

Contribution to the knowledge of the bumblebee fauna in the Southern Taymyr

YuS Kolosova¹, GS Potapov¹, NA Zubrii¹, MYu Gofarov¹, OD Kovalev¹,
OV Aksenova¹, SE Sokolova¹, OV Travina¹, AR Shevchenko¹, OD Kononov¹

¹ N. Laverov Federal Center for Integrated Arctic Research, Russian Academy of Sciences (Arkhangelsk, Russian Federation)

Corresponding author: Grigory Potapov (grigorij-potapov@yandex.ru)

Academic editor: Yu. V. Bespalaya ♦ **Received** 24 October 2019 ♦ **Accepted** 11 November 2019 ♦ **Published** 31 December 2019

Citation: Kolosova YuS, Potapov GS, Zubrii NA, Gofarov MYu, Kovalev OD, Aksenova OV, Sokolova SE, Travina OV, Shevchenko AR, Kononov OD (2019) Contribution to the knowledge of the bumblebee fauna in the Southern Taymyr. Arctic Environmental Research 19(4): 146–152. <https://doi.org/10.3897/issn2541-8416.2019.19.4.146>

Abstract

The bumblebee fauna of the Southern Taymyr region, northern Siberia, is represented by 10 species, i.e., *Bombus consobrinus*, *B. flavidus*, *B. lapponicus*, *B. hypnorum*, *B. jonellus*, *B. cingulatus*, *B. balteatus*, *B. pyrrhopygus*, *B. hyperboreus*, and *B. cryptarum*. During the field research for this study, 7 species of bumblebee on the Putorana Plateau (or the Putorana Mountains, on the northwestern edge of the Central Siberian Plateau) and 6 species near Dudinka Town were observed and *B. consobrinus* was found for the first time on the Putorana Plateau. To date, *B. consobrinus* was known only in the southern and central parts of the Krasnoyarsk Krai. Regarding the regional fauna, Transpalearctic and Holarctic species are presented. According to the latitudinal aspect, in this region there are arcto-boreal, arcto-temperate, boreal and temperate species. An analysis of the community was carried out regarding bumblebees that live on the Putorana Plateau. It was found that species of the subgenus *Pyrobombus* and *Alpinobombus*, that are typical for the tundra and forest-tundra zones in the Northern Palearctic, are dominant within the bumblebee community.

Keywords

bumblebees, fauna, Taymyr, Arctic ecosystem, species diversity

Introduction

In various types of biomes, bumblebees (Hymenoptera: Apidae: *Bombus* Latr.) have one of the key roles in the functioning of ecosystems that is associated with the pollination of a large number of entomophilous plants. They are a particularly important part of the ecosystems of the taiga, forest-tundra, and tundra zones (Chernov 1966, 1978a). Compared with other groups of bees, bumblebees have significant species richness in the high latitudes and they are able to successfully forage in the extreme climatic conditions of Arctic ecosystems (Goulson 2010).

To our knowledge there are not many studies in the body of literature that are related to the regional fauna of bumblebees of Taymyr and the surrounding territories. Chernov (1966, 1978a) studied the bumblebee ecology in the tundra communities of Taymyr in the period of the 1960s to the 1970s. In the early part of the twenty-first century, data on the local fauna of bumblebees in the Putorana Plateau were analyzed by Berezin and Tkacheva (2007). The annotated species list for the studied region is given by Byvaltsev et al. (2016). It can be concluded that the fauna and ecology of bumblebees of Taymyr and the surrounding territories are incompletely studied. For this reason, any new data related to this region are important. The obtained results are important in the general aspect of studying the influence of global climatic trends on insects.

During this research, the existing data were supplemented and new data were obtained, concerning the bumblebee fauna in the Taymyrsky Dolgano-Nenetsky District of Krasnoyarsk Krai, Siberia. The bumblebee community of the Putorana Plateau is analyzed.

Materials and methods

The studied territory is located beyond the Arctic Circle and belongs to the Taymyrsky Dolgano-Nenetsky District of the Krasnoyarsk Krai, Siberia. This area includes a number of the collecting localities on the Putorana Plateau, located in the north-

west of the Central Siberian Plateau. The surroundings of Dudinka Town are located on the bank of the Yenisei River.

Bumblebees were collected by random sampling in the studied habitats using an entomological net. This type of sampling of insects allows one to make the correct conclusions about the ratios of species in the communities (Pesenko 1972). Some specimens of bumblebee were manually collected from the roadsides near Dudinka Town.

The field research was carried out in July–August 2018, i.e., July 14 to July 17 by PhD O.V. Aksenova, S.E. Sokolova, O.V. Travina and A.R. Shevchenko near Dudinka Town (approximately 69°24'N, 86°19'E), as well as in the period of July 17 to August 9 by PhD N.A. Zubrii and O.D. Kovalev in various types of habitats on the Putorana Plateau, Kharaelakh Mountains (approximately 69°27'N, 88°42'E) (Fig. 1). The approximate coordinates of these localities are provided here because the bumblebees were collected in several habitats. A total number of 223 bumblebee individuals were collected.

The bumblebees were studied in alpine and nival meadows, larch forest, raised bog, meadow communities along the roadsides of the Putorana Plateau, tundra communities and meadow communities along the river banks and roadsides of Dudinka Town. A number of habitats in the Southern Taymyr, where bumblebees were collected are given in Fig. 2.

The species of bumblebee were identified according to Løken (1973, 1984) and Panfilov (1978). Identification of species of the *Bombus lucorum* complex is according to Rasmont (1984), Rasmont et al. (1986), and Rasmont and Terzo (2017). The nomenclature of bumblebee species follows Williams (2019). The analysis of types of distribution are given according to Gorodkov (1984), and Pekkarinen and Teräs (1993).

The specimens of bumblebees are deposited in the Russian Museum of the Biodiversity Hotspots (RMBH) of the Federal Center for Integrated Arctic Research (FCIARctic) of the Russian Academy of Sciences (RAS), and in the Northern (Arctic) Federal University named after M.V. Lomonosov (NARFU), Arkhangelsk, Russia.



Fig. 1. Map of the Southern Taymyr. Black circles indicate the studied localities

Results

According to the results of the field research for the present study, 8 species of bumblebees (Table 1) were collected. *B. consobrinus* Dahlbom, 1832 and *B. jonellus* (Kirby, 1802) were recorded for the first time in the studied localities. However, *B. jonellus* is well known in a number of localities of the Southern Taymyr, but it has not been indicated for the Putorana Plateau and

the surroundings of Dudinka Town (Panfilov 1982, Byvaltsev et al. 2016). *B. consobrinus* was previously recorded only in the southern and central parts of the Krasnoyarsk Krai up until the present day (Skorikov 1922, Byvaltsev et al. 2016). In general, 7 species of bumblebees on the Putorana Plateau and 6 species near Dudinka Town were found during the present study.

Transpalearctic and Holarctic species, i.e., 5 and 3 species respectively, are presented for the studied

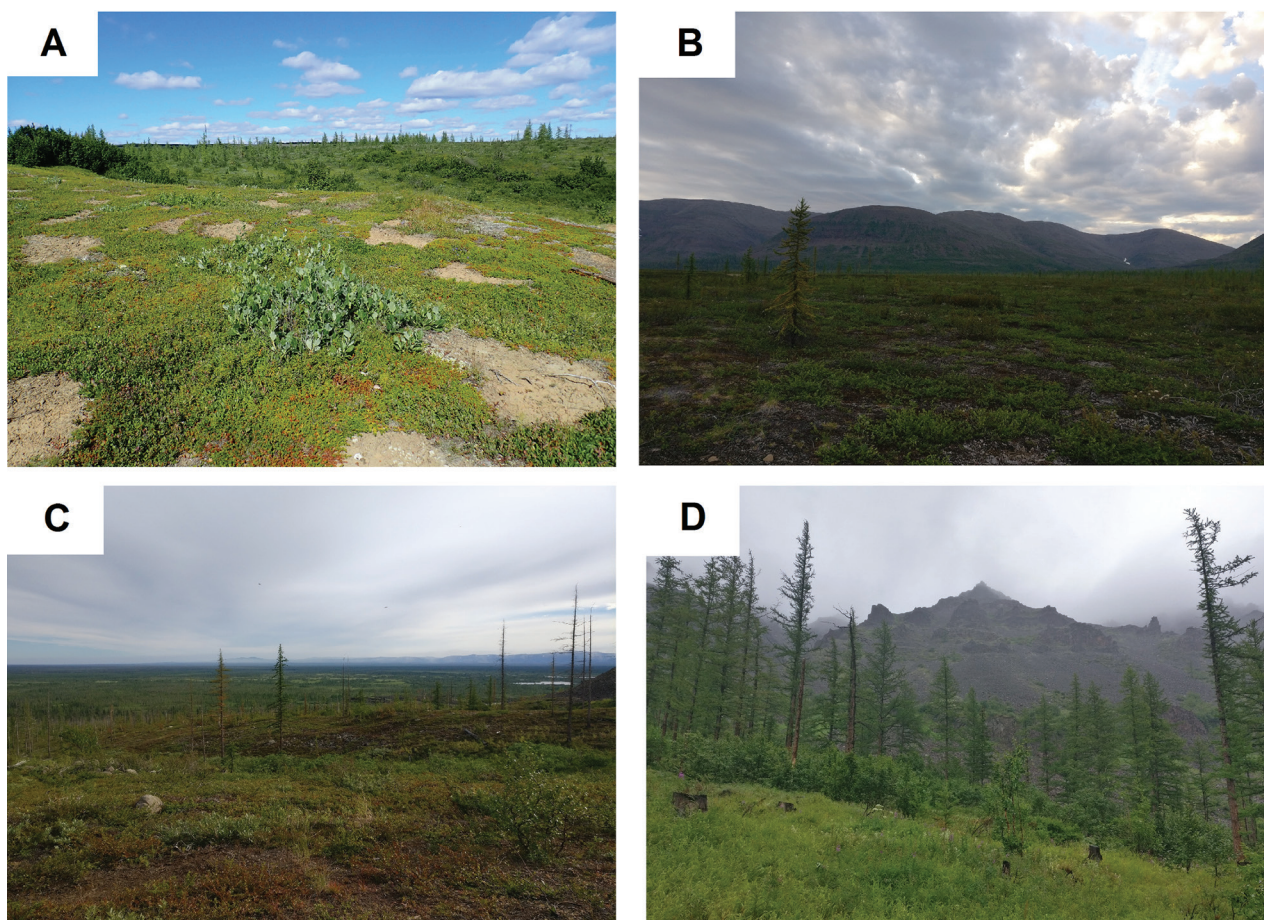


Fig. 2. Habitats of bumblebees in the Southern Taymyr: (A) the surroundings of the Dudinka Town, (B, C, D) the Putorana Plateau. Photos: N.A. Zubrii (Putorana) and O.V. Aksenova (Dudinka)

Table 1. List of the bumblebee species that were recorded in the Southern Taymyr during the field research in 2018 (on the Putorana Plateau; in the surrounding areas of Dudinka Town)

N ^o	Species	Type of distribution		Putorana	Dudinka	% (Putorana)*
1	<i>Bombus (Megabombus) consobrinus</i> Dahlbom, 1832	Tp	Te	●	–	1.6
2	<i>B. (Psithyrus) flavidus</i> Eversmann, 1852	Hol	Bo	●	–	5.7
3	<i>B. (Pyrobombus) lapponicus</i> (Fabricius, 1793)	Tp	Ab	–	●	–
4	<i>B. (Pyrobombus) hypnorum</i> (Linnaeus, 1758)	Tp	Te	●	●	0.5
5	<i>B. (Pyrobombus) jonellus</i> (Kirby, 1802)	Hol	At	●	●	20.2
6	<i>B. (Pyrobombus) cingulatus</i> Wahlberg, 1854	Tp	Bo	●	●	10.4
7	<i>B. (Alpinobombus) balteatus</i> Dahlbom, 1832	Tp	Ab	●	●	52.3
8	<i>B. (Bombus) cryptarum</i> (Fabricius, 1775)	Hol	At	●	●	9.3
Total				7	6	100.0

Notes: Hol – Holarctic, Tp – Transpalaeartic, Ab – arcto-boreal, At – arcto-temperate, Bo – boreal, Te – temperate. Symbols: * – the percentage in the sample was calculated only for bumblebees from the Putorana Plateau; bumblebees collected near Dudinka Town were not taken into account. (●) – recorded, according to the examined material, (–) – absent.

regional fauna. Concerning the zonal distribution, 2 species of each of the Transpalaeartic and Holarctic species are arcto-boreal, arcto-temperate, boreal, and temperate.

Discussion

According to Byvaltsev et al. (2016) in their study that was dedicated to the bumblebee fauna of the Krasnoyarsk Krai, the regional fauna is represented by 45 species. Seven species authors are found to have studied within the Taymyr and surrounding areas, i.e., *B. hypnorum* (Linnaeus, 1758), *B. cingulatus* Wahlberg, 1854, *B. jonellus*, *B. lapponicus* (Fabricius, 1793), *B. balteatus* Dahlbom, 1832, *B. pyrrhopygus* Friese, 1902 and *B. hyperboreus* Schönherr, 1809.

For the surrounding areas of Dudinka Town, Byvaltsev et al. (2016) indicated 5 species, i.e., *B. cingulatus*, *B. hypnorum*, *B. hyperboreus*, *B. balteatus* and *B. pyrrhopygus*. Regarding the present study, according to the results of the field research in 2018, *B. hyperboreus* and *B. pyrrhopygus* were not observed in near Dudinka. However, in the present study, *B. jonellus*, *B. lapponicus* and *B. cryptarum* (Fabricius, 1775) were recording, but to our knowledge, they were not observed in previous studies. The local fauna of bumblebees in the surrounding areas of Dudinka Town is represented by 8 species, according to generalised data.

Concerning the Putorana Plateau, Byvaltsev et al. (2016) are not provided the data on bumblebees. According to the materials of Berezin and Tkacheva (2007), 6 species of bumblebees were recorded in the western part of the Putorana Plateau: *B. balteatus*, *B. polaris* Curtis, 1835, *B. lapponicus*, *B. hypnorum*, *B. lucorum* (Linnaeus, 1761), and *B. flavidus* Eversmann, 1852.

It should be mentioned that according to Williams et al. 2015, 2019, *B. polaris* is found only in North America and Greenland, and is considered as a sister species of the Eurasian *B. pyrrhopygus*.

Difficulties, concerning the morphological identification of the cryptic species *Bombus lucorum* complex (*B. lucorum*, *B. cryptarum* and *B. magnus* Vogt,

1911) until the end of the 2000s, led to the circumstance that in various regional studies these species were recorded actually as a species complex *B. lucorum* (Rasmont and Iserbyt 2019). In the most cases it is necessary the DNA barcoding (Bossert 2015). It is known that *B. cryptarum* almost completely replaces *B. lucorum* and *B. magnus* in the territories to the north of the Arctic Circle (Pamilo et al. 1997, Rasmont and Iserbyt 2019). For this reason, the presence of *B. lucorum* on the Putorana Plateau is unlikely.

Hence, the local fauna of bumblebees on the Putorana Plateau has 9 species, according to generalised data. In the present study, *B. consobrinus*, *B. jonellus* and *B. cingulatus* were recorded for the first time in this territory.

In general, the fauna of bumblebees in the Southern Taymyr is represented by 10 species, i.e., *B. consobrinus*, *B. flavidus*, *B. lapponicus*, *B. hypnorum*, *B. jonellus*, *B. cingulatus*, *B. balteatus*, *B. pyrrhopygus*, *B. hyperboreus* and *B. cryptarum*. It is typical for the tundra and forest-tundra ecosystems of Eurasia. In the above are presented the species that are widely distributed throughout Eurasia.

The percentage of samples was calculated only for bumblebees from the Putorana Plateau, because near Dudinka Town collections were carried out manually in transect. In the latter case, it is impossible to make this type of analysis.

The highest percentage in the sample from the studied locality of the Putorana Plateau is represented by species from the subgenus *Pyrobombus* and *Alpinobombus*. *B. balteatus* represents the largest number of individuals (over 50%) in the community. This hemiarctic species is dominant here.

The maximum abundance of hemiarctic species occurs in the middle and southern parts of the subzone of the typical tundra. To the south, they are distributed over the forest-tundra (Chernov 1978b). The presence of hemiarctic species is also typical in the mountain ecosystems located along the transition zone between taiga and tundra.

According to Berezin and Tkacheva (2007), in the western part of the Putorana Plateau, the hemiarctic *B. lapponicus* (over 50% of the sample) is dominant, and *B. balteatus* is less numerous (26.6%). However,

B. lapponicus was not recorded during the field research of the present study.

Quite abundant in the studied sample are *B. jonellus*, *B. cingulatus*, and *B. cryptarum*. These species are typical and widely represented in taiga and forest-tundra habitats of Northern Eurasia. *B. flavidus* is a rather rare species in the community (5.7%). It is the nest parasite of *B. jonellus* and *B. lapponicus* (Løken 1984; Lhomme and Hines 2018).

It is noteworthy that there is the presence of *B. consobrinus* in the local fauna of the Putorana Plateau. This species was known only in the southern and central part of the Krasnoyarsk Krai until the present day (Skorikov 1922, Byvaltsev et al. 2016). For this reason, the Putorana Plateau is probably the most northern locality of the record of *B. consobrinus* in the Krasnoyarsk Krai.

In Northern Europe, *B. consobrinus* is closely associated with its food plant *Aconitum septentrionale* Koelle. Hence, the ranges of *B. consobrinus* and *A. septentrionale* are almost identical here (Løken 1973, Pekkarinen and Teräs 1993, Bolotov and Kolosova 2006). In other regions of Eurasia, the close connection of *B. consobrinus* with *A. septentrionale* is not clearly expressed (Sam-Eun et al. 2002, Bolotov and Kolosova 2006). The same is possible in the studied area of the Putora-

na Plateau, where no bumblebees were recorded on *A. septentrionale* during the present study.

Conclusions

The bumblebee fauna of the Southern Taimyr is typical of territories located in the tundra and forest-tundra zones of Northern Eurasia, and is represented by 10 species, according to the results of the aforementioned studies of the present authors in 2018 and other available publications in the literature. During the field research for the present study, the regional fauna was supplemented by *B. consobrinus*, which is not previously recorded in this territory.

Acknowledgements

The field research has been performed with the help of Mikhail G. Bondar and the Association of Taymyr Nature Reserves. This study was carried out according to the federal programme of the FCIARctic no. 0409-2016-0022 (no. AAAA-A17-117033010132-2). Special thanks are due to Dr. M. Copley for improving the language of the article.

References

- Berezin MV, Tkacheva EYu (2007) Study of fauna and ecology of bumblebees (Hymenoptera: Apidae, Bombini) in the western part of the Putorana Plateau. In: Romanov AA (Ed.) Biodiversity of ecosystems in the Putorana Plateau and surrounding areas. Putoranskiy Nature Reserve, Moscow, 234–245.
- Bolotov IN, Kolosova YuS (2006) Trends in the formation of biotopic complexes of bumblebees (Hymenoptera, Apidae: Bombini) in the northern taiga karst landscapes of the Western Russian Plain. Russian Journal of Ecology 37(3): 156–166. <https://doi.org/10.1134/S1067413606030039>
- Bossert S (2015) Recognition and identification of bumblebee species in the *Bombus lucorum*-complex (Hymenoptera, Apidae) – a review and outlook. Deutsche Entomologische Zeitschrift 62(1): 19–28. <https://doi.org/10.3897/dez.62.9000>
- Byvaltsev AM, Proshchalykin My, Levchenko TV, Kupianskaya AN, Akulov EN (2016) Bumble bee fauna (Hymenoptera, Apidae: *Bombus* Latreille) of Krasnoyarsk Territory. A.I. Kurentsov's Annual Memorial Meetings 27: 137–154.
- Chernov YuI (1966) The complex of anthophilous insects in the tundra zone. Problems of Geography. Organisms and the Environment 69: 76–97.
- Chernov YuI (1978a) Anthophilous insects in the typical tundra subzone of West Taimyr and their role in plant pollination. In: Tikhomirov BA (Ed.) The Structure and Function of Biogeocenoses of the Taimyr Tundra. Nauka, Leningrad, 204–290.
- Chernov YuI (1978b) Structure of the animal population in the Subarctic. Nauka, Moscow, 167 pp.
- Gorodkov KB (1984) Types of areas of tundra and forests zones insects of the European Part of the USSR. In: Skarlato

- OA (Ed.) Provisional atlas of the insects in the European part of USSR. Nauka, Leningrad, 3–20.
- Goulson D (2010) Bumblebees. Behaviour, ecology and conservation. Oxford University Press, Oxford, 330 pp.
 - Lhomme P, Hines HM (2018) Ecology and evolution of cuckoo bumblebees. *Annals of the Entomological Society of America*. <https://doi.org/10.1093/aesa/say031>
 - Løken A (1973) Studies of Scandinavian bumblebees (Hymenoptera, Apidae). *Norsk Entomologisk Tidsskrift* 20(1): 1–218.
 - Løken A (1984) Scandinavian species of the genus *Psithyrus* Lepeletier (Hymenoptera, Apidae). *Entomologica Scandinavica* 23: 1–45.
 - Pamilo P, Tengö J, Rasmont P, Pirhonen K, Pekkarinen A, Kaarnama E (1997) Pheromonal and enzyme genetic characteristics of the *Bombus lucorum* species complex in Northern Europe. *Entomologica Fennica* 7: 187–194. <https://doi.org/10.33338/ef.83908>
 - Panfilov DV (1978) Key to species of the Family Apidae – Bees. In: Medvedev GS (Ed.) Key to insects of the European Part of the USSR. Nauka, Leningrad 3(1): 508–519.
 - Panfilov DV (1982) Map 150: *Bombus jonellus* (Kirby, 1802) In: Skarlato OA (Ed.) Provisional atlas of the insects in the European part of USSR. Nauka, Leningrad, 28.
 - Pekkarinen A, Teräs I (1993) Zoogeography of *Bombus* and *Psithyrus* in Northwestern Europe (Hymenoptera, Apidae). *Annales Zoologici Fennici* 30(3): 187–208.
 - Pesenko YuA (1972) About the methods of quantitative accounting of insects-pollinators. *Russian Journal of Ecology* 3(1): 88–95.
 - Rasmont P (1984) Les bourdons du genre *Bombus* Latreille sensu stricto en Europe occidentale et central. *Spixiana* 7: 135–160.
 - Rasmont P, Iserbyt S (2019) Atlas of the European Bees: genus *Bombus*. Mons University, Mons. <http://www.zoologie.umh.ac.be/hymenoptera/page.asp?ID=169>
 - Rasmont P, Terzo M (2017) Catalogue et clé des sous-genres et espèces du genre *Bombus* de Belgique et du nord de la France (Hymenoptera, Apoidea). 2e édition. Mons University, Mons, 28 pp.
 - Rasmont P, Scholl A, de Jonghe R, Obrecht E, Adamski A (1986) Identité et variabilité des mâles de bourdons du genre *Bombus* Latreille sensu stricto en Europe occidentale et centrale (Hymenoptera, Apidae, Bombinae). *Revue suisse de Zoologie* 93: 661–682. <https://doi.org/10.5962/bhl.part.79505>
 - Sam-Eun K, Hyung-Joo Y, Heung-Sik L, Sang-Beom L, In-Gyun P (2002) Occurring season of overwintered bumblebee queens in Korea and their visiting flowers. *Korean Journal Applied Entomology* 41(3): 191–197.
 - Skorikov AS (1922) Bumblebees of the Petrograd Region. *Fauna of the Petrograd Region* 2(11): 1–51.
 - Williams PH, Byvaltsev AM, Cederberg B, Berezin MV, Ødegaard F, Rasmussen C, Richardson LL, Huang J, Sheffield CS, Williams ST (2015) Genes suggest ancestral colour polymorphism are shared across morphologically cryptic species in Arctic bumblebees. *PLoS ONE* 2015. <https://doi.org/10.1371/journal.pone.0144544>
 - Williams PH (2019) Bumblebees of the World. The Natural History Museum, London. <http://www.nhm.ac.uk/research-curation/projects/bombus/index.html>
 - Williams PH, Berezin MV, Cannings SG, Cederberg B, Ødegaard F, Rasmussen C, Richardson LL, Rykken J, Sheffield CS, Thanosing C, Byvaltsev AM (2019) The arctic and alpine bumblebees of the subgenus *Alpinobombus* revised from integrative assessment of species' gene coalescences and morphology (Hymenoptera, Apidae, *Bombus*). *Zootaxa* 4625: 1–68. <https://doi.org/10.11646/zootaxa.4625.1.1>