

**NEW DATA ON BUMBLEBEE FAUNA (Hymenoptera: Apidae, *Bombus* Latr.)
OF VAYGACH ISLAND AND THE YUGORSKY PENINSULA¹**

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The paper presents new data on the bumblebee fauna of Vaygach Island and the Yugorsky Peninsula. The authors use materials collected on these territories as well as data from published sources. 5 species of bumblebee fauna are found on Vaygach Island: *Bombus flavidus*, *B. lapponicus*, *B. pyrrhopygus*, *B. balteatus* and *B. hyperboreus*. 11 species are met in the Yugorsky Peninsula: *B. flavidus*, *B. norvegicus*, *B. lapponicus*, *B. hypnorum*, *B. jonellus*, *B. cingulatus*, *B. pyrrhopygus*, *B. balteatus*, *B. hyperboreus*, *B. sporadicus* and *B. cryptarum pallidocinctus*. 2 specimen of bumblebees (*B. sporadicus* and *B. cryptarum pallidocinctus*) are studied by DNA-barcoding to confirm the morphological identification. The local studied faunae are characterized by species widely spread in the Palaearctic. Most of them are trans-Palaearctic. The number of species on Vaygach Island is comparable with the number of species of the regional island faunae of the Arctic territories in the European North of Russia. The

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number of bumblebee species in the Yugorsky Peninsula is higher, due to the presence of species, which are not typical of zonal tundra habitats. The regional bumblebee fauna has a low specificity that is the result of the post-glacial origin of faunae in the European North.

Keywords: *bumblebee, fauna, Bombus Latr., Arctic, Vaygach Island, Yugorsky Peninsula.*

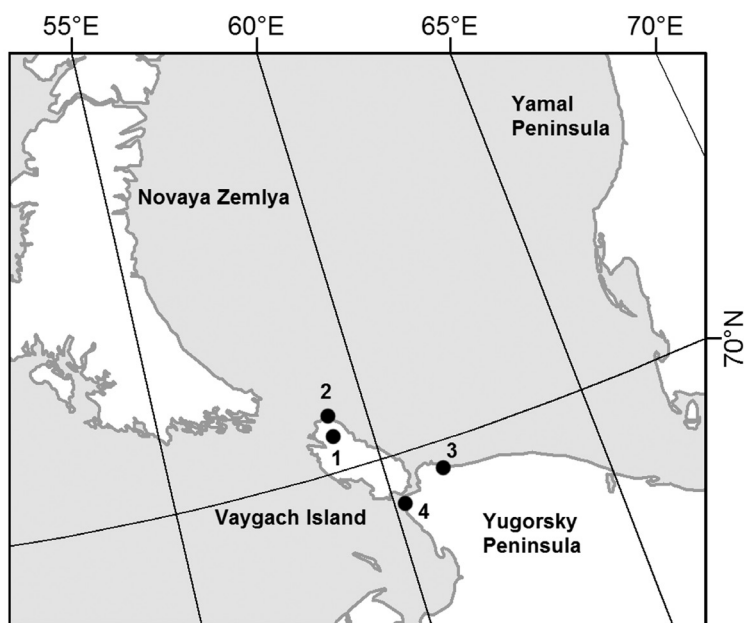
Studies of bumblebee fauna in the Arctic have been included in entomological studies since the 19th century and Yu.I. Chernov [1] notes that “as a result of faunal studies in tundra and arctic desert, which began in the 1st half of the last century and have been particularly intense in the early 20th century, a relatively large number of faunal data on various groups of arctic insects, including anthophilous fauna has been accumulated”.

However, some areas in the East European Arctic remain poorly studied because they are hard to reach and such territories include Vaygach Island and the Yugorsky Peninsula, whereby materials for these areas are scarce. It is data of the late 19th and early 20th centuries, collected mainly by

A.E. Holmgren and H. Friese. In the mid-20th century, the materials from these territories were collected by Yu.I. Chernov.

The main aim of this study was to analyse new data on the bumblebee fauna, which were obtained during the field research in Vaygach Island (2010 and 2013) and the Yugorsky Peninsula (2010, 2012 and 2015).

Materials and methods. Our research was based on the study of a collection of materials, which were obtained by the researchers N.A. Zubriy, B.Yu. Filippov, A.A. Vlasova, V.M. Spitsyn and I.N. Bolotov. Samples for this study were collected from Vaygach Island – Yangoto Lake (70°15'N, 59°05'E) and Bolvansky Cape (Fedorov Station)



Map of the study region. Sampling localities (dots): 1 – Yangoto Lake, 2 – Bolvansky Cape, 3 – Amderma Settlement, 4 – Bely Nos Cape

(70°26'N, 59°05'E); the Yugorsky Peninsula – Amderma Settlement (69°45'N, 61°34'E) and Bely Nos Cape (69°37'N, 60°14'E). The collecting localities are shown on the map (*figure*). The source of the map was the Environmental Systems Research Institute (ESRI) ArcGIS 10.0 software. We also studied materials from the Zoological Institute of the Russian Academy of Sciences (St. Petersburg, Russian Federation) and the Zoological Museum of the Moscow State University (Moscow, Russian Federation).

The given subgeneric classification and the synonymy of species were in accordance with Williams [2]. Bumblebees were identified by following Løken [3, 4] and Panfilov [5]. Additionally, we used the published paper of Bertsch et al. [6] for the identification of *Bombus cryptarum* (Fabricius, 1775). Two individuals of *Bombus* sensu stricto species were studied by DNA-barcoding to confirm the morphological identification [7]. They were identified by using (Basic Local Alignment Search Tool) BLAST analysis in NCBI Genbank (COI fragment). Specimens were deposited in the Russian Museum of the Biodiversity Hotspots (RMBH) of the Federal Center for Integrated Arctic Research (FCIARctic) (Arkhangelsk, Russian Federation).

Molecular analysis (purification and PCR) was performed in the Federal Center for Integrated Arctic Research. A total DNA was extracted from a single leg of each dry specimen using a standard phenol / chloroform procedure [8]. One mitochondrial gene, i.e. the cytochrome c oxidase subunit I (COI) was amplified and sequenced using primers pairs C1-J-1718 and C1-N-2329R [9]. The PCR mix contained approximately 200 ng of total cell DNA, 10 pmol of each primer, 200 µmol of each dNTP, 2.5 µl of PCR buffer (with 10 x 2 mmol MgCl₂), 0.8 units Taq DNA polymerase (SybEnzyme Ltd.), and H₂O was added for a final volume of 25 µl. Temperature cycling was as follows: 95 °C (4 min), 40 cycles of 95 °C (45 sec), 48–53 °C (40 sec), 72 °C (50 sec) and a final extension at 72 °C (5 min).

The sequencing was carried out at the facilities of the Inter-Institution Center of Group

Use (Genom) (Engelhardt Institute of Molecular Biology of the Russian Academy of Sciences, Moscow) using the ABI PRISM® BigDye™ Terminator v. 3.1 reagents kit. Reaction products were analysed using an automatic sequencer ABI PRISM® 3730 (Applied Biosystems). The obtained results were analysed using BioEdit v. 7.2.5 [10]. The sequences were submitted to NCBI Genbank (accession no. MF409659 and MF409660).

Results. We give the list of examined material below. Here are localities, data of sampling, and numbers of individuals and names of collectors [in brackets]. Queens of bumblebees are marked as ♀, workers are marked as ♂, and males are marked as ♂.

Most of the materials were collected by the authors during the period of 2010–2015. In addition we have checked several specimens from the Zoological Institute of the Russian Academy of Sciences (ZISP) and Zoological Museum of the Moscow State University (ZMMU). We have not examined the materials collected by G.G. Jacobson, H. Friese, B. Pittioni, Yu.I. Chernov and give them from published references.

Distribution patterns of species are according to Gorodkov [11]. The materials concerning distribution of bumblebees are based mainly on the data of Pekkarinen & Teräs [12], Byvaltsev [13], and Levchenko & Tomkovich [14].

Two bumblebee specimens were studied by DNA-barcoding. Specimen one (Genbank No. MF409659) was identified as *B. sporadicus* Nylander, 1848, and the other specimen (Genbank No. MF409660) was identified as *B. cryptarum pallidocinctus* Bertsch, 2014. Genbank numbers are marked in the species list for each specimen.

Bombus (Psithyrus) flavidus Eversmann, 1852
= *B. flavidus*: Potapov et al. [15, p. 82]
(Yugorsky)

Examined material. Vaygach: Dyakonov Cape, 16.VIII.1947, 1♀, [leg.?] (ZMMU); Bolvansky Cape, 18.VIII.2013, 1♀, [Zubriy]. Yugorsky: Amderma, 17.VI.2012, 1♀, [Zubriy]; Amderma, 29.VI.2012, 1♀, [Zubriy]; Amderma, 21.VII.2012, 1♀, [Zubriy].

Type of distribution: Holarctic.

Bombus (Psithyrus) norvegicus (Sparre-Schneider, 1918)

= *B. norvegicus*: Rasmont, Iserbyt [16] (Yugorsky).

Examined material. No specimens examined.

Type of distribution: Trans-Palaeartic.

Bombus (Pyrobombus) lapponicus (Fabricius, 1793)

= *B. lapponicus*: Friese [17, p. 3] (Vaygach); Pittioni [18, p. 194] (Vaygach); Chernov [1, p. 79] (Yugorsky); Chernov [19, p. 42] (Vaygach, Yugorsky); Potapov et al. [15, p. 83] (Vaygach, Yugorsky); Rasmont, Iserbyt [16] (Vaygach, Yugorsky).

Examined material. Vaygach: Yangoto Lake, 07, 12.VIII.2010, 2♀, [Zubriy & Bolotov]; Bolvansky Cape, 14.VII.2013, 4♀, 4♂, [Zubriy & Filippov]; Bolvansky Cape, 07, 15, 18, 28.VIII.2013, 3♂, 1♀, 1♂, [Zubriy & Filippov]; 3 km from Bolvansky Cape, 17, 19.VII.2013, 6♀, 19♂, [Zubriy & Filippov]; 3 km from Bolvansky Cape, 04.VIII.2013, 12♂, [Zubriy & Filippov]; 4 km from Bolvansky Cape, 17, 24, 25.VII.2013, 33♀, 50♂, [Zubriy & Filippov]; 4 km from Bolvansky Cape, 01, 04, 15.VIII.2013, 6♀, 2♂, 2♂, [Zubriy & Filippov]; 5 km from Bolvansky Cape, 24.VII.2013, 14♂, [Zubriy & Filippov]; 10 km from Bolvansky Cape, 08.VIII.2013, 1♀, 3♂, 2♂, [Zubriy & Filippov]. Yugorsky: Amderma, 27.VII.2010, 1♀, 7♂, [Bolotov]; Amderma, 21.VI.2012, 2♀, [Vlasova]; Amderma, 07, 09.VII.2012, 2♀, [Vlasova]; Amderma, 17, 19.VII.2012, 3♀, 5♂, 1♂, [Zubriy & Filippov]; Amderma, 21, 25, 27, 29.VII.2012, 10♀, 17♂, [Zubriy & Filippov]; Bely Nos Cape, 08.VII.2015, 1♀, [Spitsyn].

Type of distribution: Trans-Palaeartic.

Bombus (Pyrobombus) hypnorum (Linnaeus, 1758)

= *B. hypnorum*: Potapov et al. [15, p. 83] (Yugorsky).

Examined material. Yugorsky: Amderma, 21.VII.2012, 1♂, [Vlasova].

Type of distribution: Trans-Palaeartic.

Bombus (Pyrobombus) jonellus (Kirby, 1802)

= *B. jonellus*: Chernov [1, p. 79] (Yugorsky); Potapov et al. [15, p. 83] (Yugorsky); Rasmont, Iserbyt [16] (Yugorsky).

Examined material. Yugorsky: Amderma, 18, 21, 27, 29.VII.2012, 6♀, 5♂, [Zubriy, Filippov & Vlasova]; Bely Nos Cape, 13.VIII.2015, 1♀, [Spitsyn].

Type of distribution: Holarctic.

Bombus (Pyrobombus) cingulatus Wahlberg, 1854

= *B. cingulatus*: Potapov et al. [15, p. 83] (Yugorsky).

Examined material. Yugorsky: Amderma, 17.VI.2012, 1♂, [Zubriy].

Type of distribution: Trans-Palaeartic.

Bombus (Alpinobombus) pyrrhopygus Friese, 1902

= *B. polaris* Curtis: Richards [20, p. 146] (Yugorsky); Potapov et al. [15, p. 83] (Yugorsky); Rasmont, Iserbyt [16] (Vaygach, Yugorsky).

= *B. arcticus* Kirby: Chernov [1, p. 79] (Yugorsky).

Examined material. Vaygach: Bolvansky Cape, 29.VII.2013, 1♀, [Zubriy]; 3 km from Bolvansky Cape, 17, 19.VII.2013, 4♀, 1♂, [Zubriy & Filippov]; 3 km from Bolvansky Cape, 04.VIII.2013, 1♂, [Zubriy]; 4 km from Bolvansky Cape, 17, 18, 24.VII.2013, 5♀, 7♂, [Zubriy & Filippov]; 4 km from Bolvansky Cape, 04.VIII.2013, 1♂, [Zubriy]; 5 km from Bolvansky Cape, 24.VII.2013, 3♂, [Zubriy]. Yugorsky: Amderma, 27.VII.2010, 8♀, [Bolotov]; Amderma, 17, 18, 21, 27, 29.VI.2012, 21♀, [Zubriy, Filippov & Vlasova]; Amderma, 07, 09.VII.2012, 10♀, [Zubriy & Filippov]; Amderma, 17, 18, 19.VII.2012, 7♀, [Zubriy & Filippov]; Amderma, 21, 27, 29.VII.2012, 9♀, 1♂, [Zubriy & Filippov].

Type of distribution: Trans-Palaeartic.

Bombus (Alpinobombus) balteatus Dahlbom, 1832

= *B. balteatus*: Potapov et al. [15, p. 83] (Yugorsky); Rasmont, Iserbyt [16] (Yugorsky).

= *B. nivalis* Dahlbom (= *B. kirbyellus* Curtis):

Holmgren [21, p. 161] (Vaygach: Cap Grebenij); Jakobson [22, p. 189] (Vaygach: Grebeni Cape); Friese [23, p. 485] (Vaygach: Cap Grebenij); Friese [17, p. 3] (Vaygach); Friese, Wagner [24, p. 165] (Vaygach).

Examined material. Yugorsky: Amderma, 29.VI.2012, 1♀, [Zubriy]; 17, 18, 19.VII.2012, 4♀, [Zubriy & Filippov]; Amderma, 21, 27, 29.VII.2012, 3♀, 3♂, [Zubriy & Filippov].

Type of distribution: Trans-Palaeartic.

Bombus (Alpinobombus) hyperboreus Schönherr, 1809

= *B. hyperboreus*: Friese [17, p. 3] (Vaygach); Chernov [1, p. 79] (Yugorsky); Richards [20, p. 146] (Vaygach, Yugorsky); Chernov [19, p. 42] (Vaygach, Yugorsky); Potapov et al. [15, p. 83] (Vaygach, Yugorsky); Rasmont, Iserbyt [16] (Vaygach, Yugorsky).

Examined material. Vaygach: Varnek Bay, 05.VIII.1925, 2♀, [Pokrovsky] (ZMMU); Yangoto Lake, 05.VIII.2010, 1♀, [Bolotov]; Bolvansky Cape, 14.VII.2013, 1♀, [Zubriy]; Bolvansky Cape, 07.VIII.2013, 1♂, [Zubriy]; 4 km from Bolvansky Cape, 18, 25.VII.2013, 3♀, [Zubriy & Filippov]; 10 km from Bolvansky Cape, 08.VIII.2013, 3♂, [Zubriy & Filippov]. Yugorsky: Amderma, 10.VIII.1961, 1♂, [Gorodkov] (ZISP); Amderma, 17, 21, 27, 29.VI.2012, 12♀, [Zubriy & Filippov]; Amderma, 07, 09.VII.2012, 7♀, [Zubriy & Filippov]; Amderma, 14, 15, 17, 18.VII.2012, 17♀, 1♂, [Zubriy & Filippov]; Amderma, 20, 21, 25, 27, 29.VII.2012, 31♀, 2♂, [Zubriy & Filippov].

Type of distribution: Trans-Palaeartic.

Bombus (Bombus) sporadicus Nylander, 1848

Examined material. Yugorsky: Amderma, 25.VI.2012, 1♀, [Vlasova]; Amderma, 18.VII.2012, 1♀ (Genbank No. MF409659), [Zubriy].

Type of distribution: Trans-Palaeartic.

Bombus (Bombus) cryptarum pallidocinctus Bertsch, 2014

Examined material. Yugorsky: Amderma, 19.VII.2012, 1♀ (Genbank No. MF409660), [Zubriy].

Type of distribution: Eurosiberian.

Discussion. The present study reveals that the bumblebee fauna of Vaygach Island includes 5 species, 4 of which are Trans-Palaeartic and 1 species is Holarctic. 11 species are in the Yugorsky Peninsula, most of them (8 species) are Trans-Palaeartic, 2 species are Holarctic and 1 is Eurosiberian.

Our materials have additional data for the species composition of bumblebees in the study areas. To the best of our knowledge, for the first time in the Yugorsky Peninsula *B. sporadicus* and *B. cryptarum* are recorded. *B. cryptarum* in the study area belongs to subspecies *B. cryptarum pallidocinctus*, which is recorded in Scandinavia, European North of Russia and Western Siberia [6]. The record of *B. lucorum* (Linnaeus, 1761) for the Yugorsky Peninsula, indicated in our paper [15], is a misidentification, because this specimen was determined earlier without the use of DNA barcoding.

The number of bumblebee species of Vaygach Island is comparable with those of the other regional island faunas of the Arctic territories in the European North of Russia, i.e. Novaya Zemlya Archipelago [15, 16, 22] and Kolguev Island [15, 16, 25]. The number of bumblebee species in the Yugorsky Peninsula is higher (8), than in Arctic islands.

In Novaya Zemlya Archipelago only 3 species are recorded, i.e. *B. lapponicus glacialis* Friese, 1902, *B. pyrrhopygus* and *B. hyperboreus*; in Kolguev Island 6 species are recorded, i.e. *B. norvegicus*, *B. lapponicus*, *B. jonellus*, *B. pyrrhopygus* (incorrectly mentioned as *B. hyperboreus* in Kolosova, Potapov [25]), *B. balteatus* and *B. hyperboreus*. According to the data of Williams et al. [26], *B. pyrrhopygus* is the sister species of Nearctic *B. polaris* Curtis, 1835. *Bombus pyrrhopygus* is distributed over an area reaching from Scandinavia across the territory of Eurasia.

The basis of the local faunas of Vaygach Island and the Yugorsky Peninsula is Arctic species *B. pyrrhopygus*, *B. hyperboreus* [12] and Arcto-boreal *B. lapponicus*, *B. balteatus* [12]. They are the most of collected specimens. These species are

widely distributed in Arctic and Subarctic territories of Eurasia [3, 25, 26]. Only *B. hyperboreus* is in the Red List of Finnish Species as near threatened [27]. The possible threat factor is climate change [27].

Other species is quite rare in the studied faunae. These are *B. hypnorum*, *B. jonellus*, *B. sporadicus* and *B. cryptarum* from the Yugorsky Peninsula. These species are not typical of zonal tundra habitats and distributed in the taiga zone [12, 25]. The presence of them is probably caused by more favourable conditions for bumblebees in the Yugorsky Peninsula than in Vaygach Island and a lack of island isolation.

The fact of presence of *B. flavidus* in Vaygach Island should be mentioned. According to Løken

[4], this species is social parasite of *B. jonellus*, which is absent in Vaygach Island. We assume that in Arctic territories *B. flavidus* can be the nest parasite of *B. lapponicus*, which is typical in Vaygach Island and belongs to subgenus *Pyrobombus* as *B. jonellus*.

Generally, bumblebee species recorded from Vaygach Island and the Yugorsky Peninsula are widely spread in the Palaearctic region. It indicates the low specificity of the bumblebee fauna in the studied territories. The reason for this is that bumblebees in the European North of Russia are young immigrants and they invaded the region after the last glaciation in Europe.

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НОВЫЕ ДАННЫЕ О ФАУНЕ ШМЕЛЕЙ (Hymenoptera: Apidae, *Bombus* Latr.) ОСТРОВА ВАЙГАЧ И ЮГОРСКОГО ПОЛУОСТРОВА

Представлены новые данные о фауне шмелей о. Вайгач и Югорского п-ова. Исследование основано на материалах, собранных авторами на данных территориях, а также на материалах из опубликованных источников. На о. Вайгач найдено 5 видов шмелей: *Bombus flavidus*, *B. lapponicus*, *B. pyrrhopygus*, *B. balteatus* и *B. hyperboreus*. На Югорском п-ове обнаружено 11 видов: *B. flavidus*, *B. norvegicus*, *B. lapponicus*, *B. hypnorum*, *B. jonellus*, *B. cingulatus*, *B. pyrrhopygus*, *B. balteatus*, *B. hyperboreus*, *B. sporadicus* и *B. cryptarum pallidocinctus*. Два экземпляра шмелей (*B. sporadicus* и *B. cryptarum pallidocinctus*) были изучены при помощи ДНК-баркодинга с целью подтверждения идентификации по морфологическим признакам. В исследованных локальных фаунах преобладают виды, широко распространенные в Палеарктике. Большинство из них являются транс-палеарктическими. Число видов на о. Вайгач сравнимо с числом видов в локальных островных фаунах арктических территорий Европейского Севера России. Число видов шмелей на Югорском п-ове выше по причине присутствия в локальной фауне видов, не типичных для зональных тундровых местообитаний. Региональная фауна шмелей имеет малую специфичность, что является результатом постгляциального происхождения фауны Европейского Севера.

Ключевые слова: шмели, фауна, *Bombus Latr.*, Арктика, остров Вайгач, Югорский полуостров.

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