Faunistic notes on Lepidoptera collected from arctic tundra in European Russia

Jaakko Kullberg[1], Boris Yu. Filippov[2], Natalia A. Zubrij[3] & Mikhail V. Kozlov[4]

[1] Finnish Museum of Natural History, Zoology Unit, University of Helsinki, P.O. Box 17, FI-00014 Helsinki, Finland

[2] Department of Zoology and Ecology, Northern (Arctic) Federal University, Lomonosova 4, 163002 Arkhangelsk, Russia

[3] Institute of Ecological Problems of the North, Ural Branch of the Russian Academy of Sciences, Severnaya Dvina Emb. 23, 163000 Arkhangelsk, Russia

[4] Section of Ecology, University of Turku, FI-20014 Turku, Finland; mikoz@utu.fi (corresponding author)

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Abstract. The insect fauna of European arctic tundra is seriously understudied in contrast to the well-documented subarctic Fennoscandian fauna. We report the results of a survey made on Kara Sea coast near Amderma (N 69°46′, E 61°40′) from 18 June to 3 August 2012. This survey yielded 156 specimens of 29 species of Lepidoptera, 16 of which are new for the Nenets Autonomous Okrug. Noteworthy is the discovery of *Gnorimoschema vastificum* Braun, 1929, so far known only from North America. Two Holarctic species, *Greya variabilis* Davis & Pellmyr, 1992 and *Udea alaskalis* (Gibson, 1920), and four Palaearctic species, *Eucosma ommatoptera* Falkovitsh, 1965, *Pediasia zellerella* (Staudinger, 1899), *Udea uralica* Slamka, 2013 (recently described from the Asiatic slopes of Polar Ural Mts) and *Xanthorhoe uralensis* Choi, 2003, are for the first time reported from Europe (in the strict geographical sense). The fauna of the surroundings of Amderma is dominated by Holarctic species, most of which are confined to tundra habitats.

Introduction

Arctic habitats have always fascinated entomologists, although only a few of them were ready to spend several months in hostile and mosquito-infested tundra environments in order to collect a few dozens of moths and butterflies. Therefore the faunistic data on Lepidoptera from the European Arctic are scarce, except for the relatively well-known but species-poor and isolated Svalbard Archipelago with only three local species (Coulson 2007). Historical data exist for Novaya Zemlya (Jacobson 1898; Rebel 1923), with 14 species included in the recent version of the Fauna Europaea (Karsholt et al. 2012). The Finnish entomologist Poppius (1906) reported 27 species of Lepidoptera from the Kanin Peninsula. Recently, Bolotov (2011) discovered in the Kanin Peninsula 29 species of butterflies, 14 of which were collected in Arctic tundra. He also reported six species of butterflies from the Kolguev Island north of the Kanin Peninsula (Bolotov 2011). Further to the East, in the Bolshezemelskaya Tundra, the region administratively belonging to the Nenets Autonomous Okrug and the Republic of Komi, Tatarinov and Kulakova (2005) recorded 61 species of butterflies. We are not aware of any data on Lepidoptera from the Yugorsky Peninsula, which lies very close to the north-eastern corner of continental Europe.

In summer of 2012, the Northern (Arctic) Federal University situated in Arkhangelsk organised an expedition to Amderma. Although the expedition focused on the investi-

gation of ground beetles (Carabidae), it also resulted in the collection of representative material of Lepidoptera. Keeping in mind the acute shortage of faunistic information from the arctic regions of European Russia we publish the list of collected species along with short comments.

Material

Amderma (N 69°46′, E 61°40′) is a small, nowadays nearly abandoned settlement in the Nenets Autonomous Okrug within the Arkhangelsk Oblast in Russia. It is located in Yugorsky Peninsula at the coast of the Kara Sea (Fig. 1), within the zone of low-shrub tundra (as defined by Walker et al. 2005). July is warmest with an average temperature of 7.3°C, and January is coldest with an average temperature of −21.3°C; annual precipitation amounts 326 mm.

Moths and butterflies were generally collected within 10 km distance from Amderma; therefore we do not report an exact sampling site. This area (5 to 70 m in elevation) is mostly covered by different types of tundra, but also includes meadows associated with small rivers and ravines, and bogs (Figs 2–5). Description of the vegetation in 14 plots of 10 × 10 m size revealed 96 species of vascular plants, among which the most common were *Dryas octopetala* L. (Rosaceae), *Carex norvegica* Retz. (Cyperaceae), *Myosotis caespitosa* Schultz (Boraginaceae), *Pachypleurum alpinum* Ledeb. (Apiaceae), *Poa alpina* L. (Poaceae), *Salix arctica* Pallas, *S. lanata* L., *S. polaris* Wahlenb. and *S. reticulata* L. (Salicaceae). Species richness of vascular plants within a plot varied from 7 to 37 species (the mean being 18 species), and vegetation cover varied from 40 to 98% (the mean being 80%).

Moths and butterflies were searched for during regular excursions from 18 June to 3 August 2012 and collected by netting. Some specimens were sampled from plants. Sweep-netting brought no results. Lepidopteran larvae were also collected by pitfall trapping, but this material is not yet identified. The specimens are deposited in the Finnish Natural History Museum (Helsinki).

In the following list, an asterisk (*) denotes species that have not yet been recorded from Europe in the strict geographical sense, i.e. from areas to the west from the dividing ridge of the Polar Ural Mts. This is done to minimize the possibility of confusion between geographical, biogeographical and administrative borders; our approach in no way compromises the understanding of the European fauna as accepted by Fauna Europaea, the project which covers the entire Ural Mts and does not follow regional borders (Karsholt et al. 2012). Note that in the checklist of the Lepidoptera of Russia (Sinev 2008) the entire regions 5 and 6 (jointly including Arkhangelsk Oblast and the Republic of Komi) belong to Europe, as well as the westernmost parts of the regions 15 (Northern Ural Mts) and 18 (Yamalo-Nenetskij Autonomous Okrug), whereas the eastern parts of regions 15 and 18 belong to Asia. A degree sign (°) indicates species that are for the first time reported from the Nenets Autonomous Okrug (region 5 in Sinev 2008). An exclamation mark (!) indicates species that had not been included in the Fauna Europaea (Karsholt et al. 2012) by April 1, 2013.

Fig. 1. Location of Amderma.

Figs 2–5. Examples of habitats near Amderma. **2.** Alpine meadow near small river. **3.** Alpine meadow on south-facing slope. **4.** Willow-*Dryas* tundra. **5.** Meadow on sandy soils, with a bog behind.

List of species

PRODOXIDAE

*!***Greya variabilis* Davis & Pellmyr, 1992**

Carex-moss bog, 9.vii, 2 exx. This Holarctic species was described from North America in 1992 and later on reported from the Chukchi Peninsula (Kozlov 1996) and Taimyr Peninsula (Kozlov et al. 2006). In the Palaearctic it is known only from tundra, but in the Nearctic it occurs also in moist coniferous forests.

TINEIDAE

°***Tineola bisselliella* (Hummel, 1823)**

Indoors, 3.viii, 2 exx. Synantropic species that was originally confined to the western Palaearctic, but is now introduced to all regions.

PLUTELLIDAE

***Plutella xylostella* (Linnaeus, 1758)**

Willow-moss tundra, 22.vi, 2 exx. Willow-grass tundra, 7.vii, 1 ex. Cosmopolitan. Generally considered as migrant in the Arctic (Makarova et al. 2012).

GELECHIIDAE

*!***Gnorimoschema vastificum* Braun, 1929** **Fig. 6**

Stony willow tundra, 9.vii, 12 exx. The species is similar to *G. bodillum* Karsholt & Nielsen, 1974 described from coastal sand dune areas of the North Sea. The morphological similarity between *G. vastificum* and *G. bodillum* had been already noted by Povolný (2002) and O. Karsholt (pers. comm.). However, the moths from Amderma differ from both these species by black forewings with few scattered whitish and orange brown scales, while both legs and the underside of the body are covered mainly by whitish scales. Our identification is primarily based on the results of DNA sequencing: our specimen is placed within a clade consisting of several dozens of specimens of *G. vastificum* from Canada and Alaska, but substantially differs from *G. bodillum* from Denmark (J.-F. Landry, V. Nazari & M. Mutanen, unpublished data in BOLD). It may indeed happen that the specimens from sandy riverbank in Taymyr Peninsula, identified as *G. bodillum* by Bidzilya (2005), belong to the same taxon, because the moths from Taimyr were almost black in contrast to sandy brownish colouration of the Danish specimens. Interestingly, the habitat in Amderma does not include open sands, but tundra with *Salix arctica* and *S. rotundifolia*.

°***Bryotropha galbanella*** (Zeller, 1839)

Willow-*Dryas* tundra, 29.vii, 5 exx.; 9.vii, 1 ex. Stony willow tundra, 9.vii, 1 ex. Stony *Arctous-Empetrum* tundra, 9.vii, 1 ex. Willow-grass tundra, 7.vii, 1 ex. Holarctic boreal species living on mosses.

TORTRICIDAE

Apotomis frigidana **(Packard, 1867)**

Stony shrubby tundra, 9.vii, 1 ex. Willow-*Dryas* tundra, 29.vii, 1 ex. Infrequent Holarctic species, which is not recorded in Fennoscandia.

Argyroploce noricana **(Herrich-Schäffer, 1851)**

Alpine meadow, 29.vi, 1 ex.; 7.vii, 1 ex.; 17.vii, 6 exx.; 19.vii, 2 exx. Stony shrubby tundra, 7.vii, 1 ex. *Rubus chamaemorus*-sedge bog, 9.vii, 1 ex. *Dryas*-moss tundra, 9.vii, 25 exx. Stony dwarf shrub tundra, 17.vii, 3 ex. Willow-*Dryas* tundra, 9.vii, 2 exx.; 19.vii, 1 ex.; 29.vii, 1 ex. This European arctoalpine species whose larvae feed on *Dryas* was most common in the study area, where the moths were observed on flowers of *Polygonum viviparum*.

Phiaris inquietana **(Walker, 1863)**

Willow-*Dryas* tundra, 9.vii, 1 ex. This Holarctic arctoalpine tundra species in Europe has only been found in Nenets Autonomous Okrug (Sinev 2008) and Polar Ural Mts (Polyarnyi Ural station: J. K., pers. obs.).

Phiaris obsoletana **(Zetterstedt, 1839)**

Alpine meadow, 7.vii, 1 ex.; 17.vii, 1 ex. *Carex*-moss bog, 9.vii, 2 exx. Meadow on sandy soil in a ravine, 11.vii, 1 ex. Sedge-moss bog, 19.vii, 1 ex. *Dryas*-moss tundra, 29.vii, 1 ex. Willow-*Dryas* tundra, 19.vii, 1 ex. Palaearctic boreomontane species typical for boreal bogs.

Phiaris turfosana **(Herrich-Schäffer, 1851)**

Stony willow tundra, 19.vii, 1 ex. Holarctic boreomontane species typical for boreal bogs.

Gypsonoma parryana **(Curtis, 1835)**

Alpine meadow, 7.vii, 5 exx.; 17.vii, 3 exx. Willow-grass tundra, 7.vii, 4 exx. Willow-*Dryas* tundra, 7.vii, 1 ex.; 9.vii, 2 exx.; 19.vii, 1 ex.; 29.vii, 1 ex. *Dryas*-moss tundra, 1.vii, 3 exx. Holarctic tundra species which in Europe has only been reported from Novaya Zemlya (Rebel 1923).

*!***Eucosma ommatoptera*** **Falkovitsh, 1965**

Meadow on sandy soil in a ravine, 27.vi, 1 ex. Alpine meadow, 7.vii, 1 ex. Willow-

Dryas tundra, 29.vii, 1 ex. Earlier reported from Taimyr (Kozlov et al. 2006) and the Russian Far East, from Chukotka to Primorye region (Sinev 2008).

PTEROPHORIDAE

°***Platyptilia calodactyla*** **(Denis & Schiffermüller, 1775)**

Carex-moss bog, 9.vii, 1 ex. Sedge-moss bog, 19.vii, 1 ex. A widely distributed Palaearctic species.

°!***Paraplatyptilia sibirica*** **Zagulajev, 1983**

Carex-moss bog, 9.vii, 1 ex. Sedge-moss bog, 19.vii, 1 ex. Palaearctic tundra species which in Europe has only been reported from the north-eastern part of the Komi Republic (Sinev 2008).

PYRALIDAE

°***Catastia kistrandella*** **Opheim, 1963**

Dryas-moss tundra, 9.vii, 1 ex.; 29.vii, 1 ex. Palaearctic subalpine and tundra species which is distributed from northern Fennoscandia to Chukotka.

****Pediasia zellerella*** **(Staudinger, 1899)**

Carex-moss bog, 9.vii, 2 exx. Sedge bog, 9.vii, 1 ex. Alpine meadow, 17.vii, 1 ex. Described from Altai Mts; recently found in Taymyr (Kozlov et al. 2006). Common in surroundings of Vorkuta in the north-eastern corner of European Russia and in Polar Ural Mts (J. K., pers. obs.).

*!***Udea alaskalis*** **(Gibson, 1920)** **Fig. 7**

Alpine meadow, 29.vi, 1 ex. Willow-grass tundra, 7.vii, 1 ex. High arctic species described from Alaska, which in Palaearctic has been reported only from Chukotka (Sinev 2008). The species is closely related to *U. torvalis* (Möschler) occurring in the Nearctic and Greenland.

*!***Udea uralica*** **Slamka, 2013**

Willow-grass tundra, 17.vii, 2 exx. The species has recently been described from the Asiatic slopes of Polar Ural Mts (Slamka 2013); it is also known from the Altai and Sayan Mts (S. Sinev, pers. comm.).

PIERIDAE

Aporia crataegi **(Linnaeus, 1758)**

Ruderal habitat, 27.vi, 1 ex. Palaearctic, most likely a migrant.

GEOMETRIDAE

***Psychophora sabini* (Kirby, 1824)**

Willow-moss tundra, 22.vi, 2 exx. Holarctic species.

***Xanthorhoe uralensis* Choi, 2003**

Alpine meadow, 29.vi, 3 exx. Sedge bog, 9.vii, 1 ex. A recently described species (Choi 2003), which was so far known only from Krasnyi Kamen in the eastern (Asiatic) slopes of the Polar Ural Mts but was attributed to the European fauna by Hausmann & Viidalepp (2012). A member of the taxonomically challenging Holarctic *X. incursata* group consisting of several closely related allopatric taxa: Central European *X. incursata* (Hübner, 1813), Fennoscandian *X. annotinata* (Zetterstedt, 1839), *X. pseudoannotinata* Vasilenko, 2007 from South Urals, south Siberian *X. sajanaria* (Prout, 1914) and east Siberian *X. derzhavini* (Djakonov, 1931).

***Entephria punctipes* (Curtis, 1835)**

Rubus chamaemorus-sedge bog, 9.vii, 1 ex. Sedge bog, 9.vii, 1 ex. Nival meadow, 19.vii, 2 exx. Willow-*Dryas* tundra, 29.vii, 1 ex. Holarctic species.

°*Dysstroma pseudimmanata* (Heydemann, 1929)

Sedge bog, 9.vii, 1 ex. The only previous record from Europe originates from South Ural Mts (Hausmann & Viidalepp 2012); also found in Polar Ural Mts near Krasnyi Kamen (J. K., pers. obs.). Widely distributed through Siberia to Kamchatka and Japan; recently, on the basis of mtDNA analysis, reported from North America (Hausmann & Viidalepp 2012).

EREBIDAE

°*Pararctia subnebulosa tundrana* Tshistjakov, 1990

Willow-grass tundra, 7.vii, 1 ex. A Holarctic tundra species, which in Europe has only been found in the easternmost part of the Republic of Komi (Polyarnyi Ural station: Tatarinov et al. 2003). Nominal subspecies described from North America.

NOCTUIDAE

°*Syngrapha hochenwarthi* (Hochenwarth, 1785)

Meadow on sandy soil in a ravine, 27.vii, 1 ex. A subalpine Holarctic species.

°*Sympistis zetterstedtii* (Staudinger, 1857)

Dryas-moss tundra, 18.vi, 1 ex. Sedge bog, 9.vii, 1 ex. *Dryas*-moss tundra, 9.vii, 2 exx. Willow-*Dryas* tundra, 9.vii, 1 ex.; 19.vii, 4 exx.; 29.vii, 1 ex. *Rubus chamaemorus*-

sedge bog, 29.vii, 1 ex. Alpine meadow, 8.viii, 1 ex. The taxonomic status of this Holarctic species is controversial. We accept it after Lafontaine & Schmidt (2013) who consider *S. zetterstedtii* as a northern Holarctic species which is separate of *S. nigrita* occurring in Alps.

***Polia richardsoni* (Curtis, 1835)**

Alpine meadow, 29.vii, 1 ex. Holarctic, circumpolar.

***Xestia liquidaria* (Eversmann, 1848)**

Carex-moss bog, 9.vii, 1 ex. *Rubus chamaemorus*-sedge bog, 9.vii, 1 ex. Stony willow tundra, 9.vii, 1 ex. Willow-*Dryas* tundra, 9.vii, 1 ex. Holarctic species with partly brachypterous females, earlier known in Europe only from Novaya Zemlya (Rebel 1923). This typical arctic tundra species was described originally as a geometroid moth from "Steppen der Kirgisen" (mainly Kazakhstan) which is an obvious mislabelling (Fibiger 1993) as there are no suitable habitats.

***Xestia quieta* (Hübner, 1813)**

Alpine meadow, 29.vi, 1 ex. A typical Holarctic species inhabiting stony scree slopes in Fennoscandia and Polar Ural Mts.

Discussion

Although the number of Lepidoptera species collected from the arctic tundra surrounding Amderma is relatively low, the discovered fauna shows an unexpectedly high (1.64) ratio between the numbers of so-called 'microlepidoptera' to 'macrolepidoptera'. This ratio is even higher than in the Murmansk region of Russia (1.52: Kozlov & Kullberg 2010), the lepidopteran fauna of which is best studied among the regions of Russia (Sinev 2008). This finding strongly suggests that the extremely low proportion of 'microlepidoptera' reported so far from the Nenets Autonomous Okrug (0.59: Sinev 2008) reflects the insufficient level of knowledge due to common sampling bias towards 'macrolepidoptera', rather than predominance of the latter group in the arctic fauna.

The largest part of Lepidoptera recorded in Amderma (19 species; 66%) is widely distributed, with 17 species having a Holarctic range, and two being cosmopolitan (*Plutella xylostella*, *Tineola bisselliella*). This proportion may appear even higher, because some Palaearctic species, like *Catastia kistrandella* (distributed from Northern Fennoscandia to Chukotka), are likely to be discovered in North America, too. In this respect the fauna of Amderma resembles the fauna of Taimyr, which included 45% of Holarctic and cosmopolitan species (Kozlov et al. 2006). The difference between the faunas of Amderma and Taimyr can be attributed to the presence of boreal forests in the southern parts of Taimyr Peninsula, while Amderma is located in arctic tundra. Consequently, about one third of species collected from Amderma were not found outside the tundra habitats (including those confined to alpine regions).

Figs 6, 7. Interesting species collected from Amderma. **6.** *Gnorimoschema vastificum* Braun, 1929. **7.** *Udea alaskalis* (Gibson, 1920).

Surprisingly, seven of the 29 species collected from Amderma are new for Europe (in the strict geographical sense), including *Gnorimoschema vastificum* which is new for the entire Palaearctic region. However, since the fauna of Ural Mts hardly differs on European and Asiatic sides, the finding of two of these species (*Udea uralica* and *Xanthorhoe uralensis*) in Europe was quite predictable, as they were already known from the Asiatic slopes of Polar Ural Mts. More than a half (16 of 29) species collected from Amderma appeared new for the Nenets Autonomous Okrug, thus increasing the number of species recorded in this region from 108 (Sinev 2008) to 124.

The records of the expedition to Amderma revealed how easy it is to discover new and unexpected species of Lepidoptera for Europe in the tundra of European Russia if you just get there. Only a handful of locations scattered over the vast area covered by tundra in the north-eastern part of Europe have been collected until the present day (and even then only poorly sampled). The opening of the Iron Curtain has not much encouraged the entomological studies of the Russian polar regions even in the light of actively continuing international debates on global warming. The effects of this phenomenon on insect fauna are expressed, in particular, in shifting the distributional range of butterflies towards the North (Parmesan et al. 1999). Therefore we are in serious danger of losing the knowledge of the present distribution of Lepidoptera species in the area where the global effect is hitting hard and the expected warming may move species distributions hundreds of kilometres towards the north.

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References

Bidzilya, A. V. 2005. On the distribution of Gelechiid Moths (Lepidoptera, Gelechiidae) in Siberia. Contribution 2. – Proceedings of Zoological Museum, Taras Shevchenko National University in Kiev **3**: 7–19. [In Russian, English summary].

Bolotov, I. N. 2011. Fauna and ecology of butterflies (Lepidoptera, Rhopalocera) from Kanin Peninsula and Kolguev Island. – Zoologicheskij Zhurnal **90**: 1365–1373. [In Russian, English abstract].

Choi, S. W. 2003. A new species of *Xanthorhoe* Hübner (Lepidoptera: Geometridae: Larentiinae) from Polar Urals, Russia. – Journal of the Kansas Entomological Society **76**: 125–130.

Coulson, S. J. 2007. The terrestrial and freshwater invertebrate fauna of the High Arctic archipelago of Svalbard. – Zootaxa **1448**: 41–58.

Fibiger, M. 1993. Noctuinae II. Noctuidae Europaeae **2**. – Entomological Press, Sorø. 230 pp.

Hausmann, A. & J. Viidalepp 2012. Larentiinae I., The Geometrid Moths of Europe, Vol. **3**. – Apollo Books, Stenstrup, 743 pp.

Jacobson, G. G. 1898. Zoological investigation on Novaya Zemlya in 1896. The insects of Novaya Zemlya. – Mémoires de l'Académie des sciences de St.-Pétersbourg. VIIIe série. Classe des sciences physiques et mathématiques **8**: 171–244. [in Russian].

Karsholt, O., E. J. van Nieukerken & Y. S. D. M. de Jong 2012. Lepidoptera, Moths. – Fauna Europaea version 2.5, http://www.faunaeur.org.

Kozlov, M. V. 1996. Incurvariidae and Prodoxidae (Lepidoptera) from Siberia and the Russian Far East, with descriptions of three new species. – Entomologica Fennica **7**: 55–62.

Kozlov, M. V., J. Kullberg & V. V. Dubatolov 2006. Lepidoptera of the Taymyr Peninsula, northwestern Siberia. – Entomologica Fennica **17**: 136–152.

Kozlov, M. V. & J. Kullberg 2010. New and interesting records of Lepidoptera from the Kola Peninsula, northwestern Russia, in 2000–2009. – Entomologica Fennica **21**: 254–272.

Lafontaine, J. D. & B. C. Schmidt 2013. Comments on differences in classification of the superfamily Noctuoidea (Insecta, Lepidoptera) between Eurasia and North America. – ZooKeys **264**: 209–217.

Makarova, O. L., A. V. Sviridov & M. A. Klepikov 2012. Moths and butterflies (Lepidoptera) of polar deserts. – Zoologicheskij Zhurnal **91**: 1043–1057. [In Russian].

Parmesan, C., N. Ryrholm, C. Stefanescu, J. K. Hill, C. D. Thomas, H. Descimon, B. Huntley, L. Kaila, J. Kullberg, T. Tammaru, W. J. Tennent, J. A. Thomas & M. Warren 1999. Poleward shifts in geographical ranges of butterfly species associated with regional warming. – Nature **399**: 579–583.

Poppius, B. R. 1906. Beiträge zur Kenntniss der Lepidopteren-Fauna der Halbinsel Kanin. – Acta Societatis pro Fauna et Flora Fennica **28** (3): 1–11.

Povolný, D. 2002. Iconographia tribus Gnorimoschemini (Lepidoptera, Gelechiidae) regionis Palaearcticae. – Franisek Slamka, Bratislava. 110 pp.

Rebel, H. 1923. Lepidoptera von Novaja Semlja. – Report of the Scientific Results of the Norwegian Expedition to Novaya Zemlya 1921, **7**: 1–15.

Sinev, S. Yu. (ed.) 2008. Catalogue of the Lepidoptera of Russia. – KMK Scientific Press, St. Petersburg & Moscow. 424 pp. [In Russian.]

Slamka, F. 2013. Pyraloidea of Europe, Vol. **3**, Pyraustinae and Spilomelinae – F. Slamka, Bratislava. 357 pp.

Tatarinov, A. G. & O. I. Kulakova 2005. Butterflies (Lepidoptera, Rhopalocera) of the Bolshezemelskaya tundra in the northeast of the European part of Russia. – Euroasian Entomological Journal **4**: 331–337.

Tatarinov, A. G., K. F. Sedykh & M. M. Dolgin 2003. Higher heteroceran Lepidoptera. Fauna of the European North-East of Russia, Vol. **7**, pt. 2. – Nauka, Moscow. 223 pp. [In Russian.]

Walker, D. A., M. K. Raynolds, F. J. A. Daniëls, E. Einarsson, A. Elvebakk, W. A. Gould, A. E. Katenin, S. S. Kholod, C. J. Markon, E. S. Melnikov, N. G. Moskalenko, S. S. Talbot, B. A. Yurtsev & the other members of the CAVM Team 2005. The Circumpolar Arctic vegetation map. – Journal of Vegetation Science **16**: 267–282.