

Distribution and habitat preference of *Bombus (Kallobombus) soroensis* (Fabricius, 1777) on the territory of Arkhangelsk Region

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Abstract

In this paper, we summarise material pertaining to the distribution and habitat preference of *Bombus (Kallobombus) soroensis* (Fabricius, 1777) on the territory of Arkhangelsk Region. *B. soroensis* is widely represented on the territory as nominative subspecies *B. soroensis* ssp. *soroensis*, which is common mainly in Fennoscandia, the British Isles and Eastern Europe. The northern border of the species range in the Arkhangelsk Region is the lower reaches of the Mezen River, located in the transition zone between the northern taiga and the forest-tundra. This locality is probably one of the most northern records of this species in the northern part of the Russian Plain. In Eastern Fennoscandia, *B. soroensis* is distributed far to the north, i.e., in the northern parts of Finland and Norway. In relation to the habitat preference, *B. soroensis* in the study region belongs to the category of meadow species. This species is typical of different types of meadows and ruderal habitats. *B. soroensis* is not typical with regards to the native taiga habitats, in most cases. This is similar to the situation on the territory of Finland, where this species is associated with open meadow habitats. Individuals of *B. soroensis* have been recorded on a wide range of entomophilous plants, and the main examples are *Rhinanthus minor*, *Epilobium angustifolium*, *Cirsium arvense*, *Scorzoneroideis autumnalis*, *Lotus corniculatus*.

Keywords

Bombus soroensis, European North, species range, habitat preference

Bombus (Kallobombus) soroensis (Fabricius, 1777) is widely distributed in Europe where this species is quite well studied (Rasmont et al. 2015). However, mate-

rial from the European North of Russia is not so abundant. There are a number of documented examples from Karelia (especially concerning the southern part

of this region), Komi Republic (Pekkarinen et al. 1981, Söderman and Leinonen 2003, Rasmont and Iserbyt 2018). The collecting localities from the Arkhangelsk Region are summarised in the checklist of Potapov and Kolosova (2016) for bumblebees of this region.

The study of distribution and habitat preference of *B. soroensis* is important in connection with the forecasts of changes in the species range under global warming (Rasmont et al. 2015). According to the available models, a significant reduction in suitable area in Europe for this species is expected by 2050 (Rasmont et al. 2015).

In this paper, we analyse the distribution of *B. soroensis* on the territory of Arkhangelsk Region and its habitat preference.

Materials and methods

Bumblebees were collected in different localities of the Arkhangelsk Region during the period 1994–2017 (Table 1). It was studied the various types of communities. The collecting localities are shown on the map of this region (Fig. 1). Bumblebees were caught with an entomological net. A total of 528 individuals of *B. soroensis* were studied.

The specimens of bumblebees are deposited in the Russian Museum of the Biodiversity Hotspots (RMBH), Federal Center for Integrated Arctic Research (FCIARctic), Russian Academy of Sciences (RAS), Arkhangelsk, Russia.

The nomenclature follows Williams (2018). Bumblebees were identified according to Løken (1973), Panfilov (1978), Intoppa et al. (2009), Rasmont and Terzo (2010). The plant species are given according to The Plant List (2013). In order to study the types of communities, we used the materials of Shmidt (2005) and Parinova et al. (2014).

The map of the Arkhangelsk Region was produced by using ArcGIS 10.0 software.

Results

In the list of the studied material we give locality, data, number of specimens, habitat where bumblebees were caught, and the name of the collector. This list of materials, except for some localities, is documented in the work of Potapov and Kolosova (2016). In the present paper, we include material from a number of additional localities.

Material examined: **Mezen**, 12.VII.2015, 18–19.VII.2015, 4♂, wet meadow in floodplain, meadow-like habitat, coniferous forest, Potapov and Pinaevskaya leg.; **Golubino**, 25–27.VIII.2000, 25–31.VIII.2004, 3♂, 29♂, wet meadow in floodplain, Bolotov and Kolosova leg.; **Arkhangelsk**, 2.VII.–31.VIII.2010, 41♂, 28♂, ruderal community, wet meadow in floodplain, roadside, agroecosystem, meadow-like habitat, Potapov and Podbolotskaya leg.; **Kholmogory**, 16–21.VIII.2010, 32♂, 45♂, roadside, ruderal community, agroecosys-

Table 1. The collecting localities of *B. soroensis* in the Arkhangelsk Region

№	Localities	Latitude (N)	Longitude (E)
1	Mezen	65°49'	44°13'
2	Golubino	64°33'	43°15'
3	Arkhangelsk and delta of the North Dvina River	64°32'	40°26'
4	Kholmogory	64°14'	41°37'
5	Solza River	64°29'	39°32'
6	Onega	63°54'	38°07'
7	Bolshoy Bor	63°36'	39°06'
8	Mirniy	62°46'	40°18'
9	Kenozero Lake	62°04'	38°11'
10	Shenkursk	62°06'	42°53'
11	Verkhnyaya Toyma	62°13'	45°02'
12	Abakumovo	61°35'	39°04'
13	Svyatoye Lake	60°51'	39°31'
14	Ilyinsko-Podomscoe	61°07'	47°56'

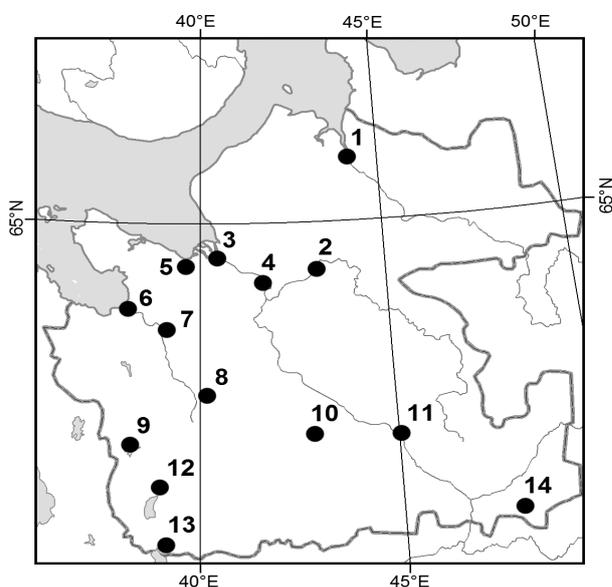


Fig. 1. Map of the Arkhangelsk Region. Numbers for the collecting localities are given in Table 1

tem, meadow-like habitat, wet meadow in floodplain, Potapov and Podbolotskaya leg.; **Solza River**, 3.IX.2005, 2♂, wet meadow in floodplain, Kolosova and Bespalaya leg.; **Onega**, 6.VIII.2017, 1♀, ruderal community, Potapov leg.; **Bolshoy Bor**, 14–16.VII.2000, 19.VIII.2000, 16♀, 18♂, wet meadow in floodplain, ruderal community, Bolotov leg.; **Mirniy**, 19–22.VIII.2007, 7♀, 23♂, meadow-like habitat, roadside near forest, Kolosova leg.; **Kenozero Lake**, 10–11.VIII.2004, 12–17.VIII.2008, 37♀, 2♂, dry meadow, roadside, meadow-like habitat, Kolosova and Podbolotskaya leg.; **Shenkursk**, 19–29.VII.2001, 2.VIII.2001, 21.VI.2014, 30.VII.–6.VIII.2015, 85♀, 60♂, dry meadow, ruderal community, meadow-like habitat, roadside, Potapov, Pinaevskaya and Iglovskiy leg.; **Verkhnyaya Toyma**, 24.VII.–12.VIII.2000, 2♀, 2♂, ruderal community, roadside, Churakova leg.; **Abakumovo**, 16.VIII.2011, 5♀, 15♂, dry meadow, Potapov and Podbolotskaya leg.; **Svyatoye Lake**, 26–30.VIII.2003, 15–16.VIII.2007, 12♀, 53♂, dry meadow, meadow-like habitat, roadside, Kolosova and Podbolotskaya leg.; **Ilyinsko-Podonskoe**, 25.VII.–29.VIII.1994, 2–31.VIII.1996, 2♀, 4♂, wet

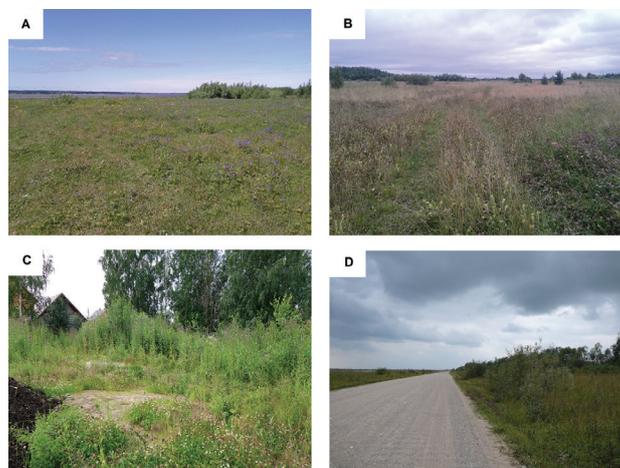


Fig. 2. Typical foraging habitats of *B. soroensis* in the Arkhangelsk Region: (A) Wet meadow in floodplain, Mezen; (B) Dry meadow, Shenkursk; (C) Ruderal community, Onega; (D) Roadside, Kholmogory. Photos: GS Potapov.

meadow in floodplain, dry meadow, ruderal community, roadside near forest, Filippov leg.

The typical foraging habitats of *B. soroensis* in the Arkhangelsk Region are shown in Fig. 2:

- 1) Wet meadows are spread along almost all large- and medium-sized rivers in the Arkhangelsk Region. Their area is particularly expansive on the banks of the Northern Dvina, Mezen, and Pinega (Shmidt 2005).
- 2) Dry meadows are widespread primarily in the southern part of the Arkhangelsk Region (Shmidt 2005). They are usually secondary meadows that have emerged from the destruction of forests in the region (Parinova et al. 2014).
- 3) Ruderal communities are different types of secondary meadow and meadow-like habitats. They are formed as a result of human activities.
- 4) Roadsides are not distinguished as a separate type of community. However, they are the locations of concentration of numerous bumblebees, hence we categorise them in a separate group.

Discussion

The studied species in the Arkhangelsk Region is represented as the nominative subspecies *B. soroensis* ssp. *soroensis*, which is common in Fennoscandia, the British Isles, Eastern Europe and a number of other regions of the European continent (Reinig 1939, Løken 1973, Dylewska 1996).

In general, *B. soroensis* is widely represented in the Arkhangelsk Region (Fig. 1). The northern border of the species range in this region is located at latitude 65°N. This is the lower reaches of the Mezen River. On the territory of the Komi Republic the northern border is also located at around 65°N (Filippov 2007, Rasmont and Iserbyt 2018). These are probably the most northern localities of the record of *B. soroensis* in the northern part of the Russian Plain.

The studied area of the lower reaches of the Mezen River is located in the transition zone between the northern taiga and the forest-tundra (Fedorov 1976). Here, there are wet meadows in the floodplain and different types of ruderal habitats. The presence of *B. soroensis* in northern localities that are similar to Mezen is explained by the fact that the studied area is located in the river basin. It is known that river valleys play a considerable role in the expansion of a number of bumblebee species, which are not typical of zonal taiga or tundra landscapes. This pattern was previously shown for the European North of Russia (Kolossova and Potapov 2011).

In Eastern Fennoscandia, the forest boundary has been shifted northwards due to frequent invasions of humid Atlantic air masses and the influence of the ice-free Barents Sea (Isachenko 1995). For this reason, *B. soroensis* is found far to the north, i.e., in the northern parts of Finland and Norway (Løken 1973, Pekkarinen et al. 1981, Söderman and Leinonen 2003, Rasmont and Iserbyt 2018).

Typical foraging habitats of *B. soroensis* on the territory of the Arkhangelsk Region are various types of meadow and ruderal communities (Fig. 2). Only in the lower reaches of the Mezen River was this species foraging on the heather community (*Calluna vulgaris* (L.) Hull) in the pine forest. However, for the

native taiga habitats, *B. soroensis* are not typical in most cases.

In the region under study, *B. soroensis* visited a wide range of entomophilous plants, the main plants of which are *Rhinanthus minor* L., *Epilobium angustifolium* L., *Cirsium arvense* (L.) Scop., *Scorzoneroides autumnalis* (L.) Moench, *Lotus corniculatus* L.

On the territory of Finland, as well as in the Arkhangelsk Region, *B. soroensis* is associated with open meadow habitats (Söderman and Leinonen 2003). However, in a number of other regions of Europe the habitat preference of *B. soroensis* is different. For example, in the British Isles this species is associated not only with meadow habitats, but also with heathlands and woodlands (Falk and Lewington 2017). In Eastern Europe, *B. soroensis* prefers forest edges in addition to open meadow habitats (Panfilov 1957, Dylewska 1996). In southern Europe, *B. soroensis* occurs mainly in mountain forest habitats (Hagen 1986, Iserbyt 2009, Manino et al 2010, Rasmont et al. 2015). On the European continent as a whole, there has been a change in the habitat preference of this species from mountain ecosystems in southern Europe to open plains in the northern part of the European continent (Rasmont et al. 2015). Here is an example of the rule of zonal change of habitats within the species range, in that the species inhabits forest communities in the south of its range and it associates to open habitats in the north (Bey-Bienko 1966).

Conclusion

The territory of the Arkhangelsk Region can be considered as one of the northern borders of *B. soroensis* in the north-east of the European continent. In relation to habitat preference, *B. soroensis* is typical of open meadow habitats, similarly for Eastern Fennoscandia.

We expect a stable existence of this species in the Arkhangelsk Region. Further monitoring is needed in connection with the expected changes in the species range in the next few decades (Rasmont et al. 2015).

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