Ann. Zool. Fennici 57: 195–208 ISSN 0003-455X (print), ISSN 1797-2450 (online)
Helsinki 16 September 2020

Additions and corrections to the fauna of moths and butterflies (Lepidoptera) of the Kola Peninsula (Murmansk Oblast), NW Russia

Mikhail V. Kozlov[1,*], Jaakko Kullberg[2] & Vitali Zverev[1]

[1)] *Department of Biology, FI-20014 University of Turku, Finland (*corresponding author's e-mail: mikoz@utu.fi)*
[2)] *Sitowise Oy, Linnoitustie 6 D, FI-02600 Espoo, Finland*

Received 14 July 2020, final version received 8 Sep. 2020, accepted 9 Sep. 2020

Kozlov, M. V., Kullberg, J. & Zverev, V. 2020: Additions and corrections to the fauna of moths and butterflies (Lepidoptera) of the Kola Peninsula (Murmansk Oblast), NW Russia. — *Ann. Zool. Fennici* 57: 195–208.

Collection of moths and butterflies during 2010–2019 revealed 15 species not previously reported from the Murmansk Oblast, Russia. Revision of published data added nine more species to the regional fauna. We also confirmed records of 14 species known only from old publications, and report records of 83 infrequent species, which clarify their distribution within the study region or demonstrate interesting ecological patterns. Especially noteworthy are records of *Argyresthia retinella*, *Levipalpus hepatariella*, *Araschnia levana*, *Macroglossum stellatarum* and *Endromis versicolora*. We discuss the occurrence of 10 moth species in the Murmansk Oblast that had been based on erroneous or doubtful identifications, and therefore not included in our list. The known fauna of moths and butterflies of the Murmansk Oblast now totals 834 species. We estimate that the regional Lepidopteran fauna may include 1000 to 1020 species.

Introduction

The Kola Peninsula (Murmansk Oblast) is the best studied region of Russia in terms of its fauna of moths and butterflies (Sinev 2019), largely due to the long history of entomological research in this region which started in pre-Soviet times (Silfverberg 1988). The northwestern part of the Murmansk Oblast, the Pechengsky District, was carefully studied by Finnish entomologists in 1920–1944, when it constituted a part of Finland (Valle 1933). In 1979–1980, Lepidoptera of this district were explored by Sinev (1988). Several dozen moth and butterfly species inhabiting the Khibiny Mountains were mentioned by Fridolin (1936). Since 1980, the first author has intensively sampled insects in the central part of the Kola Peninsula (Kozlov 1987, 1996, Kozlov & Jalava 1994), on the Barents Sea shore (Kozlov & Kullberg 2008), on the White Sea shore (Kozlov & Kullberg 2006), and in unpopulated areas between Kirovsk and Umba (Kozlov & Kullberg 2011). Many interesting records originated from the Kandalaksha Nature Reserve (Shutova *et al*. 1999, Kozlov *et al*. 2000, Shutova 2004, 2008).

The first regional list (Kozlov & Jalava 1994) included 585 species of Lepidoptera; 91 species were added based on materials collected in 1994–2000 (Kozlov *et al.* 2000), and further

138 species were added in 2001–2009 (Kozlov & Kullberg 2006, 2008, 2011). This paper summarises findings of Lepidoptera made between 2010 and 2019, with some additions based on materials collected earlier. It also reports interesting records of infrequent species and discusses problematic records in the Russian literature concerning moths from this region.

Material and methods

During the past decade our efforts to collect moths were reduced by about half as compared with those in 2000–2009, mainly because we shifted our interests to more eastern regions of European Russia (Kozlov *et al*. 2014, 2017a, 2019). We continued collection in diverse habitats in the central parts of the Murmansk Oblast, including the heavily polluted sites around Monchegorsk, and we arranged several excursions to the White Sea shore to monitor the expected arrival of more southern species to our study region (Fig. 1).

This paper is based on examinations of nearly 12 000 collected specimens, including about 2000 pinned specimens. These pinned materials are deposited in the Zoological Museum, University of Helsinki (MZH). We also identified some 300 specimens from collections of the Zoological Museum in St. Petersburg (ZISP), and few specimens for which georeferenced photographs are available at iNaturalist (www.inaturalist.org) or were provided by our colleagues. Some records are based on over 3000 mines made by moth larvae in leaves of different plants. The voucher specimens of leaf mines are deposited in the Naturalis Biodiversity Center, Leiden (RMNH).

As in our earlier papers (Kozlov & Jalava 1994, Kozlov *et al.* 2000, Kozlov & Kullberg 2006, 2008, 2011), we use numeric codes for the localities, with new localities added to the end of the list (numbers 127–135) (Table 1). All localities on the Kola Peninsula in which (to our knowledge) moths and butterflies have ever been collected are shown in Fig. 2.

List of species

Both nomenclature and order of species follow Aarvik *et al*. (2017). An asterisk (*) denotes species previously not recorded from the Kola Peninsula. A degree symbol (°) indicates species reported from this region by other researchers after the publication of our most recent addition to the regional fauna (Kozlov & Kullberg 2011). An exclamation mark (!) indicates confirmed records of species included in our previous lists based on earlier publications only. New findings of other species (mostly of so-called ʻmicros') are reported only when they concern infrequent species (primarily those that were known from one or two localities only) or indicate interesting ecological patterns, such as mass occurrence of formerly uncommon species, or gradual spreading of species towards the north.

The number of species expected to occur on the Kola Peninsula (n_e) was estimated from the recorded number of species (n_r) and numbers of species known from one or two localities only (n_1 and n_2, respectively), as follows: $n_e = n_r + n_1^2/2n_2$ (Chao *et al*. 2009: eq. 2).

Nepticulidae

Stigmella luteella (Stainton). 38-11: 1 mine on *Betula pubescens* 24 August 2009, 1 mine on 12 August 2016, and 7 mines on 18 August 2018; 38-13: 1 mine on *B. pubescens* 20 August 2011; 43-17: 1 mine on *B. pubescens* 10 August 2013; 43-41: 1 mine on *B. pubescens* 18 August 2013; 71: 4 mines 18 August 2013 (identified by E. J. van Nieukerken). Earlier known only from 38-11 (Kozlov & Kullberg 2011) and 61 (Shutova 2008).

°*S. arbusculae* (Klimesch). 38-5: 1 mine on *Salix glauca* 4 August 2014 (record published by van Nieukerken & Sinev 2019).

S. myrtillella (Stainton). 23: 1 mine on *Vaccinium uliginosum* 20 August 2014; 38-11, 38-5, 43-1, 43-9: 10 mines on *V. uliginosum* 12 August 2014; 46: 1 mine on *V. uliginosum* 26 August 2012, 3 mines 8–15 August 2013; 56a: 1 ex. 29 June 2001; 132: 1 mine on *V. uliginosum* 21 August 2014. Earlier known only from 61 (Kozlov *et al*. 2000).

S. zelleriella (Snellen). 43-1: 18 exx. 14 July 1997. Earlier known only from 55 (Kozlov & Jalava 1994).

**S. assimilella* (Zeller). 132: 1 mine on *Populus tremula* 21 August 2014.

**S. continuella* (Stainton). 38-11: 1 mine on *B. pubescens* 18 August 2018; 132: 1 mine on *B. pubescens* 14 August 2018.

°*S. tristis* (Wocke). 46 (Raswumchorr): 1 mine on *B. nana* 8 August 2013; 46 (Kukiswumchorr): 1 mine on *B. nana* 8 August 2014; 56 (Botanical Garden): 1 mine on *B. nana* 8 August 2014. van Nieukerken and Sinev (2019) classified these records as questionable.

Fig. 1 (above)**.** Examples of habitats in the Murmansk Oblast. — **a**: locality 43-7, industrial barren 7 km south of Monchegorsk; — **b**: locality 46, Khibiny Mountains to the east of Malyi Vudjavr; — **c**: locality 56a, coniferous forest 15 km east of Kirovsk; — **d**: locality 71, seashore at Olenitsa; — **e**: locality 77, meadow near the Varzuga River, 4 km northeast of Kuzomen; — **f**: locality 126, seashore at Lodochnyi.

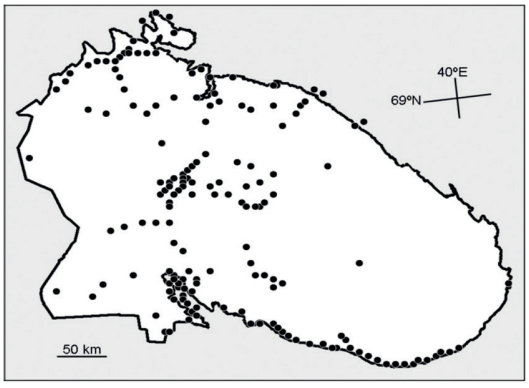

Fig. 2 (right)**.** Collection localities on the Kola Peninsula. For names and coordinates *see* Table 1.

Table 1. List of collection localities on the Kola Peninsula.

No.	Name	Co-ordinates*	
		latitude N	longitude E
1	Kervanta (Kervanto)	69°54´	31°57´
2	Vayda-Guba (Vaitolahti)	69°56´	31°58´
4	Liinahamari	69°38´	31°21´
6	Barkino (Parkkino)	69°33´	31°13´
8	Haukilampi	69°26´	30°46´
9	Salmijärvi	69°27´	30°08´
10	Luostari (Yläluostari)	69°25´	30°06´
12	Pechenga (Petsamo)	69°33´	31°13´
13	Ainovy Islands	69°50´	31°34´
14	Rybatshij Peninsula	–	–
15	Zemlyanaya (Pummanki)	69°49´	31°47´
17	Pasvik (Paatsjoki)	69°20´	29°42´
21	Pitkäjärvi	69°28´	31°13´
23	Murmansk	68°57´	33°05´
27	Köngäs	68°35´	29°28´
28	Lutto	–	–
30	Verkhetulomskij	68°36´	31°48´
31	Kola	68°53´	33°05´
34	Voronja River	–	–
36	Saariselkä	–	–
37	Nuortjärvi	–	–
38-1	Road St. Petersburg–Murmansk, 1 km N of locality 39	67°56´04´´	32°49´08´´
38-3	id., 3 km N of locality 39	67°57´11´´	32°50´46´´
38-5	id., 5 km N of locality 39	67°58´08´´	32°52´29´´
38-11	id., 11 km N of locality 39	68°00´59´´	32°57´03´´
38-13	id., 13 km N of locality 39	68°01´42´´	32°58´56´´
38-15	id., 15 km N of locality 39	68°02´20´´	33°00´53´´
39	Monchegorsk	67°56´	32°56´
40	Olenegorsk	68°09´	33°17´
43-1	Road St. Petersburg–Murmansk, 1 km S of locality 39	67°54´52´´	32°48´44´´
43-5	id., 5 km S of locality 39	67°52´59´´	32°46´41´´
43-7	id., 7 km S of locality 39	67°51´58´´	32°47´50´´
43-9	id., 9 km S of locality 39	67°51´01´´	32°48´10´´
43-14	id., 14 km S of locality 39	67°48´03´´	32°46´56´´
43-17	id., 17 km S of locality 39	67°46´36´´	32°47´45´´
43-20	id., 20 km S of locality 39	67°45´31´´	32°48´29´´
43-23	id., 23 km S of locality 39	67°43´47´´	32°50´23´´
43-26	id., 26 km S of locality 39	67°42´15´´	32°58´57´´
43-29	id., 29 km S of locality 39	67°40´39´´	32°49´27´´
43-35	id., 35 km S of locality 39	67°38´21´´	32°45´00´´
43-41	id., 41 km S of locality 39	67°34´38´´	32°32´54´´
43-47	id., 47 km S of locality 39	67°34´46´´	33°35´22´´
44	Tshunosero	67°39´06´´	32°38´51´´
44a	Tshuna-tundra Mts.	–	–
45	Jokostrov (Ekostroff)	67°33´52´´	33°04´26´´
46	Khibiny Mts.	–	–
48	Lovozero Mts.	–	–
55	Apatity	67°35´	32°23´
56	Kirovsk	67°38´	33°42´
56a	15 km E of Kirovsk	67°32´16´´	33°57´52´´
58a	Vuorijarvi	66°47´	30°08´
59	Alakurtti	66°58´	30°21´
60	Kandalaksha	67°10´	32°25´

continued

Table 1. Continued.

No.	Name	Co-ordinates*	
		latitude N	longitude E
61	Luvenga	67°07′	32°42′
62	Knyazhaya Guba	66°49′	32°21′
64a	Kolvitsa	67°05′	33°00′
66	Kovda (Kouta)	66°41′	32°52′
67	Umba	66°42′	34°19′
68	Turij, 20 km E of Umba	66°36′	34°43′
71	Olenitsa	66°28′	35°12′
72	74 km E of Umba	66°22′	35°42′
73	Kashkarantsy	66°21′	35°58′
74	Varzuga	66°24′	36°36′
75	128 km E of Umba	66°17′	36°28′
76	132 km E of Umba	66°17′	36°33′
77	Kuzomen	66°18′	36°46′
80	Korchozero	66°24′	32°21′
82-KR	Krasotka Island	67°04′48′′	32°43′33′′
83	Northern Archipelago	–	–
83-RJ	Rjashkov Island	67°02′56′′	32°33′37′′
84	Porya Guba	66°48′	33°43′
84-GO	Gorelyi Island	66°25′48′′	33°46′27′′
85-VE	Velikyi Island	66°33′57′′	33°20′00′′
90	13 km NW of Chavanga	66°09′43′′	37°30′18′′
91	mouth of Rombach River	66°05′31′′	37°53′27′′
95	2 km N of Chapoma	66°06′54′	38°51′18′′
115	Khibiny railway station	67°40′20′′	33°14′58′′
126	Lodochnyi	66°17′35′′	36°24′48′′
127	5 km SE of Varzuga	66°22′15′′	36°40′44′′
128	Pyrshozero	68°19′	31°26′
129	Korchozero	66°23′42′′	32°20′54′′
130	5 km W of Korchozero	66°23′30′′	32°12′42′′
131	Lupche-Savino	67°11′45′′	32°20′40′′
132	12 km NW of Zelenoborskij	66°56′04′′	32°12′24′′
133	Polyarny (Alexandrovsk)	66°12′	33°28′
134	Rizh-Guba	67°52′17′′	33°04′19′′
135	Beloe More railway station	67°04′00′′	32°16′36′′

* Co-ordinates were rounded to minutes when the sampled area exceeded 1 km^2 or when the exact extent of the historical sampling area was unknown. Co-ordinates are not given if the locality covered an area exceeding 100 km^2.

Incurvariidae

Incurvaria pectinea Haworth. Nine localities around 39: 324 mines were observed on *B. pubescens* from 1994–2010 (Kozlov *et al*. 2017b). Earlier known only from 37, 55 (Kozlov & Jalava 1994), 43-35 (Kozlov & Kullberg 2011) and 61 (Shutova *et al*. 1999).

Phylloporia bistrigella (Haworth). 43-5: 1 ex. 22 June 2000; 43-29: 1 ex. 5 July 2000; 132: 1 mine on *B. pubescens* 21 August 2014; 134: 1 ex. 10 August 2013. Also 144 mines on *B. pubescens* leaves have been observed in 25 localities around 39 from 1994–2016 (Kozlov *et al*. 2017b). Earlier known only from 43-7 (Kozlov & Jalava 1994).

Adelidae

!*Nematopogon magna* (Zeller). 43-35: 1 ex. 22 June 2003; 71: 1 ex. 18 June 2019. Earlier known only from 27 (Krogerus 1943).

N. robertella (Clerck). 43-20, 43-29, 43-35, 43-41, 56a: 10 exx. 28 June–24 July 1995–2005. Earlier known only from 12 (Valle 1933), 44 (Kozlov & Jalava 1994), 61 (Shutova *et al*. 1999, as *N. pilellus*) and 84 (Shutova 2004).

Psychidae

Dahlica charlottae (Meier). 126: 1 ex. 18 June 2019.

Phalacropterix graslinella (Boisduval). 43-35: 1 ex. 22 July 1998. Earlier known only from 43-17 (Kozlov & Jalava 1994).

Tineidae

Tineola bisselliella (Hummel). 56a: 1 ex. 8 July 1997; 133: 1 ex. (ZISP, no collection date). Earlier known only from 10, 39, 55 (Kozlov & Jalava 1994) and 61 (Shutova *et al*. 1999).

**Tinea pellionella* Linnaeus. 55: 1 ex. 22 June 2012.

Roeslerstammiidae

Roeslerstammia erxlebella (Fabricius). 129: 1 ex. 10 July 2010; 132: 1 ex. 23 June 2010. Earlier known only from 55 (Kozlov & Jalava 1994), 56a (Kozlov & Kullberg 2011) and 61 (Shutova 2008).

Gracillariidae

Caloptilia stigmatella (Fabricius). 126: 1 ex. 18 June 2019. Earlier reported only from 28 (Krogerus 1943) and 55 (Kozlov & Kullberg 2011).

Phyllonorycter corylifoliellus (Hübner). 39 and 27 localities around it: 318 mines were observed on *B. pubescens* in 1993–2016 (Kozlov *et al*. 2017b). Earlier known only from 43-15 and 82-KR (Kozlov *et al*. 2000).

Ph. junoniella (Zeller). 38-3, 38-11, 43-1, 43-5, 43-9, 43-14, 43-20, 43-29, 43-35, 56a: 38 exx. 24 June–10 August 1994–2006. Earlier known only from 55 and 61 (Kozlov & Jalava 1994).

**Ph. populifoliella* (Treitschke). 55: 1 ex. 17 August 2014, ex l. on *Populus* × *hybrida*, 17 August 2014. Earlier found inside a building in 60 (Shutova 2004) and considered occasional migrant. In 2010, we did not find mines of this species in either 55 or 60, despite substantial sampling effort (Kozlov & Kullberg 2011). In Finland the northernmost records are from Kuopio, several hundreds of kilometres south of 55 (https://laji.fi/en). We conclude that this species became established on the Kola Peninsula only recently.

Yponomeutidae

Swammerdamia compunctella Herrich-Schäffer. 46 (Rak *et al*. 2018, as *Archips crataegana*). Earlier known only from 61 (Kozlov *et al*. 2000).

Paraswammerdamia lapponica (W. Petersen). 43-35: 1 ex. 23 July 1994. Earlier known only from 8 and 55 (Kozlov & Jalava 1994).

Cedestis subfasciella (Stephens). 43-5: 1 ex. 28 July 2005. Earlier known only from 55, 62 (Kozlov & Jalava 1994) and 61 (Shutova *et al*. 1999).

Ocnerostoma friesei Svensson. 38-1: 1 ex. 29 June 2000. Earlier known only from 38-15, 44 (Kozlov & Jalava 1994) and 61 (Shutova 2004).

Argyresthiidae

Argyresthia bergiella (Ratzeburg). 43-5: 1 ex. 13 July 2002; 43-7: 1 ex. 22 June 2006; 43-29: 1 ex. 12 June 2002, 1 ex. 28 June 2005; 55: 1 ex. 21 June 2014; 56a: 1 ex. 9 July 1995, 1 ex. 27 July 1996, 1 ex. 9 July 2002, 1 ex. 27 June 2005. Earlier known only from 43-26 and 44 (Kozlov & Jalava 1994).

!*A. aurulentella* Stainton. 77: 19 August 2019. Earlier known only from 61 (Shutova *et al*. 1999).

**A. retinella* Zeller. 71, 73, 77, 126, 127: common 18–19 August 2019 (we observed 300+ specimens). Birch feeding species, which seems to benefit from warming climate.

Praydidae

Atemelia torquatella (Lienig & Zeller). 38-11: 1 mine on *B. pubescens* 12 August 2014; 43-9: 1 mine on *B. pubescens* 12 August 2014; 132: 1 mine on *B. pubescens* 21 August 2014; 134: 1 mine on *B. pubescens* 20 August 2011. Earlier known only from 56 (Kozlov & Jalava 1994) and 61 (Shutova *et al*. 1999).

Lyonetiidae

°*Lyonetia clerkella* (Linnaeus). 56 (Rak *et al*. 2018, Rak & Litvinova 2020). Several leaf mines were found on *Prunus padus* and *Malus* spp. growing on the territory of the Botanical garden, so the species could have been introduced with plants. The northernmost records in Russia were previously from Karelia (Sinev 2019) and the Arkhangelsk Oblast (Kozlov *et al*. 2017a). In Finland, the northernmost record is from Kuusamo (https://laji.fi/en).

Choreutidae

Choreutis diana (Hübner). 127: 1 ex. 19 August 2019. Earlier known only from 38-1, 43-29 and 46 (Kozlov & Kullberg 2011).

Tortricidae

Pandemis cerasana (Hübner). 43-23: 1 ex. 4 July 2014, ex l. on *B. pubescens*; 43-47: 1 ex. 5 July 2012, ex l. on *B. pubescens*; 55: 1 ex. 13 August 2012, at light. Earlier known only from 38-1 (Kozlov & Kullberg 2011) and 61 (Kozlov & Jalava 1994).

Argyrotaenia ljungiana (Thunberg). 38-1: 1 ex. 25 June 2004; 43-29: 3 exx. 20 June 2003, 6 exx. 25 June 2004; 43-35: 2 exx. 20 June 2003, 1 ex. 25 June 2004; 126: 1 ex. 18 June 2019. A few specimens were collected several decades ago from 28 (Krogerus 1943), 36 (Krogerus 1943) and 46 (Kozlov & Jalava 1994).

Cochylis nana (Haworth). 56a: 1 ex. 15 July 2004. Earlier known only from 44a (Kozlov 1996).

**Apotomis betuletana* (Haworth) (*sensu stricto*). 46 (Raswumchorr): 1 ex. 16 August 2015. We follow Sinev *et al*. (2019) and accept *A. betuletana* and *A. boreana* Krogerus (which is common on the Kola Peninsula) as separate species, although Aarvik *et al*. (2017) considered the larger *A. boreana* as a boreal form of *A. betuletana* with two-year long development.

A. fraterculana Krogerus. 43-29: 1 ex. 26 June 2001. Earlier known only from 43-9 (Kozlov *et al*. 2000).

**Hedya ochroleucana* (Frölich). 77: 1 ex. 19 August 2019.

**Celypha striana* (Denis & Schiffermüller). 126: 1 ex. 18 August 2019.

Pseudohermenias abietana (Fabricius). 56a: 1 ex 15 July 2004. Earlier known only from 48 and 58a (Kozlov & Jalava 1994).

Ancylis paludana (Barret). 61: 2 exx. 17 June 2018. Earlier known only from 77 (Kozlov & Kullberg 2011).

A. badiana (Denis & Schiffermüller). 68, 73, 77, 126, 127: abundant 18–19 June 2019 (we observed 60+ specimens). This species, which was infrequent in early 1990s, gradually became common on the Kola Peninsula, and now occurs in much higher densities than *A. myrtillana* (Treitschke), whose abundance greatly declined during the past decades.

Rhopobota ustomaculana (Curtis). 126: 1 ex. 18 August 2019. Earlier known only from 61 (Kozlov & Jalava 1994) and 83 (Shutova 2004).

Epinotia solandriana (Linnaeus). 68, 73, 77, 127: common 18–19 August 2019 (we observed 30+ specimens). Earlier known only from 44, 56 and 61 (Kozlov & Kullberg 2011).

E. brunnichana (Linnaeus). 55: 1 ex. 11 August 2012, at light; 127: 1 ex. 19 August 2019; 132: 1 ex. 10 August 2019. Earlier known only from 38-1, 38-11 and 61 (Kozlov & Kullberg 2011).

E. ramella (Linnaeus). 71: 1 ex. 18 August 2019; 73: 3 exx. 18 August 2019. Earlier known only from 38-1, 56 (Kozlov & Kullberg 2011) and 61 (Shutova 2008).

E. immundana (Fischer von Röslerstamm). 68: 2 exx. 18 June 2019; 71: 3 exx. 18 June 2019; 74: 1 ex. 19 June 2019. Earlier known only from 34 (Kozlov & Kullberg 2011).

E. tenerana (Denis & Schiffermüller). 73: 1 ex. 18 June 2019. Earlier known only from 46 (Kozlov & Kullberg 2011).

E. gimmerthaliana (Lienig & Zeller). 129: 8 exx. 10 July 2010; 130: 1 ex. 10 July 2010. Earlier known only from 23 (Djakonov 1911), 60 (Kozlov & Jalava 1994) and 83-RJ (Shutova *et al*. 1999).

Pelochrista guentheri (Tengström). 71: 1 ex. 18 June 2019. Earlier known only from 68 and 72 (Kozlov *et al*. 2000).

Epiblema sticticana (Fabricius). 64a: 1 ex. 17 June 2018. Earlier known only from 56 (Kozlov & Jalava 1994).

E. cirsiana (Zeller). 127: 4 exx. 19 June 2019. Earlier known only from 43-35 and 55 (Kozlov & Kullberg 2011).

Dichrorampha plumbana (Scopoli). 43-9: 1 ex. 27 June 2005. Earlier known only from 58a (Kozlov & Jalava 1994).

!*D. vancouverana* (McDunnough). 135: 1 ex. 10 July 2010. Earlier known only from 61 (Shutova 2008).

D. petiverella (Linnaeus). 71: 1 ex. 18 August 2019. Earlier known only from 43-5 (Kozlov & Kullberg 2011).

!*Cydia coniferana* (Saxesen). 43-5: 1 ex. 24 June 2005. Earlier reported from 27 (Krogerus 1943), 85-VE (Shutova 2004) and 83-RJ (Shutova *et al*. 1999).

C. indivisa (Danilevsky). 43-35: 1 ex. 27 June 1999. Earlier known only from 43-9 (Kozlov *et al*. 2000), 90 and 95 (Kozlov & Kullberg 2011).

Sesiidae

Synanthedon scoliaeformis (Borkhausen). 43-35: 1 ex. 8 July 2006. Earlier known only from 43-41 (Kozlov & Jalava 1994).

S. culiciformis (Linnaeus). 60: 1 ex. (https://www.inaturalist.org/observations/19073039). Earlier known only from 9 (Kozlov & Jalava 1994).

S. formicaeformis (Esper). 38-1: 1 ex. 8 July 2006. Earlier known only from 43-9 (Kozlov & Jalava 1994).

Depressariidae

**Levipalpus hepatariella* (Lienig & Zeller). 73: 1 ex. 18 August 2019. This species, which lives on *Antennaria* spp., is rapidly declining in Finland (Nupponen *et al*. 2019) because of the declining numbers of plants its feeds on.

Gelechiidae

Bryotropha senectella (Zeller). 74: 1 ex. 27 July 2004, at light. Earlier known only from 91 (Kozlov & Kullberg 2006).

Scrobipalpa acuminatella (Sircom). 38-1: 1 ex. 26 July 1996. Earlier known only from 55 and 60 (Kozlov & Jalava 1994).

Caryocolum pullatella (Tengström). 55: 1 ex. 11 August 2012, at light. Earlier known only from 61 (Shutova *et al*. 1999) and 74 (Kozlov & Kullberg 2011).

Carpatolechia proximella (Hübner). 38-1: 1 ex. 8 July 2006; 43-41: 1 ex. 24 June 1993. Earlier known only from 55 (Kozlov & Jalava 1994) and 68 (Shutova 2004). In 2012 and 2013, larvae of this species were most common among leaf-rolling species damaging *B. pubescens* at multiple sites around 39 (Zvereva *et al*. 2014).

C. epomidella (Tengström). 43-35: 1 ex. 6 July 1995, 1 ex. 5 July 2001. Earlier known only from 21 (Valle 1933), 27 (Krogerus 1943) and 38-1 (Kozlov & Jalava 1994).

Exoteleia dodecella (Linnaeus). 38-1: 1 ex. 23 June 2005; 43-14: 1 ex. 15 July 1996, 1 ex. 22 July 1998. Earlier known only from 61 (Kozlov *et al*. 2000).

Elachistidae

Elachista eleochariella Stainton. 56a: 1 ex. 29 July 1995. Earlier known only from 55 (Kozlov & Jalava 1994).

E. albidella Nylander. 43-5: 1 ex. 23 July 1996; 43-7: 1 ex. 17 July 1995, 2 exx. 9 July 1997. Earlier known only from 43-9, 55 (Kozlov & Jalava 1994) and 61 (Shutova 2004).

E. leifi Kaila & Kerppola. 43-14: 1 ex. 28 July 1995. Earlier known only from 43-5 and 55 (Kozlov & Jalava 1994).

E. excelsicola Braun. 38-1: 1 ex. 16 July 1996; 43-29: 1 ex. 12 July 1998; 43-35: 1 ex. 6 July 1995; 130: 1 ex. 10 July 2010. Earlier known only from 44a and 48 (Kozlov & Jalava 1994).

E. nielswolffi Svensson. 43-29: 2 exx. 15–16 July 1994; 56a: 1 ex. 17 July 1994, 1 ex. 9 July 1995, 1 ex. 7 August 1995. Earlier known only from 10 and 43-20 (Kozlov & Jalava 1994).

E. canapennella (Hübner). 43-7: 1 ex. 5 July 2001; 43-20: 1 ex. 11 July 1994. Earlier known only from 21 (Valle 1933) and 48 (Kozlov & Jalava 1994).

**E. baltica* E. Hering. 130: 1 ex. 10 July 2010.

Batrachedridae

**Batrachedra praeangusta* (Haworth). 56a: 1 ex. 15 August 2014.

Coleophoridae

Coleophora glaucicolella Wood. 38-1: 1 ex. 26 July 1996; 43-29: 1 ex. 15 July 1994, 1 ex. 15 July 2004; 56a: 3 exx. 18 August 1996. Earlier known only from 38-15 and 55 (Kozlov & Jalava 1994).

C. adjunctella Hodgkinson. 38-1: 1 ex. 27 June 2005; 43-5: 1 ex. 28 June 2005. Earlier known only from 61 and 67 (Kozlov & Jalava 1994).

C. milvipennis Zeller. 38-15: 1 ex. 24 July 1996. Earlier known only from 43-35 and 80 (Kozlov *et al*. 2000).

°*C. gryphipennella* (Hübner). 46 (Anikin 2019, and pers. comm.).

°*C. arctostaphyli* Meder. 46 (Anikin 2019, and pers. comm.).

Scythrididae

Scythris fuscopterella Bengtsson. 43-29: 1 ex. 7 July 1997. Earlier known only from 39 (Kozlov & Jalava 1994).

Pterophoridae

**Stenoptilia pterodactyla* (Linnaeus). 61: 1 ex. 18 August 2019.

Pieridae

!*Leptidea sinapis* (Linnaeus). 61: 1 ex. 17 June 2018; 127: 2 exx. 19 June 2019. Earlier known only from 12 (Linnaluoto & Koponen 1980), 61 and 84 (Shutova *et al*. 1999).

Pieris brassicae (Linnaeus). 46: 3 exx. 11 June and 4 September 1936 (ZISP). All records of this species from the Kola Peninsula are rather old; it was never collected by the first author in 1980–2019. It is also absent from the lists by Isakov and Gromov (1997) and Shutova *et al*. (1999). Occasional migrant in northern Finland (https://laji.fi/en).

°*Colias hyale* (Linnaeus). 46 (Tatarinov & Kulakova 2009). Very surprising record, because this species is rare even in central Finland (https://laji.fi/en), where temporary local populations are formed by offspring of early season immigrants.

Nymphalidae

Boloria napaea (Hoffmannsegg). 46 (Tatarinov & Kulakova 2009). The most recent and, likely, the second reliable record of this species from the Murmansk Oblast. In our earlier work (Kozlov & Jalava 1994) this species was reported from seven localities (1, 2, 12, 14, 15, 31, 46). The MZH collection does not contain any specimen of this species from the Kola Peninsula (L. Kaila pers. comm.), and the origin of information on the occurrence of this species in localities 1, 2, 12 and 15 remains unknown. The record from Rybachij Peninsula (locality 14) was given after Kotzsch (1933; as *B. pales*). We withdraw the record from 31 as erroneous: it was based on two misidentified specimens from ZISP (A. Lvovsky pers. comm.). The record from 46 was given after Fridolin (1936), but it is presumably also based on misidentified specimens as we did not find *B. napaea* among materials donated by Fridolin to ZISP.

°*Araschnia levana* (Linnaeus). 60: 10+ larvae on *Urtica dioica* 5 August 2011; 61: 1 ex. 17 June 2018; 66: 1 ex. 10 June 2014; 68: 1 ex. 18 June 2019. The first documented record of this species from the Kola Peninsula dates back to 2006, when a single butterfly was found in 61; already in 2010–2012 this species was common in many localities from 60 to 67 (Shutova 2013). The species was recently recorded as new to the Norwegian fauna from the surroundings of the Tana River close to the Atlantic coast (Aarvik *et al*. 2019).

Vanessa cardui (Linnaeus). 68, 71, 73, 74, 77, 126, 127: common 18–19 August 2019 (we observed 30+ specimens). Until the early 1990s, this species was extremely rare on the Kola Peninsula (Valle 1933, Fridolin 1936, Kozlov & Jalava 1994, Isakov & Gromov 1997); its abundance started to increase from 1996 (Shutova & Shklyarevich 1999).

Oeneis jutta (Hübner). 46 (Tatarinov & Kulakova 2009). Earlier reported from 30 (Isakov & Gromov 1997) and 66 (Nordström *et al*. 1955).

Lycaenidae

!*Celastrina argiolus* (Linnaeus). 60: 1 ex. 21 June 2020 (https://www.inaturalist.org/observations/50385494); 61: 1 ex. 17 June 2018; 68: 1 ex. 18 June 2019; 77: 1 ex. 19 June 2019. Earlier reported from 4, 15 and 59 (Nordström *et al*. 1955).

Pyralidae

!*Ortholepis betulae* (Goeze). 43-5: 1 ex. 10 July 2014; 43-7: 1 ex. 11 July 2014; 43-17: 1 ex. 15 July 2015. All these

specimens were reared from larvae collected from *B. pubescens*. Earlier known only from 67 (Shutova 2004).

Plodia interpunctella (Hübner). 55: 1 ex. 15 August 2014. Earlier known only from 10 and 14 (Kozlov & Jalava 1994). A synantropic species of subtropical origin.

Crambidae

Loxostege commixtalis (Walker). 43-14: 1 ex. 23 July 1996, 1 ex. 6 July 2005. Earlier known only from 36 (Krogerus 1943) and 45 (Kozlov & Jalava 1994).

L. sticticalis (Linnaeus). 38-1: 1 ex. 24 July 2000. Earlier known only from 15 (Valle 1933) and 46 (Kozlov & Jalava 1994). The current report on mass occurrence of this species near Murmansk (Anikina 2018) is, most likely, based on misidentification of *Udea* sp. A migrant species.

Catoptria margaritella (Denis & Schiffermüller). 130: 1 ex. 10 July 2010. Earlier known only from 55 and 61 (Kozlov & Jalava 1994).

Agriphila biarmicus (Tengström). 56a: 1 ex. 28 July 1996. Earlier known only from 28 (Krogerus 1943), 44 and 44a (Kozlov & Jalava 1994).

Crambus hamella (Thunberg). 43-35: 1 ex. 15 July 1994, 1 ex. 15 July 2004, 1 ex. 4 August 2005; 71: 1 ex. 18 August 2019. Earlier known only from 27 (Krogerus 1943), 44 and 64a (Kozlov & Jalava 1994).

C. perlella (Scopoli). 43-5: 1 ex. 24 July 2000. The northernmost record from the Kola Peninsula. Earlier known only from 73, 75, 77 (Kozlov & Jalava 1994) and 84 (Shutova 2004).

Drepanidae

Achlya flavicornis (Linnaeus). 39 and 11 localities around it: 19 larvae were recorded feeding on *B. pubescens* from 1992–2008 (Kozlov *et al*. 2017b). Earlier known from 9 (Valle 1933), 10, 12, 17 (Kozlov & Jalava 1994) and 46 (Fridolin 1936).

Geometridae

!*Epirrhoe tristata* (Linnaeus). 127: 1 ex. 19 June 2019. The first confirmed record from the Kola Peninsula. Earlier known only from 17 based on a single specimen collected more than a century ago (Kozlov & Jalava 1994).

Eulithis testata (Linnaeus). 68, 71, 77, 126: common 18–19 August 2019 (we observed 20+ specimens). In the early 1990s, this species was rare on the Kola Peninsula (Kozlov & Jalava 1994, Shutova *et al*. 1999).

Coenocalpe lapidata (Hübner). 68: 3 exx. 18 August 2019. Earlier known only from 61 (Kozlov *et al*. 2000).

Mesotype didymata (Linnaeus). 68, 73, 126, 127: common 18–19 August 2019 (we observed 30+ specimens). Earlier known only from 74 (Kozlov & Kullberg 2011).

Perizoma affinitata (Stephens). 61: 1 ex. 17 June 2018. Earlier known only from specimens collected in the former Petsamo area long time ago (Kozlov & Jalava 1994) and from 13 (Shutova *et al*. 1999).

°*Pasiphila rectangulata* (Linnaeus). 40: 1 ex. 2 July 2012 (Blinova & Mironov 2012).

Eupithecia pusillata (Denis & Schiffermüller). 55: 1 ex. 12 August 2012, at light. Earlier known only from 8 (Kozlov & Jalava 1994).

!*E. tantillaria* Boisduval. 131: 1 ex. 17 June 2018. This species was reported for the first time from the Murmansk Oblast by Sinev (2008); the source of this information, however, cannot be verified (V. Mironov pers. comm.).

!*E. succenturiata* (Linnaeus). 55: 1 ex. 13 August 2012, at light. Earlier known only from 61 and 85-VE (Shutova 2008).

Macaria loricaria (Eversmann). 38-3: 1 ex. 2 July 2014, ex. l on *Salix myrsinifolia*. Earlier known only from 55 (Kozlov & Jalava 1994), 61, 84 and 85-VE (Shutova *et al*. 1999).

!*Lycia hirtaria* (Clerck). 43-29: 1 ex. 20 April 2013, ex l. on *B. pubescens*. Earlier known only from 84-GO (Shutova *et al*. 1999).

Epione repandaria (Hufnagel). 55: 1 ex. 8 August 2019. The northernmost record from the Kola Peninsula. Earlier known only from 61 and 84 (Kozlov *et al*. 2000).

Hylaea fasciaria (Linnaeus). 38-1: 1 ex. 26 July 1999; 43-35: 1 ex. 22 July 1998. Earlier known only from 61 (Kozlov & Jalava 1994) and 83-RJ (Shutova *et al*. 1999).

Endromidae

**Endromis versicolora* (Linnaeus). 38-11: 11 larvae on one *B. pubescens* tree 14 August 2017. 128: 1 larva on *Alnus* sp. 14 August 2017 (A. Humala pers. comm.).

Sphingidae

**Macroglossum stellatarum* (Linnaeus). 60: 1 ex. 11 August 2018 (https://ok.ru/video/668509342458). A long-distance migrant species; the northernmost records in Finland are from Sodankylä in 2010 and from Inari in 2020 (https://laji.fi/en).

Notodontidae

Notodonta dromedarius (Linnaeus). 39 and 17 localities around it: a total of 50 larvae were recorded on *B. pubescens* from 1993–2011 (Kozlov *et al*. 2017b). Earlier known only from 6, 9, 46 (Kozlov & Jalava 1994), 38-1 (Kozlov & Kullberg 2011) and 61 (Shutova 2004).

°*Odontosia sieversii* (Ménétriés). 17 (Khlebosolov *et al.* 2008, as *O. carmelita*).

Erebidae

**Hypena proboscidalis* (Linnaeus). 55: 3 exx. 11–13 August 2012, at light.

Gynaephora fascelina (Linnaeus). 46 (Aikuaivenchorr, 860 m a.s.l.): 1 larva 18 August 2019 on *Saxifraga oppositifolia* (photographed by N. Koroleva). Earlier reported from 46 by Kozhanchikov (1950) and from

38-15 (erroneously named 39-15) by Kozlov & Kullberg (2011).

!*Setina irrorella* (Linnaeus). 46: 4 exx. 21–26 July 1926 (ZISP). Reported from 2 (Valle 1933), 12 (Valle 1933) and 45 (Nordström *et al*. 1961).

Noctuidae

!*Diachrysia stenochrysis* (Warren). 74: 1 ex. 18 August 2019. Earlier reported from 60 (Shutova 2008) and 61 (Sviridov *et al.* 2006).

Acronicta psi (Linnaeus). 60: 1 ex. 13 July 2019 (https://www.inaturalist.org/observations/28740576). Earlier known only from 76 (Kozlov & Jalava 1994).

Parastichtis suspecta (Hübner). 55: 3 exx. 13 August 2012, at light. Earlier known only from 10 and 56a (Kozlov & Jalava 1994).

Erroneous records from the Kola Peninsula

Ochsenheimeria urella Fischer von Röslerstamm. Erroneously reported for the Murmansk Oblast (Zagulajev 1988) based on a male collected by A. Günther in Munozero, southern Karelia.

Archips podana (Scopoli). Reported from 46 (Rak & Litvinova 2018, 2020, Rak *et al*. 2018) based on erroneously identified sawfly and fly larvae (Kozlov 2019).

A. crataegana (Hübner). Reported from 46 (Rak & Litvinova 2018, 2020, Rak *et al*. 2018) based on erroneously identified larva of *Swammerdamia compunctella* and of a pupa of an unknown leafroller species, most likely *Pandemis* sp. (Kozlov 2019).

Elachista parvula Parenti. The distribution record from the Kola Peninsula by Parenti (2002) citing Kozlov and Jalava (1994) is a mistake as such a record does not exist in that publication (Kaila 2015).

Psychophora cinderella Viidalepp. Reported from 115 (surrounded by lowland spruce forest) and from 56 based on 5 males collected in 1926–1946 (Makarova *et al*. 2012), and subsequently included in Belyaev and Mironov (2019). We consider this identification doubtful, because *P. cinderella* was not reported from well studied polar regions of either Norway or Finland (Aarvik *et al*. 2017); the nearest reliable record is from Novaya Zemlya (Kullberg *et al*. 2019). Most likely, the specimens investigated by Makarova *et al*. (2012) belonged to *P. sabini* Kirby.

Erannis defoliaria Clerck. Reported from 46 (Rak & Litvinova 2018, 2020, Rak *et al*. 2018) based on an erroneously identified larva of *Epirrita autumnata* (Borkhausen) (Kozlov 2019). An earlier record from the same locality (Novitskaja 1962) is also likely to be erroneous, because in neighbouring Finland *E. defoliaria* occurs in the southernmost regions only (https://laji.fi/en).

Bupalus piniaria (Linnaeus). Reported from forests surrounding Imandra Lake based on larvae that were observed feeding on Scots pine in mid-July (Nesterchuk 1930). We consider this record unreliable, because G. I. Nesterchuk was not an entomologist but a forestry expert, hence he did not possess the skills needed to identify moth larvae. Furthermore, in mid-July this species should be on wing; and of 858 records of this species from Finland, only one was made north of the Arctic Circle (https://laji.fi/en).

Dendrolimus pini (Linnaeus). Reported for forests surrounding Imandra Lake based on larvae that were observed feeding on Scots pine in mid-July (Nesterchuk 1930),when this species should be on wing.. We consider this record unreliable, because this species in Finland does not reach the Arctic Circle (https://laji.fi/en).

Panolis flammea (Denis & Schiffermüller). Reported from forests surrounding Imandra Lake based on larvae feeding on Scots pine in mid-July (Nesterchuk 1930). We consider this record unreliable, because only two of 760 records of this species from Finland were made north of the Arctic circle (https://laji.fi/en).

Agrotis segetum (Denis & Schiffermüller). Reported for the Murmansk Oblast by Vershinina (1991) citing Novitskaja (1962). This is a mistake as such a record does not exist in Novitskaja (1962).

Discussion

Between 2010 and 2019, only 24 species were recorded for the first time from the Kola Peninsula. This number is much smaller compared with 136 new records reported in 2000–2009 (Kozlov & Kullberg 2011) and 90 new records from 1994–1999 (Kozlov *et al*. 2000). However, we do not think that this decrease indicates that our species list is close to being complete, because the percentage of species which are known from one and two localities in the study region did not decrease relative to 1999 and 2009 (Table 2).

Nearly one quarter of all the species of Lepidoptera found on the Kola Peninsula are known from a single locality (Table 2). Of these 197 species, 139 are known based on a single specimen and 9 were collected only before 1950. The most doubtful records are those published for *Glaucopsyche alexis* (Poda) from locality 4 (Nordström *et al*. 1955) and for *Cryptoblabes bistriga* (Haworth) from locality 27 (Krogerus 1943), because these species have not been recorded north of the Arctic Circle in Finland (https://laji.fi/en). At the same time, *Lycaena virgaureae* (Linnaeus), which is relatively common in northern Finland (https://laji.fi/en), has not been collected in the Murmansk Oblast since 1861.

Several species which were collected for the first time from the study region in 2010–2019 were either migrants (e.g. *Colias hyale* and *Macroglossum stellatarum*) or newcomers that had recently expanded northwards (e.g. *Endromis versicolora* and *Araschnia levana*). However, the records of the majority of these species could have been expected because they were known in northern Finland already for long (https://laji.fi/en). Abundances of some newly recorded species are increasing gradually (e.g. *Araschnia levana* and *Leptidea sinapis*), whereas other species (e.g. *Argyresthia retinella*) have immediately appeared in great numbers.

Between 1991 and 2014, the spring and autumn temperatures increased by 2.5–3 °C in the central part of the Kola Peninsula (Zvereva *et al.* 2016). During this period, the annual census of larvae of 12 actively and regularly collected birch-feeding moth species revealed a significant increase in the abundance of *Phylloporia bistrigella* and *Coleophora serratella* (Linnaeus), whereas the abundance of *Falcaria lacertinaria* (Linnaeus) and *Achlya flavicornis* decreased. Abundances of the eight remaining species did not change markedly (Kozlov *et al.* 2017b). Similarly, studies carried out in 2018–2019 on the White Sea shore (the warmest part of the Murmansk Oblast) yielded only few new records, possibly because climatic changes are not equally favourable to all insect species, and because northward expansion is easier in more continental locations.

We are concerned by repeated publications of incorrect identifications of moths and other insects by unqualified scientists. In particular, the team of botanists from Kirovsk, Russia, published the same information, including erroneous records of multiple insect species, in three separate works (Rak & Litvinova 2018, 2020, Rak *et al*. 2018). Notably, the newest of these publications (Rak & Litvinova 2020) appeared after the critical comments in Kozlov (2019) were communicated to the authors. We urge authors of faunistic studies to provide adequate description of measures taken to assure correct identification of insects, such as the use of major collections and consultations with experts. We suggest that, with rare exceptions, deposition of voucher insect specimens in appropriate museums should be seen by editors and reviewers as an obligatory condition for publication of faunistic data on insects.

The known fauna of moths and butterflies of the Murmansk region now totals 834 species. This number is slightly lower than the sum of the records reported in our earlier publications and in the current study. First, one species, *Coleophora betulaenanae* Klimesch, listed by Kozlov and Jalava (1994), was synonymised (Itämies & Tabel 1997) with *C. vacciniella*, which was mentioned in the same publication. Second, *Psyche* sp., reported by Kozlov and Jalava (1994), should be removed from the list because both *P. casta* (Pallas) and *P. norvegica* (Schöyen) were later found to occur on the Kola Peninsula (Kozlov *et al*. 2000). Third, *Sterrhopterix standfussi* (Wocke) was erroneously counted as a new record by Kozlov *et al*. (2000), although this species was already mentioned in Kozlov and Jalava (1994). Similarly, *Epinotia immundana* (Fischer von Röslerstamm) was listed as a new record twice (Kozlov & Kullberg 2008, 2011). Based on the numbers of species

Table 2. Accumulation of knowledge on Lepidoptera of the Murmansk Oblast.

Year	Number of species			Source
	cumulated* (n_r)	known from one locality only (n_1)	known from two localities only (n_2)	
1993	585	121	89	Kozlov & Jalava 1994
1999	675	166	94	Kozlov *et al.* 2000
2009	810	203	106	Kozlov & Kullberg 2011
2019	834	197	111	this study

* after amendment of the previously published data.

that have been found to date in one or two localities only (Table 2), we estimate that the Lepidopteran fauna of the Kola Peninsula may include 1000 to 1020 species.

It seems that we have exhausted the pool of relatively common species of moths and butterflies inhabiting the Kola Peninsula. Therefore, routine sampling during short excursions to different localities, which we practiced for decades, no longer brings many new records. The future sampling strategy should be oriented towards a search for species which are expected on the Kola Peninsula on the basis of records made in neighbouring regions and/or on the long-term use of bait and light traps or on targeted use of pheromone traps for particular species (e.g. Sesiidae).

Acknowledgements

We thank A. Popova for assistance in collection of Lepidoptera, N. Koroleva for sharing a photograph of *Gynaephora fascelina* larva and for help in obtaining Russian publications, and V. V. Anikin, A. E. Blinushov, A. Humala, L. Kaila, A. L. Lvovsky, O. Makarova, V. Mironov, M. Mutanen and S. Yu. Sinev for identification of problematic species and/or for providing useful information, E. J. van Nieukerken for identification of leaf miners, and T. Tammaru for comments on an earlier draft of this manuscript. Fieldwork on the Kola Peninsula was supported by the Academy of Finland (projects 122133, 124152, 276671, 316182), and by the Finnish Lepidopterological Society.

References

Aarvik, L., Bengtsson, B. Å., Elven, H., Ivinskis, P., Jürivete, U., Karsholt, O., Mutanen, M. & Savenkov, N. 2017: Nordic-Baltic checklist of Lepidoptera. — *Norwegian Journal of Entomology*, Supplement 3: 1–236.

Aarvik, L., Berggren, K., Engdal, J., Slagsvold, P. K., Sørlibråten, O. & Voith, R. 2019: Nye funn av sommerfugler i Norge 11. — *Insekt-nytt* 44(1): 26.

Anikin, V. V. [Аникин, В. В.] 2019: Coleophoridae. — In: Sinev, S. Yu. [Синёв, С. Ю.] (ed.), [*Catalogue of the Lepidoptera of Russia*, 2nd ed.]: 70–85. Zoological Institute, St. Petersburg. [In Russian].

Anikina, A. V. [Аникина, А. В.] 2018: [Species composition of flying insects in forest-tundra near Severomorsk (Murnamsk oblast)]. — In: Aleshkovskii, I. A., Andriyanov, A. V. & Antipov, E. A. [Алешковкий, И. А., Андриянов, А. В. & Антипов, Е. А.] (eds.), [*Materials of the International Scientific Forum of Young Scientists "Lomonosov-2018"*]: 1. MAKS Press, Moscow; also available at https://lomonosov-msu.ru/archive/Lomonosov_2018/data/12728/66462_uid240987_report.pdf. [In Russian].

Belyaev, A. E. & Mironov, V. G. [Беляев, А. Е. & Миронов, В. Г.] 2019: Geometridae. — In: Sinev, S. Yu. [Синёв, С. Ю.] (ed.), [*Catalogue of the Lepidoptera of Russia*, 2nd ed.]: 235–281. Zoological Institute, St. Petersburg. [In Russian].

Blinova, I. V. & Mironov, V. G. 2012: New records of spiders and insects for NE Fennoscandia (Murmansk Region, Russia). — *Memoranda Societatis pro Fauna et Flora Fennica* 88: 80.

Chao, A., Colwell, R. K., Lin, C.-W. & Gotelli, N. J. 2009: Sufficient sampling for asymptotic minimum species richness estimators. — *Ecology* 90: 1125–1133.

Djakonov, A. M. [Дьяконов, А. М.] 1911: [Notes on the Lepidoptera of Murmansk coast]. — *Russian Entomological Review* 11: 13–17. [In Russian].

Fridolin, V. Yu. [Фридолин, В. Ю.] 1936: [*Community of animals and plants of Khibiny mountain area. Biocenotical investigations in 1930–1935*]. — Academy of Sciences of the USSR, Moscow & Leningrad. [In Russian].

Isakov, V. N. & Gromov, I. A. [Исаков, В. Н. & Громов, И. А.] 1997: [Butterflies (Lepidoptera, Rhopalocera) of the northwestern Murmansk Province]. — *Entomologicheskoe Obozrenie* 76: 122–126. [In Russian].

Itämies, J. & Tabell, J. 1997: Variation in male genitalia of *Coleophora vacciniella* H.-S. (Lepidoptera, Coleophoridae). — *Entomologica Fennica* 8: 145–150.

Kaila, L. 2015: The *Elachista dispunctella* (Duponchel) complex (Lepidoptera, Elachistidae) revisited, with exceptional level of synonymy. — *Zootaxa* 3980: 301–358.

Khlebosolov, E. I., Khlebosolova, O. A., Ananieva, S. I., Blinushov, A. E., Zuev, N. V., Zhiryakov, S. M., Savkin, A. P., Vorobyeva, N. S. & Shcherbakova, G. P. [Хлебосолов, Е. И., Хлебосолова, О. А., Ананьева, С. И., Блинушов, А. Е., Зуев, Н. В., Жиряков, С. М., Савкин, А. П., Воробьева, Н. С. & Щербакова, Г. П.] 2008: [Study of moths and butterflies (Insecta, Lepidoptera) near Pasvik Reserve]. — In: Polikarpova, N. V. [Поликарпова, Н. В.] (ed.), [*Proceedings of the State Nature Reserve Pasvik (Pasvik Zapovednik)*]: 54–62. Ryazan Regional Institute of Education, Ryazan. [In Russian].

Kotzsch, H. 1933: Auf Schmetterlingsjagd am nördlichen Eismeer. — *Entomologische Zeilung* 47: 142–145, 152–155.

Kozhanchikov, I. V. [Кожанчиков, И. В.] 1950: [*Orgyidae. Fauna of the USSR. Lepidoptera*, vol. 12]. — Academy of Sciences of the USSR, Moscow & Leningrad. [In Russian].

Kozlov, M. V. [Козлов, М. В.] 1987: [Leafrollers (Lepidoptera, Tortricidae) as plant pests in Murmansk region]. — In: Sinadskii, Y. V. [Синадский, Ю. В.] (ed.), [*Migration of pest organisms with introduced plants*]: 33–38. Kola Science Centre, Apatity. [In Russian].

Kozlov, M. V. 1996: Subalpine and alpine assemblages of Lepidoptera in the surroundings of a powerful smelter on the Kola Peninsula, NW Russia. — *Nota Lepidopterologica* 18: 17–37.

Kozlov, M. V. 2019: Insects identified by unqualified scientists: Multiple "new" records from the Murmansk oblast of Russia are dismissed as false. — *Arctic Environmen-*

tal Research 19: 153–158.

Kozlov, M. V. & Jalava, J. 1994: Lepidoptera of Kola Peninsula, Northwestern Russia. — *Entomologica Fennica* 5: 65–85.

Kozlov, M. V. & Kullberg, J. 2006: Lepidoptera of Terskij seashore of the Kola Peninsula, Northwestern Russia. — *Entomologica Fennica* 17: 123–129.

Kozlov, M. V. & Kullberg, J. 2008: Lepidoptera of tundra habitats of the northern Kola Peninsula, Northwestern Russia. — *Entomologica Fennica* 19: 114–121.

Kozlov, M. V. & Kullberg, J. 2011: New and interesting records of Lepidoptera from the Kola Peninsula, Northwestern Russia, in 2000–2009. — *Entomologica Fennica* 21: 254–272.

Kozlov, M. V., Jalava, J. & Shutova, E. 2000: New records of Lepidoptera from the Kola Peninsula, Northwestern Russia. — *Entomologica Fennica* 11: 131–136.

Kozlov, M. V., Kullberg, J. & Zverev, V. 2014: Moths and butterflies (Lepidoptera) of the Arkhangelsk oblast of Russia: an annotated checklist. — *Entomologica Fennica* 25: 113–141.

Kozlov, M. V., Kullberg, J. & Zverev, V. 2017a: New records of Lepidoptera from Arkhangelsk oblast of Russia. — *Entomologica Fennica* 28: 169–182.

Kozlov, M. V., Zverev, V. & Zvereva, E. L. 2017b: Combined effects of environmental disturbance and climate warming on insect herbivory in mountain birch in subarctic forests: results of 26-year monitoring. — *The Science of the Total Environment* 601–602: 802–811.

Kozlov, M. V., Kullberg, J. & Zverev, V. 2019: Moths and butterflies (Insecta: Lepidoptera) of the continental part of the Nenets Autonomous Okrug, Russia. — *Entomologica Fennica* 30: 72–89.

Kozlov, M. V., van Nieukerken, E. J., Zverev, V. & Zvereva, E. L. 2013: Abundance and diversity of birch-feeding leafminers along latitudinal gradients in Northern Europe. — *Ecography* 36: 1138–1149.

Krogerus, H. 1943: Lepidopterologiska studier i södra Petsamo. — *Notulae Entomologicae* 23: 19–43.

Kullberg, J., Filippov, B. Yu., Spitsyn, V. M., Zubrij, N. A. & Kozlov, M. V. 2019: Moths and butterflies (Insecta: Lepidoptera) of the Russian Arctic islands in the Barents Sea. — *Polar Biology* 42: 335–346.

Linnaluoto, E. T. & Koponen, S. 1980: Lepidoptera of Utsjoki, northernmost Finland. — *Kevo notes* 5: 1–68.

Makarova, O. L., Sviridov, A. V. & Klepikov, M. A. [Макарова, О. Л., Свиридов, А. В. & Клепиков, М. А.] 2012: Moths and butterflies (Lepidoptera) of polar deserts. — *Zoologicheskij Zhurnal* 91: 1043–1057. [In Russian].

Nesterchuk, G. I. [Нестерчук, Г. И.] 1930: [Forests of Karelo-Murmansk region and their pests]. — *Bolezni Rastenij* 19(3–4): 159–181. [In Russian].

Nordström, F., Opheim, M. & Valle, K. J. 1955: De fennoskandiska dagfjärilarnas utbredning. Lepidoptera Diurnia (Rhopalocera & Hesperioidea). — *Lunds Universitets Årsskrift* 51: 1–177.

Nordström, F., Opheim, M. & Sotavalta, O. 1961: De fennoskandiska svärmarnas och spinnarnas utbredning (Sphinges, Bombycomorpha etc.). — *Lunds Universitets Årsskrift* 57: 1–92, maps 1–181.

Novitskaya, L. A. [Новицкая, Л. А.] 1962: [Review of pests damaging decorative plants in Murmansk Oblast]. — In: Avrorin, N. A. [Аврорин, Н. А.] (ed.), [*Decorative Plants and Gardening for the Extreme North of the USSR*]: 182–186. Academy of Sciences of the USSR, Moscow & Leningrad. [In Russian].

Nupponen, K., Nieminen, M., Kaitila, J.-P., Hirvonen, P., Leinonen, R., Koski, H., Kullberg, J., Laasonen, E., Pöyry, J., Sallinen, T. & Välimäki, P. 2019: Butterflies and moths. — In: Hyvärinen, E., Juslén, A., Kemppainen, E., Uddström, A. & Liukko, U.-M. (eds.), *The 2019 Red List of Finnish Species*: 263–312. Ministry of the Environment & Finnish Environment Institute, Helsinki.

Parenti, U. 2002: Corrections and additions to the checklist of European Elachistidae (Lepidoptera: Elachistidae). — *SHILAP Revista de lepidopterologia* 30: 149–153.

Rak, N. S. & Litvinova, S. V. [Рак, Н. С. & Литвинова, С. В.] 2018: [Entomological monitoring of introduced woody plants of family Rosaceae in the collection of the Polar-Alpine Botanical Garden Institute]. — *Hortus Botanicus* 13: 240–249. [In Russian].

Rak, N. S. & Litvinova, S. V. [Рак, Н. С. & Литвинова, С. В.] 2020: [Invertebrates damaging foliage of the plant family Rosaceae in the dendrological collection of the Polar-Alpine Botanical Garden Institute]. — *Entomological Review* 99: 58–70. [In Russian].

Rak, N. S., Goncharova, O. A., Poloskova, E. Yu., Litvinova, S. V., Zotova, O. E. & Lipponen, I. N. [Рак, Н. С., Гончарова, О. А., Полоскова, Е. Ю., Литвинова, С. В., Зотова, О. Е. & Липпонен, И. Н.] 2018: [*Bioecological analysis of introducents of the family Rosaceae Juss.*] — Kola Science Centre, Apatity. [In Russian].

Shutova, E. V. [Шутова, Е. В.] 2004: [Additions and changes to the checklist of Lepidoptera of the Kandalaksha State Nature Reserve]. — In: Klyuikov, E. Yu. [Клюйков, Е. Ю.] (ed.), [*Rational exploitation of the coastal zone of the Northern Seas. 6th and 7th International Workshops. Materials of the reports* [sic!], pt. 1]: 144–160. Russian State Hydrometeorological University, St. Petersburg. [In Russian].

Shutova, E. V. [Шутова, Е. В.] 2008: [Second addition to the check-list of Lepidoptera of the Kandalaksha Reserve.] — In: Mel'nikov, M. V. [Мельников, М. В.] (ed.), [*Ecologo-Faunistic Studies in Central Black Earth Zone and Neighbouring Areas. Materials of 3rd regional conference, Lipetsk, 19–21 February 2008*]: 159–165. Lipetsk State Pedagogical University, Lipetsk. [In Russian].

Shutova, E. V. [Шутова, Е. В.] 2013: *Araschnia levana* (L.) (Nymphalidae, Lepidoptera) in the Southern part of the Kola Peninsula. — In: Degteva, S. V. [Дегтева, С. В.] (ed.), [*Problems of Animals' Study and Protection in the North: Proceedings of II Russian Scientific Conference (Syktyvkar, April 8–12, 2013*]: 227–229. Komi Scientific Centre, Syktyvkar. [In Russian].

Shutova, E. V. & Shklyarevich, F. N. [Шутова, Е. В. & Шкляревич, Ф. Н.] 1999: [Occurence of migratory butterflies in the North]. — In: Luchkov, A. I. [Лучков, А. И.] (ed.), [*Belovezhskaya Pushcha at the Turn of the Third Millennium: Materials of Scientific Conference,*

22–24 December 1999]: 409–410. Belarus State University, Minsk. [In Russian].

Shutova, E. V., Antonova, E. M., Sviridov, A. V. & Kutenkova, N. N. [Шутова, Е. В., Антонова, Е. М., Свиридов, А. В. & Кутенкова, Н. Н.] 1999: [*Lepidoptera of the Kandalaksha reserve*]. — Commission of the Russian Academy of Sciences on Nature Reserves, Moscow. [In Russian].

Silfverberg, H. 1988: Finnish entomologists on the Kola Peninsula. — *Notulae Entomologicae* 68: 115–120.

Sinev, S. Yu. [Синёв, С. Ю.] 1988: [On the lepidopterous fauna of the Pechenga district of the Murmansk province]. — In: Zlobin, V. V. [Злобин, В. В.] (ed.), [*The Connections between Entomofauna of North Europe and Siberia*]: 168–173. Zoological Institute, Leningrad. [In Russian].

Sinev, S. Yu. [Синёв, С. Ю.] (ed.) 2008: [*Catalogue of the Lepidoptera of Russia*]. — KMK Scientific Press, St. Petersburg & Moscow. [In Russian.]

Sinev, S. Yu. [Синёв, С. Ю.] (ed.) 2019: [*Catalogue of the Lepidoptera of Russia*, 2nd ed.] — Zoological Institute, St. Petersburg. [In Russian].

Sinev S. Yu., Nedoshivina, S. V. & Dubatolov, V. V. [Синёв, С. Ю., Недошивина, С. В. & Дубатолов, В. В.] 2019: Tortricidae. — In: Sinev, S. Yu. [Синёв, С. Ю.] (ed.), [*Catalogue of the Lepidoptera of Russia*, 2nd ed.]: 120–156. Zoological Institute, St. Petersburg. [In Russian].

Sviridov, A. V., Trofimova, T. A., Uskov, M. V., Mukhanov, A. V., Lobkova, L. E., Shchurov, V. I., Shutova, E. V., Kuznetsov, I. V., Lovtsova, Yu. A., Korzhov, P. N., Okulov, V. S. & Klepikov, M. A. [Свиридов, А. В., Трофимова, Т. А., Усков, М. В., Муханов, А. В., Лобкова, Л. Е., Щуров, В. И., Шутова, Е. В., Кузнецов, И. В., Ловцова, Ю. А., Коржов, П. Н., Окулов, В.С. & Клепиков, М. А.] 2006: [Noctuid moths (Lepidoptera) new for different regions of Russia. 2]. — *Eversmannia* 7/8: 46–68. [In Russian].

Tatarinov, A. G. & Kulakova, O. I. [Татаринов, А. Г. & Кулакова, О. И.] 2009: [Local faunas of butterflies (Lepidoptera) in the European North of Russia: Khibini mountains]. — *Vestnik Pomorskogo Universiteta, Ser. Estestvennye nauki*, issue 1: 68–76. [In Russian].

Valle, K. J. 1933: Die Lepidopterenfauna des Petsamogebietes under faunistisch-zoogeographischer Berücksichtigung der Fauna ganz N-Fennoscandias. — *Annales Zoologici Societatis Zoologicae Botanicae Fennicae "Vanamo"* 1: 1–262.

van Nieukerken, E. J. & Sinev, S. Yu. [ван Ньюкеркен, Э. Й. & Синёв, С. Ю.] 2019: Nepticulidae. — In: Sinev, S. Yu. [Синёв, С. Ю.] (ed.), [*Catalogue of the Lepidoptera of Russia*, 2nd ed.]: 17–22. Zoological Institute, St. Petersburg. [In Russian].

Vershinina, N. P. [Вершинина, Н. П.] 1981: [Pests of decorative plants in Murmansk region]. — In: Andreev, G. N. [Андреев, Г. Н.] (ed.), [*Development of Botanical Investigations in the Kola Area*]: 138–147. Kola Branch of the Academy of Sciences of the USSR, Apatity. [In Russian].

Zagulajev, A. K. [Загуляев, А. К.] 1988: [*Families Ochsenheimeriidae and Eriocottidae. Fauna of USSR. Lepidoptera*, vol. 4, pt. 7]. — Nauka, Leningrad. [In Russian].

Zvereva, E. L., Zverev V. & Kozlov, M. V. 2014: High densities of leaf-tiers in open habitats are explained by host plant architecture. — *Ecological Entomology* 39: 470–479.

Zvereva, E. L., Hunter, M. D., Zverev, V. & Kozlov, M. V. 2016: Factors affecting population dynamics of leaf beetles in a subarctic region: the interplay between climate warming and pollution decline. — *The Science of the Total Environment* 566–567: 1277–1288.