

# Bumblebees of the Subarctic Region in European Russia— Their Significance and Conservation †

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**Abstract:** Regarding the bumblebee fauna, a number of regions of Russia are still insufficiently studied. These include Arkhangelsk Region, the large territory that is partly located in the subarctic region of Northern European Russia. In this research, we present the information on the distribution of bumblebees of the studied region and discuss the bumblebee communities and also their conservation in Northern European Russia. The regional fauna of bumblebees is presented by species that are widely distributed in the Palaearctic. The species richness of bumblebees is maximum in the valleys of large rivers and in secondary meadows due to the appearance of species, which are not common of the zonal taiga ecosystems. These include *Bombus ruderarius*, *B. veteranus*, *B. soroensis*, *B. sichelii* and other species are belonging to a group of meadow species. One species, *B. consobrinus*, is considered as a rare species in the regional fauna. It is presented quite locally in most districts of Arkhangelsk Region. In the north of Arkhangelsk Region, *B. consobrinus* is most abundant in the native taiga habitats but it is rare in the other areas of the studied region. *B. consobrinus* in Arkhangelsk Region prefers the meadows near coniferous forests, where its main food plant, *Aconitum septentrionale*, is concentrated.

**Keywords:** bumblebees; north of European Russia; subarctic; diversity; conservation

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## 1. Introduction

Bumblebees (Hymenoptera: Apidae: *Bombus* Latr.) are one of the most thoroughly studied groups of Hymenoptera. There are approximately 250 species in the world fauna, confined mainly to temperate regions, i.e., Eurasia and North America [1].

Bumblebees are quite well adapted to the climatic conditions of the Subarctic, in comparison with other groups of bees [2]. Their high adaptive capabilities in the development of high latitudes are primarily due to the features of morphological structure, thermoregulation and life cycle [3]. Bumblebees are well-known as pollinators of many plant species.

At the same time, some territories of the Eastern European sector of the Subarctic still remain insufficiently studied, due to their inaccessibility. In this research, we consider the distribution of bumblebees of the subarctic region in European Russia. We are also discussing the bumblebee communities and their conservation in Northern European Russia.

## 2. Materials and Methods

Specimens of bumblebees (total  $N = 6725$ ) in the studied region (the north of Arkhangelsk Region, according the administrative division of Russia) were collected during the period of 1994–2021 by researchers from the N. Laverov Federal Center for Integrated Arctic Research of the Ural Branch of the Russian Academy of Sciences (FCIARctic) and

the Northern (Arctic) Federal University named after M.V. Lomonosov (NArFU), i.e., PhD G.S. Potapov, PhD Yu. S. Kolosova, PhD M.V. Podbolotskaya, Dr. Sc. I.N. Bolotov, and V.M. Spitsyn. A number of specimens was studied in the collections of the Zoological Institute of the Russian Academy of Sciences (Saint Petersburg) and Finnish Museum of Natural History (Helsinki). Our collected specimens of bumblebees are deposited in the Russian Museum of the Biodiversity Hotspots (RMBH) of the FCIARctic, Arkhangelsk, Russia. The species of bumblebees were identified according to Løken [4,5], Panfilov [6], Rasmont and Terzo [7]. We used DNA barcoding for the reliable identification of *Bombus lucorum*-complex [8].

### 3. Results

28 species of bumblebees are found in the north of Arkhangelsk Region [9]. The presence of *B. modestus* Eversmann, 1852 in the studied area requires additional research [9]. The most common species in the majority of communities of bumblebees are *B. cryptarum* (Fabricius, 1775), *B. pascuorum* (Scopoli, 1763), *B. hypnorum* (Linnaeus, 1758), *B. veteranus* (Fabricius, 1793), *B. hortorum* (Linnaeus, 1761). Typical foraging habitats for these species of bumblebees are meadows in the vicinity of settlements (Figure 1). Bumblebee species, like *B. schrencki* Morawitz, 1881, *B. consobrinus* Dahlbom, 1832, *B. pratorum* (Linnaeus, 1761), *B. jonellus* (Kirby, 1802), are mainly prefer as foraging habitats, ruderal communities near native taiga.



**Figure 1.** Meadows (a) and ruderal communities (b) as typical foraging habitats for bumblebees in the north of Arkhangelsk Region.

### 4. Discussion

The species richness of bumblebees is the maximum in the valleys of large rivers and in secondary meadows due to the appearance of species, which are not common of the zonal taiga ecosystems. It was previously noted [10] that in the conditions of anthropogenic landscapes in European North, the bumblebee communities are enriched with species of a more southern origin, i.e., a group of meadow species. They are not widespread in the native taiga ecosystems and common for more southern biomes than the taiga [10]. These include *B. ruderarius* (Müller, 1776), *B. veteranus*, *B. soroensis* (Fabricius, 1777), *B. sichelii* Radoszkowski, 1860 and other meadow species. The species of bumblebees, like *B. schrencki*, *B. consobrinus*, *B. cingulatus* Wahlberg, 1854, *B. pratorum*, *B. sporadicus* Nylander, 1848, are belonging to a group of forest species and they are typical for the native taiga habitats [11].

27 species of bumblebees recorded within the lower reaches of the Northern Dvina are about 80% of the fauna of the taiga zone of Northern European Russia [9]. This is quite large compared to other regions. For example, in the agroecosystems of Finland there are 15 species of bumblebees [12]. Differences in species richness are primarily associated with the degree of transformation of ecosystems during agricultural impact and partly with the

zonal gradient. Therefore, in agroecosystems there is a rapid degradation of bumblebee communities due to intensive farming. On the contrary, in Northern European Russia was a sharp decline in agricultural production and the development of succession processes on agricultural land in the 1990s [10]. This factor has undoubtedly had a positive impact on bumblebee communities in our region.

One species of bumblebees in the studied region is rare. *B. consobrinus* is presented quite locally in most districts of Arkhangelsk Region. This species is considered as oligolectic in Fennoscandia and is related with *Aconitum septentrionale* [4,13]. *A. septentrionale* has the disjunction of its range in the studied region. This species of plant has been recorded in native taiga ecosystems of the Belomorsky-Kuloysky plateau and along the major rivers of the north of Arkhangelsk Region [14]. *A. septentrionale* has not a conservation status in this region, because it is quite common here.

Hence, in the north of Arkhangelsk Region, *B. consobrinus* is most abundant in the native taiga habitats, but it is rare in the other areas of the studied region [9,11]. *B. consobrinus* in Arkhangelsk Region prefers the meadows near coniferous forests, where its main food plant, i.e., *A. septentrionale*, is concentrated [14]. *B. consobrinus* is also rare in Finland and Karelia [13]. Due to this reason, *B. consobrinus* is vulnerable to anthropogenic changes of habitats. It is included in the Red List of Species of Arkhangelsk Region [15].

## 5. Conclusions

Further studies of bumblebees in the subarctic region of Northern European Russia should be aimed at the monitoring of bumblebee communities in anthropogenic landscapes. Decline of bumblebee populations under anthropogenic influences may have consequences such as the disappearance of some species from the regional fauna.

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