Moths and butterflies (Lepidoptera) of the continental part of the Nenets Autonomous Okrug, Russia

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Until very recently, Nenets Autonomous Okrug (NAO), located in the north-eastern part of European Russia, was the least studied region of Russia in terms of its moth fauna. Intensive sampling in the surroundings of Naryan-Mar, combined with critical revision of earlier publications and evaluation of museum collections, resulted in the discovery of a relatively rich fauna of Lepidoptera. The first regional checklist of moths and butterflies of the continental part of NAO includes 324 species (169 species of microlepidoptera and 155 species of macrolepidoptera), 178 of which are reported from NAO for the first time. We estimate that 40 to 180 species remain to be found in the study region. The recorded species mostly belong to residents of northern boreal forests and bogs. The fauna of moths and butterflies of NAO clearly differs from the fauna of Fennoscandia, due to the relatively higher proportion of East Palaearctic and Beringian species.

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1. Introduction

Historically, insect collecting has been a widespread endeavour, and it became a very popular educational hobby in the Victorian age. However, the rapid development of molecular research techniques has made the entomologist, who hunts insects in the wild to learn their distribution and biology, not only comical but also old-fashioned. Unfortunately, this opinion is shared not only by the general public, but also by decision-makers, who steadily and permanently decrease the funding of natural history museums.

At the same time, the importance of biodiversity for ecosystem functions and, consequently, for mankind, is not questioned. However, there is a risk that a large part of the Earth's biodiversity will become extinct before it is described (Hanski *et al.* 1995). Similarly, the distribution of organisms is currently undergoing modifications at an increasing rate due to both globalisation and environmental change, and especially climate warming (Parmesan *et al.* 1999, Hill *et al.* 2002, Early *et al.* 2016). Consequently, we are in danger of facing irreversible losses of as yet undocumented distribution patterns of organisms — patterns, which were formed during the millennia before humans started to dominate the Earth. This especially concerns the Polar regions, where climatic change appears disproportionately rapid (Walther *et al.* 2002, Doney *et al.* 2012, Zvereva *et al.* 2016).

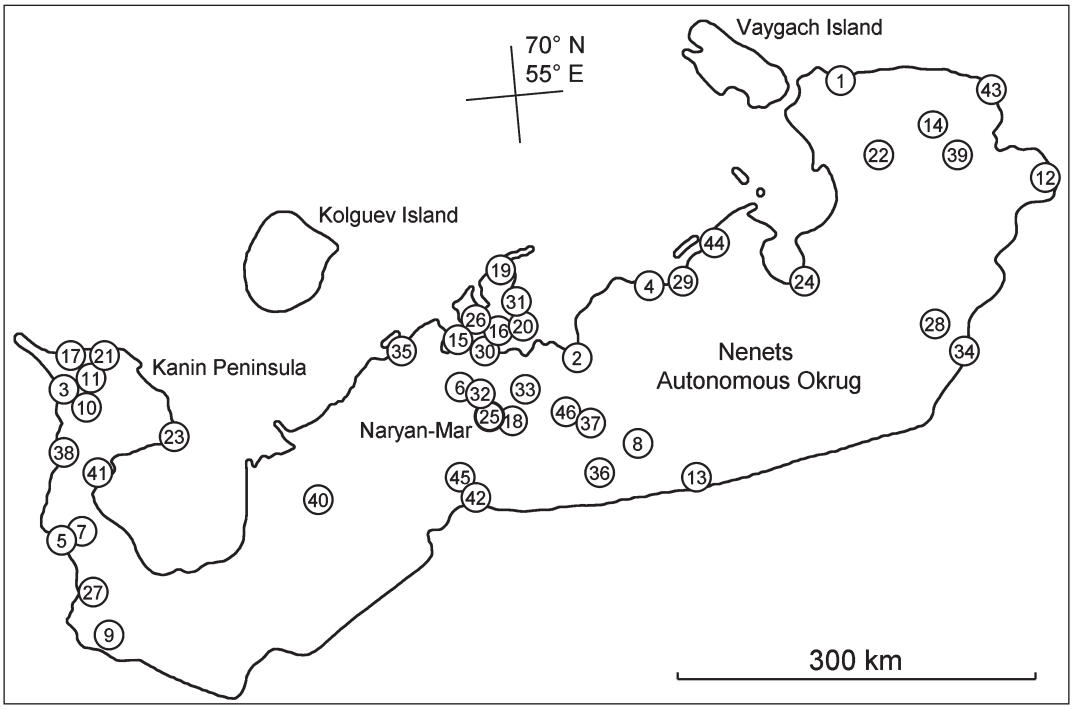

Fig. 1. Sampling localities in the continental part of the Nenets Autonomous Okrug: 1, Amderma; 2, Bolvanskaya Guba; 3, Bugryanitsa; 4, Chernaya; 5, Chizha; 6, Golodnaya Guba; 7, Gorby; 8, Jangech-Mylk; 9, Kabanova; 10, Kambalnitsa; 11, Kaninskij Kamen'; 12, Kara; 13, Kharyaginskij; 14, Khubtape; 15, Kolokolkova; 16, Korovinskaya; 17, Krynka; 18, Kuja; 19, Kuznetskaya; 20, Lovetskij; 21, Madakha; 22, Malaya Padeya; 23, Mikulkin; 24, More-Yu; 25, Naryan-Mar; 26, Nenetskaya Gryada; 27, Nes'; 28, Padimey; 29, Pakhancheskaya Guba; 30, Pechora site 2; 31, Pechora site 3; 32, Pechora site 4; 33, Pechora site 7; 34, Seida; 35, Sengeiskij; 36, Shapkina, middle flow; 37, Shapkina, upper flow; 38, Shoina; 39, Sibirchatayaha; 40, Svetlaya; 41, Syatorei; 42, Toshviska; 43, Ust-Kara; 44, Varandey; 45, Velikovisochnoye; 46, Vesniyu. For the position of the Nenets Autonmous Okrug in Russia, see Fig. 3b.

Arctic habitats have always fascinated entomologists, although only few of these researchers were ready to spend several months in hostile and mosquito-infested tundra environments to collect a few dozen moths and butterflies (Kullberg *et al.* 2013). Therefore, the faunistic data on Lepidoptera from the Arctic are generally scarce. Nevertheless, a surprising observation is that the least studied (in terms of moth and butterfly fauna) region of Russia lies in Europe, rather than in remote parts of Siberia: only 108 species have been reported in the Catalogue of Russian Lepidoptera from the Nenets Autonomous Okrug (NAO hereafter) and the Novaya Zemlya archipelago (Sinev 2008), a region of 267,350 km^2.

Of course, the diversity of Lepidoptera is extremely low in Polar regions: the fauna of the relatively well-known Svalbard Archipelago includes only three breeding moth species (Coulson 2007), and only four species of Lepidoptera were found on Bolshevik Island in the Severnaya Zemlya Archipelago (Makarova *et al.* 2013). However, the continental part of NAO lies at about the same latitudes as the Kola Peninsula, which houses at least 813 species of Lepidoptera (Kozlov & Kullberg 2010). We therefore hypothesised that the low number of species recorded from NAO reflects an insufficient collecting effort rather than a faunistic poverty in this region. We tested this hypothesis by conducting insect collection in the surroundings of Naryan-Mar. We also revised the historical records (in particular, those by Poppius 1906) and accounted for faunistic information on Lepidoptera published during the past decades. Most of this published material has been written in Russian, which has

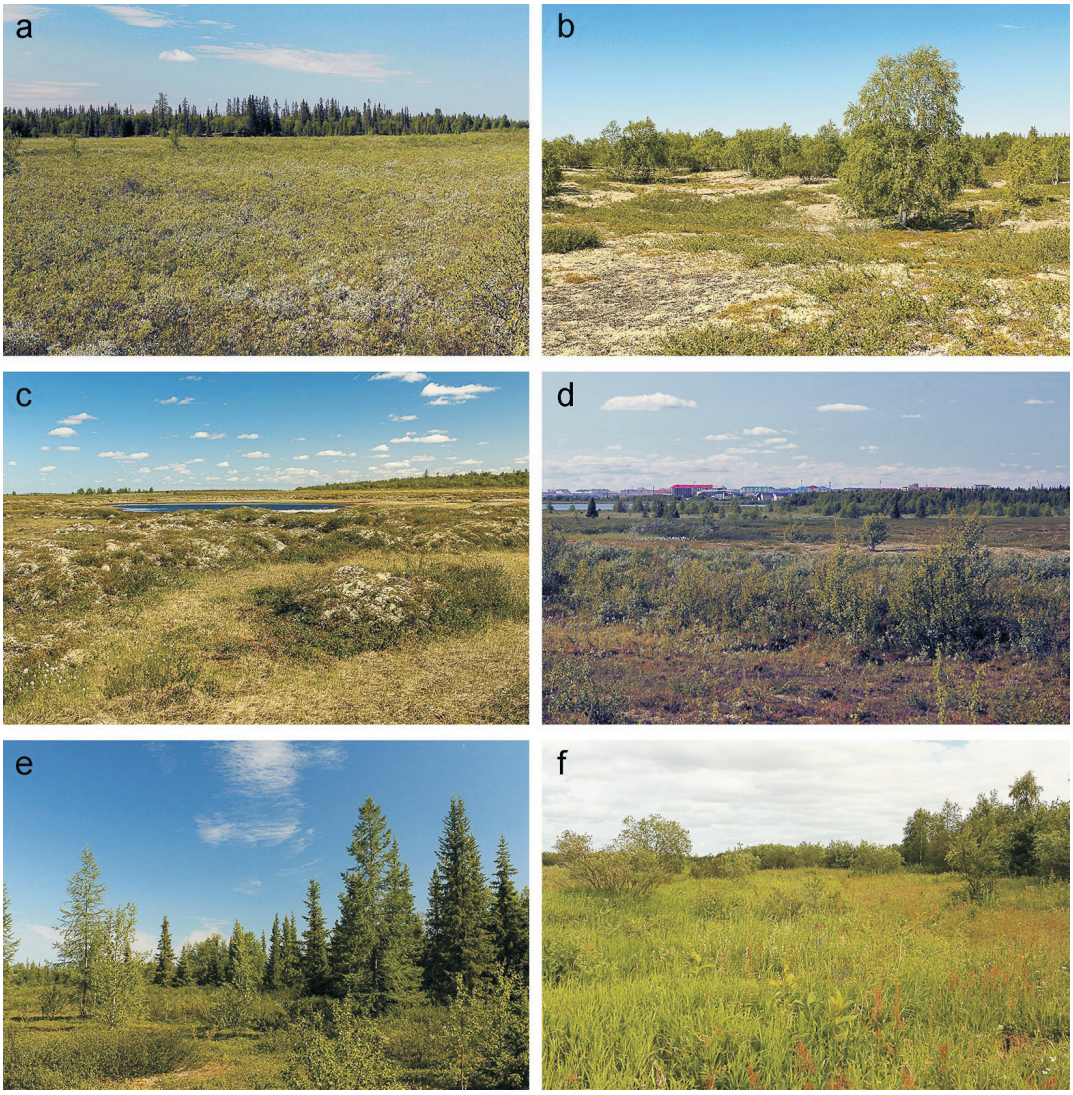

Fig. 2. Habitats in surroundings of Naryan-Mar. – a. Erect dwarf-shrub wet tundra in front of spruce forest. – b. Low-shrub dry tundra at the border of birch woodland. – c. Low-shrub tundra and sedge wetland. – d. Mixture of habitat patches at the outskirts of Naryan-Mar. – e. Mixed forest formed by Norway spruce, larch and birch. – f. Meadow along a riverbank.

restricted its availability to the international scientific community. This published information (Ross 2000, Tatarinov & Kulakova 2005, 2010, 2013, Bolotov 2012, Vlasova *et al.* 2014, Tatarinov 2016) concerns butterflies and larger moths primarily, whereas records of so-called "microlepidoptera" has remained scarce (but see Kullberg *et al.* 2013).

In this paper, we summarise the recent knowledge of the moths and butterflies of the continental part of NAO. A complementary study of Lepidoptera of the Russian Arctic islands located in the Barents Sea will soon be published (Kullberg *et al.* 2019). We report our main results in a form of a checklist that includes all species recorded from NAO and all localities from which each species has been collected. We believe that, despite its incompleteness, this list may prove useful for ecological and biographical research and will facilitate further studies of Lepidoptera in Polar regions by elucidating taxonomic and geographic gaps in the present knowledge.

2. Materials and methods

2.1. Study region

The continental part of NAO (Fig. 1) covers approximately 170,000 km^2 (slightly more than the Baltic States: Lithuania, Latvia and Estonia together), but has a human population of only 42,000. One half of its inhabitants live in the town of Naryan-Mar, the only settlement in NAO which has scheduled flight connections with Moscow and St. Petersburg. NAO is located in three vegetation zones: tundra (77% of the territory), forest-tundra (15%) and northern taiga forests (8%). The average air temperatures in NAO range from –17 to –19 °C in December and from 7 to 10 °C in July. The larger part of NAO belongs to the border security zone, so visiting these restricted areas requires a special permit.

2.2. Collecting

Our study is primarily based on the material collected around Naryan-Mar on 2–12 July 2013 by M.V.K. and V.Z. and on 3 July–1 August 2015 by A. Stekolstchikov. Occasional sampling was also performed in Toshviska, Velikovisochnoe and Lovetskij by T. Dyaditsyna (in 2014–2016) and in Bolvanskaja Guba and Pakhancheskaya Guba by O. Makarova (18–28 July 2015). In combination with the published data, this yielded a total of 46 collecting localities (Fig. 1, Table 1).

In the surroundings of Naryan-Mar (67°38' N, 53°00' E), which is located on the bank of the Pechora River, we collected moths and butterflies in the following habitats: (1) erect dwarf-shrub tundra with a dense cover of *Betula nana* (up to 80 cm tall) and several species of willows, including *Salix lanata* (Fig. 2a); (2) low-shrub tundra with a sparse cover of *B. nana* (20–30 cm tall), dwarf shrubs (*Vaccinium uliginosum*, *V. vitis-idaea*, *Arctous alpina*) and lichens (*Cladonia* spp.) (Fig. 2b); (3) sedge wetlands, which included swampy areas covered by *Sphagnum* mosses, sedges (*Eriophorum angustifolium*, *E. vaginatum*, *Carex paupercula*) and *Comarum palustre*, with small spots of open water, and drier areas covered by *Andromeda polifolia*, *Rubus chamaemorus* and *B. nana* (Fig. 2c, d); (4) downy birch (*B. pubescens*) woodland on sandy soils, sometimes with larch (*Larix sibirica*), with spots of lichens scattered among sparse field layer vegetation consisting of *Empetrum hermaphroditum*, *Arenaria* sp., *Tanacetum bipinnatum*, *Allium schoenoprasum* var. *sibiricum* and *Campanula* sp. (Fig. 2b); (5) forest islands formed by Norway spruce (*Picea abies*), larch and downy birch, with a dense understory consisting of *Juniperus sibirica*, *Lonicera pallasii*, *Rosa* sp., *Ribes rubrum* and diverse herbaceous vegetation, including *Chamenerion angustifolium*, *Veratrum lobelianum*, *Solidago virgaurea*, *Geranium sylvaticum*, *Trollius europaea*, *Rubus arcticus*, *Thalictrum minus*, *Aquilegia* sp., *Trifolium pratense*, *Tanacetum bipinnatum*, *Allium schoenoprasum* var. *sibiricum*, *Clematis sibirica*, *V. uliginosum*, *V. vitis-idaea*, *Polygonum viviparum*, *Galium boreale*, *Equisetum arvense*, *Valeriana* sp. and *Linnaea borealis* (Fig. 2a, e); and (6) relatively narrow, 10–50 m wide, meadows that extended along riverbanks and were covered primarily by *C. angustifolium*, *V. lobelianum*, *T. vulgaris*, *P. viviparum*, *Achillea millefolium*, *Filipendula ulmaria*, *Veronica* sp., *Alchemilla* sp. and *Galium boreale* (Fig. 2f).

The insects were collected by netting; the total collecting time by M.V.K. and V.Z. was ca. 140 person-hours and by A. Stekolstchikov ca. 80 person-hours. We attempted light trapping in Naryan-Mar, but did not capture even a single moth during a three–night session. We also recorded easily identifiable species based on visual observations, collected leaf mines and reared moths from field-collected larvae. The pinned specimens are mostly deposited in the Zoological Museum, University of Helsinki, Finland (MZH); about one half of the samples collected in 2013 was donated to the Natural History Museum (London). The plant leaves with insect mines are deposited in the Naturalis Biodiversity Center, Leiden, the Netherlands (RMNH).

2.3. Revision of earlier records

The specimens collected by Poppius (1906) in NAO are deposited in the MZH; among them, we examined all specimens, which, in our opinion, may have been misidentified. We checked the collections of the Zoological Institute in St. Pe-

Table 1. List of sampling localities in the continental part of the Nenets Autonmous Okrug[1].

Locality name and type	Latitude, N	Longitude, E	No of species[2]	Data sources
Amderma (village)	69°45'	61°40'	0/35	Kullberg *et al.* (2013), Vlasova *et al.* (2014), Tatarinov (2016)
Bolvanskaya Guba (bay)	68°05'	54°47'	1/0	O. Makarova leg. (2015)
Bugryanitsa (river)	68°14'	44°14'	0/4	Poppius (1906)
Chernaya (river)	68°35'	56°35'	0/16	Tatarinov (2016)
Chizha (river)	67°05'	44°22'	0/1	Poppius (1906)
Golodnaya Guba (bay)	67°56'	52°46'	0/58	Tatarinov & Kulakova (2013), Tatarinov (2016)
Gorby (village)	67°07'	44°30'	0/1	Poppius (1906)
Jangech-Mylk (village)	67°22'	55°52'	0/27	Tatarinov & Dolgin (1999), Tatarinov & Kulakova (2005), Tatarinov (2016)
Kabanova (lake)	66°18'	45°22'	0/2	Tatarinov (2016)
Kambalnitsa (river)	68°02'	44°26'	1/6	Poppius (1906), ZISP collection
Kanin (peninsula)	–	–	2/2	Hacker *et al.* (2002), MZH collection
Kaninskij Kamen' (mountains)	68°14'	44°51'	0/11	Tatarinov (2016)
Kara (river)	68°37'	65°13'	0/28	Tatarinov (2006a,b), Morgun (2017)
Kharyaginskij (village)	67°09'	56°43'	0/30	Tatarinov & Dolgin (1999), Tatarinov & Kulakova (2005), Tatarinov (2016)
Khubtape (mount)	69°12'	62°47'	0/1	Tatarinov (2006b)
Kolokolkova Guba (bay)	68°18'	52°32'	0/3	Tatarinov (2016)
Korovinskaya Guba (bay)	68°23'	53°27'	0/11	Tatarinov (2016)
Krynka (river)	68°32'	44°15'	0/12	Poppius (1906)
Kuja (river)	67°38'	53°17'	85/0	M.V.K. & V.Z. leg. (2013)
Kuznetskaya Guba (bay)	68°51'	53°34'	0/4	Tatarinov (2016)
Lovetskij (island)	68°20'	53°55'	2/0	T. Dyaditsyna leg. (2016)
Madakha (beacon)	68°33'	44°45'	0/6	Poppius (1906)
Malaya Padeya (mountains)	69°04'	62°09'	0/16	Tatarinov & Gorbunov (2014), Bolotov *et al.* (2015), Tatarinov (2016)
Mikulkin (cape)	67°49'	46°38'	0/8	Poppius (1906)
More-Yu (river)	68°19'	59°41'	0/3	Tatarinov (2016)
Naryan-Mar (town)	67°38'	53°00'	215/18	M.V.K., V.Z. & A. Stekolstchikov leg. (2013, 2015), Tatarinov *et al.* (2003), Tatarinov & Kulakova (2005), Tatarinov (2016)
Nenetskaya Gryada (mountains)	68°22'	53°06'	0/36	Tatarinov (2016)
Nes' (village)	66°35'	44°41'	0/33	Bolotov (2012), Tatarinov (2016)
Padimey (lakes)	67°35'	62°10'	0/27	Tatarinov & Kulakova (2010), Tatarinov (2016)
Pakhancheskaya Guba (bay)	68°29'	57°13'	3/0	O. Makarova leg. (2015)
Pechora site 2 (landmark)	68°20'	53°05'	0/1	Ross (2000)
Pechora site 3 (landmark)	68°29'	53°54'	0/2	Ross (2000)
Pechora site 4 (landmark)	67°42'	53°07'	0/1	Ross (2000)
Pechora site 7 (landmark)	67°48'	54°01'	0/1	Ross (2000)
Seida (river)	67°24'	62°51'	0/54	Tatarinov (2016)
Sengeiskij (strait)	68°21'	51°22'	0/2	Tatarinov (2016)
Shapkina (river), middle flow	67°14'	54°39'	0/40	Tatarinov & Kulakova (2005), Tatarinov (2006c, 2016)
Shapkina (river), upper flow	67°32'	54°56'	3/37	Tatarinov & Kulakova (2005), Tatarinov (2016)
Shoina (river)	67°51'	44°10'	0/11	Bolotov (2012), Tatarinov (2016)
Sibirchatayaha (river)	68°44'	63°44'	0/28	Tatarinov (2016)
Svetlaya (river)	67°18'	49°26'	0/5	Tatarinov (2016)
Syatorei (lake)	67°28'	44°40'	0/11	Tatarinov (2016)
Toshviska (village)	67°07'	52°18'	49/0	T. Dyaditsyna leg. (2016)
Ust-Kara (village)	69°15'	64°55'	0/2	Tatarinov (2016)
Varandey (village)	68°49'	58°04'	0/5	Tatarinov (2016)
Velikovisochnoye (village)	67°15'	52°02'	4/3	T. Dyaditsyna leg. (2014–2016), Tatarinov (2016)
Vesniyu (river)	67°39'	54°43'	0/24	Tatarinov (2016)

1) Coordinates of some localities may have low accuracy (up to 50 km) due to insufficient details provided in the original publications. This especially concerns localities associated with rivers and mountain ridges.
2) Before the slash: based on data that have not been published earlier; after the slash: based on published records.

tersburg (ZISP) for specimens of all 108 species reported (Sinev 2008) from the biogeographical region that includes NAO. We also sought specimens from NAO in the so-called "Arctic collection" created by N. Y. Kusnezov in the 1930s and in accession materials deposited in ZISP. Finally, we carefully searched for published data on Lepidoptera from NAO and examined all published records for the reliability of identifications. We contacted the authors of the Catalogue of Lepidoptera of Russia (Sinev 2008) for clarification of those records for which we were unable to locate any supporting information. Note that, for the sake of brevity, we always refer to the entire catalogue, although the primary responsibility for the correctness of the information is held by the authors of each specific part of the catalogue.

2.4. Nomenclature, data format and data analysis

The nomenclature and the order of species generally follow the recent Nordic-Baltic checklist of Lepidoptera (Aarvik *et al.* 2017). An asterisk (*) indicates species that are recorded for the first time from NAO. An exclamation mark (!) indicates species that have been reported from this region by Sinev (2008) either erroneously or without a proper factual support, but have been discovered in NAO since then. Each record based on published data is referenced; an exception is butterflies for which the references are given only to excessively long lists of localities, as these are not included in the present manuscript. The abundance data are not included either, because this list is compilative and aims only at revealing species composition in the study region. Noteworthy species are provided with brief comments on their distribution and status. The similarities between the faunas of different regions were quantified by the Sørensen index (i.e. by the doubled number of common species divided by the sum of species numbers in two compared faunas, Sørensen 1948).

3. Results

3.1. List of Lepidoptera species

Eriocraniidae

* *Eriocrania* sp. Naryan-Mar. Larvae mining leaves of *B. pubescens* and *Alnus alnobetula* ssp. *fruticosa*. Barcoding (BOLD sequence pages: LRMNH067-17 and LRMNH068-17) surprisingly demonstrated that they belong to an undescribed species, which is close to *E. sakhalinella* Kozlov, described from Sakhalin Island in Russia and later found in Japan.

Hepialidae

* *Hepialus humuli* (Linnaeus). Kuja. Likely the northernmost record of this species.

Nepticulidae

* *Stigmella lapponica* (Wocke). Naryan-Mar.
* *S. salicis* (Stainton). Naryan-Mar.
* *S. sorbi* (Stainton). Naryan-Mar.
* *Ectoedemia minimella* (Zetterstedt). Naryan-Mar.

Prodoxidae

* *Lampronia capitella* (Clerck). Naryan-Mar.
* *L. standfussiella* Zeller. Toshviska. This species was considered rare for decades but appeared widely distributed in the northern regions, from Sweden to Labytnangi on the Asian side of the Ural Mts. (Kozlov *et al.* 2014).
* *L. rupella* (Denis & Schiffermüller). Upper flow of Shapkina River.

Greya variabilis Davis & Pellmyr. Amderma (Kullberg *et al.* 2013), Naryan-Mar. The record of this Beringian species in Naryan-Mar extends its distribution range 400 km to the west, indicating that *G. variabilis* can potentially be discovered in northern Fennoscandia. The moths were collected from several bogs around the city.

Incurvariidae

Incurvaria vetulella (Zetterstedt). Kambalnitsa (Poppius 1906), Madakha (Poppius 1906). The specimens have not been discovered in MZH, so their identity remains problematic: they may actually represent both *I. vetulella* (Zetterstedt) and *I. circulella* (Zetterstedt).
* *I. oehlmanniella* (Hübner). Naryan-Mar.

Adelidae

* *Nemophora ochsenheimerella* (Hübner). Naryan-Mar. This very unexpected finding of a species feeding on conifers narrows the distribution gap between Denmark (Aarvik *et al.* 2017) and Asia, where this species is known from Eastern Siberia to Japan (Kozlov 1997).

Tineidae

Tineola bisselliella (Hummel). Amderma (Kullberg *et al.* 2013).

Gracillariidae

* *Parornix loganella* (Stainton). Naryan-Mar.
* *P. polygrammella* (Wocke). Naryan-Mar.
* *Phyllonorycter ulmifoliella* (Hübner). Naryan-Mar.
* *P. sorbi* (Frey). Naryan-Mar.
* *P. hilarella* (Zetterstedt). Naryan-Mar.

Yponomeutidae

* *Paraswammerdamia lapponica* (W. Petersen). Naryan-Mar.
* *P. conspersella* (Tengström). Naryan-Mar.

Argyresthiidae

* *Argyresthia laevigatella* (Heydenreich). Naryan-Mar.
* *A. glabratella* (Zeller). Naryan-Mar.
* *A. svenssoni* Bengtsson & Johansson. Naryan-Mar. This recently described species has so far been known from Sweden, Norway, Finland, Italy, Slovakia and Switzerland (Lewis & Sohn 2015, Schmid 2016). The first record from Russia shows that *A. svenssoni* has a much wider distribution that could be originally expected, so it may well be found in Asia as well.
* *A. abdominalis* Zeller. Naryan-Mar.
* *A. pygmaeella* (Denis & Schiffermüller). Kuja, Naryan-Mar.
* *A. conjugella* Zeller. Naryan-Mar.

Plutellidae

Plutella xylostella (Linnaeus). Amderma (Kullberg *et al.* 2013), Bugryanitsa (Poppius 1906), Chizha (Poppius 1906), Gorby (Poppius 1906), Krynka (Poppius 1906), Kuja, Lovetskij, Naryan-Mar, Toshviska.
* *P. porrectella* (Linnaeus). Kuja, Naryan-Mar.

Glyphipterigidae

* *Glyphipterix forsterella* (Fabricius). Naryan-Mar.
* *G. simpliciella* (Stephens). Kuja, Naryan-Mar.

Ypsolophidae

* *Ypsolopha scabrella* (Linnaeus). Naryan-Mar.

Choreutidae

* *Anthophila fabriciana* (Linnaeus). Naryan-Mar.

Tortricidae

* *Sparganothis rubicundana* (Herrich-Schäffer). Kuja, Naryan-Mar.
* *Clepsis rogana* (Guenée). Kuja, Naryan-Mar.
* *C. moeschleriana* (Wocke). Naryan-Mar. The westernmost record of this Beringian species, which earlier was reported from Taymyr Peninsula (Kozlov *et al.* 2006) and Polar Ural (Aarvik 2013).
! *Aphelia viburnana* (Denis & Schiffermüller). Kuja, Naryan-Mar.
* *Lozotaenia forsterana* (Fabricius). Naryan-Mar.
* *Syndemis musculana* (Hübner). Naryan-Mar, Toshviska.
! *Eana osseana* (Scopoli). Bugryanitsa (Poppius 1906: as *Cnephasia longana*), Kuja, Naryan-Mar, Toshviska.
* *Acleris comariana* (Lienig & Zeller). Naryan-Mar, Toshviska.
! *A. effractana* (Hübner). Toshviska. Earlier this species was indicated from this region as *A. emargana* (Sinev 2008).
! *A. maccana* (Treitschke). Kanin Peninsula.
* *A. implexana* (Walker). Naryan-Mar.
* *Eulia ministrana* (Linnaeus). Kuja, Naryan-Mar.
* *Aethes smeathmanniana* (Fabricius). Kuja, Naryan-Mar.
* *Cochylidia subroseana* (Haworth.). Naryan-Mar.
* *C. implicitana* (Wocke). Naryan-Mar.
* *Pseudosciaphila branderiana* (Linnaeus). Kuja.
Apotomis betuletana (Haworth). Naryan-Mar.
A. frigidana (Packard). Amderma (Kullberg *et al.* 2013).
* *Orthotaenia undulana* (Denis & Schiffermüller). Naryan-Mar.

Celypha lacunana (Denis & Schiffermüller). Kuja, Naryan-Mar.
* *Phiaris umbrosana* (Freyer). Kuja, Naryan-Mar.
! *P. obsoletana* (Zetterstedt). Amderma (Kullberg *et al.* 2013), Kanin Peninsula, Kuja, Naryan-Mar, upper flow of Shapkina River, Toshviska.
P. metallicana (Hübner). Krynka (Poppius 1906), Mikulkin (Poppius 1906).
* *P. schulziana* (Fabricius). Kambalnitsa (Poppius 1906), Madakha (Poppius 1906).
! *P. turfosana* (Herrich-Schäffer). Amderma (Kullberg *et al.* 2013), Kuja, Naryan-Mar.
* *P. palustrana* (Lienig & Zeller). Naryan-Mar, Toshviska.
* *P. septentrionana* (Curtis). Kuja, Naryan-Mar.
* *P. bipunctana* (Fabricius). Kuja, Naryan-Mar.
P. inquietana (Walker). Amderma (Kullberg *et al.* 2013). A locally abundant Beringian species, which lives on *Pedicularis oederi* Wahl. (Kuznetsov 1978). The foodplant has a gap in distribution between Scandinavian mountain regions and northern Russia (Hultén 1986), which may explain the absence of this species in northern Fennoscandia.
* *Argyroploce lediana* (Linnaeus). Naryan-Mar.
A. noricana (Herrich-Schäffer). Amderma (Kullberg *et al.* 2013).
* *Bactra lancealana* (Hübner). Kuja, Naryan-Mar.
* *Ancylis unguicella* (Linnaeus). Kuja, Naryan-Mar, Toshviska.
* *A. subarcuana* (Douglas). Kuja, Naryan-Mar.
* *A. habeleri* Huemer & Tarmann. Kuja. This species, described from Austria, was since then found from France (Blanchemain 2015) to Iran (Alipanah 2015) and Finland (Aarvik *et al.* 2017). The first record from Russia substantially expands its distribution range to the North and East.
* *A. badiana* (Denis & Schiffermüller). Kuja, Naryan-Mar.
Eriopsela quadrana (Hübner). Kambalnitsa (Poppius 1906), Madakha (Poppius 1906).
* *Epinotia immundana* (Fischer von Röslerstamm). Kuja, Naryan-Mar.
* *E. tetraquetrana* (Haworth). Kuja, Naryan-Mar.
* *E. nemorivaga* (Tengström). Kuja, Naryan-Mar.
* *E. tedella* (Clerck). Naryan-Mar.
* *E. granitana* (Herrich-Schäffer). Naryan-Mar.
* *E. cruciana* (Linnaeus). Kuja, Naryan-Mar.
* *E. gimmerthaliana* (Lienig & Zeller). Naryan-Mar.
* *E. nanana* (Treitschke). Naryan-Mar.
! *E. crenana* (Hübner). Toshviska.
* *Pelochrista guentheri* (Tengström). Naryan-Mar.
* *Eucosma obumbratana* (Lienig & Zeller). Naryan-Mar.
* *E. aspidiscana* (Hübner). Naryan-Mar.
* *E. suomiana* (A. Hoffmann). Kuja.
E. ommatoptera Falkovich. Amderma (Kullberg *et al.* 2013).
* *E. tetraplana* (Möschler). Naryan-Mar. This species is widely distributed in Russia (Sinev 2008) but does not occur in the Nordic and Baltic countries (Aarvik *et al.* 2017).
Gypsonoma parryana (Curtis). Amderma (Kullberg *et al.* 2013).
Epiblema scutulana (Denis & Schiffermüller). Mikulkin (Poppius 1906).
* *Dichrorampha plumbana* (Scopoli). Kuja, Naryan-Mar.
* *D. sedatana* Busck. Kuja, Naryan-Mar.
* *D. acuminatana* (Lienig & Zeller). Naryan-Mar.
* *D. montanana* (Duponchel). Kuja, Naryan-Mar. The northernmost records of this species, which does not occur in the Nordic and Baltic countries (Aarvik *et al.* 2017).
* *D. plumbagana* (Treitschke). Naryan-Mar.
* *Grapholita compositella* (Fabricius). Naryan-Mar.
* *G. orobana* Treitschke. Kuja, Naryan-Mar.
* *Pammene clanculana* (Tengström). Naryan-Mar.
* *P. obscurana* (Stephens). Naryan-Mar.
* *P. aurana* (Fabricius). Naryan-Mar.

Oecophoridae
* *Denisia stroemella* (Fabricius). Naryan-Mar.
! *Pleurota bicostella* (Clerck). Naryan-Mar.
* *Ethmia quadrillella* (Goeze). Naryan-Mar.

Gelechiidae
* *Neofaculta infernella* (Herrich-Schäffer). Kuja, Naryan-Mar.
* *Acompsia subpunctella* Svensson. Kuja, Naryan-Mar.
Bryotropha galbanella (Zeller). Amderma (Kullberg *et al.* 2013).
* *Monochroa* sp. nr. *simplicella* (Lienig & Zeller). Naryan-Mar. This species, which has also been collected from Polar Ural by J. Jalava and J. Kullberg, is now under description by O. Karsholt.
* *Athrips pruinosella* (Lienig & Zeller). Naryan-Mar.
Prolita sexpunctella (Fabricius). Krynka (Poppius 1906), Madakha (Poppius 1906), Naryan-Mar.
* *Chionodes continuella* (Zeller). Naryan-Mar.
* *C. viduella* (Fabricius). Naryan-Mar.
Gnorimoschema vastificum Braun. Amderma (Kullberg *et al.* 2013).

Elachistidae
* *Elachista subalbidella* Schläger. Naryan-Mar.
* *E. eleochariella* Stainton. Naryan-Mar.
* *E. alpinella* Stainton. Kuja, Naryan-Mar.
* *E. diederichsiella* E. Hering. Kuja, Naryan-Mar.
* *E. zernyi* Hartig. Naryan-Mar.
* *E. apicipunctella* Stainton. Kuja, Naryan-Mar.
* *E. maculicerusella* Bruand. Naryan-Mar.
* *E. baltica* E. Hering. Naryan-Mar.

Coleophoridae
* *Coleophora striatipennella* Nylander. Naryan-Mar.
* *C. trochilella* (Duponchel). Naryan-Mar.
* *C. squamosella* Stainton. Naryan-Mar.
* *C. virgaureae* Stainton. Kuja, Naryan-Mar.
* *C. pappiferella* O. Hofmann. Naryan-Mar.
* *C. alticolella* Zeller. Kuja, Naryan-Mar.
* *C. frischella* (Linnaeus). Kuja, Naryan-Mar.
* *C. alcyonipennella* (Kollar). Kuja, Naryan-Mar.
* *C. idaeella* O. Hofmann. Naryan-Mar.
* *C. ledi* Stainton. Naryan-Mar.
* *C. plumbella* Kanerva. Kuja, Naryan-Mar.
* *C. glitzella* O. Hofmann. Naryan-Mar.
* *C. murinella* Tengström. Naryan-Mar.
* *C. albidella* (Denis & Schiffermüller). Naryan-Mar.
* *C.* sp. Naryan-Mar. This species, which does not resemble any known representative of the Palaearctic fauna, is now being examined by J. Tabell.

Momphidae
* *Mompha raschkiella* (Zeller). Naryan-Mar.
* *M. conturbatella* (Hübner). Naryan-Mar.

Scythrididae
* *Scythris obscurella* (Scopoli). Naryan-Mar.
* *S. noricella* (Zeller). Naryan-Mar.
* *S. fuscopterella* Bengtsson. Naryan-Mar.

Epermeniidae
* *Phaulernis fulviguttella* (Zeller). Kuja, Naryan-Mar, Toshviska.

Pterophoridae
* *Platyptilia gonodactyla* (Denis & Schiffermüller). Naryan-Mar.
P. calodactyla (Denis & Schiffermüller). Amderma (Kullberg *et al.* 2013), Kuja, Naryan-Mar.
* *Gillmeria pallidactyla* (Haworth). Kuja, Naryan-Mar.
Paraplatyptilia sahlbergi (Poppius). Krynka (Poppius 1906).
P. sibirica (Zagulajev). Amderma (Kullberg *et al.* 2013).
* *Stenoptilia pterodactyla* (Linnaeus). Kuja, Naryan-Mar.
* *S. veronicae* Karvonen. Kuja, Naryan-Mar.
* *Hellinsia didactylites* (Ström). Naryan-Mar.

Papilionidae
Parnassius corybas Fischer de Waldheim (*phoebus* auct. nec Fabricius). Kara; several more localities in the eastern part of NAO were listed by Tatarinov (2006a). The westernmost records of this Siberian species.
Papilio machaon Linnaeus. Golodnaya Guba, Kharyaginskij, Kuja, Malaya Padeya, Naryan-Mar, middle flow of Shapkina River, and other 13 localities (Tatarinov 2016).

Hesperiidae
Pyrgus centaureae (Rambur). Golodnaya Guba,

Jangech-Mylk, Kara, Kharyaginskij, Nes', Padimey Lakes, and other six localities (Tatarinov 2016).

Carterocephalus palaemon (Pallas). Golodnaya Guba. Kuja, Naryan-Mar, Padimey Lakes, Toshviska, and other eight localities (Tatarinov 2016).

C. silvicola (Meigen). Nenetskaya Gryada, Golognaya Guba, Kuja, Naryan-Mar, Seyda.

Hesperia comma (Linnaeus). Padimey Lakes, upper flow of Shapkina River.

Pieridae

Leptidea sinapis (Linnaeus). Naryan-Mar, Nes', middle flow of Shapkina River, Seyda.

Anthocharis cardamines (Linnaeus). Jangech-Mylk, Kharyaginskij, Naryan-Mar, Nes', Padimey Lakes, upper flow of Shapkina River, and other eight localities (Tatarinov 2016).

Aporia crataegi (Linnaeus). Amderma, Golodnaya Guba, Kharyaginskij, Naryan-Mar, Nes', and other seven localities (Tatarinov 2016).

Pieris rapae (Linnaeus). Kharyaginskij, Naryan-Mar, Nes', Toshviska, Velikovisochnoe, and other five localities (Tatarinov 2016).

P. napi (Linnaeus). Amderma, Golodnaya Guba, Kara (Morgun 2017 as *P. bryoniae*), Kuja, Naryan-Mar, Pechora site 4, Toshviska, and other 15 localities (Tatarinov 2016).

Pontia daplidice (Linnaeus). Sibirchatayaha (as *P. callidice*: Tatarinov 2016).

Colias hyale (Linnaeus). Middle flow of Shapkina River, Seyda.

C. hecla Lefèbvre. Chernaya, Jangech-Mylk, Kara, Malaya Padeya, Padimey Lakes, middle flow of Shapkina River, Sibirchatayaha.

C. tyche (Böber). Kara, Khubtape, Sibirchatayaha.

C. palaeno (Linnaeus). Golodnaya Guba, Jangech-Mylk, Kara, Naryan-Mar, Nes', Toshviska, and other 17 localities (Tatarinov 2016).

Gonepteryx rhamni (Linnaeus). Naryan-Mar, Nes', upper flow of Shapkina River, Kabanova.

Nymphalidae

Boloria eunomia (Esper). Golodnaya Guba, Jangech-Mylk, Kara, Kharyaginskij, Naryan-Mar, Nes', and other eight localities (Tatarinov 2016).

B. euphrosyne (Linnaeus). Naryan-Mar, Nes', middle flow of Shapkina River, Seyda.

B. selene (Denis & Schiffermüller). Golodnaya Guba, Jangech-Mylk, Kara, Kharyaginskij, Kuja, Naryan-Mar, and other eight localities (Tatarinov 2016).

B. chariclea (Schneider). Amderma, Golodnaya Guba, Jangech-Mylk, Kara, Malaya Padeya, Seyda, and other four localities (Tatarinov 2016).

B. freija (Thunberg). Golodnaya Guba. Jangech-Mylk, Kharyaginskij, Malaya Padeya, Naryan-Mar, and other 13 localities (Tatarinov 2016).

B. polaris (Boisduval). Kara, Malaya Padeya, upper flow of Shapkina River, Ust-Kara.

B. thore (Hübner). Golodnaya Guba, Jangech-Mylk, Naryan-Mar, Padimey Lakes, upper flow of Shapkina River, and other five localities (Tatarinov 2016).

B. frigga (Thunberg). Amderma, Golodnaya Guba, Jangech-Mylk, Kara, Kharyaginskij, Naryan-Mar, and other 14 localities (Tatarinov 2016).

B. improba (Butler). Amderma, Jangech-Mylk, Kara, Kuznetskaya, Malaya Padeya, Varandey, and other five localities (Tatarinov 2016).

B. aquilonaris (Stichel). Golodnaya Guba, Jangech-Mylk, Kharyaginskij, Kuja, Naryan-Mar, and other ten localities (Tatarinov 2016).

B. alaskensis (Holland). Amderma, Chernaya, Golodnaya Guba, Jangech-Mylk, Kara, Malaya Padeya, Nenetskaya Gryada.

B. angarensis (Erschoff). Golodnaya Guba, Naryan-Mar, Padimey Lakes, Seyda, upper flow of Shapkina River, Vesniju.

Issoria eugenia (Eversmann). Kara, Kharyaginskij, Padimey Lakes, Seyda, upper and middle flow of Shapkina River, Sibirchatayaha.

Brenthis ino (Rottemburg). Kuja, Naryan-Mar, middle flow of Shapkina River, Seyda.

Argynnis aglaja (Linnaeus). Kuja, Naryan-Mar, middle flow of Shapkina River, Seyda.

Araschnia levana (Linnaeus). Nes', middle flow of Shapkina River, Seida.

Vanessa atalanta (Linnaeus). Naryan-Mar, Seida, upper flow of Shapkina River, Velikovisochnoe. Occasional migrant.

V. cardui (Linnaeus). Krynka, Malaya Padeya, Naryan-Mar, Pechora site 3, Toshviska, Velikovisochnoe, and other 11 localities (Tatarinov 2016). Occasional migrant.

Aglais urticae (Linnaeus). Kharyaginskij, Naryan-Mar, Nenetskaya Gryada, Nes', Seida.

Nymphalis antiopa (Linnaeus). Amderma, Golodnaya Guba, Kharyaginskij, Naryan-Mar, Nenetskaya Gryada, Nes', Seida, upper and middle flow of Shapkina River.

N. xanthomelas (Esper). Amderma, Golodnaya Guba, Kara, Malaya Padeya, Naryan-Mar, Padimey Lakes, upper and middle flow of Shapkina River, Toshviska, and other nine localities (Tatarinov 2016).

Polygonia c-album (Linnaeus). Seida, middle flow of Shapkina River.

Euphydryas iduna (Dalman). Jangech-Mylk, Naryan-Mar, Nenetskaya Gryada, upper flow of Shapkina River.

E. maturna (Linnaeus). Naryan-Mar, Seida, middle flow of Shapkina River.

Melitaea athalia (Rottemburg). Kabanova.

Coenonympha tullia (Müller). Golodnaya Guba. Jangech-Mylk, Kara, Kharyaginskij, Kuja, Naryan-Mar, Padimey Lakes, upper and middle flow of Shapkina River, and other 11 localities (Tatarinov 2016).

Erebia ligea (Linnaeus). Jangech-Mylk, Seida, middle flow of Shapkina River.

E. euryale (Esper). Golodnaya Guba, Kaninskij Kamen', Kharyaginskij, Kuja, Naryan-Mar, Nenetskaya Gryada, Nes', Seida, Shoina, middle flow of Shapkina River.

E. embla (Thunberg). Naryan-Mar, Seida. The record from Kharyaginskij (Tatarinov and Dolgin 1999) is based on a mislabelled specimen (A. Tatarinov, pers. comm.).

E. disa (Thunberg). Golodnaya Guba, Jangech-Mylk, Kharyaginskij, Malaya Padeya, Naryan-Mar, Nes', Padimey Lakes, upper and middle flow of Shapkina River, and other nine localities (Tatarinov 2016).

E. pandrose (Borkhausen). Kambalnitsa, Kaninskij Kamen', Korovinskaya, Krynka, Mikulkin, Naryan-Mar, Shoina.

E. discoidalis (Kirby). Kara, Kharyaginskij, Seida.

E. fasciata Butler. Golodnaya Guba, Jangech-Mylk, Kara, Kharyaginskij, Malaya Padeya, Naryan-Mar, Padimey Lakes, upper and middle flow of Shapkina River, and other seven localities (Tatarinov 2016)

E. jeniseiensis Trybom. Golodnaya Guba, Jangech-Mylk, Nenetskaya Gryada, Naryan-Mar, Padimey Lakes, upper flow of Shapkina River, Vesniju.

E. rossii (Curtis). Jangech-Mylk, Kharyaginskij, Malaya Padeya, Naryan-Mar, Padimey Lakes, upper and middle flow of Shapkina River, and other 14 localities (Tatarinov 2016).

Oeneis norna (Thunberg). Golodnaya Guba, Jangech-Mylk, Kharyaginskij, Naryan-Mar, Nenetskaya Gryada, Nes', Padimey Lakes, Seida, upper and middle flow of Shapkina River, Velikovisochnoe, Vesniju.

O. bore (Schneider). Jangech-Mylk, Kharyaginskij, Naryan-Mar, Padimey Lakes, upper and middle flow of Shapkina River, and other six localities (Tatarinov 2016).

O. jutta (Hübner). Kharyaginskij, Nes', Seida, middle flow of Shapkina River.

O. melissa (Fabricius). Kara, Sibirchatayaha.

Lycaenidae

Cupido minimus (Fuessly). Golodnaya Guba, Nenetskaya Gryana, Naryan-Mar, Seida.

Celastrina argiolus (Linnaeus). Kharyaginskij, Naryan-Mar, Seida, upper and middle flow of Shapkina River.

Plebeius idas (Linnaeus). Golodnaya Guba, Naryan-Mar, Nes', Seida, upper and middle flow of Shapkina River.

Aricia artaxerxes (Fabricius). Golodnaya Guba, Naryan-Mar, Nes', middle flow of Shapkina River, Seida.

Eumedonia eumedon (Esper). Golodnaya Guba, Naryan-Mar, Seida.

Cyaniris semiargus (Rottemburg). Golodnaya Guba, Kharyaginskij, Kuja, Naryan-Mar, Nenetskaya Gryada, Nes', Seida, Toshviska.

Agriades optilete (Knoch). Golodnaya Guba, Jangech-Mylk, Kara, Kharyaginskij, Kuja, Malaya Padeya, Naryan-Mar, Nes', Padimey Lakes, Shoina, upper and middle flow of

Shapkina River, and other ten localities (Tatarinov 2016).

A. aquilo (Boisduval). Kara, Sibirchatayaha (as *A. glandon*; Tatarinov 2016).

Polyommatus icarus (Rottemburg). Kharyaginskij, Kuja, Naryan-Mar, Nes', Vesniju, Seida, middle flow of Shapkina River.

P. eros (Ochsenheimer). Kara, Seida.

Lycaena phlaeas (Linnaeus). Kharyaginskij, Naryan-Mar, Seida, upper flow of Shapkina River.

Lycaena helle (Denis & Schiffermüller). Golodnaya Guba, Kuja, Naryan-Mar, Nenetskaya Gryada, Nes', Padimey Lakes, Pechora site 2, upper and middle flow of Shapkina River, Vesniju.

Lycaena hippothoe (Linnaeus). Golodnaya Guba, Kharyaginskij, Naryan-Mar, Nenetskaya Gryada, Padimey Lakes, Seida, upper flow of Shapkina River, Vesniju.

Callophrys rubi (Linnaeus). Golodnaya Guba, Kharyaginskij, Lovetskij, Naryan-Mar, Nenetskaya Gryada, Nes', Seida, Padimey Lakes, Pechora site 7, upper and middle flow of Shapkina River.

Pyralidae

* *Anerastia lotella* (Hübner). Kuja, Naryan-Mar.

* *Catastria marginea* (Denis & Schiffermüller). Naryan-Mar.

C. kistrandella Opheim. Amderma (Kullberg et al. 2013).

Pyla fusca (Haworth). Krynka (Poppius 1906), Kuja, Mikulkin (Poppius 1906), Naryan-Mar.

Polopeustis altensis (Wocke). Krynka (Poppius 1906), Mikulkin (Poppius 1906).

* *Anania funebris* (Ström). Kuja, Naryan-Mar.

* *A. fuscalis* (Denis & Schiffermüller). Toshviska.

* *Udea inquinatalis* (Lienig & Zeller). Kuja, Naryan-Mar.

U. decrepitalis (Herrich-Schäffer). Krynka (Poppius 1906), Kuja, Naryan-Mar.

U. alaskalis (Gibson). Amderma (Kullberg et al. 2013).

U. uralica Slamka. Amderma (Kullberg *et al.* 2013), Kambalnitsa, Kuja, Naryan-Mar. This species, which was recently described from Ural Mts., seems to be widespread in northern Russia, and our new records expand its distribution range some 800 km to the West. The earlier record of *U. cretacea* Fil. from Taymyr (Kozlov *et al.* 2006) should be attributed to this species.

Eudonia alpina (Curtis). Kambalnitsa (Poppius 1906), Madakha (Poppius 1906), Naryan-Mar.

* *E. murana* (Curtis). Naryan-Mar.

Catoptria furcatellus (Zetterstedt). Bugryanitsa (Poppius 1906).

* *C. maculalis* (Zetterstedt). Kuja, Naryan-Mar.

Pediasia zellerella (Staudinger). Amderma (Kullberg *et al.* 2013).

* *Chrysoteuchia culmella* (Linnaeus). Kuja, Naryan-Mar.

* *Crambus pascuella* (Linnaeus). Naryan-Mar.

* *C. silvella* (Hübner). Naryan-Mar.

* *C. ericella* (Hübner). Naryan-Mar.

* *C. alienellus* (Germar & Kaulfuss). Naryan-Mar.

* *C. hamella* (Thunberg). Kuja, Naryan-Mar.

* *C. perlella* (Scopoli). Kuja, Naryan-Mar.

Drepanidae

* *Ochropacha duplaris* (Linnaeus). Toshviska.

Geometridae

Cyclophora pendularia (Clerck). Golodnaya Guba (Tatarinov & Kulakova 2013).

* *Timandra comae* A. Schmidt. Naryan-Mar.

* *T. griseata* W. Petersen. Naryan-Mar.

* *Scopula frigidaria* (Möschler). Kuja, Naryan-Mar.

S. ternata Schrank. Golodnaya Guba (Tatarinov & Kulakova 2013), Naryan-Mar.

Scotopteryx chenopodiata (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013).

Psychophora sabini Kirby. Amderma (Kullberg *et al.* 2013).

* *Xanthorhoe designata* (Hufnagel). Naryan-Mar, Toshviska.

* *X. abrasaria* (Herrich-Schäffer). Kuja, Naryan-Mar.

* *X. decoloraria* (Esper). Kuja, Naryan-Mar, Toshviska.

* *X. spadicearia* (Denis & Schiffermüller). Naryan-Mar.

* *X. ferrugata* (Clerck). Naryan-Mar, Toshviska.

* *X. montanata* (Denis & Schiffermüller). Kuja, Naryan-Mar, Toshviska.
* *X. fluctuata* (Linnaeus). Toshviska.
X. annotinata (Zetterstedt). Krynka (Poppius 1906), Madakha (Poppius 1906), Naryan-Mar, Toshviska.
X. uralensis Choi. Amderma (Kullberg *et al.* 2013).
* *Epirrhoe hastulata* (Hübner). Kuja, Naryan-Mar.
* *E. alternata* (Müller). Naryan-Mar, Toshviska.
Entephria polata (Duponchel). Pakhancheskaya Guba, Toshviska
E. byssata (Aurivillius). Amderma (Kullberg *et al.* 2013, as *E. punctipes*), Kambalnitsa (Poppius 1906), Krynka (Poppius 1906), Mikulkin (Poppius 1906), Pakhancheskaya Guba.
E. caesiata (Denis & Schiffermüller). Naryan-Mar.
* *Spargania luctuata* (Denis & Schiffermüller). Kuja, Naryan-Mar.
* *Hydriomena furcata* (Thunberg). Bolvanskaya Guba, Naryan-Mar, Toshviska.
* *H. impluviata* (Denis & Schiffermüller). Naryan-Mar, Toshviska.
* *Heterothera serraria* (Lienig & Zeller). Naryan-Mar.
* *Eulithis testata* (Linnaeus). Toshviska.
! *E. populata* (Linnaeus). Kuja, Naryan-Mar, Toshviska.
* *Dysstroma citrata* (Linnaeus). Toshviska.
D. pseudimmanata (Heydenreich). Amderma (Kullberg *et al.* 2013).
* *Colostygia turbata* (Hübner). Naryan-Mar.
* *Lampropteryx otregiata* (Metcalfe). Toshviska.
* *Epirrita autumnata* (Borkhausen). Toshviska, Velikovisochnoe.
! *Rheumaptera hastata* (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013), Kuja, Naryan-Mar.
R. subhastata (Nolcken). Golodnaya Guba (Tatarinov & Kulakova 2013), Naryan-Mar.
* *Coenocalpe lapidata* (Hübner). Toshviska.
* *Perizoma affinitata* (Stephens). Toshviska.
* *P. alchemillata* (Linnaeus). Toshviska.
* *P. blandiata* (Denis & Schiffermüller). Kuja, Naryan-Mar, Toshviska.
* *P. albulata* (Denis & Schiffermüller). Naryan-Mar.
**Pasiphila debiliata* (Hübner). Upper flow of Shapkina River.
* *Eupithecia abietaria* (Goeze). Naryan-Mar.
* *E. pygmaeata* (Hübner). Kuja, Naryan-Mar.
* *E. gelidata* Möschler. Naryan-Mar.
* *E. conterminata* (Lienig & Zeller). Naryan-Mar.
* *E. veratraria* Herrich-Schäffer Kuja, Naryan-Mar.
* *E. intricata* (Zetterstedt). Naryan-Mar.
! *E. satyrata* (Hübner). Kuja.
* *E. vulgata* (Haworth). Naryan-Mar.
* *E. succenturiata* (Linnaeus). Kuja, Naryan-Mar, Toshviska.
! *Carsia sororiata* (Hübner). Naryan-Mar, Toshviska.
* *Macaria alternata* (Denis & Schiffermüller). Kuja, Naryan-Mar, Toshviska.
M. brunneata (Thunberg). Mikulkin (Poppius 1906), Naryan-Mar.
M. fusca (Thunberg). Bugryanitsa (Poppius 1906), Naryan-Mar, Pakhancheskaya Guba.
* *Chiasmia clathrata* (Linnaeus). Kuja, Naryan-Mar, Toshviska.
Ematurga atomaria (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013).
Ennomos autumnaria (Werneburg). Golodnaya Guba (Tatarinov & Kulakova 2013).
Elophos vittaria (Thunberg). Krynka (Poppius 1906), Naryan-Mar.
Glacies coracina (Esper). Golodnaya Guba (Tatarinov & Kulakova 2013).

Saturniidae
Saturnia pavonia (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013); middle flow of Shapkina River (Tatarinov 2006c).

Sphingidae
Hyles gallii (Rottemburg). Golodnaya Guba (Tatarinov & Kulakova 2013), Kharyaginskij (Tatarinov *et al.* 2003), Naryan-Mar (Tatarinov *et al.* 2003).

Erebidae
Scoliopteryx libatrix (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013).
Apantesis quenseli (Paykull). Golodnaya Guba (Tatarinov & Kulakova 2013).
Arctia lapponica (Thunberg). Golodnaya Guba (Tatarinov & Kulakova 2013).

A. subnebulosa tundrana Tshistjakov. Amderma (Kullberg *et al.* 2013), Malaya Padeya (Bolotov *et al.* 2015).
Euclidia glyphica (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013), Naryan-Mar.
* *E. mi* (Clerck). Naryan-Mar.

Noctuidae
Diachrysia chrysitis (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013).
* *D. stenochrysis* (Warren). Toshviska.
Autographa gamma (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013), Pechora site 3 (Ross 2000), Toshviska.
Syngrapha hochenwarthi (Hochenwarth). Amderma (Kullberg *et al.* 2013), Kuja, Naryan-Mar.
* *S. microgamma* (Hübner). Naryan-Mar.
Sympistis zetterstedtii (Staudinger). Amderma (Kullberg *et al.* 2013), Golodnaya Guba (Tatarinov & Kulakova 2013).
* *Helicoverpa armigera* (Hübner). Toshviska. A subtropical migrant species, which is regularly recorded in the Nordic and Baltic countries (Aarvik *et al.* 2017).
* *Amphipoea fucosa* (Freyer). Toshviska.
* *Hillia iris* (Zetterstedt). Toshviska.
Coranarta cordigera (Thunberg) Golodnaya Guba (Tatarinov & Kulakova 2013).
Polia conspicua (A. Bang-Haas). Kanin Pns. (Hacker *et al.* 2002: distribution map).
Polia richardsoni (Curtis). Amderma (Kullberg *et al.* 2013), Kanin Pns. (Hacker *et al.* 2002: distribution map).
* *Papestra biren* (Goeze). Naryan-Mar.
Agrotis exclamationis (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013).
* *Diarsia mendica* (Fabricius). Naryan-Mar.
Eurois occulta (Linnaeus). Golodnaya Guba (Tatarinov & Kulakova 2013), Toshviska.
Xestia quieta (Hübner). Amderma (Kullberg *et al.* 2013), Mikulkin (Poppius 1906).
X. liquidaria (Eversmann). Amderma (Kullberg *et al.* 2013).

3.2. Species excluded from the list

In total, 30 species has been erroneously reported, or reported without a proper factual support, from NAO and the Novaya Zemlya region in the Catalogue of the Lepidoptera of Russia (Sinev 2008). However, 12 of these species (labelled with an exclamation mark in the list above) have been found to occur in NAO since then, so only the records of the following 18 species have not yet been confirmed.

Choreutis diana (Hübner), *Phiaris turfosana* (Herrich-Schäffer), *Epinotia crenana* (Hübner) and *Macaria carbonaria* (Clerck) were included in the Catalogue based on misinterpreted records by Poppius (1906), who recorded these species for a locality that lies outside NAO (S. Sinev & V. Mironov, pers. comm.). Similarly, *Malacodea regelaria* Tengström was reported from the region based on the specimen from Ust-Tsilma, Republic of Komi (V. Mironov, pers. comm.).

Three species were reported based on misidentified specimens. *Cnephasia longana* (Haworth) from Bugryanitsa (Poppius 1906) appeared to be *Eana osseana* (Scopoli), *Epagoge grotiana* (Fabricius) from Dolgij Island appeared to be *Clepsis mehli* (Opheim) and *Apotomis demissana* Kennel from Dolgij Island was reidentified as *Apotomis frigidana* (Packard).

The authors of the Catalogue were unable to provide any information regarding the reasons for reporting the following species from the region that includes NAO and Novaya Zemlya archipelago: *Rhigognostis senilella* (Zetterstedt), *Acleris hastiana* (Linnaeus), *Apotomis sororculana* (Zetterstedt), *Phiaris glaciana* (Möschl.), *Gesneria centuriella* (Denis & Schiffermüller), *Loxostege sticticalis* (Linnaeus), *Gynaephora relictus* (O. Bang-Haas), *Leucoma salicis* (Linnaeus), *Polia lamuta* (Herz) and *Xestia tecta* (Hübner) (S. Sinev and A. Matov, pers. comm.). All these species were therefore excluded from our list.

Parnassius mnemosyne (Linnaeus) was reported from NAO by Bolotov *et al.* (2012) based on the record made near Kosminskoe Lake, which is located at the border of NAO, Arkhangelsk oblast and the Komi Republic. However, the species was collected on the territory of the Komi Republic (Tatarinov 2016), so its occurrence in NAO, although very likely, remains to be confirmed (A. Tatarinov, pers. comm.).

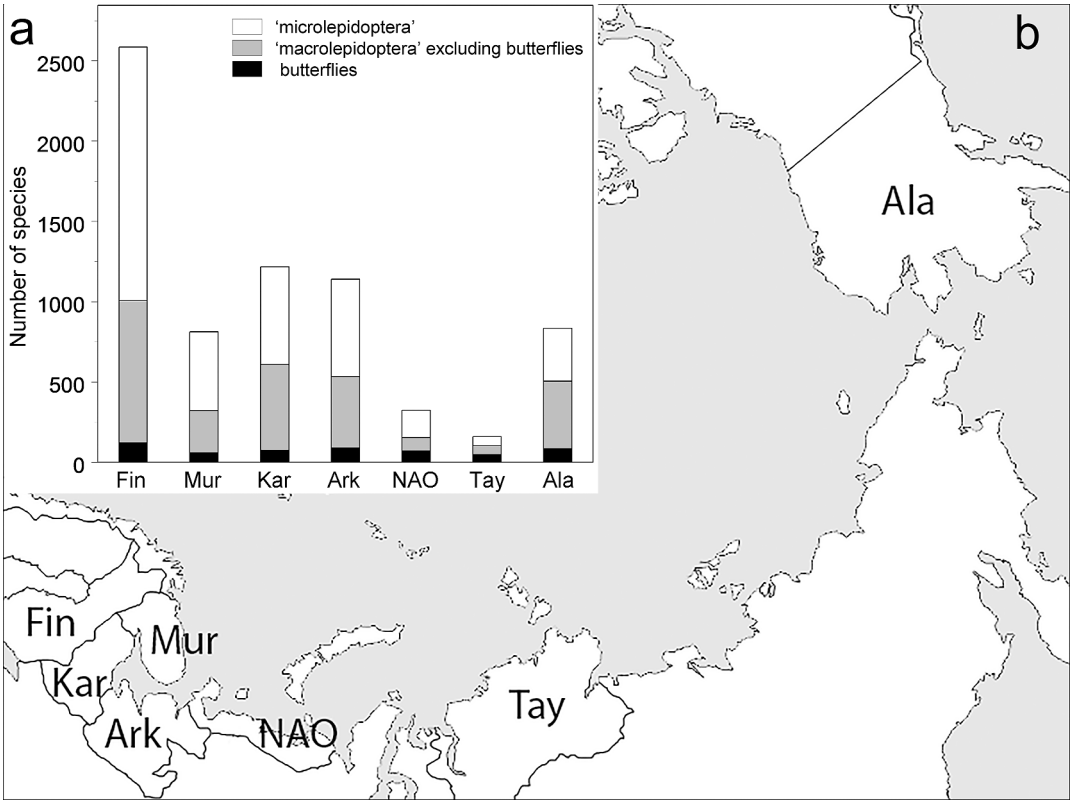

Fig. 3. Locations and compositions of lepidopteran faunas of the Arctic and Subarctic continental regions. – a. Numbers of Lepidoptera species with subdivision to "microleipidoptera", "macroleipidoptera" and butterflies. – b. Nenets Autonmous Okrug relative to other regions, with which the lepidopteran fauna of the former is compared. Abbreviations of the regions (source of data of Fig. 3a in parentheses): Fin, Finland (Aarvik *et al.* 2017); Kar, Republic of Karelia, Russia (Sinev 2008); Mur, Murmansk oblast, Russia (Kozlov & Kullberg 2010); Ark, Arkhangelsk oblast, Russia (Kozlov et al. 2014, 2017); NAO, continental part of the Nenets Autonomous Okrug, Russia (present study); Tay, Taymyr Peninsula, Russia (Kozlov *et al.* 2006); Ala, Alaska, USA (Pohl *et al.* 2018).

3.3. Similarities between Arctic regional faunas

Due to insufficient levels of faunistic knowledge on "microlepidoptera", we have restricted our analysis of faunistic similarity to butterflies. In terms of its composition of butterfly fauna, NAO has an intermediate position between Fennoscandia and the Taymyr peninsula, and is equally similar to both these regions (Sørenson index 0.59–0.65). In comparison to these regions, it differs primarily in the proportion of the Beringian species (e.g. *Parnassius corybas*, *Boloria alaskensis*, *Erebia discoidalis*, *Oeneis melissa*). When compared to the fauna of the more southern Arkhangelsk oblast (Sørenson index 0.62), the fauna of NAO differs in the presence of tundra species (e.g. *Boloria chariclea*, *B. polaris*, *B. improba*, *Erebia pandrose*).

4. Discussion

4.1. The level of faunistic knowledge

More or less complete lists of moths and butterflies are available only for a few Arctic and sub-Arctic regions (Fig. 3b). Restricting our comparison to continental faunas we conclude that the level of faunistic knowledge decreases substantially from Fennoscandia to the East (Fig. 3a). Of course, the absolute numbers of species recorded

in different regions depend on both their area and climate, but the ratio between "microlepidoptera" and "macrolepidoptera", which serves an index of the completeness of the faunistic inventory (Sinev 2008), decreases from 1.5–1.6 in Finland and Murmansk oblast to 1.1 in the Arkhangelsk oblast and NAO and then to 0.5–0.6 in the Taymyr Peninsula and Alaska. The percentage of butterfly species in these faunas seems to increase towards the north, from 5 to 10%; however, the question remains whether this increase reflects real changes in the structure of regional faunas or is an artefact of the level of faunistic knowledge.

We used two approaches to evaluate the completeness of the faunistic list we compiled. First, we assumed that the list of butterflies of NAO, with 70 reported species, is nearly complete. Only 42 of these species were found in Naryan-Mar; the remaining 28 species are either Arctic tundra residents or are limited to more southern parts of NAO. Assuming that this proportion between different faunistic elements is valid for other groups of Lepidoptera, and that the fauna of moths in the surroundings of Naryan-Mar is relatively well explored, we estimate that the fauna of NAO is likely to include 360 species of Lepidoptera. Second, we assumed that the list of so-called "macrolepidoptera" is reasonably complete. The number of the so-called "microlepidoptera" species in well-studied northern faunas exceeds the number of "macrolepidoptera" species by a factor of 1.6 (Sinev 2008). This means that the fauna of NAO is likely to include approximately 250 species of "microlepidoptera" or 400 species of moths and butterflies in total. Allowing for a 20% underestimation of the number of "macrolepidoptera" in the current list, we accept 500 species of Lepidoptera as a realistic upper estimate of the fauna of the continental part of NAO.

4.2. Composition of regional fauna

The fauna of moths and butterflies of NAO clearly differs from the fauna of Fennoscandia, due to a relatively high proportion of Beringian species in NAO. It also differs from the faunas of Taymyr and Alaska by the presence of West Palaearctic species in NAO. In particular, 33 species found in NAO (i.e. 10% of the fauna) have never been recorded from Finland. Conversely, only a handful of species (for example, *Boloria napaea*) are relatively common in Fennoscandia but have not yet been found in NAO or to the east of NAO.

Our findings demonstrated that several Beringian species occur in regions farther west than was previously thought. In particular, the records of *Greya variabilis* and *Clepsis moeschleriana* in Naryan-Mar extended the distribution range of these species some 400 km to the west. Similarly, records of *Nemophora ochsenheimerella, Hepialus humuli, Dichrorampha montanana* and *Ancylis habeleri* near Naryan-Mar substantially expanded the distribution limits of these species to the north. However, it remains unclear whether these species with generally more southern distribution have occurred in NAO for millennia or whether they have recently migrated there following climate warming.

We estimate that some 80% of the Lepidoptera species recorded from NAO belong to residents of northern boreal forests and bogs. In other words, the composition of the local fauna of moths and butterflies is much more similar to the Arkhangelsk oblast of Russia (Fig. 3a), which is almost completely covered by taiga forests, than would have been expected prior our sampling. This conclusion is similar to the one made based on the investigation of aphids: Stekolstchikov (2017) concluded that the number of truly Arctic aphids in NAO is surprisingly low. However, the extent to which these conclusions are due to a much lower sampling effort in tundra relative to forests remains unclear. To date, Amderma (1 in Fig. 1) remains the only locality in the tundras of NAO where "microlepidoptera" have been specifically collected (Kullberg *et al.* 2013).

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