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Moths and butterflies (Insecta: Lepidoptera) of the Russian Arctic islands in the Barents Sea

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Abstract

Faunistic data are scarce for the Lepidoptera from the Arctic islands of European Russia. New sampling and revision of the earlier findings have revealed the occurrence of 60 species of moths and butterflies on Kolguev, Vaygach and Dolgij Islands and on the Novaya Zemlya archipelago. The faunas of Kolguev and Dolgij Islands (19 and 18 species, respectively) include typical moths of the northern taiga (*Aethes deutschiana*, *Syricoris lacunana* and *Xanthorhoe designata*), and the low numbers of species discovered on these islands have resulted primarily from low collecting efforts. By contrast, the fauna of Vaygach Island (22 species) is relatively well known and includes several high Arctic species, such as *Xestia aequaeva, X. liquidaria* and *X. lyngei*. Nevertheless, Vaygach Island is depauperated even relative to the fauna of Amderma (29 species), which is located on the continent next to the Vaygach Island. The fauna of Novaya Zemlya totals 30 species, but only eight of these were collected from the Northern Island, mostly near Matochkin Shar strait. Noteworthy is the record of *Plutella polaris* from Novaya Zemlya: this species was recently re-discovered in Svalbard, where the type series was collected in 1873. *Udea itysalis*, described from North America, is reported here for the first time from Europe. The fauna of the Russian Arctic islands in the Barents Sea is dominated by holarctic species, many of which are confined to tundra habitats. We estimate that some 40–60 moth species remain to be found in this region.

Keywords Arctic islands · Barents Sea region · Biogeography · Insects · Faunistic structure · Tundra

Introduction

The high Arctic habitats of Europe are restricted to several islands and archipelagos located within the Barents Sea or bordering this sea from other parts of the Arctic Ocean. The Russian Arctic islands are particularly difficult to access due to the scarcity (or complete absence) of public transportation and the need to obtain special permits to visit these remote areas. Consequently, faunistic data are scarce for Lepidoptera from the Arctic islands of Europe, except for the relatively well known but species-poor and isolated Svalbard archipelago, which has only three local species (Coulson 2007). The records of 15 species of moths and butterflies from Novaya Zemlya, which are included in the recent version of the Fauna Europaea (Karsholt and van Nieukerken 2013), are based exclusively on materials collected about a century ago (Jacobson 1898; Rebel 1923). The recently published entomological data from the Russian Arctic (Vaygach, Kolguev and Dolgij Islands) concern butterflies primarily (Tatarinov and Dolgin 1999; Makarova 2004; Bolotov 2011; Vlasova et al. 2014; Tatarinov 2016), whereas the so-called microlepidoptera (an artificial group of moth families, commonly known as the 'smaller moths', as opposed to the 'macrolepidoptera' comprising larger moths and butterflies) of this extensive region remain almost unexplored.

During the past years, the Northern (Arctic) Federal University situated in Arkhangelsk has organised expeditions to Vaygach Island (2013) and the southern island of Novaya Zemlya (2015). Although these expeditions focused

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on exploration of ground beetles (Carabidae), the researchers managed to collect representative materials of Lepidoptera, which are deposited in the Russian Museum of the Biodiversity Hotspots in Arkhangelsk (RMBH) and the Finnish Museum of Natural History in Helsinki (MZH). We have also reported the results of occasional samplings conducted on Kolguev and Dolgij Islands, as well as the identifications of specimens collected about a century ago and deposited at the Zoological Institute in St. Petersburg, Russia (ZISP). Keeping in mind the acute shortage of faunistic information from the Arctic islands of European Russia, we critically analysed the records that were published earlier but were not supported by the materials investigated by us, and we provided a complete list of Lepidoptera species in this region.

Materials

Administratively, all islands involved in the present study (Fig. 1) belong to Arkhangelsk oblast of Russia. On Kolguev Island, moths and butterflies were collected by B.Y.F. and N.A.Z. during a short stop made by the research vessel on 4 July 2013 near Bugrino. The vegetation of this region, according to Walker et al. (2005), is classified as dwarf-shrub tundra. The sampled area (Fig. 2a, b) was covered by low-stature shrubs of *Salix lanata* L., *S. lapponum* L., *S. myrtilloides* L. and *S. phylicifolia* L. (Salicaceae); herbaceous layer was dominated by *Polemonium boreale* Adams (Polemoniaceae), *Deschampsia* sp. (Poaceae), *Myosotis caespitosa* Schultz (Boraginaceae), *Petasites frigidus* (L.) Fr. and *Artemisia tillesii* Ledeb. (Asteraceae); moss layer consisted of *Pleurosium* sp. and *Aulacomnium* sp. July is the warmest month, with an average temperature of 13.3 °C, and January is the coldest month, with an average temperature of − 18.9 °C; the annual precipitation is 410 mm.

Sampling on Dolgij Island was performed by O. L. Makarova and V. V. Gorbatovskii on 3–28 July 2004. These collectors sent the Lepidoptera specimens to different researchers; some identifications were reported by Makarova (2004). We investigated only a part of this material, which was identified by M. A. Klepikov and deposited at ZISP. Dolgij Island is a small (39 km long and up to 4 km wide) shelf island located 12 km from the mainland (Fig. 1). The topography of the island is relatively flat, with small lakes and patches of southern tundra. The most common shrub species are *S. lanata* L. and *S. myrsinites* L.; for a description of the vegetation and for photographs of landscapes, consult Makarova and Makarov (2006). The average temperature is 13.3 °C in July and − 21.3 °C in January; the annual precipitation is 326 mm.

Sampling on Vaygach Island was conducted by B.Y.F. and N.A.Z. on 7 July–3 September 2013 near the Bolvanskij Nos meteorological station. Searches for moths and butterflies

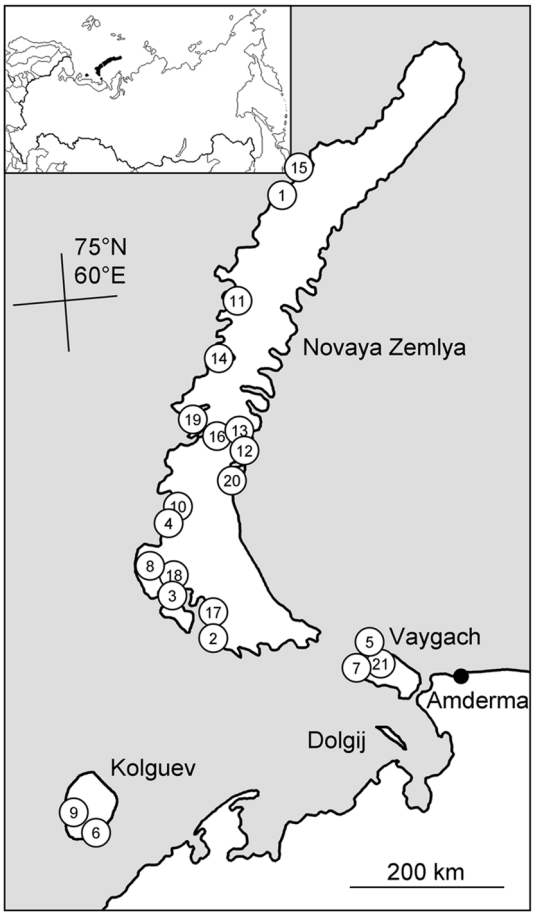

Fig. 1 Collecting localities. *1* Arkhangelskaya Guba; *2* Bashmachnaja Guba; *3* Belushja Guba; *4* Bolshie Karmakuly; *5* Bolvanskij Nos; *6* Bugrino; *7* Dyrovataja Guba; *8* Gusinyi Nos; *9* Krivoye Lake; *10* Malye Karmakuly; *11* Mashigina Guba; *12* Matochkin Shar; *13* Nochuev Ruchei; *14* Olginskyi; *15* Pankratieva Peninsula; *16* Pereuzie; *17* Propastchaja Guba; *18* Rogachev Bay; *19* Serebryanka Guba; *20* Shubert Bay; *21* Yangoto Lake. Inset: position of the study region in Russia

were conducted during regular excursions, and the specimens were typically collected by netting or, less frequently, by pitfalls or sampling from plants. The surveyed area belongs to the zone of prostrate-shrub tundra (as defined by Walker et al. 2005), but includes meadows associated with small rivers and ravines, as well as bogs (Fig. 2c, d). A survey of the vegetation in 11 plots (10 × 10 m size) revealed 62 species of vascular plants, among which the most common were *Dryas octopetala* L. (Rosaceae), *Carex aquatilis* Wahlenb. (Cyperaceae), *Bistorta vivipara* (L.) Delarbre (Polygonaceae), *Myosotis alpestris* F. W. Schmidt (Boraginaceae), *Pedicularis oederi* Vahl in Hornem. (Orobanchaceae), *Poa alpina* L. and *Festuca rubra* L. (Poaceae), *Ranunculus borealis* Trautv. (Ranunculaceae), *Astragalus alpinus* L. (Fabaceae), *Saxifraga hirculus* L. (Saxifragaceae), *Artemisia tillesii* Ledeb. (Asteraceae), S. *reptans* Rupr., *S.*

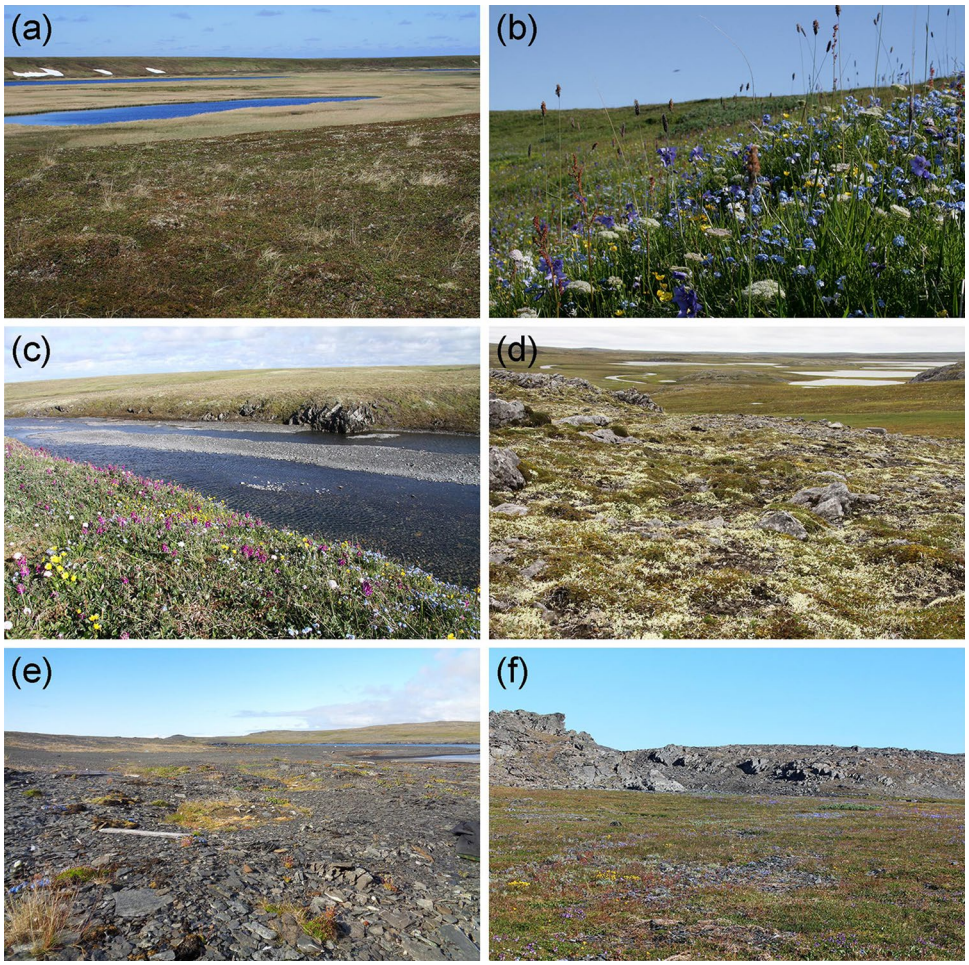

Fig. 2 Examples of habitats on Arctic islands: **a**, **b** Kolguev Island, surroundings of Bugrino; **c**, **d** Vaygach Island, surroundings of Bolvanskij Nos; **e**, **f** Novaya Zemlya, surroundings of Malye Karmakuly

polaris Wahlenb. and *S. reticulata* L. (Salicaceae). Species richness of vascular plants within a plot varied from 3 to 18 species (mean = 13 species), and vegetation cover varied from 40 to 100% (mean = 71%). The average July temperature is 6.9 °C, and average January temperature is − 15.7 °C; the annual precipitation is 326 mm.

Sampling on Novaya Zemlya was conducted by V.M.S. on 17 July–11 August 2015 near the Malye Karmakuly meteorological station, within the zone of the barrens and graminoid tundras, with patches of prostrate-shrub tundra associated with depressions and floodplains (Fig. 2e, f). These prostrate-shrub tundras are dominated by *S. arctica* Pall., with occasional specimens of *S. lapponum* L. and *S. lanata* L. (Salicaceae). The vegetation cover in the study area ranged from 5 to 20%; for a detailed description of the vegetation, consult Shakhin (1993).

In addition to processing the new materials, we checked the collections at ZISP for specimens of all 108 species reported (Sinev 2008) from the biogeographical region that includes the studied islands. We also sought specimens from this region 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 the published records on Lepidoptera from the Arctic islands of European Russia, and we examined all discovered records for the reliability of identifications.

Nomenclature and data format

The nomenclature and the order of species follow the recent Nordic-Baltic checklist of Lepidoptera (Aarvik et al. 2017); locality data are listed in alphabetic order. An asterisk (*) indicates species that are reported for the first time from the Nenets Autonomous Okrug and Novaya Zemlya (region 5 in Sinev 2008). Each record based on published data is referenced; noteworthy species are provided with brief comments on their distribution and status (Table 1).

Table 1 Collecting localities

Locality name and type	Coordinates (N, E)[a]	Error radius, km	Number of species[b]
Arkhangelskaya Guba [bay]	75.843, 59.183	10	0/1
Bashmachnaja Guba [bay]	70.946, 53.757	10	1/0
Belushja Guba [bay]	71.550, 52.267	5	3/5
Bolshie Karmakuly [settlement, abandoned]	72.422, 52.812	5	1/0
Bolvanskij Nos [cape]	70.419, 59.046	5	14/3
Bugrino [settlement]	68.783, 49.327	5	13/2
Dolgij [island]	69.267, 59.103	20	8/10
Dyrovataja Guba [bay]	70.196, 58.491	5	1/0
Gusinyi Nos [cape]	71.780, 51.867	35	0/4
Kolguev [island]	–	–	0/5
Krivoye [lake]	69.004, 48.756	5	0/1
Malye Karmakuly [settlement]	72.407, 52.828	5	10/0
Mashigina Guba [bay]	74.717, 56.183	10	0/2
Matochkin Shar [settlement, abandoned]	73.200, 56.450	5	6/1
Nochuev Ruchei [river]	73.281, 56.400	3	7/1
Novaya Zemlya [archipelago]	–	–	0/2
Olginskyi [settlement, abandoned]	74.133, 55.300	10	1/1
Pankratieva Peninsula	76.058, 60.403	10	0/1
Pereuzie [strait]	73.318, 55.575	10	1/0
Propastchaja Guba [bay]	71.170, 53.783	5	4/0
Rogachev Bay	71.617, 52.416	10	1/0
Serebryanka Guba [bay]	73.463, 54.442	5	0/2
Shubert Bay	72.750, 55.922	10	0/6
Shumilina Bereg [coast], Novaya Zemlya	Not identified	–	1/0
Vaygach [island]	–	–	0/4
Vilcheka [mount], Novaya Zemlya	Not identified	–	1/0
Vosmaya Guba [bay], Novaya Zemlya	Not identified	–	1/0
Yangoto [lake]	70.251, 59.092	5	0/1

[a]Coordinates are given in the wgs84 system. Coordinates of some localities may have low accuracy due to insufficient details provided in original publications

[b]Above the slash: based on specimens investigated by us; below the slash: based on published records

Results

List of Lepidoptera species

New sampling and revision of the earlier findings have revealed the occurrence of 60 species of moths and butterflies on Kolguev, Vaygach and Dolgij Islands and on the Novaya Zemlya archipelago (Table 2). Below we provide comments on distribution and status of noteworthy species.

Prodoxidae

Greya variabilis Davis & Pellmyr, 1992. This Holarctic species was described from North America and later on reported from the Chukchi Peninsula (Kozlov 1996), Taymyr Peninsula (Kozlov et al. 2006), Amderma (Kullberg et al. 2013) and Naryan-Mar (Kozlov et al. 2018) in NW Europe.

Tineidae

Tineola bisselliella (Hummel, 1823). Synanthropic cosmopolitan species that was originally confined to western Palaearctic, but now is introduced to all regions.

Plutellidae

Plutella xylostella (Linnaeus, 1758). Cosmopolitan. Found on many of high Arctic islands, including Severnaya Zemlya; is generally considered as migrant (Makarova et al. 2012).

**Plutella polaris* Stainton & Zeller in Stainton, 1880. Karsholt and Razowski (1996) and Aarvik et al. (2017) attributed this name to Zeller; however, the primary description published by Stainton (1880) clearly indicated that both authors investigated the specimens and agreed that they represent a distinct species. This species, described from

Table 2 Moths and butterflies of the Russian Arctic islands in the Barents Sea

Family	Species	Locality	Dates of sampling	Exx.	Data source	Repository
Prodoxidae	*Greya variabilis* Davis & Pellmyr, 1992	Bolvanskij Nos	8.–18.vii.2013	2	Own data	MZH
Tineidae	*Tineola bisselliella* (Hummel, 1823)	Bolvanskij Nos	19.viii.2013	1	Own data	MZH
Plutellidae	*Plutella xylostella* (Linnaeus, 1758)	Bolvanskij Nos	7.–22.vii.2013	10	Own data	MZH
		Dolgij	15.–25.vii.2004	2	Own data	ZISP
		Malye Karmakuly	27.vii.2015	15	Own data	MZH
		Serebryanka Guba	–	–	Rebel (1923)	–
	Plutella polaris Stainton & Zeller in Stainton, 1880*	Matochkin Shar	13.vii.1925	1	Own data	ZISP
	Plutella mariae Rebel, 1923	Belushja Guba	–	–	Rebel (1923)	–
		Serebryanka Guba	–	–	Rebel (1923)	–
Tortricidae	*Clepsis mehli* (Opheim, 1964)*	Bolvanskij Nos	18.vii.2013	1	Own data	MZH
		Bugrino	4.vii.2013	2	Own data	MZH
		Dolgij	15.–27.vii.2004	2	Own data	ZISP
	Aethes deutschiana (Zetterstedt, 1839)*	Bugrino	4.vii.2013	7	Own data	MZH
	Apotomis frigidana (Packard, 1867)	Bolvanskij Nos	31.vii.1905	1	Own data	ZISP
		Bolvanskij Nos	7.vii.–4.viii.2013	9	Own data	MZH
		Dolgij	10.–15.vii.2004	3	Own data	ZISP
	Celypha lacunana (Denis & Schiffermüller, 1775)	Dolgij	21.vii.2004	1	Own data	ZISP
	Phiaris inquietana (Walker, 1863)	Dolgij	4.–15.vii.2004	3	Own data	ZISP
	Argyroploce mengelana (Fernald, 1894)	Belushja Guba	19.viii.1921	1	Rebel (1923) and Aarvik (2013)	NHM Oslo
	Argyroploce aquilonana Karvonen, 1932	Bolvanskij Nos	1.viii.1897	1	Own data	ZISP
		Dyrovataja Guba	6.viii.1897	1	Kuznetzov (1978)	ZISP
		Malye Karmakuly	27.vii.2015	1	Own data	MZH
		Novaya Zemlya	–	–	Kuznetzov (1978)	–
	Argyroploce noricana (Herrich-Schäffer, 1851)	Dolgij	4.–27.vii.2004	25	Own data	ZISP
		Malye Karmakuly	19.–27.vii.2015	3	Own data	MZH
	Epinotia tedella (Clerck, 1759)	Malye Karmakuly	27.vii.2015	1	Own data	MZH
	Eucosma ommatoptera Falkovitsh, 1965	Bolvanskij Nos	7.vii.–1.viii.2013	3	Own data	MZH
		Dolgij	15.vii.2004	1	Own data	ZISP
	Gypsonoma parryana (Curtis in Ross, 1835)	Belushja Guba	–	–	Rebel (1923)	–
		Malye Karmakuly	19.–27.vii.2015	2	Own data	MZH
		Propastchaya Guba	26.vii.1913	1	Own data	ZISP
Gelechiidae	*Bryotropha galbanella* (Zeller, 1839)	Malye Karmakuly	19.–27.vii.2015	1	Own data	MZH
	Chionodes nubilella (Zetterstedt, 1839)*	Malye Karmakuly	19.–27.vii.2015	2	Own data	MZH
Coleophoridae	*Coleophora glitzella* Hofmann, 1869	Dolgij	–	–	Anikin (2006)	–

Table 2 (continued)

Family	Species	Locality	Dates of sampling	Exx.	Data source	Repository
Pterophoridae	*Paraplatyptilia sahlbergi* (Poppius, 1906)	Dolgij	–	–	Makarova (2004)	–
	Platyptilia calodactyla (Denis & Schiffermüller, 1775)	Malye Karmakuly	24.vii.2015	1	Own data	MZH
Pyralidae	*Udea alaskalis* (Gibson, 1920)	Belushja Guba	13.vii.1907	1	Own data	ZISP
		Bolvanskij Nos	8.vii.–1.viii.2013	8	Own data	MZH
		Matochkin Shar	11.–19.vii.1925	8	Own data	ZISP
		Nochuev Ruchei	11.–19.vii.1925	17	Own data	ZISP
	Udea itysalis Walker, 1859*	Bugrino	4.vii.2013	4	Own data	MZH
	Udea uralica Slamka, 2013	Bugrino	4.vii.2013	1	Own data	MZH
	Eudonia alpina (Curtis, 1850)	Bugrino	4.vii.2013	4	Own data	MZH
		Dolgij	10.–15.vii.2004	1	Own data	ZISP
	Pediasia zellerella (Staudinger, 1899)	Bugrino	4.vii.2013	1	Own data	MZH
Pieridae	*Aporia crataegi* (Linnaeus, 1758)	Bolvanskij Nos	9.vii.2013	1	Vlasova et al. (2014)	–
		Dolgij	–	–	Makarova (2004)	–
	Pieris napi (Linnaeus, 1758)	Bugrino	–	–	Bolotov (2011)	–
	Colias palaeno (L.)	Dolgij	–	–	Makarova (2004)	–
	Colias tyche werdandi Zetterstedt, 1840	Nochuev Ruchei	23.vii.1924	3	Own data	ZISP
			18.vii.1925	5	Own data	ZISP
			31.viii.[sic!]1925	2	Own data	ZISP
		Shubert Bay	4.viii.1879	–	Jacobson (1898)	–
Nymphalidae	*Boloria chariclea* (Schneider, 1794)	Bolvanskij Nos	18.vii.2013	1	Vlasova et al. (2014)	–
		Dolgij	–	–	Makarova (2004)	–
		Gusinyi Nos [?]	–	–	Lukhtanov and Lukhtanov (1994), Fig. 230	–
		Kolguev	–	–	Lvovsky and Morgun (2007) and Bolotov (2011)	–
		Shubert Bay	4.viii.1879	–	Jacobson (1898)	–
	Boloria polaris (Boisduval, 1828)	Kolguev	–	–	Tatarinov and Dolgin (1999)	–
		Propastchaya Guba	6.viii.1912	1	Kusnezov (1925)	ZISP
		Vaygach	–	–	Tatarinov (2016)	–
	Boloria frigga (Thunberg, 1791)	Dolgij	–	–	Makarova (2004)	–
		Novaya Zemlya	–	–	Kozhanchikov (1958)	–
	Boloria improba (Butler, 1877)	Dolgij	–	–	Makarova (2004)	–
		Gusinyi Nos [?]		–	Lukhtanov and Lukhtanov (1994), Fig. 234	–
		Shubert Bay	4.viii.1879	–	Jacobson (1898)	–
		Vaygach	–	–	Tatarinov (2016)	–
	Boloria alaskensis (Holland, 1900)	Bolvanskij Nos	18.vii.–1.viii.2013	25	Vlasova et al. (2014)	–
		Dolgij	–	–	Makarova (2004)	–
	Vanessa cardui (Linnaeus, 1758)	Dolgij	–		Makarova (2004)	–
		Kolguev	–		Bolotov (2011)	–
	Nymphalis antiopa (Linnaeus, 1758)	Yangoto Lake	–		Vlasova et al. (2014)	–

Table 2 (continued)

Family	Species	Locality	Dates of sampling	Exx.	Data source	Repository
	Erebia disa (Thunberg, 1791)	Belushja Guba	–	–	Lvovsky and Morgun (2007), and pers. comm.	–
		Kolguev	–	–	Lvovsky and Morgun (2007), and pers. comm.	–
		Vaygach	–	–	Lvovsky and Morgun (2007), and pers. comm.	–
	Erebia pandrose (Borkhausen, 1788).	Bugrino	4.vii.2013	1	Own data	RMBH
		Krivoye Lake	–	–	Tatarinov (2016)	–
	Erebia fasciata Butler, 1868	Belushja Guba	–	–	Lvovsky and Morgun (2007), and pers. comm.	–
	Erebia rossii (Curtis in Ross, 1834)	Kolguev	–	–	Kusnezov (1925)	–
		Vaygach	–	–	Tatarinov (2016)	–
Geometridae	*Psychophora sabini* Kirby, 1824	Arkhangelskaya Guba	–	–	Rebel (1923)	–
		Bashmachnaya Guba	20.vii.1911	2	Own data	ZISP
		Belushja Guba	5.vii.1904	2	Own data	ZISP
		Bolshie Karmakuly	20.vi.–1.7.1889	2	Own data	ZISP
		Bolvanskij Nos	7.–10.vii.2013	3	Own data	MZH
		Mashigina Guba	–	–	Rebel (1923)	–
		Matochkin Shar	29.vii.1879	–	Jacobson (1898)	–
		Matochkin Shar	vii.1925	4	Own data	ZISP
		Nochuev Ruchei	26.vii.1912	1	Own data	ZISP
		Nochuev Ruchei	vii.1925	6	Own data	ZISP
		Olginskyi	16.vii.1911	1	Sumakow (1912)	ZISP
		Pankratieva Peninsula	–	–	Rebel (1923)	–
		Pereuzie	21.viii.1907	1	Own data	ZISP
		Propastchaya Guba	30.vii.–8.viii.1913	2	Own data	ZISP
		Propastchaya Guba	4.vii.1919	1	Own data	ZISP
		Propastchaya Guba	1.–6.viii.1919	4	Own data	ZISP
		Shubert Bay	4.viii.1879	–	Jacobson (1898)	–
		Shumilina Bereg	4.viii.1907	3	Own data	ZISP
		Vilcheka Mount	2.vii.1907	2	Own data	ZISP
		Vosmaya Guba	15.viii.1907	1	Own data	ZISP
	Psychophora cinderella Viidalepp, 2001	Nochuev Ruchei	14.v.–19.vii.1925	3	Own data	ZISP
	Xanthorhoe designata (Hufnagel, 1767)	Bugrino	4.vii.2013	5	Own data	MZH
	Xanthorhoe ferrugata (Clerck, 1759)	Bugrino	4.vii.2013	1	Own data	MZH
	Xanthorhoe annotinata (Zetterstedt, 1839)	Bugrino	4.vii.2013	2	Own data	MZH
	Eupithecia satyrata (Hübner, 1813)	Bugrino	4.vii.2013	1	Own data	MZH
	Macaria fusca (Thunberg, 1792)	Bugrino	4.vii.2013	1	Own data	MZH
Erebidae	*Arctia lapponica* (Thunberg, 1791)	Dolgij	–	–	Makarova (2004)	–
	Arctia subnebulosa tundrana Tshistjakov, 1990	Belushja Guba	14.vii.1907	1	Own data	ZISP
		Bugrino	–	–	Bolotov et al. (2015)	–

Table 2 (continued)

Family	Species	Locality	Dates of sampling	Exx.	Data source	Repository
Noctuidae	*Sympistis zetterstedti* (Staudinger, 1857)	Bolvanskij Nos	18.vii.–18.viii.2013	20	Own data	MZH
	Apamea lateritia (Hufnagel, 1766)	Rogachev Bay	8.vii.1911	1	Sumakow (1912)	ZISP
	Polia richardsoni (Curtis, 1834)	Bolvanskij Nos	18.vii.–22.viii.2013	3	Own data	MZH
		Matochkin Shar	20.vii.1924	1	Own data	ZISP
		Matochkin Shar	23.vi.1925	5	Own data	ZISP
		Shubert Bay	–	–	Rebel (1923)	–
	Lasionycta staudingeri (Aurivillius, 1891)	Malye Karmakuly	24.–27.vii.2015	2	Own data	RMBH
		Matochkin Shar	18.vii.1924	1	Own data	ZISP
		Nochuev Ruchei	1925	2	Own data	ZISP
		Shubert Bay	–	–	Hampson (1905)	–
	Graphiphora augur (Fabricius, 1775)*	Bolvanskij Nos	2.vii.2013	1	Own data	MZH
	Xestia quieta (Hübner, 1813)	Nochuev Ruchei	1925	2	Own data	ZISP
	Xestia lyngei (Rebel, 1923)	Malye Karmakuly	27.vii.2015	1	Own data	RMBH
		Mashigina Guba			Rebel (1923)	–
		Matochkin Shar	18.vii.1924	1	Own data	ZISP
		Nochuev Ruchei	1925	14	Own data	ZISP
		Olginskyi [?]	–	–	Lafontaine et al. (1983), map 5	–
	Xestia liquidaria (Eversmann, 1848)	Bolvanskij Nos	9.vii.–22.viii.2013	91	Own data	MZH
		Gusinyi Nos	16.–20.vii.1875	–	Jacobson (1898)	–
		Propastchaja Guba	1.viii.1912	1	Own data	ZISP
	Xestia aequaeva (Benjamin, 1934)	Bolvanskij Nos	8.–18.vii.2013	7	Own data	MZH
		Gusinyi Nos [?]	–	–	Lafontaine et al. (1983), map 4	–
	Xestia thula (Lafontaine & Kononenko, 1983)	Nochuev Ruchei [?]	–	–	Lafontaine et al. (1983), map 1	–

An asterisk (*) indicates species that are reported for the first time from the Nenets Autonomous Okrug and Novaya Zemlya [region 5 in Sinev (2008)]

MZH Finnish Museum of Natural History in Helsinki, *RMBH* Russian Museum of the Biodiversity Hotspots in Arkhangelsk, *ZISP* Zoological Institute in St. Petersburg, Russia

Wijdefjorden [Wide Bay] in Svalbard, has not been observed for more than a century, until a single female was found in 2015 near the type locality (Aarvik et al. 2017; Søli et al. 2018). Zagulajev (1981) included this species into the key for Lepidoptera of European Russia and described new subspecies, *Plutella polaris continentalis* Zagulajev, 1981, without providing any data on the type specimen. Kozlov (1989), referring to a private letter by K. Sattler, who investigated male genitalia of the type specimen of *P. polaris*, indicated that this species differs from *P. xylostella* by wide, nearly triangular valva and thick phallus without two basal arms, which are present in *P. xylostella*. Based on these characters, Kozlov (1989) synonymised *P. polaris continentalis* to *P. xylostella* and concluded that *P. polaris* had not been found in Russia by that date. Consistently, *P. polaris* was not included into the Catalogue of the Russian Lepidoptera (Sinev 2008). Coulson and Refseth (2004), without any justification, synonymised *P. polaris* to *P. xylostella*, and this incorrect synonymy was cited in several subsequent publications (e.g. Makarova et al. 2012). However, after Baraniak (2007) published photographs of the moth and of the male genitalia of *P. polaris*, Coulson et al. (2014) concluded that the distinct features currently support the specific status of *P. polaris*. We agree with the latter conclusion, and our finding, along with the current discovery of this species in Altai Mountains (Huemer et al. 2017), indicates that *P. polaris* is

not endemic to Svalbard, as it was believed for more than a century.

Plutella mariae Rebel, 1923. This species is very similar to *P. polaris* in characters of male genitalia, but differs from the latter species externally. Still there remains the possibility that *P. mariae* is a junior synonym of *P. polaris*.

Tortricidae

**Clepsis mehli* (Opheim, 1964). Arctic species, which so far was reported only from northern Norway (Aarvik and Larsen 1984) and Taymyr Peninsula in Russia (Kozlov et al. 2006).

Phiaris inquietana (Walker, 1863). This species was reported from Eastern Europe by Karsholt and Razowski (1996), subsequently included into the Fauna Europaea (without any distribution record) and listed for the Nenets Autonomous Okrug by Sinev (2008). However, we were unable to locate any specimen of this species originating from Europe or a published information listing exact locality data. The former westernmost records of this Beringian species were from Taymyr Pns. (Kozlov et al. 2006) and Amderma (Kullberg et al. 2013). In Greenland and Ellesmere Island, the larva of this species bores the stems and roots of several species of *Pedicularis* (MacKay and Downes 1969).

Argyroploce mengelana (Fernald, 1894). This record, under the name *Olethreutes glaciana* Möschler, was published by Rebel (1923); identification was corrected by Aarvik (2013). In Greenland and Ellesmere Island, the larva of this species feeds by spinned leaves of *Dryas integrifolia* (MacKay and Downes 1969).

A. aquilonana Karvonen, 1932. The source of information on the occurrence of this species in Novaya Zemlya (Kuznetzov 1978) remains unknown.

Epinotia tedella (Clerck, 1759). Presumably migrant; the host plants of this leafroller, *Picea obovata* Ledeb. and, presumably, *Larix* species, were not recorded in Novaya Zemlya (Sekretareva 2004).

Eucosma ommatoptera Falkovitsh, 1965. The westernmost records; earlier, this species was reported from Amderma (Kullberg et al. 2013), Taymyr Peninsula (Kozlov et al. 2006) and the Russian Far East, from Chukotka to Primorye region (Sinev 2008).

Gypsonoma parryana (Curtis in Ross, 1835). Holarctic species, described from Canada; in Russia was reported from Taymyr Peninsula (Kozlov et al. 2006), Chukotka and Magadan oblast (Sinev 2008).

Pterophoridae

Platyptilia calodactyla (Denis & Schiffermüller, 1775). The principal host plant of this species, *Solidago virgaurea* L., was not recorded in Novaya Zemlya (Sekretareva 2004). However, its larva may also feed on *Senecio* spp. and other Asteraceae.

Pyralidae

Udea alaskalis (Gibson, 1920). High Arctic species described from Alaska; recently was found in Amderma (Kullberg et al. 2013).

**Udea itysalis* Walker, 1859. A variable Holarctic species, which was described from North America, where it is widely distributed (Pohl et al. 2018). In Russia, this species was earlier recorded from Chukotka, Kamchatka and Magadan oblast (Sinev 2008). The first record from Europe.

Udea uralica Slamka, 2013. The species was recently described from the Asiatic slopes of Polar Ural Mountains (Slamka 2013); it is also known from Amderma (Kullberg et al. 2013) and from the Altai and Sayan Mountains (S. Sinev, pers. comm.). The earlier record of *U. cretacea* Fil. from Taymyr Peninsula (Kozlov et al. 2006) should be attributed to this species.

Pediasia zellerella (Staudinger, 1899). Described from Altai Mountains; recently found in Taymyr Peninsula (Kozlov et al. 2006) and in Amderma (Kullberg et al. 2013); common in surroundings of Vorkuta and in Polar Ural Mountains (J.K., pers. obs.). The westernmost record.

Pieridae

Aporia crataegi (Linnaeus, 1758). Palaearctic species, most likely a migrant.

Colias tyche werdandi Zetterstedt, 1840. This taxon may appear conspecific with *Colias nastes zemblica* Verity, 1911, described from Shubert Bay. Lvovsky and Morgun (2007) reported records of *C. n. zemblica* in Belushja Guba, but did not include Novaya Zemlya into the distribution range of *C. tyche*. However, we follow Tuzov et al. (1997) and Fauna Europaea (Karsholt and van Nieukerken 2013) and attribute the specimens from Novaya Zemlya to *C. tyche*.

Nymphalidae

B. frigga (Thunberg, 1791). The data behind the record from Novaya Zemlya (Kozhanchikov, 1958) remain unknown; no specimens from Novaya Zemlya were found in ZISP.

B. improba (Butler, 1877). Bolotov (2011) reported this species also from Kolguev, with reference to Lukhtanov and Lukhtanov (1994) and Tatarinov and Dolgin (1999); however, two latter publications did not include information on records of this species from the Kolguev Island.

Vanessa cardui (Linnaeus, 1758). A migrant.

Nymphalis antiopa (Linnaeus, 1758). Holarctic species, obviously a migrant.

Erebia rossii (Curtis in Ross, 1834). Record from Kolguev (Kusnezov 1925) is questionable (Bolotov 2011).

Geometridae

Psychophora sabini Kirby, 1824. Holarctic species. Some of published records may actually refer to *P. cinderella* Viidalepp.

Erebidae

Arctia lapponica (Thunberg, 1791). The record from Novaya Zemlya (Karsholt and Nieukerken 2013) was based on data from Rebel (1923) (B. Skule, pers. comm.); however, the latter work does not contain any information on *A. lapponica*.

Arctia subnebulosa tundrana Tshistjakov, 1990. The record from Belushja Guba is based on pinned dry larva.

Noctuidae

Sympistis zetterstedtii (Staudinger, 1857). The taxonomic status of this Holarctic species is controversial. We accept it after Lafontaine and Schmidt (2013) who consider *S. zetterstedtii* as a northern Holarctic species, which is separate of *S. nigrita* occurring in Alps.

Lasionycta staudingeri (Aurivillius, 1891). The record from Shubert Bay was published as *Anarta zemblica* (Hampson 1905).

Xestia aequaeva (Benjamin, 1934). The record from Gusinyi Nos [?] (Lafontaine et al. 1983, map 4) was published as *X. brachiptera* Kononenko, 1981. Holarctic species; recently found in polar deserts of Severnaya Zemlya (Makarova et al. 2012).

Species erroneously reported from the study region

Sterrhopterix fusca (Haworth, 1809). Novaya Zemlya (Arnscheid 2013). Presumably a technical error that occured at the time of data entry into the Fauna Europaea database (W. Arnscheid, pers. comm.). The record of this species in the Nenets Autonomous Okrug by Sinev (2008) is presumably based on Fauna Europaea and should therefore be disregarded.

S. standfussi (Wocke, 1851). Novaya Zemlya (Arnscheid 2013). Same as for the previous species.

Phiaris glaciana (Möschler, 1860). Reported from Novaya Zemlya (Belushja Guba) by Rebel (1923) on the basis of two misidentified specimens of *Argyroploce mengelana* (L. Aarvik, pers. comm.). The record of *P. glaciana* in the Nenets Autonomous Okrug by Sinev (2008) is based on publication by Rebel (1923) and should therefore be disregarded.

Epagoge grotiana (Fabricius, 1781). Reported from in the Nenets Autonomous Okrug by Sinev (2008) on the basis of misidentified specimens of *Clepsis mehli* from Dolgij Island.

Apotomis demissana Kennel, 1900. Reported from in the Nenets Autonomous Okrug by Sinev (2008) on the basis of misidentified specimens of *Apotomis frigidana* from Dolgij Island.

Entephria punctipes (Curtis 1835). Reported (as *Larentia byssata* Aurivillius, 1891) from Novaya Zemlya (Olginskyi) by Sumakow (1912) on the basis of a misidentified specimen of *Psychophora sabini*.

Discussion

According to the recent review of invertebrate biodiversity of the archipelagos of the Barents Sea, only 23 species of Lepidoptera have thus far been recorded from Svalbard and Novaya Zemlya (Coulson et al. 2014). Our study, reporting 60 species, clearly demonstrated that earlier impressions regarding the extremely low species richness of moths and butterflies on Arctic islands primarily reflect a low sampling effort, especially of so-called microlepidoptera. Based on the list of species found in the continental part of the Nenets Autonomous Okrug (Kozlov et al. 2018), we estimate that some 40–60 species of moths still remain to be found in this region, especially in Kolguev Island.

Six of the 60 species were recorded for the first time from the region consisting of the Nenets Autonomous Okrug (NAO) and the Novaya Zemlya archipelago. Interestingly, some of these species, such as *Aethes deutschiana* and *Graphiphora augur*, are widely distributed in Eurasia; nevertheless, they have not been collected in the continental part of the NAO until now (Kozlov et al. 2018). At the same time, we report several biogeographically important findings: *Udea itysalis* is recorded for the first time in Europe, and both *Clepsis mehli* and *Plutella polaris* are recorded for the first time in the European part of Russia. Our findings also expand the known distribution ranges of *Phiaris inquietana*, *Eucosma ommatoptera* and *Pediasia zellerella* further west.

Some 30% of Lepidoptera species, which have been recorded earlier from Svalbard and Novaya Zemlya, are considered to be vagrants and not residents of these archipelagos (Coulson et al. 2014). Of course, given the current paucity of knowledge, it is almost impossible to conclude whether a species completed its life cycle in a given locality. Indeed,

even the absence of known host plants cannot exclude the possibility that a local population evolved to use alternative hosts. Nevertheless, we have classified five of 60 species recorded in the Arctic islands of European Russia as likely migrants.

The faunas of Dolgij and Kolguev Islands (18 and 19 species, respectively) include moths typical of northern taiga forests (e.g. *Aethes deutschiana*, *Celypha lacunana* and *Xanthorhoe designata*), and we believe that the low numbers of Lepidoptera species discovered on these islands have resulted primarily from a low collecting effort. By contrast, the fauna of Vaygach Island (22 species) is relatively well known and includes several high Arctic species, such as *Xestia aequaeva*, *X. liquidaria* and *X. lyngei*. However, it is depauperated even relative to the fauna of Amderma (29 species: Kullberg et al. 2013), a site located on the continent only 80 km to the south of Bolvanskij Nos, the main sampling site on Vaygach Island. The fauna of Novaya Zemlya totals 30 species of Lepidoptera, only eight of which were collected from the Northern Island, mostly near Matochkin Shar strait.

Three quarters of the moth and butterfly species recorded on the Arctic islands were reported earlier from the continental part of the NAO (Kozlov et al. 2018). Importantly, ten of these 45 common species within the continental part of the NAO were found only in Amderma. We estimate that some 20 of the 60 species recorded on the Arctic islands, primarily those found on the Novaya Zemlya archipelago and Vaygach Island, are either limited to the polar desert zone or are most abundant in the northern tundras.

Interestingly, the ratio between the numbers of 'microlepidoptera' and 'macrolepidoptera' recorded on Arctic islands (0.76) is only slightly lower than that determined for the continental part of the NAO (1.09; Kozlov et al. 2018), indicating that the faunas of moths and butterflies of these two areas have been explored to about the same level. Still, the local fauna of Amderma, the relatively well-studied continental locality near Vaygach Island, has an unexpectedly high (1.64) ratio between the numbers of 'microlepidoptera' and 'macrolepidoptera'. This ratio is even higher than that found in the Murmansk region (1.52: Kozlov and Kullberg 2011), which has the best studied lepidopteran fauna among the regions of Russia (Sinev 2008). This finding confirms that the relatively low proportion of 'microlepidoptera' reported so far from the Arctic islands reflects the common sampling bias towards 'macrolepidoptera', rather than a predominance of the latter group in the Arctic fauna. The question remains whether, as suggested by Makarova et al. (2012), the northernmost representatives of Lepidoptera are *Psychophora* spp. and *Cynaephora groenlandica*, or whether this conclusion is biased by the absence of knowledge on the 'microlepidoptera' that inhabit polar deserts.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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