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 example, 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-
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’shoy 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.

<table>
<thead>
<tr>
<th>Code</th>
<th>Locality</th>
<th>Co-ordinates*</th>
<th>Number of species**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>latitude N</td>
<td>longitude E</td>
</tr>
<tr>
<td>Ka1</td>
<td>Kargopol</td>
<td>61°30’21”</td>
<td>38°56’56”</td>
</tr>
<tr>
<td>Ka6</td>
<td>3 km S of Kargopol</td>
<td>61°29’04”</td>
<td>38°57’23”</td>
</tr>
<tr>
<td>Ka7</td>
<td>Ileksinskaya</td>
<td>61°41’51”</td>
<td>38°04’00”</td>
</tr>
<tr>
<td>Ka11</td>
<td>1 km E of Khotenovo</td>
<td>61°12’06”</td>
<td>38°35’13”</td>
</tr>
<tr>
<td>Ka12</td>
<td>Kononovo</td>
<td>61°07’01”</td>
<td>38°45’08”</td>
</tr>
<tr>
<td>Ka14</td>
<td>1 km NW of Dubrovo</td>
<td>60°58’26”</td>
<td>38°32’46”</td>
</tr>
<tr>
<td>Ka20</td>
<td>6 km S of Kargopol</td>
<td>61°26’46”</td>
<td>38°57’25”</td>
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<td>Ka22</td>
<td>1 km N of Lapinskaya</td>
<td>61°22’26”</td>
<td>38°55’46”</td>
</tr>
<tr>
<td>Ka23</td>
<td>5 km SW of Lapinskaya</td>
<td>61°20’13”</td>
<td>38°51’29”</td>
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<tr>
<td>Ka27</td>
<td>11 km NW of Gavrilovskaya</td>
<td>61°37’43”</td>
<td>38°10’24”</td>
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<td>Ka28</td>
<td>3 km W of Gavrilovskaya</td>
<td>61°33’47”</td>
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<tr>
<td>Ka29</td>
<td>10 km W of Kargopol</td>
<td>61°31’08”</td>
<td>38°45’00”</td>
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<tr>
<td>Kh9</td>
<td>5 km NE of Emetsk</td>
<td>63°31’00”</td>
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<td>Kh10</td>
<td>3 km N of Oseredok</td>
<td>63°30’16”</td>
<td>41°33’18”</td>
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<td>Kh19</td>
<td>3 km SE of Palenga</td>
<td>64°09’48”</td>
<td>42°18’46”</td>
</tr>
<tr>
<td>Kh20</td>
<td>12 km SE of Palenga</td>
<td>64°05’19”</td>
<td>42°25’18”</td>
</tr>
<tr>
<td>Kh21</td>
<td>4 km W of Glubokoe</td>
<td>64°03’17”</td>
<td>42°38’59”</td>
</tr>
<tr>
<td>Kt3</td>
<td>6 km SW of Koryazhma</td>
<td>61°16’35”</td>
<td>47°04’04”</td>
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<tr>
<td>Kt4</td>
<td>3 km E of Solvychegodsk</td>
<td>61°19’43”</td>
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<tr>
<td>Me2</td>
<td>34 km SE of Mezen</td>
<td>65°34’24”</td>
<td>44°37’36”</td>
</tr>
<tr>
<td>On1</td>
<td>Onega</td>
<td>63°55’</td>
<td>38°06’</td>
</tr>
<tr>
<td>On6</td>
<td>2 km NE of Pavlovsky Bor</td>
<td>63°36’26”</td>
<td>39°05’19”</td>
</tr>
<tr>
<td>On9</td>
<td>Vyzhiga River</td>
<td>62°46’03”</td>
<td>37°08’21”</td>
</tr>
<tr>
<td>Pi1</td>
<td>Karpogory</td>
<td>64°00’26”</td>
<td>44°26’01”</td>
</tr>
<tr>
<td>Pi11</td>
<td>18 km SE of Siya</td>
<td>63°52’25”</td>
<td>43°20’14”</td>
</tr>
<tr>
<td>Pi12</td>
<td>1 km E of Zemtsovo</td>
<td>63°54’22”</td>
<td>44°03’46”</td>
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<tr>
<td>Pi13</td>
<td>Shasta</td>
<td>64°16’28”</td>
<td>44°17’02”</td>
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<td>Pi14</td>
<td>Kochmogora</td>
<td>64°15’23”</td>
<td>44°16’24”</td>
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<tr>
<td>Pi15</td>
<td>1 km N of Cheshegora</td>
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<td>Pi16</td>
<td>4 km N of Kurcha</td>
<td>64°08’55”</td>
<td>44°13’56”</td>
</tr>
<tr>
<td>Pi17</td>
<td>Kurcha</td>
<td>64°06’43”</td>
<td>44°14’31”</td>
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<tr>
<td>Pi18</td>
<td>Yasnyy</td>
<td>64°01’42”</td>
<td>44°06’53”</td>
</tr>
<tr>
<td>Pi19</td>
<td>1 km W of Maryina</td>
<td>64°01’29”</td>
<td>44°11’51”</td>
</tr>
<tr>
<td>Pi20</td>
<td>7 km NE of Losevo</td>
<td>63°49’54”</td>
<td>45°02’47”</td>
</tr>
<tr>
<td>Pi21</td>
<td>2 km E of Kushkopol</td>
<td>63°50’37”</td>
<td>44°46’35”</td>
</tr>
<tr>
<td>Pi22</td>
<td>4 km E of Shardonem</td>
<td>63°54’17”</td>
<td>44°40’53”</td>
</tr>
<tr>
<td>Pi23</td>
<td>1 km S of Tserkova</td>
<td>63°55’50”</td>
<td>44°36’01”</td>
</tr>
<tr>
<td>Pi24</td>
<td>37 km NE of Shuya</td>
<td>63°42’48”</td>
<td>46°18’49”</td>
</tr>
<tr>
<td>Pi17</td>
<td>4 km SE of Plesetsk</td>
<td>62°41’49”</td>
<td>40°13’42”</td>
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<tr>
<td>Pi16</td>
<td>Ust-Pocha</td>
<td>62°09’14”</td>
<td>38°09’23”</td>
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<tr>
<td>Pr1</td>
<td>Arkhangelsk</td>
<td>64°33’</td>
<td>40°33’</td>
</tr>
<tr>
<td>Pr5</td>
<td>Talagi</td>
<td>64°38’</td>
<td>40°38’</td>
</tr>
<tr>
<td>Pr12</td>
<td>Severodvinsk</td>
<td>64°35’33’</td>
<td>39°50’58”</td>
</tr>
<tr>
<td>So4</td>
<td>Bolshaya Muksalma Island</td>
<td>65°01’</td>
<td>35°54’</td>
</tr>
<tr>
<td>So5</td>
<td>Botanical Garden</td>
<td>65°03’09’</td>
<td>35°39’50”</td>
</tr>
<tr>
<td>So6</td>
<td>Near Solovetsky settlement</td>
<td>65°01’</td>
<td>35°45’</td>
</tr>
<tr>
<td>Vi7</td>
<td>Mamonikha</td>
<td>63°25’12’</td>
<td>46°07’06”</td>
</tr>
</tbody>
</table>

* 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

M. aruncella (Scopoli). Ka7, Ka11, Ka14, Ka22, Ka28–29.
M. calthella (Linnaeus). Ka14, Ka20, Ka22, Ka28.
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. conjugella (Zeller). Ka1, Pi17.

Plutellidae


Glyphipterigidae

G. thrasonella (Scopoli). Kh20, Pi11.

Ypsolophidae

Ypsoloph a parenthesella (Linnaeus). So5.

Choreutidae

P. ultimana (Krušlikovsky). Ka23, Ka28, So6.
Choreutis diana (Hübner). So6.

Tortricidae

Philedone gerningana (Denis & Schiffermüller). Pi16, Pi21.
Adoxophyes orana (Fischer von Röslerstamm). Ka11.
P. heparana (Denis & Schiffermüller). Pi1.
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.
Acleris laterana (Fabricius). So5–6.
Phtheochroa inopiana (Haworth). Pr1.
Aethes margaritana (Haworth). Ka20.
C. dubitana (Hübner). Ka7, Ka28.
Apopotis infida (Heinrich). Ka11.
Orthotaenia undulana (Denis & Schiffermüller). Ka23, Pi12.
Hedyta salicella (Linnaeus). Ka6.
Celypha rufana (Scopoli). Ka1, Kh21, Pi1, Pi12, Pi15–16, Pi20.
C. striana (Denis & Schiffermüller). Ka1, Ka11, Ka14, Ka20, Ka22.
C. rarestrana (Duponchel). Pi22–23.
C. cespitana (Hübner). Ka7, Ka28, Pi1, Pi19.
C. rivulana (Scopoli). Ka7, Ka11, Ka14, Ka20, Ka22, Ka29, Kh19, Kh21, Pi11–12, Pi15–17, Pi20–22.
Phiaris schulziana (Fabricius). Pi16, Pi21.
Ph. nicana (Denis & Schiffermüller). Pi16.
!*Ph. palustrana (Lienig & Zeller). Pi21.
Ph. bipunctana (Fabricius). Ka27.
Olethreutes arcuella (Clerck). Ka29.
Lobesia virulenta Bae & Komai. Ka14.
Bactra furfurana (Haworth). Pi1, Pi11, Pr1.
Ancylis myrtillana (Treitschke). Ka14.
A. buffana (Denis & Schiffermüller). Ka1, Ka7, Ka20, Ka22–23, Ka27–28.
Rhopobota naevana (Hübner). Pi14, Pi16, Pi21, So6.
Epinotia indecorana (Zetterstedt). 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. signata (Douglas). Pr1, Pi13.
E. cruciana (Linnaeus). Ka1, Ka20, Pi12, Pi16.
E. nanana (Treitschke). Ka1, Ka22, Ka27.
E. crenana (Hübner). So6.
E. cana (Haworth). Ka14, Ka20, Ka22, Ka27, Pi1, Pr1.
E. hohenwartiana (Denis & Schiffermüller). Ka1, Ka7, Ka11, Ka14, Ka20, Pi12, Pi15.
Epiblema sticticiana (Fabricius). Ka1, Ka22–23.
E. grandeaevana (Lienig & Zeller). Pr1, Pi1.

*Gypsonoma oppositana (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.


Dichrorampha plumana (Scopoli). Ka11, Ka14, Ka28.

D. consortana (Stephens). Ka11, Ka14.

Zygaenidae

Zygaena osterdensis Reiss. Ka7.
Z. viciae (Denis & Schiffermüller). Ka7, Ka14.

Oecophoridae

Denisia similella (Hübner). Pi1.

Depressariidae

A. angeliciella (Hübner). Pi1.
Depressaria sordidatella Tengström. Pi1, Pi19.
Hypercalla 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 cinctella (Clerck). Pi12.

*Mesorhops silacella (Hübner). Ka22: 1 ex. 30 June 2019. A bit surprising record of a species living on Helianthemum ssp. 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 limosella (Schläger). Pi1.

Acompsia cinnepella (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, Pi22.

Metzneria lappina (Linnaeus). Ka11, Ka14, Ka20, Pi1, Pr1.

*M. metzneriella (Stainton). Ka12, Ka27.

Argolamprotes micella (Denis & Schiffermüller). Pi1.

*A. tetrapunctella (Thunberg). Ka28.

Gelechia muscosella Zeller. Pr1.

*Scrobipalpula acuminatella (Sircom). Ka20: 2 ex. 30 June 2019.


Elachistidae

Elachista eleochariella (Stainton). Ka28.


E. albifrontella (Hübner). Ka28.


Coleophoridae


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. gryphipennella* (Hübner). Ka27.

*C. serratella* (Linnaeus). Ka1.


*C. mayrella* (Hübner). Ka14.

**Momphidae**


*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.


**Pterophoridae**

*Platptilia 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. ochroductyla* (Denis & Schiffermüller). Kh19, Pi19, Pr1.

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


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

*Geina didactyla* (Linnaeus). Ka7.


*Hellinsia osteodactyla* (Zeller). Ka20, Ka22, Ka27, Pi22.

*H. didactylites* (Strömgren). 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.


*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.


**Pyralidae**

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

*Onocera semirubella* (Scopoli). Kh21, Pi1, Pi12.

*Sciota festiva* (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.


*Pyla fusca* (Haworth). Pi1.

*Hypochalcia ahenella* (Denis & Schiffermüller). Ka7.

*Acrabasis advenella* (Zincken). Pi1, Pr1.


*Pyralis farinalis* (Linnaeus). Pr1.
Crambidae

Paratalanta hyalinalis (Hübner). Ka14, Ka29.
Pyrausta purpurella (Linnaeus). Pi20.
Nascia ciliata (Hübner). Ka6.
Sitochroa verticalis (Linnaeus). Ka29, Pi1.
Psammotis pulveralis (Hübner). Ka2.
Anania perlucidalis (Hübner). Ka20, Ka28, Pi1.
A. fuscalis (Denis & Schiffermüller). Ka1, Ka6–7, Ka20, Ka22, Ka27–29, Kh19, Pi1, Pi17, Pi19, Pr1.
A. hortulata (Treitschke). Pi1.
A. terrealis (Hübner). Ka1, Ka27–28.
Anania perlucidalis (Hübner). Pr1.

Epirrhoe tristata (Linnaeus). Ka7, Ka28.

Drepanidae

Ochropacha duplaris (Linnaeus). Ka11.

Geometridae

Idaea serpentina (Hufnagel). Ka1, Ka7, Ka14, Ka20, Ka22.
I. biselata (Hufnagel). Ka11, Pr1.
I. aversata (Linnaeus). Pr1.
I. straminella (Borkhausen). Ka1, Ka7, Ka14, Ka20, Ka22, Ka27–29, Pi15.
Scototerpex xenopodia (Linnaeus). Ka7, Ka14, Ka20, Ka22, Kh19–21, Pi11–13, Pi15–17, Pi19–20, Pi22.
Xanthorhoe quadripunctata (Clerck). Ka1, Ka11, Ka20, Pr1, Pi1, Pi15, Pi19.
X. montanata (Denis & Schiffermüller). Ka6, Ka20, Ka23, Ka27–28.
X. fluctuata (Linnaeus). Pi1.

Kozlov et al. • ANN. ZOOL. FENNICI Vol. 57
Notodontidae

Notodontia torva (Hübner). Pi1, Pr1.

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 (Jürivet 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.


Thumatha senex (Hübner). Ka11.

Cybosia mesomella (Linnaeus). Ka11, Ka28.

Atolmis rubricollis (Linnaeus). Ka11.

Eilema lurideola (Zincken). Pi1.


Arctia flavia (Fuessly). Vt7 (Spitsyn 2017).

Eilema lurideola (Zincken). Pi1.


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

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

Hypenodes humidalis Doubleday. Pi14, Pi21.


Lygephila pastinum (Treitschke). Pr1.

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

Noctuidae

Abrostola tripartita (Hufnagel). Pi1.

Diachrysis chrysis (Linnaeus). Pr1, Pr1.

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, Pi19, Pi22, Pi1.

Plusia putnami (Grote). Pi1.

Deltoe pygargia (Hufnagel). Ka20, Ka27–28.

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


Brachionycha nubeculosa (Esper). Pr1 (Spitsyn 2017).

Elaphria venustula (Hübner). Ka14.

Caradrina morpheus (Hufnagel). Pi1, Pr1.

C. petraea Tengström. Pi1.


Amphipoea fuscata (Freyer). Pi1.

Phragmatiphila nixa (Hübner). So6.

Apamea crenata (Hufnagel). Pi1.

A. lateritia (Hufnagel). Pi1.


Resapamea hedeni (Graeser). Pr1.

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

Oligia strigilis (Linnaeus). Pi1.

Xanthia togata (Esper). So6.


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.

Crypotarcha chalybii (Boisd. duval). Pi1.

Eurois oculta (Linnaeus). Pi1.

Anaplectoides prasina (Denis & Schiffermüller). Pi1.


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

Protolampra sobrina (Duponchel). Pi1.


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 Kargopory, 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 convagana, 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 mnesosyne (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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