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Shared but overlooked: 30 species of Holarctic Microlepidoptera revealed by DNA barcodes and morphology

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Abstract

This study reports 30 species of Lepidoptera previously known from either the Palearctic or the Nearctic that are newly recorded as Holarctic. For 28 of these species, their intercontinental distributions were initially detected through DNA barcode analysis and subsequently confirmed by morphological examination; two Palearctic species were first detected in North America through morphology and then barcoded. When possible, the origin and status of each species (introduced, overlooked Holarctic species, or unknowingly re-described) is discussed, and its morphology is diagnosed and illustrated. The species involved include Tineidae: *Scardia amurensis* Zagulajev, *Triaxomera parasitella* (Hübner), *Nemapogon cloacella* (Haworth), *Elatobia montelliella* (Schantz), *Tinea svenssoni* Opheim; Gracillariidae: *Caloptilia suberinella* (Tengström), *Parornix betulae* (Stainton); *Phyllonorycter maestingella* (Müller); Yponomeutidae: *Paraswammerdamia albicapitella* (Scharfenberg), *P. conspersella* (Tengström); Plutellidae: *Plutella hyperboreella* Strand; Lyonetiidae: *Lyonetia pulverulentella* Zeller; Autostichidae: *Oegoconia deauratella* (Herrich-Schäffer), *O. novimundi* (Busck); Blastobasidae: *Blastobasis glandulella* (Riley), *B. maroccanella* (Amsel), *B. tarda* Meyrick; Depressariidae: *Agonopterix conterminella* (Zeller), *Depressaria depressana* (F.); Coleophoridae: *Coleophora atriplicis* Meyrick, *C. glitzella* Hofmann, *C. granulatella* Zeller, *C. texanella* Chambers, *C. vitisella* Gregson; Scythrididae: *Scythris sinensis* (Felder & Rogenhofer); Gelechiidae: *Altenia perspersella* (Wocke), *Gnorimoschema jalavai* Povolný, *Scrobipalpa acuminatella* (Sircom), *Sophronia gelidella* Nordman; Choreutidae: *Anthophila fabriciana* (L.); and Tortricidae: *Phiaris bipunctana* (F.). These cases of previously unrecognized faunal overlap have led to their redescription in several instances. Five new synonyms are proposed: *Blastobasis glandulella* (Riley, 1871) = *B. huemeri* Sinev, 1993, syn. nov.; *B. tarda* Meyrick, 1902 = *Neoblastobasis ligurica* Nel & Varenne, 2004, syn. nov.; *Coleophora atriplicis* Meyrick, 1928 = *C. cervinella* McDunnough, 1946, syn. nov.; *C. texanella* Chambers, 1878 = *C. coxi* Baldizzone & van der Wolf, 2007, syn. nov., and = *C. vagans* Walsingham, 1907, syn. nov. Lectotypes are designated for *Blastobasis tarda* Meyrick and *Coleophora texanella* Chambers. Type specimens were examined where pertinent to establish new synonymies. We identify 12 previously overlooked cases of species introductions, highlighting the power of DNA barcoding as a tool for biosurveillance.

Key words: Autostichidae, biosurveillance, Blastobasidae, Choreutidae, Coleophoridae, Depressariidae, Gelechiidae, Gracillariidae, Lepidoptera, Lyonetiidae, non-native insects, Plutellidae, Scythrididae, Tineidae, Tortricidae, Yponomeutidae

Introduction

Because DNA barcoding provides a rapid, standardized means for species identification (Hebert *et al.* 2003; Hebert *et al.* 2010), its use has been advocated for the detection of non-indigenous and invasive species amidst the background diversity of native fauna (Armstrong & Ball 2005; Floyd *et al.* 2010; Armstrong 2010; deWaard *et al.* 2010; Wilson & Schiff 2010; Nagoshi *et al.* 2011; Quiao *et al*. 2012; Collins *et al.* 2012; Frewin *et al.* 2013; Porco *et al.* 2013). Although barcoding may overlook some closely related species, it can significantly accelerate the tedious morphological scrutiny of individual specimens, which is otherwise necessary to obtain even near-species-level identification in many small, mega-diverse taxa, such as arthropods. Morphological examination can then be conducted selectively and more effectively on representative specimens of DNA barcode clusters. While traditional morphology-based methods are still widely employed in species surveys, DNA barcoding is quickly emerging as a powerful tool for the detection of non-indigenous species, previously unsuspected shared native species, and taxonomic synonyms.

The development of DNA barcode libraries providing coverage for thousands of Lepidoptera species (e.g. Hebert *et al.* 2010; deWaard *et al.* 2011; Hausmann *et al.* 2011; Huemer & Hebert 2012; Hebert *et al.* 2013) now enables the search for shared faunal elements that previously have been overlooked (Mutanen *et al.* 2012b). Using a combination of DNA barcoding and morphology, several papers have recently reported the presence of European or Palearctic Lepidoptera from North America: *Lampropteryx suffumata* (Geometridae) (deWaard *et al.* 2008); *Paraswammerdamia nebulella* (as *lutarea*) and *Argyresthia pruniella* (Yponomeutidae); *Prays fraxinella* (Praydidae); *Dichelia histrionana* (Tortricidae) (deWaard *et al.* 2009); *Gypsonoma aceriana* (Tortricidae) (Humble *et al.* 2009); and *Eupithecia pusillata* (Geometridae) (deWaard *et al.* 2010). Other studies have documented cases of misidentifications, as well as synonymous and cryptic species (Mutanen *et al.* 2012a; Yang *et al.* 2012).

The frequent necessity for genitalia dissections to assess diagnostic characters in Microlepidoptera, even at supra-specific levels, coupled with incomplete taxonomy and the low quality of specimens obtained in surveillance surveys, are additional factors that impede species identification and detection through morphology.

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Appendix 1

Sample information for specimens included in this study. Sample IDs are specimen identifiers; Process IDs are sequence identifiers in BOLD; BINs are Barcode Identification Number in BOLD. Details of collecting data, images, sequences, and trace files for the barcoded specimens are available in the BOLD dataset "DS-28NHM", accessed at dx.doi.org/10.5883/DS-28NHM. Specimens without Process ID and BIN were examined but not barcoded.

Species	BIN	Sample ID	Process ID	GenBank	Dissection #	Sex	Region	Depository
Agonopterix conterminella	BOLD:AAE7213	CNCLEP00029286	MNAD377-07	KF808534	MIC5361	M	Canada; British Columbia	CNC
Agonopterix conterminella	BOLD:AAE7213	CNCLEP00084860	MNAO273-11	KF808784			Canada; Ontario	CNC
Agonopterix conterminella	BOLD:AAE7213	HLC-23757	LBCD937-05	KF808655			Canada; British Columbia	BIOUG
Agonopterix conterminella	BOLD:AAE7213	MM00768	LEFIB280-10	HM871182			Finland; Northern Ostrobothnia	ZMUO
Agonopterix conterminella	BOLD:AAE7213	MM02198	LEFIB558-10	HM871440			Finland; South Karelia	ZMUO
Agonopterix conterminella	BOLD:AAE7213	MM10277	LEFIE913-10	HM874630			Finland; Lapland	ZMUO
Agonopterix conterminella	BOLD:AAE7213	MM15555	LEFIG691-10	HM876348			Finland; Lapland	ZMUO
Agonopterix conterminella	BOLD:AAE7213	MM17544	LEFIJ919-10	JF853898			Finland; Lapland	ZMUO
Agonopterix conterminella	BOLD:AAE7213	MM17547	LEFIJ922-10	KF808674			Finland; Lapland	ZMUO
Agonopterix conterminella	BOLD:AAE7213	MM18888	LEFIL590-10	JF854675			Finland; Lapland	ZMUO
Agonopterix conterminella	BOLD:AAE7213	MM18889	LEFIL591-10	JF854676			Finland; Lapland	ZMUO
Agonopterix conterminella	BOLD:AAE7213	MM18890	LEFIL592-10	JF854677			Finland; Lapland	ZMUO
Agonopterix conterminella	BOLD:AAE7213	MM18891	LEFIL593-10	JF854678			Finland; Lapland	ZMUO
Agonopterix conterminella	BOLD:AAE7213	TLMF Lep 08446	PHLAH627-12	KF808517			Austria; Vorarlberg	VNGA
Agonopterix conterminella	BOLD:AAE7213	UKLB26B04	CGUKC367-09	KF808629			United Kingdom; England	BMNH