

Additions to the fauna of moths and butterflies (Lepidoptera) of the Arkhangelsk Oblast, Russia

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Collection of moths and butterflies in the city of Arkhangelsk, Solovetsky Islands, Pinezhsky and Kargopolsky districts carried out between 2017 and 2019, and identification of occasional samples resulted in the discovery of 47 species of Lepidoptera not previously reported from the Arkhangelsk Oblast; three more species were added to the regional fauna based on published data. Especially noteworthy are the findings of *Coleophora proterella* (a recently described species; the first record from Russia), *Clostera albosigma* (the westernmost European record) and *Bryotropha affinis* (a rare, mainly coastal species in Fennoscandia). We also confirmed the records of eight species known from old publications only, and we report new localities for 318 species. To date, the known fauna of the Arkhangelsk Oblast totals 1188 species of moths and butterflies (639 species of microlepidoptera and 549 species of macrolepidoptera); 62 of these are classified as threatened in Finland. We estimate that the regional fauna of Lepidoptera amounts to 1800 species.

Introduction

Changes in climatic conditions observed during the past decades combined with projections for the nearest future, are comparable in magnitude to the largest global changes that occurred in the past 65 million years (Diffenbaugh & Field 2013). Consequently, species distributions worldwide are changing at accelerating rates (Pecl *et al.* 2017), and current distribution patterns of mobile biota may be replaced by new ones before we have a chance to study them. This is especially evident in continental areas at high latitudes, where the effects of climate change are particularly pronounced. For exam-

ple, in the central part of the Kola Peninsula, Russia, the spring and autumn temperatures increased between 1990 and 2015 at a rate of 0.1 °C per year (Zvereva *et al.* 2016). In all likelihood, by 2050, the vegetation in the Arctic will mostly shift from tundra dominated by lichens and mosses to boreal forest dominated by conifers (Pearson *et al.* 2013). This high rate of environmental change gives increasing importance to faunistic studies, as these provide the data for testing ecological hypotheses, for understanding factors shaping biogeographical patterns, and for conservation of global biodiversity.

Our study contributes to the body of knowledge on the current diversity of subarctic ter-

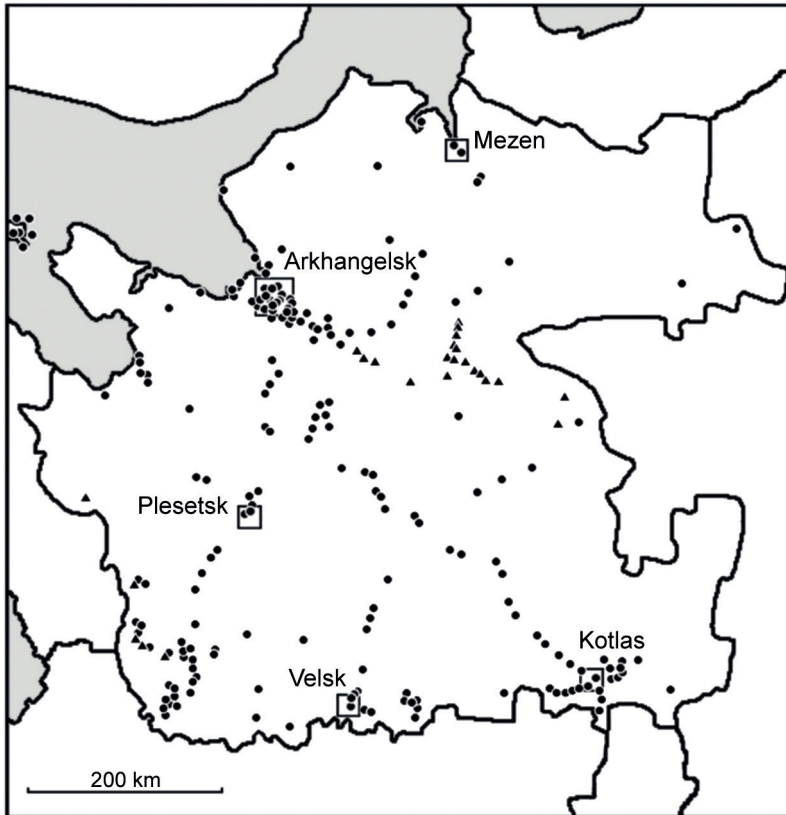


Fig. 1. Collection localities in the Arkhangelsk Oblast. Localities marked by triangles were sampled only in 2017–2019. The settlements are shown by squares.

restrial invertebrates by reporting new records of moths and butterflies (Lepidoptera) from the Arkhangelsk Oblast of Russia, and thus clarifying their distribution patterns in eastern Europe. This insufficiently explored area has high biogeographical importance, because its eastern parts are adjacent to the region designated by Henry Seebohm (1880) as ‘Siberia in Europe’ which may house Asiatic and Beringian species not yet discovered in Europe.

Material and methods

The study is based on approximately 2000 pinned specimens, selected by the first author from over 10 000 specimens collected from 31 localities in the Arkhangelsk Oblast (Table 1). Among these, 22 localities had not been previously explored for their insect fauna (Fig. 1). One specimen of each species collected from each locality had always been pinned, whereas

multiple specimens of trivial species had been disregarded. The moths and butterflies reported in this paper were mainly collected in the city of Arkhangelsk (locality Pr1) between 28 July and 1 August 2017, in the surroundings of Karpogory (localities Kh19–21, Pi1, and Pi11–23) between 2 and 5 August 2017, on the Bol’shoi Solovetsky Island (localities So5 and So6) between 26 and 28 August 2018, and around Kargopol (localities Ka1, Ka6–7, Ka11, Ka14, Ka20, Ka22–23, and Ka27–29) between 28 June and 1 July 2019.

The insects were sampled during daytime (until dusk) by netting, and the total collection time was ca. 140 person-hours. We also recorded easily identifiable species based on visual observations. In addition, we searched for leaf mines, and we reared moths from field-collected larvae. We performed light trapping in Arkhangelsk, Solovetsky, Karpogory and Kargopol; however, light trapping in Kargopol, unlike during our earlier visits to this locality, did not yield even a single moth during three collection nights.

Table 1. List of collection localities in the Arkhangelsk Oblast.

Code	Locality	Co-ordinates*		Number of species**	
		latitude N	longitude E	authors' own data	unconfirmed published records
Ka1	Kargopol	61°30'21''	38°56'56''	142	3
Ka6	3 km S of Kargopol	61°29'04''	38°57'23''	38	0
Ka7	Ileksinskaya	61°41'51''	38°04'00''	90	0
Ka11	1 km E of Khotenovo	61°12'06''	38°35'13''	91	0
Ka12	Kononovo	61°07'01''	38°45'08''	41	0
Ka14	1 km NW of Dubrovo	60°58'26''	38°32'46''	122	0
Ka20	6 km S of Kargopol	61°26'46''	38°57'25''	60	0
Ka22	1 km N of Lapinskaya	61°22'26''	38°55'46''	59	0
Ka23	5 km SW of Lapinskaya	61°20'13''	38°51'29''	20	0
Ka27	11 km NW of Gavrilovskaya	61°37'43''	38°10'24''	42	0
Ka28	3 km W of Gavrilovskaya	61°33'47''	38°16'24''	66	0
Ka29	10 km W of Kargopol	61°31'08''	38°45'00''	39	0
Kh9	5 km NE of Emetsk	63°31'00''	41°42'54''	15	0
Kh10	3 km N of Oseredok	63°30'16''	41°33'18''	17	0
Kh19	3 km SE of Palenga	64°09'48''	42°18'46''	25	0
Kh20	12 km SE of Palenga	64°05'19''	42°25'18''	12	0
Kh21	4 km W of Glubokoe	64°03'17''	42°38'59''	16	0
Kt3	6 km SW of Koryazhma	61°16'35''	47°04'04''	16	0
Kt4	3 km E of Solvychevodsk	61°19'43''	46°58'57''	54	0
Me2	34 km SE of Mezen	65°34'24''	44°37'36''	6	0
On1	Onega	63°55'	38°06'	4	0
On6	2 km NE of Pavlovsky Bor	63°36'26''	39°05'19''	30	0
On9	Vyzhiga River	62°46'03''	37°08'21''	1	0
Pi1	Karpogory	64°00'26''	44°26'01''	86	0
Pi11	18 km SE of Siya	63°52'25''	43°20'14''	11	0
Pi12	1 km E of Zemstvo	63°54'22''	44°03'46''	25	0
Pi13	Shasta	64°16'28''	44°17'02''	11	0
Pi14	Kochmogora	64°15'23''	44°16'24''	12	0
Pi15	1 km N of Cheshegora	64°13'02''	44°13'52''	17	0
Pi16	4 km N of Kurcha	64°08'55''	44°13'56''	19	0
Pi17	Kurcha	64°06'43''	44°14'31''	8	0
Pi18	Yasnyy	64°01'42''	44°06'53''	1	0
Pi19	1 km W of Maryina	64°01'29''	44°11'51''	22	0
Pi20	7 km NE of Losevo	63°49'54''	45°02'47''	9	0
Pi21	2 km E of Kushkopala	63°50'37''	44°46'35''	15	0
Pi22	4 km E of Shardonem	63°54'17''	44°40'53''	23	0
Pi23	1 km S of Tserkova	63°55'50''	44°36'01''	11	0
Pi24	37 km NE of Shuyga	63°42'48''	46°18'49''	1	0
Pl7	4 km SE of Plesetsk	62°41'49''	40°13'42''	35	0
Pl16	Ust-Pocha	62°09'14''	38°09'23''	1	0
Pr1	Arkhangelsk	64°33'	40°33'	299	44
Pr5	Talagi	64°38'	40°38'	10	4
Pr12	Severodvinsk	64°35'33''	39°50'58''	36	2
So4	Bolshaya Muksalma Island	65°01'	35°54'	75	0
So5	Botanical Garden	65°03'09''	35°39'50''	53	0
So6	Near Solovetsky settlement	65°01'	35°45'	246	0
Vt7	Mamonikha	63°25'12''	46°07'06''	0	1

* Co-ordinates were rounded to minutes when the sampled area exceeded 1 km².

** Total number of species reported from the locality equals the sum of the two values.

We report several records based on specimens collected earlier but accidentally missed from the previous lists (Kozlov *et al.* 2014, 2017). We also identified few specimens, georeferenced photographs of which are available at iNaturalist (www.inaturalist.org) and other websites, and we included these findings in our list, along with records published by other researchers (Spitsyn 2017, Spitsyn *et al.* 2017, van Nieukerken & Sinev 2019). The moths are mostly deposited in the Zoological Museum of the University of Helsinki (MZH), whereas the mined plant leaves were donated to Naturalis Biodiversity Center in Leiden (RMNH).

List of species

Both nomenclature and order of taxa follow Aarvik *et al.* (2017). For each species, we provide a list of new localities. Codes of the localities include two-letter abbreviations of the administrative units (Russian *район* [rayon], translated as district) within the Arkhangelsk Oblast (for a map of administrative units, *see* Kozlov *et al.* 2014) and a numerical code. The only exception is the Solovetsky Islands, for which we use the codes starting with ‘So’, although this archipelago administratively belongs to the Primorsky District.

An asterisk (*) denotes species previously not recorded from the Arkhangelsk Oblast. 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 *et al.* 2017). An exclamation mark (!) indicates confirmed records of species included in our previous lists based on earlier publications only. For all these categories of species, along with the locality code, we report the numbers of specimens and collection dates. We briefly comment on the most interesting findings, primarily in terms of their distribution in northern Europe.

Micropterigidae

Micropterix mansuetella Zeller. Ka28–29.
M. aruncella (Scopoli). Ka7, Ka11, Ka14, Ka22, Ka28–29.
M. calthella (Linnaeus). Ka14, Ka20, Ka22, Ka28.

Eriocraniidae

Eriocrania sparrmannella (Bosc). Pi21, Pi16.

Hepialidae

Phymatopus hecta (Linnaeus). Ka28, Pi20.

Nepticulidae

Stigmella lapponica (Wocke). Me2, Pi14, Pi17, Pi19, Pi21, Pi23.

S. confusella (Wood). Pi14.

S. luteella (Stainton). Kt3.

S. magdalenae (Klimesch). Pi19.

S. sorbi (Stainton). Pi17, Pi23.

°*Ectoedemia rosae* Nieukerken & Berggren. Kt4, On6, Pi7, Pr1, Pr12. This species was recently described from France and Norway (van Nieukerken & Berggren 2011). Reported from the Arkhangelsk Oblast by van Nieukerken and Sinev (2019).

Prodoxidae

**Lampronia flavimitrella* (Hübner). Ka27: 1 ex. 28 June 2019.
L. standfussiella Zeller. Ka14.

Incurvariidae

Incurvaria pectinea Haworth. So4.

I. oehlmanniella (Hübner). Ka11.

Phylloporia bistrigella (Haworth). So4.

Adelidae

Nemophora metallica (Poda). Ka7.

N. degeerella (Linnaeus). Ka23.

**Cauchas rufimitrella* (Scopoli). Ka6: 1 ex. 30 June 2019.

**Nematopogon metaxella* (Hübner). Ka11: 5 exx. 30 June 2019.

Psychidae

Psyche casta (Pallas). Pi19.

**Phalacropterix grasilinella* (Boisduval). Ka 28: 1 ex. 28 June 2019.

Tineidae

**Morophaga choragella* (Denis & Schiffermüller). Pr1: 2 exx. 28–31 July 2017, at light.

Bucculatricidae

Bucculatrix demaryella (Duponchel). Kt3.

B. nigricomella (Zeller). Ka27–28.

Gracillariidae

- Caloptilia stigmatella* (Fabricius). Pr5.
Phyllonorycter strigulatella (Lienig & Zeller). Kh20, Pi15,
 Pi22, Pi23.

Yponomeutidae

- Yponomeuta evonymella* (Linnaeus). Pi1.
Swammerdamia caesiella (Hübner). Ka14.
Paraswammerdamia conspersella (Tengström). Pi1, Pi14,
 Pi21.

Argyresthiidae

- Argyresthia brockeella* (Hübner). Ka1, Ka6.
A. pygmaeella (Denis & Schiffermüller). Ka14, Ka20, Ka22.
 **A. curvella* (Linnaeus). Pr1: 1 ex. 28–31 July 2017, at light.
A. retinella Zeller. So6.
A. conjugella Zeller. Ka1, Pi17.

Plutellidae

- Plutella xylostella* (Linnaeus). Ka7, Ka11, Ka14, Ka28–29.

Glyphipterigidae

- Glyphipterix simpliciella* (Stephens). Ka28–29.
G. thrasonella (Scopoli). Kh20, Pi11.

Ypsolophidae

- Ypsolopha parenthesesella* (Linnaeus). So5.

Choreutidae

- **Prochoreutis myllerana* (Fabricius). Pr1: 1 ex. 18 June 2015
 (<https://www.inaturalist.org/observations/32688880>).
P. ultimana (Krulikovsky). Ka23, Ka28, So6.
Choreutis diana (Hübner). So6.

Tortricidae

- Philedone gerningana* (Denis & Schiffermüller). Pi16, Pi21.
Adoxophyes orana (Fischer von Röslerstamm). Ka11.
Pandemis cinnamomeana (Treitschke). So6.
P. heparana (Denis & Schiffermüller). Pi1.
 **Clepsis rurinana* (Linnaeus). Ka11: 3 exx. 30 June 2019,
 Ka23: 1 ex. 30 June 2019.
Zelotherses paleana (Hübner). Ka20, Pi15.
Z. unitana (Hübner). Ka7, Ka14, Ka20, Ka22–23, Ka27–29,
 Kh19, Pi1, Pr1.
Archips rosana (Linnaeus). Kh19, Pi1, Pi22.
Eana osseana (Scopoli). Kh19.

- E. argentana* (Clerck). Ka1, Ka7, Ka14, Ka20, Ka22, Ka28–
 29, Kh19, Pi1, Pi12.
 **Cnephasia asseclana* (Denis & Schiffermüller). Ka1: 1 ex.
 30 June 2019, Ka7: 1 ex. 28 June 2019, Ka22: 1 ex. 30
 June 2019.
Acleris laterana (Fabricius). So5–6.
A. effractana (Hübner). So6.
A. variegana (Denis & Schiffermüller). So6.
A. aspersana (Hübner). Pi16, Pi21, So6.
Phtheochroa inopiana (Haworth). Pr1.
 !*Agapeta hamana* (Linnaeus). Ka1: 1 ex. 30 June 2019,
 Ka11: 1 ex. 30 June 2019.
 **Eupoecilia angustana* (Hübner). Ka14: 2 exx. 30 June 2019,
 Ka20: 3 exx. 30 June 2019.
Aethes margaritana (Haworth). Ka20.
A. cnicana (Westwood). Ka14.
 **Cochylis hybridella* (Hübner). Ka27: 1 ex. 28 June 2019.
C. dubitana (Hübner). Ka7, Ka28.
 **Pseudargyrotoza conwagana* (Fabricius). Pr1: 1 ex. 28–31
 July 2017, at light.
Apotomis infida (Heinrich). Ka11.
A. turbidana Hübner. Pi20.
Orthotaenia undulana (Denis & Schiffermüller). Ka23, Pi12.
Hedya salicella (Linnaeus). Ka6.
Celypha rufana (Scopoli). Ka1, Ka7, Kh21, Pi1, Pi12, Pi15–
 16, Pi20.
C. striana (Denis & Schiffermüller). Ka1, Ka11, Ka14, Ka20,
 Ka22.
C. rurestrana (Duponchel). Pi22–23.
C. cespitana (Hübner). Ka7, Ka28, Pi1, Pi19.
C. lacunana (Denis & Schiffermüller). Ka20, Ka22–23,
 Ka28–29.
C. rivulana (Scopoli). Ka1, Ka7, Ka11, Ka14, Ka20, Ka22,
 Ka29, Kh19, Kh21, Pi11–12, Pi15–17, Pi20–22.
Phiaris schulziana (Fabricius). Pi16, Pi21.
Ph. micana (Denis & Schiffermüller). Pi16.
 !*Ph. palustrana* (Lienig & Zeller). Pi21.
Ph. bipunctana (Fabricius). Ka27.
Olethreutes arcuella (Clerck). Ka29.
Lobesia virulenta Bae & Komai. Ka14.
Bactra fufurana (Haworth). Pi1, Pi11, Pr1.
Ancylis myrtillana (Treitschke). Ka14.
A. badiana (Denis & Schiffermüller). Ka1, Ka7, Ka20,
 Ka22–23, Ka27–28.
Rhopobota naevana (Hübner). Pi14, Pi16, Pi21, So6.
Epinotia indecorana (Zetterstedt). So6.
 **E. sordidana* (Hübner). So5–6: 3 exx. 25–27 August 2018.
E. solandriana (Linnaeus). So6.
Epinotia brunnichiana (Linnaeus). So5–6.
E. subocellana (Donovan). Ka14, Ka27.
E. ramella (Linnaeus). Pi1.
E. tetraquetrana (Haworth). Ka28.
E. cinereana (Haworth). So6.
E. tedella (Clerck). Ka1, Ka7, Ka22–23, Ka27–29.
E. signatana (Douglas). Pr1, Pi13.
E. cruciana (Linnaeus). Ka1, Ka20, Pi12, Pi16.
E. nanana (Treitschke). Ka1, Ka22, Ka27.
E. crenana (Hübner). So6.
Eucosma obumbratana (Lienig & Zeller). Pr1.

- E. cana* (Haworth). Ka14, Ka20, Ka22, Ka27, Pi1, Pr1.
E. hohenwartiana (Denis & Schiffermüller). Ka1, Ka7, Ka11, Ka14, Ka20, Pi12, Pi15.
Epiblema sticticana (Fabricius). Ka1, Ka22–23.
E. grandaevana (Lienig & Zeller). Pr1, Pi1.
 **Gypsonoma oppressana* (Treitschke). Ka1: 1 ex. 29 June 2019. The moth was collected in the town of Kargopol, where its host plants, cultivated poplars, are common.
Notocelia roborana (Denis & Schiffermüller). Pi1.
 **N. trimaculana* (Haworth). Kh19: 1 ex. 2 August 2017. A somewhat surprising record, because in Europe larvae of this species feed on native *Crataegus* spp., which are missing from the native flora of the Arkhangelsk Oblast (Schmidt 2005). Occurs on the Åland Islands (Kullberg et al. 2002) and in the Baltic states (Aarvik et al. 2017), where it has not been observed to feed on commonly cultivated American hawthorns.
 **Rhyacionia pinivorana* (Lienig & Zeller). Ka22: 1 ex. 30 June 2019, On9: 1 ex. 10 July 2014 (<https://www.inaturalist.org/observations/18575990>).
Dichrorampha plumbana (Scopoli). Ka11, Ka14, Ka28.
D. uralensis (Danilevsky). Ka1, Ka14.
D. aeratana (Pierce & Metcalfe). Ka28.
D. consortana (Stephens). Ka11, Ka14.
D. acuminatana (Lienig & Zeller). Kh21.
D. simpliciana (Haworth). Kh19.
D. sequana (Hübner). Ka7, Ka20, Ka22, Ka28.
D. vancouverana McDunn. Pi12.
 **D. alpinana* (Treitschke). Ka28: 1 ex. 28 June 2019.
D. petiverella (Linnaeus). Ka14, Ka27–28.
D. obscuratana (Wolff). Ka7, Ka22, Ka29.
D. agilana (Tengström). Ka7, Ka20, Ka22, Ka28.
Grapholita compositella (Fabricius). Ka7, Ka20, Ka22, Ka27–29, Kh19, Pi12, Pi22.
G. orobana Treitschke. Ka28.
G. tenebrosana Duponchel. Pi11.
Pammene germana (Hübner). Pi16.
P. aurana (Fabricius). Ka7.
Cydia nigricana (Fabricius). Ka28–29, Kh19.
Lathronympha strigana (Fabricius). Ka7, Ka22, Ka28, Pi12, Pi16–17, Pi19, Pi21.

Zygaenidae

- Zygaena osterodensis* Reiss. Ka7.
Z. viciae (Denis & Schiffermüller). Ka7, Ka14.

Oecophoridae

- Denisia similella* (Hübner). Pi1.

Depressariidae

- Exaeretia ciniflonella* (Lienig & Zeller). So6.
Agonopterix heracliana (Linnaeus). So6.
A. angelicella (Hübner). Pi1.
Depressaria sordidatella Tengström. Pi1, Pi19.
Hypercallia citrinalis (Scopoli). Ka14, Ka28.

- **Ethmia pyrausta* (Pallas). Pi15: larva collected from *Thalictrum minus*; 1 ex. emerged on 20 March 2018. The species is considered critically endangered in Finland, where a few stable populations occur on the Åland Islands (Kullberg et al. 2002). In Sweden, this species is distributed in more northern regions. It prefers grazed, sunny, moist meadows with *Thalictrum* spp. The moth flies in daytime very early in the season, and is likely overlooked in northern regions of European Russia.

Gelechiidae

- Aproaeremia cincitella* (Clerck). Pi12.
 **Mesophleps silacella* (Hübner). Ka22: 1 ex. 30 June 2019. A bit surprising record of a species living on *Helianthemum* spp. on dry calcareous meadows. In Fennoscandia, this species reaches Stockholm and occurs on the Åland Islands (Kullberg et al. 2002) as well as in the Baltic states (Aarvik et al. 2017). It was reported from the northern coast of the Gulf of Finland as occasional vagrant only. The northernmost records in Russia are from the north-western region (Sinev 2019).
Dichomeris limosellus (Schläger). Pi1.
Acompsia cinerella (Clerck). Ka7, Ka27–28, Pi1.
 **Bryotropha affinis* (Haworth). Ka7: 1 ex. 28 June 2019. In Finland, this rare species is associated with coastal habitats. Its larva lives on mosses growing in sandy and dry habitats like dunes, roadsides, heathlands and gravel pits. The nearest record is from Karelia (Sinev 2019).
B. similis (Stainton). Ka11, Pi1, Pr1.
B. senectella (Zeller). Kh21, Pi1, Pi12, Pi14, Pi16, Pi18, Pi20, Pr1.
Metzneria lappella (Linnaeus). Ka11, Ka14, Ka20, Pi1, Pr1.
M. metzneriella (Stainton). Ka12, Ka27.
Argolamprotes micella (Denis & Schiffermüller). Pi1.
Athrips tetrapunctellus (Thunberg). Ka28.
Chionodes holosericeus (Herrich-Schäffer). Ka7.
Gelechia muscosella Zeller. Pr1.
 **Scrobipalpa acuminatella* (Sircom). Ka20: 2 ex. 30 June 2019.
 **Scrobipalpa psilella* (Herrich-Schäffer). Pr1: 1 ex. 28–31 July 2017, at light.
 **Caryocolum pullatella* (Tenström). Ka7: 1 ex. 28 June 2019.

Elachistidae

- Elachista eleochariella* (Stainton). Ka28.
 **E. kilmunella* Stainton. Ka14: 1 ex. 30 June 2019, Ka22: 1 ex. 30 June 2019.
E. albifrontella (Hübner). Ka28.
 **E. canapennella* (Hübner). Pi12: 1 ex. 2 August 2017.

Coleophoridae

- **Coleophora expressella* Klemensiewicz. Pi1: 1 ex. 2–3 August 2017, at light.
C. striatipennella Nylander. Ka14.
 **C. proterella* Wikström & Tabell. Ka11: 1 ex. 30 June 2019.

Formerly overlooked species closely related to *C. virgaureae*; feeds on *Solidago virgaurea*. It has been found in Finland, Sweden, Norway, Estonia, Latvia, Germany, Hungary, Portugal and Spain. First record for Russia.

**C. taeniipennella* Herrich-Schäffer. Ka11: 3 exx. 30 June 2019, Ka14: 1 ex. 30 June 2019, Pr1: 1 ex. 28–31 July 2017, at light.

C. glaucicolella Wood. Ka14.

C. gryphipennella (Hübner). Ka27.

C. serratella (Linnaeus). Ka1.

C. deauratella Lienig & Zeller. Ka20, Ka27–29.

C. mayrella (Hübner). Ka14.

Momphidae

Mompha idaei (Zeller). Ka28, Ka29.

M. raschkiella (Zeller). Ka28, Pi16, Pi23.

M. conturbatella (Hübner). Kh20.

Scythrididae

Scythris inspersella (Hübner). Pi19.

**S. laminella* (Denis & Schiffermüller). Ka28: 3 exx. 28 June 2019. A dry meadow species, which is endangered in Fennoscandia due to habitat loss.

Thyrididae

Thyris fenestrella (Scopoli). Ka27.

Epermeniidae

Phaulernis fulviguttella (Zeller). Ka7.

**P. dentella* (Zeller). Ka22: 1 ex. 30 June 2019, Ka23: 1 ex. 30 June 2019.

Pterophoridae

Platyptilia gonodactyla (Denis & Schiffermüller). Ka27, Kh20, Pi1, Pi22, So6.

Gillmeria pallidactyla (Haworth). Ka7, Ka11, Ka14, Ka20, Ka22, Ka27–29, Kh19, Pi1, Pi12, Pi15, Pi20, Pi22.

G. ochrodactyla (Denis & Schiffermüller). Kh19, Pi19, Pr1.

Stenoptilia pterodactyla (Linnaeus). Ka7, Ka20, Ka28, Kh19–21, Pi12–14, Pi17, Pi19, Pi23, Pr1.

**S. veronicae* Karvonen. Kh19: 2 exx. 2 August 2017, Pi12: 1 ex. 2 August 2017, Pi19: 1 ex. 3 August 2017, Pi22: 1 ex. 3 August 2017.

S. bipunctidactyla (Scopoli). Pi1, Pi12–13, Pi23, Pr1.

Geina didactyla (Linnaeus). Ka7.

**Oxyptilus ericitorum* (Stainton). Kh21: 1 ex. 2 August 2017.

Hellinsia osteodactylus (Zeller). Ka20, Ka22, Ka27, Pi22.

H. didactylites (Ström). Ka7, Ka27.

Papilionidae

Papilio machaon Linnaeus. Pi22.

Hesperiidae

Thymelicus lineola (Ochsenheimer). Pi22.

Ochlodes sylvanus (Esper). Ka1, Ka27–29.

Pieridae

Pieris rapae (Linnaeus). So5.

P. napi (Linnaeus). Ka7, Pi22–23.

Gonepteryx rhamni (Linnaeus). So5.

Nymphalidae

Brenthis ino (Rottemburg). Ka7, Ka20.

Argynnis aglaja (Linnaeus). Kh19.

A. adippe (Denis & Schiffermüller). Ka22.

Vanessa atalanta (Linnaeus). So5–6 (very abundant in 2018).

V. cardui (Linnaeus). So5.

Aglais urticae (Linnaeus). Ka28–29.

Melitaea diamina (Lang). Ka22.

Limenitis populi (Linnaeus). Ka27.

!*Pararge aegeria* (Linnaeus). So5: 1 ex. 28 August 2018.

Lasiommata maera (Linnaeus). Ka27.

Coenonympha glycerion (Borkhausen). Ka20, Ka22.

Aphantopus hyperantus (Linnaeus). Ka7, Ka14, Ka20, Ka22, Ka27–29, Kh19, Pi12.

Erebia euryale (Esper). Kh19.

Lycaenidae

Cyaniris semiargus (Rottemburg). Ka1, Ka20, Ka22, Ka27–29.

Polyommatus amandus (Schneider). Ka1, Ka7, Ka11, Ka20, Ka27, Ka29, Kh19, Pi22.

P. icarus (Rottemburg). Pi11–12.

Lycaena dispar (Haworth). Ka22, Ka29.

L. hippothoe (Linnaeus). Ka7.

!*Satyrrium pruni* (Linnaeus). Ka7: 1 ex. 28 June 2019.

Pyralidae

**Anerastia lotella* (Hübner). Ka7: 1 ex. 28 June 2019. This species, which prefers sandy areas in Fennoscandia, was collected from a dry sandy meadow.

Oncocera semirubella (Scopoli). Kh21, Pi1, Pi12.

Sciota fumella (Eversmann). Ka14, Ka22.

**S. lucipetella* (Jalava). Ka29: 1 ex. 1 July 2019. This rarely collected, night flying species, which has been described from Finland, has recently been expanding westwards.

**Dioryctria simplicella* Heinemann. Pi1: 1 ex. 2–3 August 2017, at light.

Pyla fusca (Haworth). Pi1.

Hypochalcia ahenella (Denis & Schiffermüller). Ka7.

Acrobasis advenella (Zincken). Pi1, Pr1.

Phycitodes binaevella (Hübner). Ka14, Ka22.

Pyralis farinalis (Linnaeus). Pr1.

Crambidae

- Paratalanta hyalinalis* (Hübner). Ka14, Ka29.
Pyrausta purpuralis (Linnaeus). Pi20.
Nascia ciliaris (Hübner). Ka6.
Sitochroa verticalis (Linnaeus). Ka29, Pi1.
Psammotis pulveralis (Hübner). Ka1.
Anania perlucidalis (Hübner). Ka20, Ka28, Pi1.
A. terrealis (Treitschke). Pi1.
A. hortulata (Linnaeus). Ka28.
A. fuscalis (Denis & Schiffermüller). Ka1, Ka6–7, Ka20, Ka22, Ka27–29, Kh19, Pi1, Pi17, Pi19, Pr1.
Udea lutealis (Hübner). Kh19–21, Pi1, Pi11–13, Pi15, Pi19, Pi23.
Patania ruralis (Scopoli). Pr1.
Diasemia reticularis (Linnaeus). Ka7, Ka22.
Evergestis pallidata (Hufnagel). Pr1.
 **Scoparia pyraeella* (Denis & Schiffermüller). Ka20: 2 exx. 30 June 2019, Ka22: 2 exx. 30 June 2019.
S. ancipitella (La Harpe). Pi1, Pi12, So6.
Catoptria permutatellus (Herrich-Schäffer). Pi1.
C. margaritella (Denis & Schiffermüller). Pi11, Pi14.
Agriphila straminella (Denis & Schiffermüller). Ka1, Ka7, Ka11, Ka20, Ka22, Ka28–29, Pi14.
Chrysoteuchia culmella (Linnaeus). Ka14, Ka20, Ka22.
Crambus pascuella (Linnaeus). Ka1, Ka11, Ka20, Ka28–29, Kh21, Pi19.
C. pratella (Linnaeus). Ka7, Kh21, Pi1, Pi12.
C. lathonella (Zincken). Ka14, Ka28–29, Kh21, Pi12.
C. hamella (Thunberg). Kh19, Pi1, Pi11, Pi14, Pi16, Pi20.
C. perlella (Scopoli). Ka7, Ka20, Ka22, Ka27, Ka29, Kh19, Kh21, Pi1, Pi12, Pi15, Pi22.
Elophila nymphaeata (Linnaeus). Ka28.
Parapopynx stratiotata (Linnaeus). Pr1.
Nymphula nitidulata (Hufnagel). Pi22.

Drepanidae

- Ochropacha duplaris* (Linnaeus). Ka11.

Geometridae

- Idaea serpentina* (Hufnagel). Ka1, Ka7, Ka14, Ka20, Ka22.
I. biselata (Hufnagel). Ka11, Pr1.
I. aversata (Linnaeus). Pr1.
I. straminata (Borkhausen). Pi1.
Scopula immorata (Linnaeus). Ka20, Ka22, Ka28–29, Pi15.
S. immutata (Linnaeus). Ka20, Ka28–29.
Scotopteryx chenopodiata (Linnaeus). Ka7, Ka14, Ka20, Ka22, Kh19–21, Pi11–13, Pi15–17, Pi19–20, Pi22.
Xanthorhoe quadrifasciata (Clerck). Ka1, Ka11, Ka20, Pr1, Pi1, Pi15, Pi19.
X. montanata (Denis & Schiffermüller). Ka6, Ka20, Ka23, Ka27–28.
X. fluctuata (Linnaeus). Pi1.
Camptogramma bilineata (Linnaeus). Ka14, Ka20, Ka22, Pi22–23.
Epirrhoe tristata (Linnaeus). Ka7, Ka28.

- E. alternata* (Müller). Ka6–7, Ka11, Ka20, Ka23, Pi1, Pi13.
Pelurga comitata (Linnaeus). Pi1.
Spargania luctuata (Denis & Schiffermüller). Pi1.
Hydriomena furcata (Thunberg). Pi13, So6.
 **Polythrena coloraria* Herrich-Schäffer. Pi24: 1 ex. 22 June 2019 (photographed by J. Kinnunen). A rare eastern species, which reaches Olonets Province in Karelia (Leinonen et al. 2006), but has not yet been found in either Finland or the Baltic States (Aarvik et al. 2017).
Cosmorhoe ocellata (Linnaeus). Ka20.
Eulithis prunata (Linnaeus). Pi1, Pi15, Pi19.
E. testata (Linnaeus). Pi16.
E. populata (Linnaeus). Pi1, Pi15–16, Pi19, Pi21–22, So6.
E. mellinata (Fabricius). Ka14.
Ecliptoptera silaceata (Denis & Schiffermüller). So6.
Chloroclysta miata (Linnaeus). So6.
Dysstroma citrata (Linnaeus). Pi13, Pi22, So5.
Colostygia aptata (Hübner). Pi1, Pi13, Pi15, Pi19.
Epirrita autumnata (Borkhausen). So6.
Hydrelia flammeolaria (Hufnagel). Ka14, Ka28.
Rheumaptera hastata (Linnaeus). Ka27, Pi11.
 **Rheumaptera undulata* (Linnaeus). Ka6: 1 ex. 30 June 2019, Ka14: 2 exx. 30 June 2019.
Mesotype didymata (Linnaeus). Pi1.
Perizoma albulata (Denis & Schiffermüller). Ka14, Ka28.
Martania taeniata (Stephens). Ka23.
Eupithecia tenuiata (Hübner). Pi1, Pr1.
E. plumbeolata (Haworth). Ka28.
E. pygmaea (Hübner). Ka7.
E. pusillata (Denis & Schiffermüller). Kh10.
E. virgaureata Doubleday. Ka22, Ka27.
 **E. groenblomi* Urbahn. Pr1: 1 exx. 28–31 July 2017, at light. A rarely collected species, whose larvae feed on *Solidago* flowers. The nearest records are from southern Karelia (Kutenkova et al. 2015) and southern Finland (<https://laji.fi/en>), but the species was also reported from Middle Ural, Kurily Islands and Primorye Region (Sinev 2019).
E. absinthiata (Clerck). Pr1.
E. succenturiata (Linnaeus). Pi1.
Odezia atrata (Linnaeus). Ka7, Ka14, Ka20, Ka22, Ka28.
Carsia sororiata (Hübner). Pi14, Pi16, Pi21.
Pterapherapteryx sexalata (Retzius). Ka28.
Lomaspilis marginata (Linnaeus). Ka27–28.
Epione repandaria (Hufnagel). So6.
Macaria notata (Linnaeus). Ka27.
M. alternata (Denis & Schiffermüller). Ka6, Ka11, Ka28.
M. signaria (Hübner). Ka27.
M. wauaria (Linnaeus). Kh20, Pi1, Pi13, Pi15, So6.
M. brunneata (Thunberg). Kh19, Kh21, Pi1, Pi11, Pi14, Pi16, Pi19, Pi21–23.
Chiasmia clathrata (Linnaeus). Ka22, Ka27–29.
Biston betularia (Linnaeus). Pr1.
Arichanna melanaria (Linnaeus). Kh21, Pi1.
Crocallis elinguaris (Linnaeus). Pi1.
Cabera pusaria (Linnaeus). Ka27–28.
C. exanthemata (Scopoli). Ka1, Ka6, Ka27–28, Kh19.
Hylaea fasciaria (Linnaeus). Pi1.
Jodis lactearia (Linnaeus). Ka11.
J. putata (Linnaeus). Ka27.

Notodontidae

Notodonta torva (Hübner). Pi21.

N. ziczac (Linnaeus). So6.

Ptilodon capucina (Linnaeus). Ka27.

**Clostera albosigma* Fitch. Pr1: 1 ex. 25 June 2011 (<http://macroid.ru/showphoto.php?photo=118234>). The westernmost confirmed record of this Holarctic species, which was not previously reported west of Mari El Republic in Russia, where a single specimen was collected (see Matveev *et al.* 1999). Old records from Estonia have been considered questionable, because moths were insufficiently labelled or the specimens were lost (Jürivete *et al.* 2000). The record from Arkhangelsk may shed some light on the old Estonian records.

Erebidae

Rivula sericealis (Scopoli). Pi1, Pr1, Ka11, Ka14, Ka29, Kh20.
Hypena proboscidalis (Linnaeus). Ka7, Ka29, Pr1, Pi19.

**Orgyia recens* (Hübner). On1: 1 ex. 27 June 2016 (<https://www.inaturalist.org/observations/19016104>).

O. antiqua (Linnaeus). Kh20–21.

**O. antiquoides* (Hübner). Pi16: 1 ex. 4 August 2017.

Thumatha senex (Hübner). Ka11.

Cybosia mesomella (Linnaeus). Ka11, Ka28.

Atolmis rubricollis (Linnaeus). Ka11.

Eilema lurideola (Zincken). Pi1.

!*Phragmatobia fuliginosa* (Linnaeus). Pr1: 2 exx. 28 May 2012 (<https://www.inaturalist.org/observations/32483634>).

°*Arctia flavia* (Fuessly). Vt7 (Spitsyn *et al.* 2017). Scattered populations of this Euro-Siberian species occur in subalpine regions of central Europe.

Polypon tentacularia (Linnaeus). Ka1, Ka7, Ka20, Ka22, Ka27–29, Pi19.

Hyphenodes humidalis Doubleday. Pi14, Pi21.

**Schranksia costaestrigalis* (Stephens). So6: 1 ex. 25–26 August 2018, at light.

Lygephila pastinum (Treitschke). Pi1.

Euclidia glyphica (Linnaeus). Ka20, Ka22, Ka29.

Noctuidae

Abrostola tripartita (Hufnagel). Pi1.

Diachrysis chrysitis (Linnaeus). Pr1, Pi1.

D. stenochrysis (Warren). Pr1, Pi1.

Autographa pulchrina (Haworth). Pi1, Pr1.

A. gamma (Linnaeus). So5.

A. macrogamma (Eversmann). Pi1, Pr1.

A. bractea (Denis & Schiffermüller). Pi1, Pi22.

Syngrapha interrogationis (Linnaeus). Kh19–21, Pi1, Pi19, Pi22, Pr1.

Plusia putnami (Grote). Pi1.

Deltote pygarga (Hufnagel). Ka20, Ka27–28.

D. bankiana (Fabricius). Ka20, Ka22, Ka28–29.

Allophyes oxycanthae (Linnaeus). So6.

°*Brachionychna nubeculosa* (Esper). Pr1 (Spitsyn 2017).

Elaphria venustula (Hübner). Ka14.

Caradrina morpheus (Hufnagel). Pi1, Pr1.

C. petraea Tengström. Pi1.

Hydraecia micacea (Esper). So6.

Amphipoea fucosa (Freyer). Pi1.

Phragmatiphila nexa (Hübner). So6.

Apamea crenata (Hufnagel). Pi1.

A. lateritia (Hufnagel). Pi1.

**A. rubirena* (Treitschke). Pi1: 1 ex. 28–31 July 2017, at light.

Resapamea hedeni (Graeser). Pr1.

Mesoligia furuncula (Denis & Schiffermüller). Pi1, Pr1.

Oligia strigilis (Linnaeus). Pi1.

Xanthia togata (Esper). So6.

**Dasytoplia templi* (Thunberg). So6: 4 exx. 25–26 August 2018, at light.

**Mniotype satura* (Denis & Schiffermüller). So6: 1 ex. 25–26 August 2018, at light.

Cerapteryx graminis (Linnaeus). Pi1.

Lacanobia suasa (Denis & Schiffermüller). Pi1.

Ceramica pisi (Linnaeus). So6.

Mythimna impura (Hübner). Pi22, Pr1.

!*Euxoa recussa* (Hübner). Pi1: 2 exx. 2–3 August 2017, at light. This species is now endangered in Finland due to the loss of open dry habitats.

!*Agrotis clavis* (Hufnagel). Pi1: 1 ex. 2–3 August 2017, at light.

Diarsia rubi (Vieweg). Pi1.

Cryptocala chardinyi (Boisduval). Pi1.

Eurois occulta (Linnaeus). Pi1.

Anaplectoides prasina (Denis & Schiffermüller). Pi1.

!*Xestia alpicola* (Zetterstedt). Pi13: 1 ex. 3 August 2017.

X. baja (Denis & Schiffermüller). Pi1, Pi15, Pr1.

Protolampra sobrina (Duponchel). Pi1.

**Naenia typica* (Linnaeus). Pr1: 1 ex. 28–31 July 2017, at light.

Nolidae

**Earias clorana* (Linnaeus). Kh20: larvae fed inside a shelter created from 5–6 uppermost leaves of *Epilobium angustifolium* and pupated in 3–5 days after collection; 2 exx. emerged on 20 March 2018. This finding is surprising, because the larva of this species usually feeds on willows (<http://www.nhm.ac.uk/hosts>).

Excluded species

Recurvaria nanella (Denis & Schiffermüller). Kh9. This finding was reported by Kozlov *et al.* (2013) based on a leaf mine collected from birch. Re-examination of the mined leaf showed that the identity of a leafminer is uncertain (E. J. van Nieukerken pers. comm.). We therefore did not include this record in the current list.

Discussion

Collection of moths and butterflies in the city of

Arkhangelsk, Solovetsky Islands, Pinezhsky and Kargopolsky districts of the Arkhangelsk Oblast between 2017 and 2019, analysis of published data and identification of occasional samples resulted in the addition of 49 species to our regional list. After the removal of duplicated records of two species, *Ectoedemia minimella* and *Phiaris bipunctana*, each of which was counted twice in our earlier publications (Kozlov et al. 2014, 2017), the fauna of the Arkhangelsk Oblast now includes 1188 species of moths and butterflies (639 species of microlepidoptera and 549 species of macrolepidoptera). Among these, records of 77 species, included in the list based on earlier publications only, still require confirmation.

Although during our two previous visits we had intensively collected moths and butterflies in the Kargopol District, about half of the species that are new for the Arkhangelsk Oblast originated from the surroundings of Kargopol. This result suggests that further collection will be most productive along the southern border of the Oblast. Our expectations to find some eastern species in the surroundings of Karpogory, inspired by the famous work of Seebom (1880), were not met, as the fauna of the sampled localities was typical for the boreal forest zone of Fennoscandia.

From the European perspective, the most interesting distributional records were those of the recently described species, *Ectoedemia rosea* and *Coleophora proterella*, and of the eastern species, *Arctia flavia* and *Clostera albosigma*. *Arctia flavia*, discovered in the eastern part of the Arkhangelsk Oblast by Spitsyn et al. (2017), is mainly Euro-Siberian, but it also occurs in the mountain regions of central Europe. The records of *Sciota lucipetella*, *Polythrena coloraria* and *Eupithecia groenblomi* in the Arkhangelsk Oblast filled in the gaps in the distribution of these rarely observed Euro-Siberian taiga species, suggesting that their occurrence in Russia may be much wider than currently thought.

Moth species associated with cultivated park and garden plants, including *Pseudargyrotoza conwagana*, *Gypsonoma oppressana* and *Notocelia trimaculana*, were hardly expected in the Arkhangelsk Oblast. Particularly surprising was the record of *N. trimaculana*, which is found

in Finland only on the Åland Islands (Kullberg et al. 2002). *Bryotropha affinis* occurs in Finland on sandy heaths in coastal areas, whereas the only specimen from the Arkhangelsk Oblast was found on a sandy dry meadow, several hundred meters from the shore of a medium-sized lake. The record of *Mesophleps silacella* in the surroundings of Kargopol may indicate the existence of an overlooked habitat of its endangered host plant, *Helianthemum rupifragum*, known so far in the Arkhangelsk Oblast only from the Pinezhsky District (Novoselov 2008). However, *M. silacella* migrates occasionally to the southern coastal regions of Finland from southwestern Europe; therefore, its record in the Arkhangelsk Oblast could also be a result of migration.

As many as 62 species in our list are classified as threatened in Finland (Hyvärinen et al. 2019). Among these, 5 species are critically endangered (*Capricornia boisduvaliana*, *Pammene aurana*, *Ethmia pyrausta*, *Cupido minimus* and *Pyrrhia exprimens*), 21 endangered and 36 vulnerable. Most of these species are associated with open habitats created and maintained by humans, with semi-natural dry and mesic meadows, and with different kinds of coastal habitats. In Finland, these species suffer primarily from overgrowing of meadows and other open habitats (Hyvärinen et al. 2019), and based on our observations, this environmental threat is also present in the Arkhangelsk Oblast due to declines in animal husbandry and agricultural activities. Several of these species are likely candidates for the Red List of the Arkhangelsk Oblast, which now includes only one Lepidoptera, *Parnassius mnemosyne* (Novoselov 2008).

Our faunistic research in the Arkhangelsk Oblast, which started in 2009, has combined short-term (usually between 30 and 90 minutes) intensive netting by two to three persons at multiple localities, light trapping at a few sites, and a dedicated search for larvae of particular species, such as Psychidae and leafminers, which are difficult to collect by netting. Our list of moths and butterflies of the Arkhangelsk Oblast is now based on 6431 georeferenced species' records from 219 localities, which represent all types of habitats occurring in the study region. However, the comparison with the Finnish fauna, which now includes 2587 species of moths and but-

terflies (Aarvik *et al.* 2017), has clearly demonstrated that our list is far from complete. Based on the analysis of host plants and of the distribution ranges of Lepidoptera in Finland and in the neighbouring areas, we estimate that some 400 to 600 species are very likely to be found in the Arkhangelsk Oblast, and thus the regional fauna of Lepidoptera may total 1600 to 1800 species.

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