



<http://dx.doi.org/10.11646/zootaxa.3741.2.1>

<http://zoobank.org/urn:lsid:zoobank.org:pub:E37C82A2-27DA-42DE-A298-838578F6B179>

## Systematics, phylogeny and biology of a new genus of Lithocolletinae (Lepidoptera: Gracillariidae) associated with Cistaceae

JURATE DE PRINS<sup>1,4</sup>, DONALD R. DAVIS<sup>2</sup>, ELIANE DE CONINCK<sup>1</sup>, JAE-CHEON SOHN<sup>2</sup> & PAOLO TRIBERTI<sup>3</sup>

<sup>1</sup>Royal Museum for Central Africa, Tervuren, Belgium

<sup>2</sup>National Museum of Natural History, Smithsonian Institution, USA

<sup>3</sup>Museo di Storia Naturale, Verona, Italy

<sup>4</sup>Corresponding author. E-mail: [jurate.de.prins@africamuseum.be](mailto:jurate.de.prins@africamuseum.be)

### Abstract

The gracillariid genus *Triberta* **gen. nov.** (Lepidoptera: Gracillariidae: Lithocolletinae Stainton, 1854) is described to accommodate two species formerly assigned to the genus *Phyllonorycter* Hübner, 1822: *Triberta helianthemella* (Herrich-Schäffer, 1861) **comb. nov.** and *T. cistifoliella* (Groschke, 1944) **comb. nov.** *Triberta cistifoliella* **bona sp.** is restored from synonymy based on morphological characters. The new genus is biologically associated with the plant family Cistaceae of the order Malvales and is endemic to the Palearctics. Our molecular analysis of eleven nuclear genes failed to unambiguously place *Triberta* in the lithocolletine phylogeny, but revealed that this genus is distinct from either clade *Phyllonorycter* + *Cremastobombycia* and *Cameraria*. The distinctiveness of *Triberta* is also supported by inferred traits in wing venation, micro morphology of the last instar larva, pupa, genital morphology of the adult and life history. A key to the species of *Triberta* is provided. The interspecific homogeneity in external morphology, coupled with minor differences in genital traits, an apparent narrow specialization on Cistaceae host plants, restricted geographical range and molecular evidence based on multi-nuclear genes jointly suggest that the generic diversification of *Triberta* is a relatively old phenomenon and driven strongly by host selection.

**Key words:** evolution, host specificity, leaf mining, morphology, taxonomy

### Introduction

This contribution presents another step towards understanding the systematics and evolutionary history of the subfamily Lithocolletinae Stainton, 1854 following the publication of the taxonomic-revisionary study about the Afrotropical Lithocolletinae (De Prins & Kawahara 2012). These tiny, attractive, distinctively ornate moths represent a highly successful lineage of Gracillariidae (Kawahara *et al.* 2011) and are placed phylogenetically among the ditrysian moths within the complex clade of the superfamilies Yponomeutoidea + Gracillarioidea (Mutanen *et al.* 2010; Sohn *et al.* 2013; Regier *et al.* 2013). The great majority of taxa within this complex possess diverse plant mining life histories (Grimaldi & Engel 2005; Sohn *et al.* 2013). Currently the monophyletic group Lithocolletinae comprises 552 species of leaf miners, with the Afrotropical *loxozona* species group as an exception in possessing a gall-forming life history. The presently known Lithocolletinae species are grouped into 10 genera (De Prins & Kawahara 2012; De Prins & De Prins 2013); nevertheless, many additional underscribed taxa can still be found in tropical regions, and many of these are already present in various research collections.

Species of Lithocolletinae have an intimate and often highly specialized feeding and reproductive interaction with a great variety of plants: no less than 771 plant species belonging to 38 families are recorded as host plants of these leaf miners (Lopez-Vaamonde *et al.* 2003, 2006; De Prins & Kawahara 2012; De Prins & De Prins 2005, 2013). However, the successful ecological colonization of congeneric lithocolletine moths which utilize the diverse variety of plant families occurred rather seldom during evolution. Six lithocolletine genera out of ten, including *Chrysaster* Kumata, 1961, *Hyloconis* Kumata, 1963, *Macrosaccus* Davis & De Prins, 2011, *Neolithocolletis*,

**Remarks.** This paper echoes the findings of V. T. Chambers (1877, 1878) published in the second volume of *Psyche, a journal of Entomology*, in which Chambers, based on his detailed study of larval morphology of the then known American lithocolletine species, for the first time suggested the possible division of the lithocolletine genus *Phyllonorycter*. V. T. Chambers, unfortunately, did not officially formulate his findings according to the rules of the ICZN, and therefore, following the Principle of Priority (Art. 23) the lithocolletine genus *Cameraria*, which in fact was discovered and studied by Chambers, was attributed officially to Chapman (1902). One hundred and thirty six years later, in the present publication, we delineate one more lithocolletine genus *Triberta* and remove both of its constituent species from the genus *Phyllonorycter*.

## Acknowledgements

Wolfram Mey (Museum für Naturkunde der Humboldt-Universität, Berlin) is kindly acknowledged for allowing us to study the historic *Triberta* specimens from the Staudinger collection and for information on additional *Triberta* specimens present in the collection under his care. We thank very much Andreas Zwick (Staatliches Museum für Naturkunde Stuttgart) for his kind assistance in searching for the types of *Lithocolletis cistifoliella* and for very valuable information on the biography of Franz Groschke (1914–1956). Matthias Nuss (Staatliches Museum für Tierkunde) in Dresden is sincerely thanked for the most valuable information on the deposition of specimens from the collection of the Forstliche Hochschule in Tharandt. Bernard Landry (Muséum d'histoire naturelle, Genève) was kind to donate the male specimen of *Triberta* which served to record SEM photographs of the last abdominal segments. We cordially thank David Wagner (University of Connecticut) for his helpful suggestions on the delimitation of the new genus *Triberta*. We also thank both reviewers for their highly pertinent comments and suggestions. Financial support was obtained from the Belgian Science Policy Office to the first author.

## References

- Amsel, H.G. (1951) Una raccolta di Microlepidotteri della Dalmazia meridionale. *Redia*, 36, 411–422.
- Arrington, J.M. & Kubitzki, K. (2003) Cistaceae. In: Kubitzki, K. (Ed.), *The families and genera of vascular plants IV. Flowering Plants. Dicotyledons. Malvales, Capparales and Non-betain Caryophyllales*. Springer, Berlin, pp. 62–70.  
[http://dx.doi.org/10.1007/978-3-662-07255-4\\_15](http://dx.doi.org/10.1007/978-3-662-07255-4_15)
- Batista, F., Bañares, A., Caujapé-Castells, J., Carqué, E., Marrero-Gómez, M. & Sosa, P.A. (2001) Allozyme diversity in three endemic species of *Cistus* (Cistaceae) from the Canary Islands: intraspecific and interspecific comparisons and implications for genetic conservation. *American Journal of Botany*, 88 (9), 1582–1592.  
<http://dx.doi.org/10.2307/3558402>
- Bentancourt, C.M. & Scatoni, I.B. (2007) Morphology and biology of *Porphyrosela minuta* Clarke 1953 (Lepidoptera: Gracillariidae, Lithocolletinae) in Uruguay. *Neotropical Entomology*, 36 (4), 514–519.  
<http://dx.doi.org/10.1590/s1519-566x2007000400005>
- Biesenbaum, W. (2005) *Die lepidopterenfauna der Rheinlande und Westfalens. Familie: Gracillariidae Stainton, 1854. Unterfamilie: Lithocolletinae Stainton, 1854. Band 12. Arbeitsgemeinschaft Rheinisch-Westfälischer Lepidopterologen e.V. mit Unterstützung der Nordrhein-Westfalen Stiftung Naturschutz, Heimat- und Kulturpflege, Leverkusen, 208 pp., 11 pls.*
- Bosch, J. (1992) Floral biology and pollinators of three co-occurring *Cistus* species (Cistaceae). *Botanical Journal of the Linnean Society*, 109 (1), 39–55.  
<http://dx.doi.org/10.1111/j.1095-8339.1992.tb00257.x>
- Bouček, Z. (1959) A study of Central European Eulophidae, I: Eulophinae (Hymenoptera), II: *Diaulinopsis* and *Cirrospilus* (Hymenoptera). *Acta Entomologica Musei Naturalis Pragae*, 33, 117–194.
- Bouček, Z. (1961) Notes on the chalcid fauna (Chalcidoidea) of Moldavian SSR. *Trudy Moldavskogo Nauchno-Issledovatel'skogo Instituta Sadovodstva, Vinogradarstva i Vinodeliya*, 7, 21.
- Bourquin, F. (1962) Microlépidopteros nuevos con sus biología. *Revista de la Sociedad Entomologica Argentina*, 23 (1960), 31–46.
- Braby, M.F., Eastwood, R. & Murray, N. (2012) The subspecies concept in butterflies: has its application in taxonomy and conservation biology outlived its usefulness? *Biological Journal of the Linnean Society*, 106 (4), 699–716.  
<http://dx.doi.org/10.1111/j.1095-8312.2012.01909.x>
- Bradley, J.D., Jacobs, S.N.A. & Tremewan, W.G. (1969) A key to the British and French species of *Phyllonorycter* Hübner (*Lithocolletis* Hübner) (Lep. Gracillariidae). *Entomologist's Gazette*, 20, 3–33.

- Braun, A.F. (1908) Revision of the North American species of the genus *Lithocolletis* Hübner. *Transactions of the American Entomological Society*, 34, 269–357, pls xx–xxiv.
- Braun, A.F. (1914) Evolution of the color pattern in the microlepidopterous genus *Lithocolletis*. *Journal of the Academy of Natural Sciences, Philadelphia*, 16, 103–168, pls iii–iv.
- Braun, A.F. (1929) A new genus and species in the Gracillariidae (Microlepidoptera). *Canadian Entomologist*, 61 (2), 38–39. <http://dx.doi.org/10.4039/ent6138-2>
- Brito, R., Gonçalves, G.L., Vargas, H.A. & Moreira, G.R.P. (2012) A new species of *Phyllocnistis* Zeller (Lepidoptera: Gracillariidae) from southern Brazil, with life-history description and genetic comparison to congeneric species. *Zootaxa*, 3582, 1–16.
- Busck, A. (1910) New Central-American Microlepidoptera introduced into the Hawaiian islands. *Proceedings of the Entomological Society of Washington*, 12, 132–135.
- Buszko, J. (1996) Gracillariidae. In: Karsholt, O. & Razowski, J. (Eds.), *Lepidoptera of Europe. A Distributional Checklist*. Apollo Books, Stenstrup, pp. 48–54.
- Carine, M.A., Russell, S.J., Santos-Guerra, A. & Francisco-Ortega, J. (2004) Relationships of the Macaronesian and Mediterranean floras: molecular evidence for multiple colonization of the continent in *Convolvulus* (Convolvulaceae). *American Journal of Botany*, 91 (7), 1070–1085. <http://dx.doi.org/10.3732/ajb.91.7.1070>
- Chambers, V.T. (1871) Micro-Lepidoptera. *Canadian Entomologist*, 3, 54–58, 84–88, 108–112, 127–130, 146–149, 161–166, 182–185, 205–209, 221–224.
- Chambers, V.T. (1877) Notes upon the American species of *Lithocolletis*. *Psyche, a Journal of Entomology*, 2, 81–87. <http://dx.doi.org/10.1155/1877/47986>
- Chambers, V.T. (1878) On larvae of Tineina, especially of *Lithocolletis*. *Psyche, a Journal of Entomology*, 2, 137–153. <http://dx.doi.org/10.1155/1878/20853>
- Chapman, T.A. (1902) The classification of *Gracilaria* [sic] and allied genera. *Entomologist, an Illustrated Journal of British Entomology*, 35, 81–88, 138–142, 159–164.
- Clemens, B. (1859) Contribution to American Lepidopterology. No. 2. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 1859, 317–328.
- Davis, D.R. & De Prins, J. (2011) Systematics and biology of the new genus *Macrosaccus* with descriptions of two new species (Lepidoptera, Gracillariidae). *ZooKeys*, 98, 29–82. <http://dx.doi.org/10.3897/zookeys.98.925>
- Davis, D.R. & Deschka, G. (2001) Biology and systematics of the North American *Phyllonorycter* leafminers on Salicaceae, with a synoptic catalog of the Palearctic species (Lepidoptera: Gracillariidae). *Smithsonian Contributions to Zoology*, 614, 1–89. <http://dx.doi.org/10.5479/si.00810282.614>
- Davis, D.R. & Robinson, G.S. (1998) The Tineoidea and Gracillarioidea. In: Kristensen, N.P. (Ed.), *Lepidoptera, moths and butterflies. Volume 1: Evolution, systematics, and biogeography. Handbuch der Zoologie IV (35)*. Walter de Gruyter, Berlin, New York, pp. 91–117.
- Davis, D.R. & Wagner, D.L. (2011) Biology and systematics of the New World *Phyllocnistis* Zeller leafminers of the avocado genus *Persea* (Lepidoptera, Gracillariidae). *ZooKeys*, 97, 39–73. <http://dx.doi.org/10.3897/zookeys.97.753>
- Davis, D.R., Diaz, R. & Overholt, W. (2013) Systematics and biology of *Cremastobombycia chromolaenae*, new species (Gracillariidae), a nocturnal enemy of *Chromolaena odorata* (L.) King and H. Robinson (Asteraceae). *Journal of the Lepidopterists' Society*, 67, 35–41.
- De Prins, J. & De Prins, W. (2013) Global Taxonomic Database of Gracillariidae (Lepidoptera). Royal Museum for Central Africa & Belgian Biodiversity Platform. Available from: <http://www.gracillariidae.net> (accessed 24 May 2013)
- De Prins, J. & Kawahara, A.Y. (2012) Systematics, revisionary taxonomy, and biodiversity of Afrotropical Lithocolletinae (Lepidoptera: Gracillariidae). *Zootaxa*, 3594, 1–283.
- De Prins, J., De Prins, W. & De Coninck, E. (2003) The pupal morphology of *Cameraria ohridella* compared with that of the genus *Phyllonorycter* (Lepidoptera: Gracillariidae). *Journal of Pest Science*, 76, 145–150. <http://dx.doi.org/10.1007/s10340-003-0009-2>
- De Prins, W. & De Prins, J. (2005) *Gracillariidae (Lepidoptera)*. In: Landry, B. (Ed.), *World catalogue of insects. Volume 6*. Apollo Books, Stenstrup, 502 pp.
- Derra, G. (1985) Records of the Lepidoptera of Greece based on the collections of G. Christensen and L. Gozmány: XI, Lithocolletidae. *Annales Musei Goulandris*, 7, 359–367.
- Deschka, G. (1975) Blattminierende Lepidopteren aus dem Nahen und Mittleren Osten. I. Teil. *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen*, 26 (1974), 41–46.
- Disqué, H. (1908) Versuch einer microlepidopterologischen Botanik. *Deutsche Entomologische Zeitschrift "Iris"*, Dresden, 21, 34–147.
- Eckstein, K. (1933) *Die Schmetterlinge Deutschlands mit besonderer Berücksichtigung ihrer Biologie und wirtschaftlichen Bedeutung. 5. Band Die Kleinschmetterlinge Deutschlands*. K. G. Lutz Verlag, Stuttgart, 223 pp., 32 pls.

- Ellul, P., Boscaiu, M., Vicente, O., Moreno, V. & Rosselló, J.A. (2002) Intra- and interspecific variation in DNA content in *Cistus* (Cistaceae). *Annals of Botany*, 90 (3), 345–351.
- Evenhuis, N.L. (2013) The insect and spider collections of the world website. Bishop Museum. Available from: <http://hbs.bishopmuseum.org/codens/> (accessed 27 May 2013)
- Falchi, A., Paolini, J., Desjobert, J.-M., Melis, A., Costa, J. & Varesi, L. (2009) Phylogeography of *Cistus creticus* L. on Corsica and Sardinia inferred by the TRNL-F and RPL32-TRNL sequences of cpDNA. *Molecular Phylogenetics and Evolution*, 52 (2), 538–543.  
<http://dx.doi.org/10.1016/j.ympev.2009.04.002>
- Fazekas, I. (2002) Systematisches und synonymisches Verzeichnis der Microlepidopteren Ungarns (Lepidoptera: Microlepidoptera). *Folia historico naturalia Musei Matraensis*, 26, 289–327.
- Frey, H. & Boll, J. (1873) Nordamerikanische Tineen. *Entomologische Zeitung*, 34, 201–224.
- Frey, H. & Boll, J. (1876) Einige Tineen aus Texas. *Entomologische Zeitung*, 37, 209–228.
- Gaedike, R., Hättenschwiler, P., Triberti, P. & Zangheri, S. (1995) Lepidoptera Tineoidea I. In: Minelli, A., Ruffo, S. & La Posta, S. (Eds.), *Checklist delle species della fauna Italiana*. Edizioni Calderini, Bologna, 81, pp. 1–19.
- Gregor, F. (1986) Faunistic records from Czechoslovakia, Lepidoptera. *Acta Entomologica Bohemoslovaca*, 83, 229–230.
- Gregor, F. & Patočka, J. (2001) Die Puppen der mitteleuropäischen Lithocolletinae (Insecta: Lepidoptera: Gracillariidae). *Mitteilungen des internationalen entomologischen Vereines e.V.*, Suppl. 8, 1–177.
- Gregor, F. & Povolný, D. (1950) The members of *Lithocolletis* Hb. mining *Acer* and *Alnus*. *Folia Entomologica Hungarica*, 13, 129–151.
- Grimaldi, D. & Engel, M.S. (2005) *Evolution of the Insects*. Cambridge University Press, Cambridge, New York, Melbourne, Madrid, Singapore, São Paulo, xv, 755 pp.
- Groschke, F. (1944) Neues über Minierer aus dem Mittelmeergebiet. *Mitteilungen der Münchner Entomologische Gesellschaft*, 34, 115–124.
- Guzmán, B. & Vargas, P. (2005) Systematics, character evolution, and biogeography of *Cistus* L. (Cistaceae) based on ITS, *trnL-trnF*, and *matK* sequences. *Molecular Phylogenetics and Evolution*, 37 (3), 644–660.  
<http://dx.doi.org/10.1016/j.ympev.2005.04.026>
- Hartig, F. (1956) Prodrómus dei Microlepidotteri della Venezia Tridentina e delle regioni adiacenti. *Studi Trentini di Scienze Naturali, Rivista del "Museo di Storia Naturale della Venezia Tridentina"*, 33, 89–148.
- Hartig, F. (1964) Microlepidotteri della Venezia Tridentina e delle regioni adiacenti. Parte III. (Fam. Gelechiidae - Micropterigidae). *Studi Trentini di Scienze Naturali, Rivista del "Museo di Storia Naturale della Venezia Tridentina"*, 41, 1–292.
- Hartwig, F. (1958) *Die Schmetterlingsfauna des Landes Braunschweig und seiner Umgebung einschließlich des Harzes, der Lüneburger Heide und des Sollings*. Forschungsanstalt für Landwirtschaft, Braunschweig, 148 pp.
- Hering, E.M. (1957) *Bestimmungstabellen der Blattminen von Europa einschliesslich des Mittelmeerbecken und der Kanarischen Inseln*. Uitgeverij Dr. W. Junk, 's-Gravenhage, 1185 pp.
- Hering, M. (1927) Die Minenfauna der Canarischen Inseln. *Zoologische Jahrbücher, Abteilung für allgemeine Zoologie und Physiologie*, 53, 405–486.
- Herrich-Schäffer, G.A.W. (1860–1862) *Neue Schmetterlinge aus Europa und den angrenzenden Ländern. Heft I-III*. Regensburg, 32 pp, 171 figs of imago, mines, 14 figs of larvae.
- Hoare, R.J.B. (2000) A new genus of primitive Nepticulidae (Lepidoptera) from eastern Australia, with a revised diagnosis of nepticulid subfamilies. *Zoological Journal of the Linnean Society*, 128 (3), 289–317.  
<http://dx.doi.org/10.1006/zjls.1998.0189>
- Horn, W. & Kahle, I. (1935–1937). Über entomologische Sammlungen, Entomologen & Entomo-Museologie. *Entomologische Beihefte*, Band 2–4, i–vi, 1–536, 38 pls.
- Huemer, P. (2013) *Die Schmetterlinge Österreichs (Lepidoptera). Systematische und faunistische Checkliste*. Tiroler Landes Museen, Innsbruck, 304 pp.
- Huemer, P. & Erlebach, S. (2007) *Schmetterlinge Innsbrucks Artenvielfalt einst und heute*. Universitätsverl Wagner, Innsbruck, 319 pp.
- Huemer, P. & Tarmann, G. (1993) Die Schmetterlinge Österreichs (Lepidoptera). Systematisches Verzeichnis mit Verbreitungsangaben für die einzelnen Bundesländer. *Veröffentlichungen des Tiroler Landesmuseums Ferdinandeum*, 73, 1–224.
- Huemer, P. & Triberti, P. (2004) Lepidotteri. In: *Il Monte Pastello. Memorie del Museo Civico di Storia Naturale di Verona. 2 Serie. Monografie naturalistiche*, 1, pp. 177–208.
- International Commission on Zoological Nomenclature (1999) *International Code of Zoological Nomenclature*. International Trust for Zoological Nomenclature, London, 306 pp. Available from: <http://www.nhm.ac.uk/hosted-sites/iczn/code/> (accessed 5 November 2013)
- Jourdheuille, C. (1870) Calendrier du microlépidopteriste. Recherche des Chenilles. *Annales de la Société entomologique de France*, (Sér 4) 10, 111–134, 233–266.
- Kawahara, A.Y., Ohshima, I., Kawakita, A., Regier, J.C., Mitter, C., Cummings, M.P., Davis, D.R., Wagner, D.L., De Prins, J. & Lopez-Vaamonde, C. (2011) Increased gene sampling strengthens support for higher-level groups within leaf-mining moths and relatives (Lepidoptera: Gracillariidae). *BMC Evolutionary Biology*, 11, 182.  
<http://dx.doi.org/10.1186/1471-2148-11-182>

- Kitching, I.J., Forey, P.L., Humphries, C.J. & Williams, D.M. (2005) *The theory and practice of parsimony analysis*. Oxford University Press, Oxford, New York, 228 pp.
- Klimesch, J. (1942) Über Microlepidopteren-Ausbeuten aus der Gegend von Zaton bei Gravosa (Süddalmatien). *Mitteilungen der Münchner Entomologische Gesellschaft*, 32, 347–399, pls. xiv–xv.
- Klimesch, J. (1956) Über einige für die Mazedonische Fauna bemerkenswerte Microlepidopteren. *Fragmenta Balcanica*, 1 (27), 209–219.
- Klimesch, J. (1968) Die Lepidopterenfauna Mazedoniens. IV. Microlepidoptera. *Prirodonaucen muzej Skopje*, 1–203.
- Klimesch, J. (1979) Beiträge zur Kenntnis der Microlepidopteren-Fauna des Kanarischen Archipels. 2. Beitrag: Bucculatricidae, Gracillariidae, Phyllocnistidae, Lyonetiidae. *Vieraea, Folia Scientiarum Biologicarum Canariensium*, 8 (1978), 147–186.
- Klots, A.B. (1970) Lepidoptera. In: Tuxen, S.L. (Ed.), *Taxonomist's glossary of genitalia in insects. (Second revised and enlarged edition)*. Munksgaard, Copenhagen, pp. 115–130.
- Knitschke, A. (1927) Über das Genus *Lithocolletis*. *Zeitschrift des Österreichischen Entomologen-Vereines*, 12, 95–98.
- Kristensen, N.P. (2003) Skeleton and muscles: adults. In: Kristensen, N.P. (Ed.), *Lepidoptera, moths and butterflies. Vol. 2. Morphology, physiology, and development. Handbook of Zoology IV (36)*. Walter de Gruyter, Berlin, New York, pp. 39–131.
- Konzalova, M. (1967) Paleontologicke zprava klokalite. *Archiv Geoindustria*, Geofond, Prague. [no pagination]
- Kumata, T. (1961) Descriptions of a new genus and a new species of Gracillariidae from Japan (Lepidoptera). *Insecta Matsumurana*, part I, 24, 52–56.
- Kumata, T. (1963) Taxonomic studies on the Lithocolletinae of Japan (Lepidoptera: Gracillariidae). *Insecta Matsumurana*, part I, 25, 53–90, part II, 26, 1–48.
- Kumata, T. (1973) On the genus *Phyllonorycter* or *Lithocolletis* from Central Nepal, with descriptions of twelve new species - notes on Gracillariidae (Lepidoptera) of Nepal. *Insecta Matsumurana, N. S.*, 1–45, 4 pls.
- Kumata, T. (1993) A contribution to the knowledge of the Malaysian Lithocolletinae (Gracillariidae, Lepidoptera), with a revision of Indian *Cameraria* associated with Leguminosae. *Insecta Matsumurana, N. S.*, 48, 1–85.
- Kumata, T. (1995) Some species of the subfamily Lithocolletinae (Gracillariidae, Lepidoptera) collected in the Philippines. *Insecta Matsumurana, N. S.*, 52, 105–131.
- Kuznetsov, V.I. (1981) Fam. Gracillariidae (Lithocolletidae) — leaf blotch miners. In: Medvedev, G.S. (Ed.), *A guide to the insects of the European part of the USSR. Lepidoptera. Vol. 4. Lepidoptera. Part 2*. Nauka, Leningrad, pp. 149–311.
- Kuznetsov, V.I. & Baryshnikova, S.V. (2004) Evolutionary-morphological approach to the systematics of leafminers of the genus *Phyllonorycter* Hbn. (Lepidoptera, Gracillariidae) with account of species feeding specialization. *Entomologicheskoe Obozrenie*, 83, 625–639.
- Kuznetsov, V.I. & Baryshnikova, S.V. (2006) Systematics of the gracillariid moth genus *Phyllonorycter* Hübner (Lepidoptera, Gracillariidae) trophically associated with plants of the family Ulmaceae. *Entomologicheskoe Obozrenie*, 85, 618–631.
- Labandeira, C.C., Dilcher, D.L., Davis, D.R. & Wagner, D.L. (1994) Ninety-seven million years of angiosperm insect association: Paleobiological insights into the meaning of coevolution. *Proceedings of the National Academy of Sciences of the U.S.A.*, 91 (25), 12278–12282.  
<http://dx.doi.org/10.1073/pnas.91.25.12278>
- Laštuvka, Z. & Marek, J. (1992) Motýli Slovenského krasu (Lepidoptera). *Zprávy Československé Společnosti Entomologick, pri CSAV*, 28, 61–69.
- Laštuvka, Z. & Liška, J. (2005) *Checklist of Lepidoptera of the Czech Republic (Insecta: Lepidoptera)*. Department of Zoology, Fisheries, Hydrobiology and Apiculture, Mendel University of Agriculture and Forestry, Brno, 39 pp.
- Le Marchand, S. (1932) A propos de quelques *Lithocolletis*. *L'Amateur de Papillons*, 6, 41–48.
- Le Marchand, S. (1936) Clé ou table analytique pour la détermination des espèces françaises de *Lithocolletis* (Famille des Gracillariidae [sic]). *L'Amateur de Papillons*, 8, 83–118.
- Le Marchand, S. (1939) Les Gracillariidae (Tineina). *Revue française de Lépidopterologie*, 9, 251–258.
- Leraut, P. (1980) *Liste systématique et synonymique des lépidoptères de France, Belgique et Corse*. Paris, 334 pp.
- Lopez-Vaamonde, C., Godfray, H.C.J., West, S.A., Hansson, C. & Cook, J.M. (2003) Evolutionary dynamics of host-plant use in a genus of leaf-mining moths. *Evolution*, 57 (8), 1804–1821.  
<http://dx.doi.org/10.1111/j.0014-3820.2003.tb00588.x>
- Lopez-Vaamonde, C., Wikström, N., Labandeira, C., Godfray, C.J., Goodman, S.J. & Cook, J.M. (2006) Fossil-calibrated molecular phylogenies reveal that leaf-mining moths radiated millions of years after their host plants. *Journal of Evolutionary Biology*, 19 (4), 1314–1326.  
<http://dx.doi.org/10.1111/j.1420-9101.2005.01070.x>
- Mann, J. (1867) Schmetterlinge, gesammelt im Jahre 1867 in der Umgebung von Bozen und Trient in Tyrol. *Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien*, 17, 829–844.
- Mutanen, M., Wahlberg, N. & Kaila, L. (2010) Comprehensive gene and taxon coverage elucidates radiation patterns in moths and butterflies. *Proceedings of the Royal Society, series B Biological Sciences*, 277 (1695), 2839–2848.  
<http://dx.doi.org/10.1098/rspb.2010.0392>
- Nickerl, O. (1894) *Catalogus insectorum faunae bohemicae III. Die Kleinschmetterlinge (Microlepidoptera) Böhmens*. Verlag der Physiokratischen Gesellschaft, Prag, i–vi, 1–38.

- Noyes, J.S. (2012) Universal Chalcidoidea Database. Natural History Museum, London. Available from: <http://www.nhm.ac.uk/chalcidoids> (accessed 29 May 2013)
- Opler, P.A. & Davis D.R. (1981) The leafmining moths of the genus *Cameraria* associated with Fagaceae in California (Lepidoptera: Gracillariidae). *Smithsonian Contributions to Zoology*, 333, i–iii, 1–58. <http://dx.doi.org/10.5479/si.00810282.333>
- Osthelder, L. (1951) Die Schmetterlinge Südbayerns und der angrenzenden nördlichen Kalkalpen. II. Teil. Die Kleinschmetterlinge. 2. Heft. Glyphipterygidae bis Micropterygidae. *Mitteilungen der Münchner Entomologische Gesellschaft*, 41, 113–250.
- Palibin, I.V. (1909) Cistaceae. In: Kuznetsov, N., Bush, N. & Fomin, A. (Eds.), *Materialy dlia flory Kavkaza : kriticheskoe sistematischesko-geograficheskoe izsledovanie*, 3, pp. 117–123.
- Palmer, W.A. & Pullen, K.R. (1995) The phytophagous arthropods associated with *Lantana camara*, L. *Hirsuta*, L. *Urticifolia* and L. *Urticoides* (Verbenaceae) in North America. *Biological Control*, 5, 54–72.
- Pastorális, G. (2008) A checklist of Microlepidoptera occurred [sic] in the territory of Hungary, No 2 (Lepidoptera: Microlepidoptera). *Acta Naturalia Pannonica*, 3, Suppl. 2, 82–160.
- Patočka, J. & Kulfan, J. (2009) *Lepidoptera of Slovakia, bionomics and ecology*. VEDA, vydavateľstvo Slovenskej akadémie vied, Bratislava, 312 pp.
- Pierce, F.N. & Metcalfe, J.W. (1935) *The genitalia of the Tineid families of the Lepidoptera in the British Isles*. (Reprint 1968). Private edition, reprint E. W. Classey Ltd., Oundle, Middlesex, xxii, 113 pp., 68 pls.
- Polunin, O. & Huxley, A. (1974) *Flowers of the Mediterranean*. Chatto and Windus, London, 260 pp.
- Polunin, O. (1997) *Flowers of Greece and the Balkans*. Oxford University Press, Oxford, 592 pp., 63 pls.
- Posada, D. (2008) jModelTest: Phylogenetic Model Averaging. *Molecular Biology and Evolution*, 25 (7), 1253–1256. <http://dx.doi.org/10.1093/molbev/msn083>
- Rambaut, A. (2009) FigTree v1.3.1. Available from: <http://tree.bio.ed.ac.uk/software/figtree> (accessed 25 January 2010)
- Regier, J.C. (2008) Protocols, concepts, and reagents for preparing DNA sequencing templates. V. 12/4/08. Available from: [http://www.umbi.umd.edu/users/jcrlab/PCR\\_primers.pdf](http://www.umbi.umd.edu/users/jcrlab/PCR_primers.pdf) (accessed 25 January 2010).
- Regier, J.C., Shultz, J.W., Ganley, A.R.D., Hussey, A., Shi, D., Ball, B., Zwick, A., Stajich, J.E., Cummings, M.P., Martin, J.W. & Cunningham, C.W. (2008) Resolving arthropod phylogeny: exploring phylogenetic signal within 41 kb of protein-coding nuclear gene sequence. *Systematic Biology*, 57 (6), 920–938.
- Regier, J.C., Mitter, C., Zwick, A., Bazinet, A.L., Cummings, A.L., Kawahara, A.Y., Sohn, J.-C., 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. <http://dx.doi.org/10.1371/journal.pone.0058568>
- Robinson, G.S. (1976) The preparation of slides of Lepidoptera genitalia with special reference to the Microlepidoptera. *Entomologist's Gazette*, 27, 127–132.
- Roüast, G. (1884) Catalogue des chenilles européennes connues. *Annales de la Société linnéenne de Lyon, N. S.*, 30 (1883), 70–152.
- Schönfelder, I. & Schönfelder, P. (1994) *Mittelmeer- und Kanarenflora*. Kosmos, Stuttgart, 304 pp.
- Sohn, J.-C., Labandeira, C.C., Davis, D. & Mitter, C. (2012) An annotated catalog of fossil and subfossil Lepidoptera (Insecta: Holometabola) of the world. *Zootaxa*, 3286, 1–132.
- Sohn, J.-C., Regier, J.C., Mitter, C., Davis, D., Landry, J.-F., Zwick, A. & Cummings, M.P. (2013) A molecular phylogeny for Yponomeutoidea (Insecta, Lepidoptera, Ditrysia) and its implications for classification, biogeography and the evolution of host plant use. *PLoS ONE*, 8 (1), e55066. <http://dx.doi.org/10.1371/journal.pone.0055066>
- Stainton, H.T. (1867) *The Tineina of Syria and Asia Minor*. John van Voorst, London, 84 pp.
- Staudinger, O. (1880) Lepidopteren-Fauna Kleinasien's (Fortsetzung). *Horae Societatis Entomologicae Rossicae*, 15, 159–435.
- Stehr, F.W. (1987) *Immature Insects*. Kendall Hunt Publishing Company, Dubuque, Iowa, 754 pp.
- Steudel, W. & Hofmann, E. (1882) Verzeichniss württembergischer Kleinschmetterlinge. *Jahreshefte des Vereins für vaterländische Naturkunde in Württemberg*, 38, 143–262.
- Stevens, P.F. (2012) Angiosperm Phylogeny Website. Version 12, July 2012. University of Missouri. Available from: <http://www.mobot.org/MOBOT/research/APweb/> (accessed 23 May 2013)
- Swezey, O.H. (1910) Some new species of Hawaiian Lepidoptera. *Proceedings of the Hawaiian Entomological Society*, 2, 103–143, 3 pls.
- Swezey, O.H. (1913) Leaf-miners of the Hawaiian Islands. *Proceedings of the Hawaiian Entomological Society*, 2, 221–227.
- Swezey, O.H. (1928) Some new species of lepidopterous leaf-miners in Hawaii. *Proceedings of the Hawaiian Entomological Society*, 7, 187–191.
- SwissLepTeam (2010) *Die Schmetterlinge (Lepidoptera) der Schweiz. Eine kommentierte, systematisch-faunistische Liste*. Centre suisse de cartographie de la faune Schweizerische Entomologische Gesellschaft, 349 pp.
- Szabóky, C., Kun, A. & Buschmann, F. (2002) Checklist of the fauna of Hungary. Volume 2. Microlepidoptera. *Hungarian Natural History Museum*, Budapest, 184 pp.
- Szöcs, J. (1981) Angaben über die minierenden Motten aus Budapest und Umgebung. *Folia Entomologica Hungarica*, 42, 209–220.

- The Plant List (2010) Royal Botanic Gardens, Kew. Available from: <http://www.theplantlist.org/> (accessed 30 May 2013)
- Thompson, J.D. (2005) *Plant Evolution in the Mediterranean*. Oxford University Press, Oxford, 288 pp.
- Triberti, P. (2007) The *Phyllonorycter* species from Palaeartic Region feeding on Rosaceae (Lepidoptera, Gracillariidae). *Bollettino del Museo Civico di Storia Naturale di Verona*, 31, 147–221.
- Vári, L. (1961) South African Lepidoptera. Vol. I. Lithocolletidae. *Transvaal Museum Memoir*, 12, 1–238, 112 pls.
- Vives Moreno, A. (1994) *Catálogo sistemático y sinonímico de los lepidópteros de la Península Ibérica y Baleares (Insecta: Lepidoptera) (segunda parte)*. Secretaria General Técnica, Ministerio de Agricultura, Pesca y Alimentación, Madrid, 775 pp.
- Walker, F. (1864) *List of the specimens of Lepidopterous insects in the collection of the British Museum. Part 30. Tineites*. Order of the trustees, London, 1096 pp.
- Walsingham, Lord (Thomas de Grey) (1908) Microlepidoptera of Tenerife. *Proceedings of the Zoological Society of London*, (1907), 911–1034, pls 51–53.  
<http://dx.doi.org/10.1111/j.1469-7998.1907.tb06964.x>
- Walsingham, Lord (Thomas de Grey) (1914) Insecta. Lepidoptera-Heterocera. Tineina, Pterophorina, Orneodina, and Pyralidina and Hepialina (part.). *Biologia Centrali-Americana, Lepidoptera-Heterocera*, 4, 225–392, pls 9–10.
- Weber, P. (1945) Die Schmetterlinge der Schweiz. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft*, 19, 347–408.
- Wocke, M.F. (1861) Microlepidoptera. In: Staudinger, O. & Wocke, M.F. (Eds.), *Catalog der Lepidopteren Europa's und der angrenzenden Länder*. O. Staudinger, und in der Königl. Hofbuchhandlung von Hermann Burdach, Dresden, 192 pp.
- Wocke, M.F. (1871) Microlepidoptera. In: Staudinger, O. & Wocke, M.F. (Eds.), *Catalog der Lepidopteren des europaischen Faunengebiets*. O. Staudinger, und in der Königl. Hofbuchhandlung von Hermann Burdach, Dresden, 426 pp.
- Zimmerman, E.C. (1978) Superfamily Gracillarioidea (Stainton). *Insects of Hawaii*, 9, i–xviii, 1–881.
- Zwickl, D.J. (2011) GARLI 2.0. Available from: <http://code.google.com/p/garli> (accessed 3 May 2011)