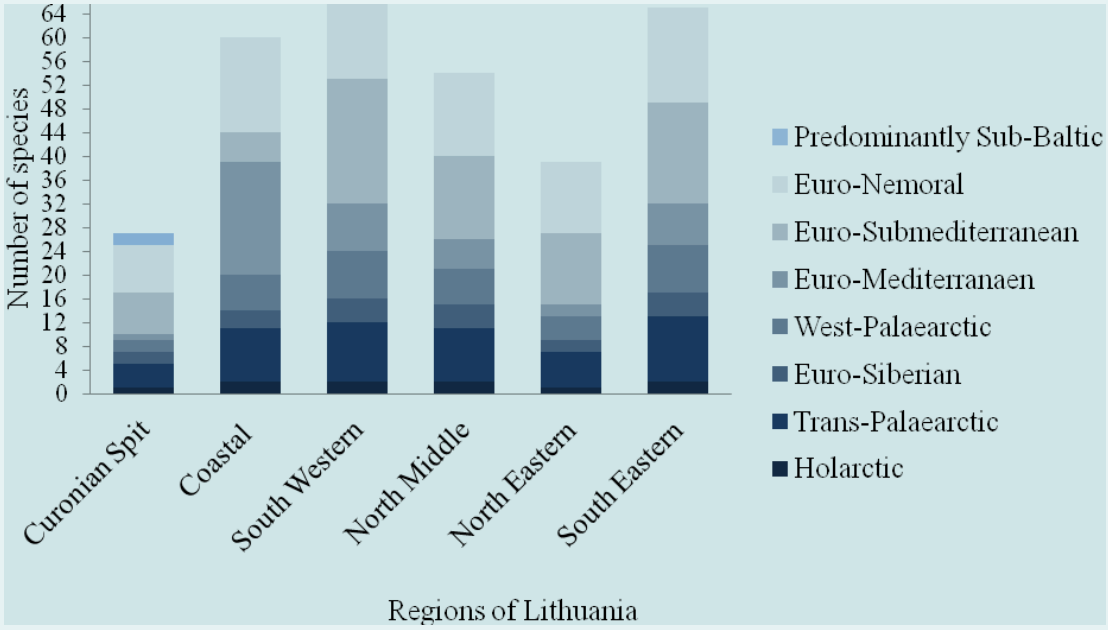

Figure 11. Chorological groups of Nepticulidae in the Lithuanian regions (After Navickaitė & Stonis, 2012).

Trophic relationships and seasonality of larval activity of the Lithuanian Nepticulidae. According to the newest data, the number of monophagous species amounts to 48. The strict oligophagous, who can mine plants of two or more species from one genus, are represented by 20 Nepticulidae species. This group of trophic specialisation prevails over the group of wide oligophagous (represented by 8 species). The almost all species of the latter group exclusively mine the plants from the Rosaceae family.

Among the Lithuanian Nepticulidae, only *Enteucha acetosae* has three generations per a year. The seasonality of larval activity in Lithuania was determined (Fig. 12).

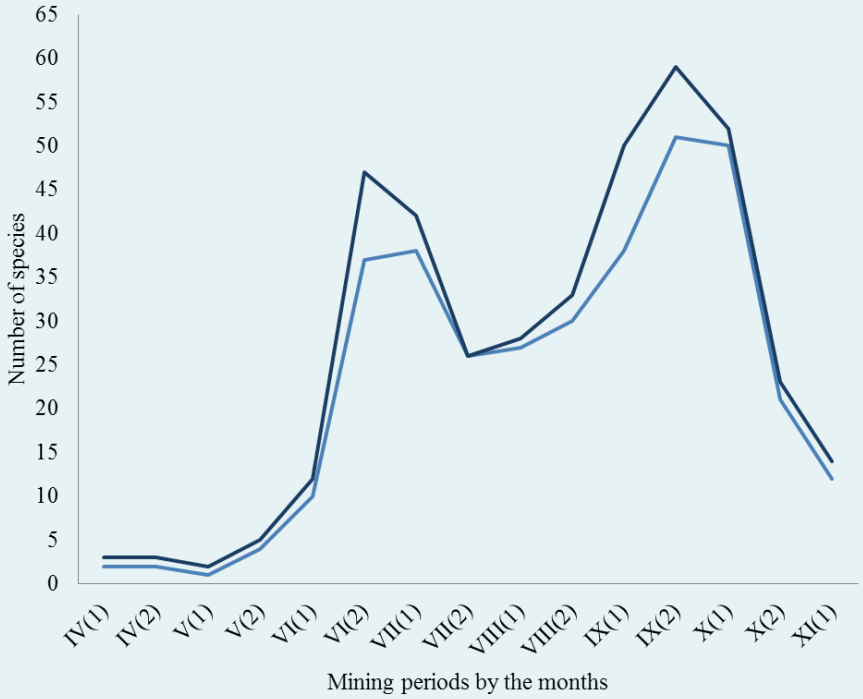

Figure 12. Larval activity of the Lithuanian Nepticulidae, with two activity peaks (darker, upper line exibit expected and calculated but not recorded peaks).

It has been determined that the Lithuanian Nepticulidae mine on host-plants from 35 genera and 15 families. Rosaceae, Salicaceae, Fagaceae and Betulaceae predominate; about 1/3 of the Lithuanian Nepticulidae is trophically associated with *Quercus*, *Betula* and *Malus*. Eleven species of the Lithuanian Nepticulidae mine fruit trees including 7 species from 3 genera (*Stigmella*, *Bohemannia* and *Ectoedemia*) which in different seasons mine the leaves of domestic apple tree (*Malus domestica*). Some Nepticulidae species (*Stigmella oxyacanthella*, *S. plagicolella* and *S. prunetorum*) can mine fruit trees of a few different plant species.

Occurrence of the Lithuanian Nepticulidae species. The evaluation of occurrence of species (common or rare) was followed by the method described in Stonis *et al.* (2012b) and Stonis *et al.* (unpublished). Among the total of Nepticulidae species recorded in Lithuania, 14 are rather widespread and abundantly mining (e.g. *Stigmella splendidissimella* and *Fomoria septembrella*). The mentioned category accounts for 1/5 of the known fauna. *Bohemannia pulverosella* is one of the 10 species which belong to the category of sparse distribution and abundant mining. They account for 13% of the Lithuanian Nepticulidae fauna. Groups of

highly limited distribution and very abundant mining (*Ectoedemia turbidella*), wide distribution but not abundant mining (*Stigmella floslactella*), and wide distribution and extremely abundant mining (*Ectoedemia argyropeza*) are represented only by single species each.

The Lithuanian Nepticulidae fauna is predominated by rare (about 40%) species. Meanwhile, it was established that 18 Lithuanian Nepticulidae species belong to common species: including 13 common (they account for 17% of the fauna) and 5 very common (about 7%) species. The latter are especially interesting since they can be regarded as potential pests.

In terms of biogeographical distribution of Nepticulidae, most of the common species (the sum of common and very common species) are characterized by Euro-Nemoral or Euro-Submediterranean distribution ranges (Fig. 13).

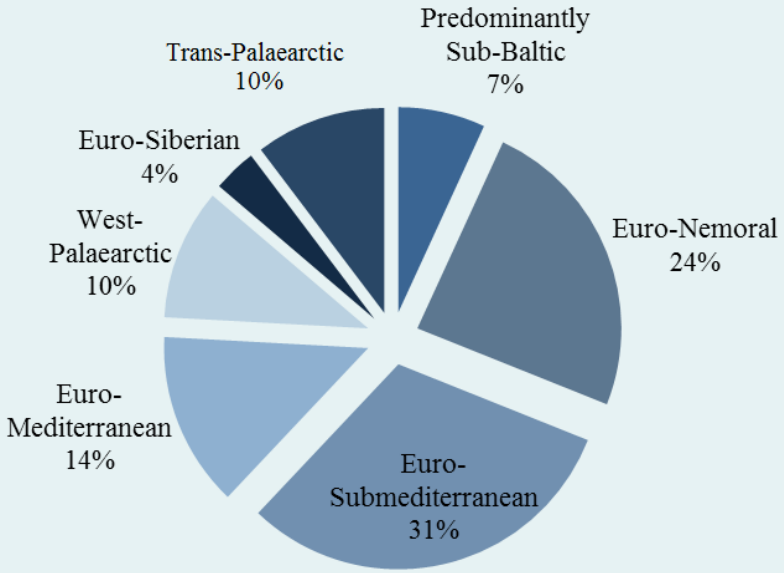

Figure 13. Belonging of the rare Lithuanian Nepticulidae species to different chorological groups.

Not abundant mining is characteristic of about half of the rare species (45%) of the Lithuanian Nepticulidae fauna: average abundance mining is characteristic of 38% of rare species and especially sporadic mining of 17% of the rare species. As distinct from the common species, the distribution of the rare species is highly limited (59%), based on solitary findings (34%) or sparse (7%). They are never widespread.

The rare species mainly mine on plants from *Ulmus*, *Fagus* and *Betula*. As distinct from the common species the rare species include miners trophically associated with host-plants belonging to *Salix*. Only two rare species – *Stigmella atricapitella* and *S. samiatella* (same as the common ones *S. ruficapitella* and *S. roborella*) mine leaves of *Quercus robur*.

CONCLUSIONS

1. Taking into consideration the recent taxonomic changes and the data on the newly described species it can be stated that currently the European Nepticulidae fauna comprises of 264 species which are trophically associated with 97, mostly woody (63%), host-plant genera and 34 plant families (mostly Rosaceae, Fagaceae and Fabaceae, in a lesser degree Betulaceae, Salicaceae, Lamiaceae, Cistaceae, Rhamnaceae,

Ulmaceae, Corylaceae, Apiaceae and Anacardiaceae). The trophic relationships of some European Nepticulidae (11%) are unknown.

2. Chorological analysis of the European fauna revealed that the Nepticulidae species of this region belong to 10 chorological groups: 29% Mediterranean, 20% Euro-Submediterranean, 12% Euro-Mediterranean, 9% Euro-Nemoral, 8% West-Palaearctic, 6% Sub-Mediterranean and Trans-Palaearctic, 2% Euro-Siberian, and 1% Holarctic. Analysis of the faunas of different European ecoregions showed that the greatest number (194) of Nepticulidae species is known from the Mediterranean ecoregion. *Simplimorpha* and *Glaucolepis* genera (93–100% of species) demonstrate an especially close links with the Mediterranean. The link of *Acalyptris, Ectoedemia* and *Parafomoria* to this region is somewhat weaker (85–89% of the 'European' species occur in the Mediterranean ecoregion).

3. The material collected during our intensive fieldwork and the material collected by other researchers helped to identify 64 species in the Crimean fauna (40% of this fauna was for the first time identified by the authors). The occurrence of a few species – *Stigmella szoecsiella, Ectoedemia albifasciella* and *E. pubescivora* – in the Crimea was not confirmed by reliable data. For this reason, these species were excluded from the list of fauna of the region.

4. Mapping of the Crimean Nepticulidae distribution ranges and chorological data analysis showed that about 72% of species discovered in the Crimea belong to the chorological groups which more or less are related with the Mediterranean ecoregion. Among the 8 chorological groups identified in the Crimean fauna, the species of the Euro-Submediterranean distribution range (36% of the known fauna of the peninsula) are dominant. Approximately one fifth of the species (22%) belongs to the Euro-Mediterranean chorological group and one sixth (16%) to the West-Palaearctic group. Meanwhile, the especially wide Euro-Siberian or Trans-Palaearctic ranges are characteristic only of 1% and 5% of species identified in the Crimea respectively.

5. Assessment of the occurrence of the species registered in the Crimean fauna allowed determining the common and rare species of the region; most of them are widespread in the forested part of the peninsula and characterized by abundant and very abundant mining. However, among the analysed Crimean fauna there are many species which are characterized by limited distribution and abundant mining or limited distribution and not abundant mining.

6. The majority of the common Crimean species mines *Quercus, Sorbus, Crataegus* and *Prunus* plants and mainly belong to the Euro-Submediterranean chorological group (about 47%). Meanwhile, as distinct from what had been expected, the least number of common species is characterized by the Sub-Mediterranean-Mediterranean distribution ranges.

7. Most of the rare species also mine on *Quercus* well as *Lotus, Alnus* and *Acer* and are characterized by Euro-Mediterranean (36%), Euro-Submediterranean and Euro-Nemoral (18% each) or Sub-Mediterranean (14%) distribution ranges. As could have been expected, the smallest number of rare species is characterized by wide distribution ranges or Sub-Mediterranean–Mediterranean distribution.

8. The data of trophic analysis showed that the majority of the Crimean Nepticulidae fauna is associated with the plants from the Rosaceae and Fagaceae (18 and 12 species respectively); about 11% of

the Crimean species are leaf-miners of cultivated plants (including *Stigmella irregularis* whose host-plant *Pyrus elaeagnifolia* was identified for the first time). According to the data of our fieldworks, the mining was reliably registered in the 1st decade of June to the 3rd decade of August (though it may continue to the 3rd decade of October). The peak of the larval activity is in July.

9. Based on the current data, 76 Nepticulidae species are known in the Lithuanian fauna. The majority of species were discovered in the South-Eastern (65 species) and South-Western (67 species) regions of the country.

10. From chorological point of view the Lithuanian Nepticulidae fauna is not homogeneous; it belongs to 8 chorological groups. The most abundant in the Lithuanian fauna are those of moderately limited European distribution: the Euro-Submediterranean (30%) and Euro-Nemoral (24%).

11. According to the available data, the species of the Euro-Submediterranean distribution constitute the major part of the Nepticulidae fauna (from 26% to 31%). Yet in the Coastal region, the number of such species is considerably lower (8%). The Coastal region is predominated by the species of the Euro-Mediterranean distribution (32%) which are less numerous in other Lithuanian regions including the Curonian Spit (they are especially few in the Curonian Spit region where they account for 4% of the regional fauna). From the chorological point of view, the Curonian Spit region is the most distinctive one among the Lithuania's regions. It is characterized by the species of the Sub-Baltic group which do not occur in other regions of the country. The Coastal region also is rather specific: the species of the Euro-Mediterranean group are occurring in greater abundance than anywhere else in Lithuania.

12. In Lithuania 15 families and 35 genera of host-plants were recorded. Most of the Lithuanian Nepticulidae is trophically associated with Rosaceae, Salicaceae, Fagaceae and Betulaceae families and about 33% of the fauna is associated with *Quercus, Betula* and *Malus* genera. The majority of the Lithuanian Nepticulidae species are trophically associated with woody plants (some of them are pest of cultivated/garden plants) and 17% of the fauna are miners of herbaceous plants.

13. The Lithuanian fauna is predominated by abundantly mining Nepticulidae (37 species or 49% of the total Lithuanian Nepticulidae fauna). It was determined that the most common in the Lithuanian Nepticulidae fauna are species of wide distribution and abundant mining (they account for more than one fifth of the total of known fauna). The smallest number is represented by species of highly limited distribution/very abundant mining or wide distribution/not abundant or sporadic mining (slightly over 1% each).

14. About 40% of the Lithuanian Nepticulidae species belong to the category of rare (rare and very rare) and 24% to the category of common species (17% of species are common and 7% very common). Nepticulidae both of common and rare species are characterized by the Euro-Nemoral and Euro-Submediterranean ranges (there are no significant chorological differences between the Lithuanian common and rare species). Yet as distinct from the common species, the rare and very rare species are characterized only by highly limited distribution (about 60% of the rare species) or almost solitary findings (34%) and, sometimes, sparse distribution (7%) yet never by wide or very wide distribution over the territory of the country.

ACKNOWLEDGEMENTS

We are grateful to DSc. Sergey Yu. Sinev (ZIN, St. Petersburg) and Dr. Yu. I. Budashkin (KRUAS, Karadag) for their contribution, consultations and recommendations. We are thankful to the researchers E. Anisimov, V. Juchnevič, S. Brusokaitė, K. Lensbergaitė, G. Varačinskas, J. Čeputytė, E. Poškaitė, V. Zeleniūtė, D. Aržuolaitytė, V. Dobrynina, J. Prakapavičiūtė, S. Šutaitė, R. Mankutė, A. Bobnis, J. Vertelytė and M. Adomaitis for their assistance in investigating the Nepticulidae fauna of Lithuania (or neighbouring countries). The first author Asta Navickaitė wishes to thank D. Mikelaitis (the Fauna Use Control Division at the Environment Protection Agency, Vilnius) for his assistance in getting permits for the exchange of study material with the Russian Academy of Sciences and the Ukrainian Academy of Sciences. Asta Navickaitė is thankful to the Director of the Regional Park of Vištytis Nerijus Paškauskas for the permission to carry out Nepticulidae research within the territory of the Park, and is grateful to the ecologist senior specialist at the Regional Park of Vištytis Vaidas Leonavičius (Vištytis) and the landscape manager senior specialist Andrius Vaičaitis (Kybartai) for their benevolent cooperation in carrying out the research and preparing the information.

REFERENCES

Dios de, R. S., Benito-Garzón, M. & Sainz-Ollero, H. 2009. Present and future extension of the Iberian submediterranean territories as determined from the distribution of marcescent oaks. *Plant Ecology*, 204 (2): 189–205.

Diškus, A. & Stonis, J. R. 2012. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 220 pp.

Diškus, A., Navickaitė, A. & Stonis, J. R. 2011. New records of four rare species of Nepticulidae (Lepidoptera) discovered in western Lithuania. *New and Rare for Lithuania Insect Species. Records and descriptions*, 23: 57–60.

Diškus, A., Navickaitė, A. & Stonis, J. R. 2012. Taksonominė Lietuvos Nepticulidae sudėtis ir papildytas faunos sąvadas. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 73–100 p.

Ivinskis, P. 2004. *Lepidoptera of Lithuania*. VU Ekologijos instituto leidykla, Vilnius. 380 pp.

Ivinskis, P. & Rimšaitė, J. 2013. Data on new and rare Lepidoptera species for Lithuanian fauna. *New and rare for Lithuania insect species. Records and descriptions*, 25: 31–36.

Ivinskis, P., Nieukerken, E. J. van & Rimšaite, J. 2012. *Trifurcula* (*Glaucolepis*) *lituanica* sp. nov., an unexpected new stem-miner on *Salvia pratensis* occuring in easter Europe (Lepidoptera: Nepticulidae). *Zootaxa*, 3570: 41–55.

Kuznetzov, V. I. & Puplesis, R. 1994. Sem. Nepticulidae (Stigmellidae) – moli-malyutki (in Russian). *In*: Kuznetzov, V. I. (ed.). *Nasekomye i kleshchi – vrediteli sel'skokhozyaistvennykh kul'tur*. Cheshuekrylye [*Insects and mites – pests of agricultural plants*. Lepidoptera], 3 (1): 12–23. Nauka Publishers, St. Petersburg.

Navickaitė, A. & Stonis, J. R. 2012. Chorologinis Lietuvos Nepticulidae faunos įvertinimas. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 101–111 p.

Navickaitė, A., Diškus, A. & Stonis, J. R. 2011a. Review of Nepticulidae (Insecta: Lepidoptera) occurring in the Curonian Spit (Baltic Coast of Lithuania). *Acta Zoologica Lituanica*, 21 (3): 221–231.

Navickaitė, A., Diškus, A. & Stonis, J. R. 2014. An updated checklist of Nepticulidae (Lepidoptera) of the Crimea, Sub-Mediterranean SE Europe. *Zootaxa*, 3847 (2): 151–202.

Navickaitė, A., Diškus, A., Stonis, J. R. & Dobrynina, V. 2011b. Taxonomic catalogue of the world Nepticuloidea and Tischerioidea (Lepidoptera) described by members of the Biosystematics Research Group (Lithuania) up to 2009. *Acta Zoologica Lituanica*, 21 (2): 113–132.

Nieukerken, E. J. van, Laštůvka, A. & Laštůvka, Z. 2010. Western Palaearctic *Ectoedemia* (*Zimmermannia*) Hering and *Ectoedemia* Busck s. str. (Lepidoptera, Nepticulidae): five new species and new data on distribution, hostplants and recognition. *ZooKeys*, 32: 1–82.

Nieukerken, E. J. van, Zolotuhin, V. V. & Mistchenko, A. 2004. Nepticulidae from the Volga and Ural region. *Nota lepidopterologica*, 27 (2/3): 125–127.

Puplesis, R. 1994. *The Nepticulidae of Eastern Europe and Asia: western, central and eastern parts*. Backhuys Publishers, Leiden. 291 pp. + figs. 840.

Puplesis, R. & Diškus, A. 2003. *The Nepticuloidea & Tischerioidea (Lepidoptera) – a global review, with strategic regional revisions*. Lututė Publishers, Kaunas. 512 pp., figs. 612.

Puplesis, R. & Robinson, G. S. 2000. A review of the Central and South American Nepticulidae (Lepidoptera) with special reference to Belize. *Bulletin of the Natural History Museum, London* (Entomology), 69 (1): 3–114.

Rueda, M., Rodríguez, M. Á. & Hawkins, B. A. 2010. Towards a biogeographic regionalization of the European biota. *Journal of Biogeography*, 37 (11): 2067–2076.

Stonis, J. R. 2010. Kodėl taksonominiai biologinės įvairovės tyrimai svarbūs Lietuvai? *Mokslo Lietuva*, 8: 1, 6.

Stonis, J. R. & Remeikis, A. 2010. Patikėkit, Karadahas ir jums patiktų. 3. Šaitano vartai ir vabzdžių rojus. *Žurnalas apie gamtą*, 2: 14–18.

Stonis, J. R. & Remeikis, A. 2011. *Acalyptris platani* (Müller-Rutz) in the Crimea, Ukraine – The Easternmost record of the Sub-mediterranean species in Europe (Insecta: Lepidoptera: Nepticulidae). *Acta Zoologica Lituanica*, 21 (2): 89–95.

Stonis, J. R., Diškus, A. & Navickaitė, A. 2012a. Nepticulidae tyrimų metodai. *In*: Diškus, A., Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 38–59 p.

Stonis, J. R., Navickaitė, A. & Diškus, A. 2012b. Lietuvos mažųjų gaubtagalvių rūšių aptinkamumo grupės. *In*: Diškus, A. & Stonis, J. R. *Leaf-mining insects of Lithuania. The Nepticulidae (Lepidoptera): taxonomy, chorological composition and trophic relationships*. Monograph [in Lithuanian]. Lututė Publishers, Kaunas. 168–174 p.

Stonis, J. R., Navickaitė, A., Rocienė, A., Remeikis, A. & Diškus, A. 2013. A provisional checklist of the Nepticulidae (Insecta, Lepidoptera) of the Crimea. *Zoology and Ecology*, 23 (1): 20–28.

Stonis, J. R., Remeikis, A., Diškus, A. & Navickaitė, A. 2014. Study methods of Nepticulidae: micro-mounts of genitalia structures. *In*: Stonis, J. R., Hill, S. R., Diškus, A. & Auškalnis, T. (eds). *Selected abstracts and papers of the First Baltic International Conference on Field Entomology and Faunistics*. Edukologija Publishers, Vilnius. 32–35 p.

CHECKLIST OF MOTHS AND BUTTERFLIES OF THE CZECH REPUBLIC (INSECTA: LEPIDOPTERA)

Zdeněk Laštůvka & Jan Liška

Mendel University, Brno, Czech Republic

The checklist of moths and butterflies (Lepidoptera) of the Czech Republic (Laštůvka & Liška, 2011) is based on catalogues of Lepidoptera of Moravia and the Czech part of Silesia (Laštůvka, 1993), of Bohemia (Novák & Liška, 1997) and of the entire Czech Republic (Laštůvka, 1998), especially its online version (Laštůvka & Liška, 2010). It takes into account all systematic and nomenclatural changes that have occured in recent times. Higher classification has been modified in accordance with results of morphological and molecular studies that aim to stabilize the nomenclature and classification of European Lepidoptera and were also applied in the Fauna Europaea database (Karsholt & van Nieukerken, 2011).

The list includes species continuously or formerly present, accompanied by at least one documented record, migrants, those with irregular occurrence and synanthropic species. However, species recorded only on the basis of misidentifications have been excluded from the list, as have species without reliable records and unique findings of obviously introduced individuals of non-indigenous species without subsequent formation of at least short-term populations.

Following tradition, occurrence in Bohemia (B) and Moravia with Czech Silesia (M) is given in the list. In order to give precision to the hitherto known distribution in the Czech Republic, the species are marked whose occurrence is known to be limited only to the thermophyticum or oreophyticum. Using indices, introduced, synanthropic, missing and extinct species are also indicated. For all species recorded since the previous lists, references to the published source are added. Various comments have been attached to some species, concerning their occurrence in the area under study, or sometimes their nomenclature, taxonomy and biology.

ZOOGEOGRAPHICALLY MOST REMARKABLE SPECIES

Species richness of Lepidoptera in the Czech Republic as well as that of other organisms has been primarily affected by climatic changes since the last glacial period, i.e. during approximately the last 12,000 years, by the geographic position and a large diversity of habitats. Position on the boundary of the Hercynian and Western Carpathian subprovinces of Central European deciduous forests and especially openness of the

area to the south-east with a large influence of Pannonia, makes possible penetration of southern European thermophilic species from the south-east, Polonian elements from the north, and western European elements above all through the Elbe River canyon into the Czech basin. An important positive role was played by several thousand years of human activities, leading to a significant increase in the landscape heterogeneity. Neolithic farmers settled the most fertile parts of central Bohemia and southern Moravia more than 6500 years ago. In the following period, they gradually enlarged deforested areas which makes possible the spread of many non-forest species especially from the south-east, or also from preserved local refuges (Laštůvka & Liška, 2011).

Especially in the warm Atlanticum period 6700–4500 years ago some thermophilic species were able to settle the Czech basin and they survived subsequent cooler periods there, while they left the area of southern Moravia. The settlement of higher altitudes and greater extensive farming in the last millennium enabled further spread of species of non-forest habitats. The area was then faunistically enriched by any, even minor climate change. More specialized species disappeared at the same time, but some of them survived in isolated, ecologically appropriate habitats. The result of these events is a mixture of species of different geographical origin, inhabiting habitats of various character. Insular occurrence of many species may be the remnant of a former larger continuous distribution, but it may be also due to the possibility of passive (aerial transportation) or active travel over long distances and the ability to colonize suitable habitats. The vulnerability of species and their importance from the faunistic, zoogeographic, ecological or conservation view is increasing with the rate of isolation of their occurrence and with reduction of their habitats (Laštůvka & Liška, 2011).

Primarily, species with isolated relict occurrence in the central Bohemian thermophyticum, that occur nearby in southern Slovakia, in Lower Austria, or Hungary in the south-east direction or in Bavaria and Baden-Würtemberg to the south-west, are very remarkable, e.g. *Phyllonorycter helianthemella, Coleophora kroneella, C. frankii, C. linosyridella, Oegoconia caradjai, Isidiella nickerlii, Pyncostola bohemiella, Pennisetia bohemica, Pyrausta castalis, Pseudophilotes baton, Luperina nickerlii, Polia serratilinea, Euxoa vitta* and *Paidia rica* (Laštůvka & Liška, 2011).

Relict or marginal occurrence of boreal and boreal-montane species is also very important. These species are mostly remnants of the last glacial or early postglacial period, but some of them were able to penetrate into central Europe with the expansion of the taiga in the period around 9000–8000 years ago or in one of the later cold periods. They often inhabit higher mountain altitudes, peat bogs, some of them inhabit mixed mesophilous forests. They are particularly *Callisto insperatella, Phyllonorycter anderidae, Levipalpus hepatariella, Exaeretia ciniflonella, Coleophora murinella, Athrips pruinosella, Bryotropha boreella, Sparganothis rubicundana, Apotomis fraterculana, Olethreutes lediana, O. obsoletana, Epinotia gimmerthaliana, Choreutis diana, Catoptria maculalis, Pediasia truncatella, Udea inquinatalis, Boloria aquilonaris, B. eunomia, Chloroclysta infuscata, Eupithecia gelidata, Odontosia sieversii, Celaena haworthii, Coenophila subrosea, Xestia sincera, X. rhaetica* and *X. alpicola* (Laštůvka & Liška, 2011).

There are no extensive high mountain massifs in the Czech Republic and its marginal mountains reach a maximum height of 1400–1600 m, but isolated occurrence of several mountain species has been recorded.

The most important are *Chionodes nebulosella, Clepsis steineriana, Blastesthia mughiana, Eudonia petrophila, Catoptria petrificella, Erebia epiphron, E. sudetica, Colostygia kollariaria, Elophos operaria* and *Psodos quadrifaria* (Laštůvka & Liška, 2011).

Mention must be also given of a greater number of species, of which the entire or partial central European distribution is very insular or they appear far from their continuous ranges there. Many of them have been found in a single locality or in a very limited area of the Czech Republic. Unlike previous groups, it is not an ecologically or zoogeographically homogeneous group of species. Most notable are *Bohemannia auriciliella, Ectoedemia viridissimella, Cephimallota praetoriella, Bucculatrix maritima, Phyllobrostis hartmanni, Depressaria ultimella, Coleophora halophilella, C. niveistrigella, Scrobipalpa samadensis, S. nitentella, Caryocolum klosi, Phalonidia affinitana, Dichrorampha podoliensis, Anthophila abhasica, Tebenna chingana, Capperia lorana* and *Polyommatus eros*. More than 100 species reach the northern margin of their whole known range in southern Moravia, or even the northernmost distributional point in central or in the whole of Europe (Laštůvka & Liška, 2011).

In recent decades the number of alien species has distinctly increased. These species can be divided into three groups: 1) species introduced from climatically similar areas, which may find suitable living conditions in the external environment (climate, habitat, host plant) and can establish in a secondary area; 2) species originating from warmer regions, usually of the tropics and subtropics, which are able to survive generally only inside temperate spaces, in buildings or in greenhouses; 3) single or repeated introductions of individual specimens of species, which do not establish long-term populations (Laštůvka & Liška, 2011).

In the Czech Republic, 12 invasive species of Lepidoptera have so far been recorded. These species were introduced into Europe mostly from North America or East Asia, although the origin some of them is not clear (Laštůvka & Liška, 2011).

REFERENCES

Karsholt, O. & Nieukerken, E. J. van (eds.). 2011. *Fauna Europaea: Lepidoptera, Moths.* Fauna Europaea version 2.4, http://www.faunaeur.org (accessed on August 1, 2014).

Laštůvka, Z. (ed.) 1993. *Katalog von Faltern der mährisch-schlesischen Region (Lepidoptera)* [in Czech]. AF VŠZ, Brno. 130 pp.

Laštůvka, Z. (ed.) 1998. *Checklist of Lepidoptera of the Czech and Slovak Republics (Insecta Lepidoptera)* [in Czech]. Konvoj, Brno, 118 pp.

Laštůvka, Z. & Liška, J. 2010. *Checklist of Lepidoptera of the Czech Republic*. Online at www.lepidoptera.wz.cz (accessed on August 1, 2014).

Laštůvka, Z. & Liška, J. 2011. *Annotated checklist of moths and butterflies of the Czech Republic* [in Czech]. Biocont Laboratory, Brno. 148 pp.

Novák, I. & Liška, J. 1997. Katalog motýlů (Lepidoptera) Čech (Katalog der Falter Böhmens). *Klapalekiana*, 33: 1–159.

THE WETLANDS OF ZERI: FLORA, VEGETATION AND AMPHIBIAN POPULATION OF PELOSO LAKE (TOSCANY, ITALY)

Alex Borrini

Genoa University, Genoa, Italy

INTRODUCTION

The study took place in the years 2012 and 2013 in the municipality of Zeri (MS) in Tuscany. The first part of the research consisted of general study of wetlands within the municipality which includes the easternmost portion of the Tyrrhenian slopes of the Ligurian Apennines and part of the Po Valley in the City of Albareto.

On the basis of geological information of the area (Giuntini, 2005a, 2005b), it has been possible to relate the origin of the mire in the municipality of Zeri with the widespread landslides and the presence of a large clay substrate. In fact the majority of these environments are found between 1,000 and 1,300 meters above sea level, often above the deposits of the eroded slopes and, with rare exceptions, on a substrate with scaly clays. The origin of marshy places in Albareto is instead mainly related to the morphogenesis of the Pleistocene Ice Age (Lastrucci *et al*., 2007).

RESULTS

One of the sites, Peloso Lake (Fig. 1A), has been investigated from the point of view of the flora and vegetation: the collection of plants in the lake area allowed us to draw up a florula, in which we found interesting species. For example, *Lycopodiella inundata* (Fig. 2), a small pteridophyte that occurs here at the southern limits of its distribution range in Italy (Camangi & Kugler, 2008) and perhaps in Western Europe. We found *Drosera rotundifolia*, a marshy carnivorous plant (Fig. 2) (Camangi *et al*., 2008), *Juncus bulbosus*, a small bulrush rooting in water and with a limited distribution in Italy as well as a large contingent of species of the Boreal distribution. Ecological (community) methods were carried out and these led to the description of the plant community. A characteristic belt of big rushes (*Juncus effusus* e *J. conglomeratus*) externally delimits the lake. There are expanses (communities) of *Carex rostrata*, trembling carpets colonized by numerous species (*Caricion fuscae*, also *Viola palustris*, *Carex canescens*, *C. stellulata*, and extensive *Sphagnum* carpets). In a depression, *Lycopodiella inundata* was found.

In the lake, particularly in a pond in the north of the site (the eye of the bog), a community of amphibians represented by *Rana temporaria*, *Triturus carnifex* and *T. alpestris* were found. Observations of these species were conducted and these outlined the phenological cycles. For *R. temporaria*, it is evident, that this is essentially a terrestrial anuran which frequents the site almost exclusively for the breeding season only, which lasts a few days (Andreone & Giacoma, 1989). The two species of newt appear, on average, a few weeks after mating of *R. temporaria* as a result of rising temperatures and remain in water for about 6 months (Bertolusso *et al*., 2013). For both *T. alpestris* and *T. carnifex* we started the monitoring of the population using the capture-mark-recapture method with surveys made in June of 2012 and 2013. The statistical results showed a high number of individuals in relation to the small size of the site, surpassing 300 individuals in total. We observed that in 2012 the two populations were almost numerically equivalent (154 *T. carnifex, T. alpestris* 163); in 2013 though, the population of *T. carnifex* has increased (254), while, on the contrary, the population of *T. alpestris* has decreased (113). The fluctuations may be connected with different average temperatures in 2012 and 2013 during the survey seasons.

DISCUSSION

Finally, we made suggestions for the conservation of wetlands in Zeri, which in addition to sites such as Peloso Lake are still quite intact. There are also degraded sites, such as the Lakes of Aracci; the causes of this degredation are still questionable, especially regarding the possible impact of the introduction of exotic fishes which threaten both populations of amphibians and aquatic vegetation.



Figure 1. Studied sites: A – the depression at Lago Peloso; B – Lago Verde di Adelano (Zeri).



Figure 2. *Lycopodiella inundata* and *Drosera rotundifolia.*

REFERENCES

Andreone, F. & Giacoma, C. 1989. Breeding dynamics of *Triturus carnifex* at a pond in northwestern Italy (Amphibia, Urodela, Salamandridae). *Holarctic Ecology*, 12 (3): 219–223.

Bertolusso, R., Seglie, D., Vallinotto, E., Sindaco, R. & Giacoma, C. 2013. Fenologia riproduttiva e direzionalità di migrazione in *Triturus carnifex* (Laurenti, 1768) nell'Italia Nord-occidentale. *In: Atti IX Congresso Nazionale della Societas Herpetologica Italica, Bari – Conversano*, 26–30 p.

Camangi, F. & Kugler, P. C. 2008. *Lycopodiella inudata* (L.) Holub (Lycopodiaceae). Notulae alla checklist della flora vascolare italiana, 1447. *Informatore Botanico Italiano*, 40 (1): 106.

Camangi, F., Kugler, P. C., Stefani, A., Sebastiani, L., Bandini, S. & Mariotti, F. 2008. *Drosera rotundifolia* L. (Droseraceae): nuove stazioni nella Toscana nord-occidentale. *Atti della Società Toscana di Scienze Naturali Residente in Pisa. Memorie. Serie B*, 115: 33–34.

Giuntini, D. 2005a. Nota preliminare sula geomorfologia dell'Alta Val Gordana (Bacino del Fiume Magra). *Atti della Società Toscana di Scienze Naturali Residente in Pisa. Memorie. Serie A*, 110: 31–41.

Giuntini, D. 2005b. *Pericolosità, rischio di frana e pianificazione. Un caso di studio nel bacino del Fiume Magra.* Dottorato di Ricerca in Scienze della Terra. Università di Pisa.

Lastrucci, L., Viciani, D., Nuccio, C. & Melillo, C. 2007. Indagine vegetazionale su alcuni laghi di origine artificiale limitrofi al Padule di Fucecchio (Toscana, Italia Centrale). *Annali Museo Civico di Rovereto*, 23: 169–203.



FIRST BALTIC INTERNATIONAL CONFERENCE ON

FIELD ENTOMOLOGY AND FAUNISTICS

June 2014, Vilnius, Lithuania



The Conference brings together international academics from the Baltic and other countries, including professors and graduate, master or postgraduate students, to present methodological novelties and faunistic research in their respective fields.
The first aim of the Conference is to provide opportunities for academics from various countries representing a range of disciplines of entomology to share their research by means of the conference podium.
The Conference's second aim is to provide opportunities for academics to receive informal in-depth feedback through discussions and enable them to establish contact with professionals from other countries and institutions.

HONOUR CHAIR

Acad. Algirdas Gaižutis (Rector of the Lithuanian University of Educational Sciences, Vilnius, Lithuania)
Dr. Donald R. Davis (Leading Scientist in the field of insect taxonomy, NMNH, Smithsonian Institution, Washington, D.C., USA)

GENERAL CHAIR

Prof. Habil. Dr. Jonas Rimantas Stonis (Chairman, Lithuanian University of Educational Sciences, Vilnius, Lithuania)

INTERNATIONAL SCIENTIFIC COMMITTEE

Prof. Dr. Virginijus Sruoga (Dean of the Faculty of Science and Technology, Lithuanian University of Educational Sciences, Vilnius, Lithuania)
Prof. Habil. Dr. Vincas Būda (Director of the Nature Research Centre, Nature Research Centre, Vilnius, Lithuania)
Prof. Habil. Dr. Rimantas Rakauskas (Head of the Zoology Department, Vilnius University, Vilnius, Lithuania)
Prof. Dr. Sigitas Podėnas (Leading Research Scientist, Nature Research Centre, Vilnius, Lithuania)
Dr. M. Alma Solis (Leading Research Scientist, USDA, NMNH, Smithsonian Institution / formerly Head of Systematic Entomology Laboratory, US Department of Agriculture, Washington, D.C., USA)
Dr. Svetlana V. Baryshnikova (Leading Research Scientist, Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia)
Dr. Aleksandr L. Lvovsky (Leading Research Scientist, Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia)
Dr. David C. Lees (Postdoctoral Research Associate, Skylab, Department of Zoology, Cambridge University, Cambridge, United Kingdom)
Dr. Blanca Huertas (Curator of the Lepidoptera Collection, Natural History Museum, London, United Kingdom)
Dr. Jean-François Landry (Leading Research Scientist and Curator, and Editor of an international zoological taxonomy journal – Zootaxa, Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Canada)
Assoc. Prof. Dr. Andrius Petrašiūnas (Vilnius University and President of the Lithuanian Entomological Society)
Assoc. Prof. Dr. Romualda Lazauskaitė (Vice-Dean of the Faculty of Science and Technology, Lithuanian University of Educational Sciences, Vilnius, Lithuania)
Assoc. Prof. Dr. Jurga Turčinavičienė (Vice-Dean of the Faculty of Natural Sciences, Vilnius University, Vilnius, Lithuania)
Dr. Brigita Tamutė (Vytautas Magnus University and Tadas Ivanauskas Zoological Museum, Kaunas, Lithuania)
Assoc. Prof. Dr. Arūnas Diškus (Senior Researcher, Lithuanian University of Educational Sciences, Vilnius, Lithuania)
Prof. Dr. Remigijus Noreika (Head of the Biology Department, Lithuanian University of Educational Sciences, Vilnius, Lithuania)
Assoc. Prof. Dr. Regimantas Bareikis (Head of the Institute for Scientific Research, Lithuanian University of Educational Sciences, Vilnius, Lithuania)
Assoc. Prof. Dr. John B. Heppner (Curator of Florida State Collection of Arthropods and the Founder of the International Association for Tropical Lepidoptera, Editor of Lepidopterorum Catalogus (new series) and Lepidoptera Novae, McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Gainesville, USA)

1st session on 3 June 2014 (Auditorium 415, FST, LEU)