

# Biogeography, landscapes, ecosystems and species of Zaonezhye Peninsula, in Lake Onega, Russian Karelia

Tapio Lindholm, Jevgeni Jakovlev & Alexey Kravchenko (eds.)





REPORTS OF THE FINNISH ENVIRONMENT  
INSTITUTE 40 | 2014

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Helsinki 2014

Finnish Environment Institute



**BPAN**

Barents Protected Area Network

REPORTS OF THE FINNISH ENVIRONMENT INSTITUTE 40 | 2014  
Finnish Environment Institute  
Natural Environment Centre

Layout: Pia Kauppinen

Cover photo: Clouded Apollo, *Parnassius mnemosyne* and Rough Hawkbit,  
*Leontodon hispidus* meet in Zaonezhye. Andrei Humala.

English revision: Minna Hartikainen

The publication is also available in the internet:  
[www.syke.fi/julkaisut](http://www.syke.fi/julkaisut) | [helda.helsinki.fi/syke](http://helda.helsinki.fi/syke)

Juvenes Print, 2015

ISBN 978-952-11-4404-2 (pbk.)  
ISBN 978-952-11-4405-9 (PDF)  
ISSN 1796-1718 (printed)  
ISSN 1796-1726 (online)



## FOREWORD

**Anna Kuhmonen**

Zaonezhye Peninsula has a distinctive and diverse natural heritage, and its unique habitats are included in regional nature conservation plans. Although the value of its habitats and landscapes has been known for a long time, the documentation necessary for the establishment of a protected area has been lacking and high conservation value forests have been threatened by forest logging.

The Barents Protected Area Network (BPAN) project promotes and supports the establishment of a representative network of protected areas in the Barents Region. Protected area networks are an important tool in biodiversity conservation as well as climate change adaptation and mitigation. A representative network of protected areas safeguards biodiversity, supports natural ecosystems and maintains ecosystem services. In addition to evaluating the network of protected areas in Northwest Russia, the BPAN project has implemented pilot projects in high conservation value areas in order to support the establishment of new protected areas.

All the countries in the Barents Region - Russia, Finland, Sweden and Norway - are parties to the Convention on Biological Diversity. In 2010, the parties committed to halting the loss of biodiversity by 2020 and set the 20 Aichi Biodiversity Targets. The Aichi Target 11 calls for at least 17% protection of terrestrial and inland water areas, especially areas of particular importance for biodiversity and ecosystem services, by 2020. Protected areas cover 13.4 % of the Barents Region, while the level of protection in the Republic of Karelia is 4.7 % (2013). Regional and national conservation plans include 59 400 km<sup>2</sup> of planned protected areas in the whole Barents Region. However, implementation of conservation plans takes time, and the global targets have been set for 2020. The results of the BPAN project show that the implementation of conservation plans should be quicker and more effective.

In 2012, the BPAN project selected five territories in Northwest Russia where nature conservation was to be promoted through field studies as well as other activities. In the Republic of Karelia, a pilot project was implemented in the high conservation value forests of Zaonezhye Peninsula. Earlier studies on the peninsula showed that the area supported valuable habitats and species. However, even though forests were included in the regional conservation plan, they were at the same time leased by forestry companies and threatened by logging.

Between 2013 and 2014, the BPAN project carried out field work and documented natural values within the planned Zaonezhye nature park, focusing on high conservation value forests. These activities were conducted by the Finnish Environment Institute, Karelian Research Centre and the Directorate of regional protected areas of the Republic of Karelia in cooperation with experts from the Universities of Helsinki and Eastern Finland, and the Finnish Nature League.

This publication presents information on hundreds of red-listed species and valuable habitats. Promoting the protection of high conservation value forests on Zaonezhye Peninsula has been an important part of the BPAN project. We are grateful to all researchers for their valuable input into the field work as well as this publication. For financing this work we thank the Nordic Council of Ministers, Ministry of the Environment and Ministry for Foreign Affairs of Finland, Sweden and Norway, and WWF-Russia.

We hope that this publication contributes to establishing the valuable nature areas of Zaonezhye Peninsula as statutory protected areas.



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# Zaonezhye Peninsula – The pearl of Lake Onega

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## Introduction

The Republic of Karelia is located mostly in the eastern part of the Baltic shield, which is composed of Precambrian crystalline rock. However, it includes areas that differ markedly in their geological background, soils and vegetation. Zaonezhye Peninsula is a particularly interesting area in terms of the variety of landscapes, habitats and species.

Zaonezhye Peninsula (Zaonezhsky Peninsula; Заонежский полуостров in Russian transcription) is situated on the northwestern coast of Lake Onega. Its eastern shores are washed by the Gulf of Zaonezhye. In the north the peninsula is bordered by Povenetskiy Bay, while to the west it is bounded by Lizhma Bay and the Gulf of Bolshoe Onego (Fig. 1). “Zaonezhye” is used here in a wider sense to include Zaonezhye Peninsula as well as two adjacent peninsulas, Lizhma and Sjar, which are separated by the long and narrow bays of Lake Onega. In the south, Zaonezhye Peninsula shelters an archipelago of numerous islands, also known as Kizhi skerries or the Kizhi archipelago. The archipelago includes two relatively large islands, Bolshoy Klimentevsky and Bolshoy Lelikovskiy, which have several old villages, fertile valleys of unique grassland and patches of old-growth forest. The most famous among the islands is Kizhi Island where monumental 17<sup>th</sup> century churches, included in the UNESCO World Heritage List, are preserved. Often the whole area on the opposite shore of Lake Onega is called Zaonezhye. It is separated from the city of Petrozavodsk by a mere few dozen kilometers of water and has therefore good connections by boat.

Zaonezhye is considered a separate biogeographic region (Ramenskaya 1983). According to modern estimates (e.g. Elina et al. 2010), the territory of Zaonezhye is unique in that it contains nearly every type of terrain and unconsolidated sediment known in the vast expanses of northwest Russia. It is characterized by a high diversity of basic limestone and carbonate rocks that determine the fertility of local soils as well

as the unique diversity of habitats, flora and fauna. Numerous rare calciphile plant and lichen species are found here, as well as rich, eutrophic wetlands. Long-term farming and animal husbandry have led to a large number of grassland communities in the area. As a result, a mosaic structure of diverse habitats has evolved here. Europe's second largest lake, Lake Onega, with its clear and deep waters also affect the local climate by making it milder.

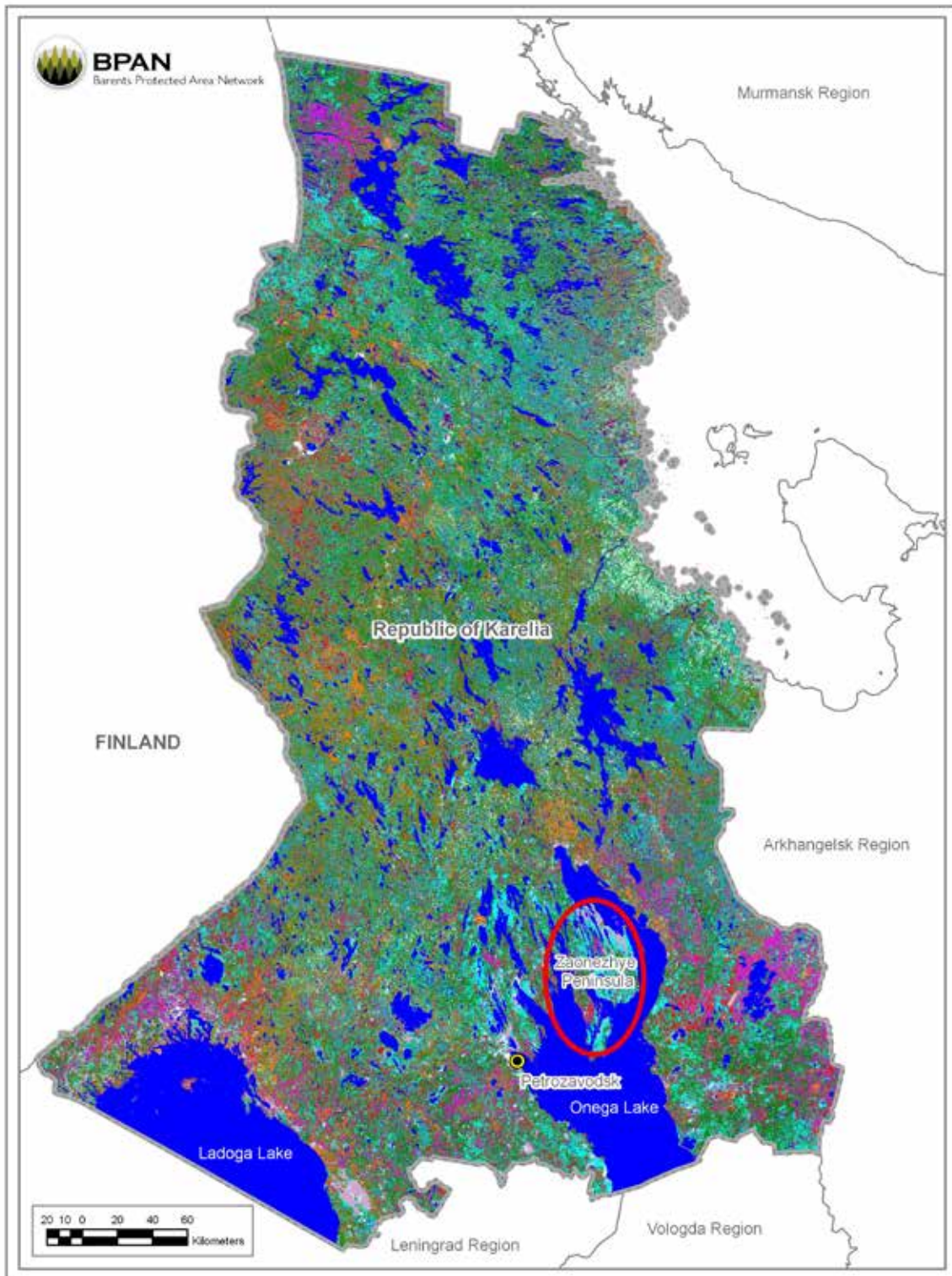


Fig.1. Geographical location on Zaonezhye Peninsula

## Old villages and traditional land use in Zaonezhye

The late-medieval villages of Zaonezhye Peninsula and the Kizhi archipelago maintained a vibrant rural society until the middle of the 20<sup>th</sup> century. According to the census of 1887 (Census of population 1904), in the end of the 19<sup>th</sup> century the population of Zaonezhye Peninsula consisted of 47 000 people. At the time, the population density of the peninsula was at its highest at 13.4 people per km<sup>2</sup>, while the population density of the entire Olonets Province (present-day Republic of Karelia) was only 2.8 people per km<sup>2</sup>. Nowadays most of the villages have been abandoned. However, extraordinary pieces of Russian wooden architecture remind us of their past glory. Many old churches are still standing thanks to summer residents who continue to repair them.



Fig. 2. Old wooden church in the village of Tambitsy on the southeastern coast of Zaonezhye Peninsula (Photo: Andrei Humala)

The southeastern parts of Zaonezhye Peninsula, together with the northern shores of Lake Ladoga, have the longest history of traditional land use in Karelia. The peninsula has been permanently inhabited for thousands of years. The first traces of pollen of crop plants such as wheat, oat and rye appeared nearly 1 000 years ago (Lavrova et al. 2005). In the past, slash-and-burn-cultivation was the main type of agriculture in Zaonezhye. However, despite a gradual increase in the proportion of cultivated land, a large part of the area has stayed relatively intact. At present, Zaonezhye Peninsula incorporates near-natural landscapes in its central part and areas showing traces of past agricultural activities along the coast of Lake Onega.

The central parts of Zaonezhye Peninsula consist of almost unpopulated ridge landscapes that have not been easily accessible for forestry or agriculture. Contrastingly, lowland areas on the southern and southeastern shores of Zaonezhye Peninsula as well as the islands of the Kizhi archipelago have been profoundly affected by slash-and-burnt cultivation over time. The present distribution of forest types is mainly the result of the earlier human activities. Originally, lowland areas were covered with coniferous forests that were growing in close to optimal conditions and were therefore characterized by their high quality. Nowadays, near-natural coniferous forest stands

are preserved only in few places where logging is difficult, including paludified areas and steep, rocky slopes close to the shoreline. A part of the preserved old-growth forests is located within the protected belts of water bodies. For example, the protected belt along the shores of Lake Onega is one kilometre wide.

According to the Soviet classification of forests (1943), which was used until the recent Forest Code (2006), forests along water bodies belonged to water protective forest group and were automatically excluded from logging. The rest of the forests have been affected by selective cuttings. Especially close to the villages, these forests have formed naturally on abandoned hay meadows and fields. According to the forest inventory of 1999 (Gromtsev & Krutov 2000), pine and spruce forests occupy nearly 60 percent of the forest cover, in approximately equal proportions. The remaining area is covered by forests, dominated by birch (ca. 30%), aspen (5%) or grey alder (6%).

Intact mires are preserved mainly in the central part of the peninsula where they cover depressions between long and narrow ridges. In lowland areas, numerous small, eutrophic fens occupy narrow bays along the shoreline. In the past, the local population used the lowlands for haymaking. At present these areas combine mire and meadow vegetation, including many red-listed species. However, the hydrology of many mires and brookside forests is affected by the Canadian beaver (*Castor canadensis*), which is relatively common in the area. The native beaver species, *Castor fiber*, has become extinct here.

## Nature studies in Zaonezhye

There is a long history of nature studies in Zaonezhye that date back to the 19<sup>th</sup> century. At that time, Finnish researchers prepared and published detailed lists of plants, lichen (Norrlin 1871, 1876) and beetles (Poppius 1899) that are of international importance. Around the same time, *Alexander Günther* from Petrozavodsk collected and documented hundreds of plant and insect species that have later been recorded from Zaonezhye also by other researchers (See Chapters 3.1, 3.3 and 3.6). After a long break in the first half of the 20<sup>th</sup> century, studies resumed first by Finnish researchers in the 1940s and then by the Karelian Research Centre of the Russian Academy of Sciences (hereinafter KRC RAS) in Petrozavodsk.

Until very recently, the flora and fauna of the area have remained largely unexplored. The Atlas of the distribution of vascular plants in northern Europe (Hulten 1971) fails to mention a number of local calciphile and other plants that require fertile soils. There are several scientific publications on the Kizhi archipelago (e.g. Elina et al. 1999, Ieshko & Protasov 2005, etc) and the central part of Zaonezhye Peninsula (e.g. Gromtsev 2013). However, the first report on the biodiversity inventories and studies of Zaonezhye (Gromtsev & Krutov 2000) still remains the only publication that covers the entire Zaonezhye Peninsula and the adjacent islands.

Mire and meadow vegetation studies have been conducted during several expeditions of the Laboratory for mire ecosystems of the Institute of biology in the past 30 years. These studies have resulted in the establishment of several nature monuments for the protection of mires. Also new data on mire and meadow vegetation and dynamics have been created (See Chapters 2.5 and 2.6).

Between 2<sup>nd</sup> and 8<sup>th</sup> July 2004, leading Finnish and Russian botanists and entomologists carried out the first Finnish-Russian expedition on the “Ecolog” research vessel of the KRC RAS. Its goal was to visit hotspots of rare and threatened plant, lichen and insect species. The expedition included 12 participants: *Alexei Kravchenko* (vascular plants), *Oleg Kuznetsov* (mire vegetation), *Margarita Boychuk* (mosses), *Margarita Fadeeva* (lichens), *Alexei Polevoi* and *Andrei Humala* (insects) from the KRC RAS; *Elena*

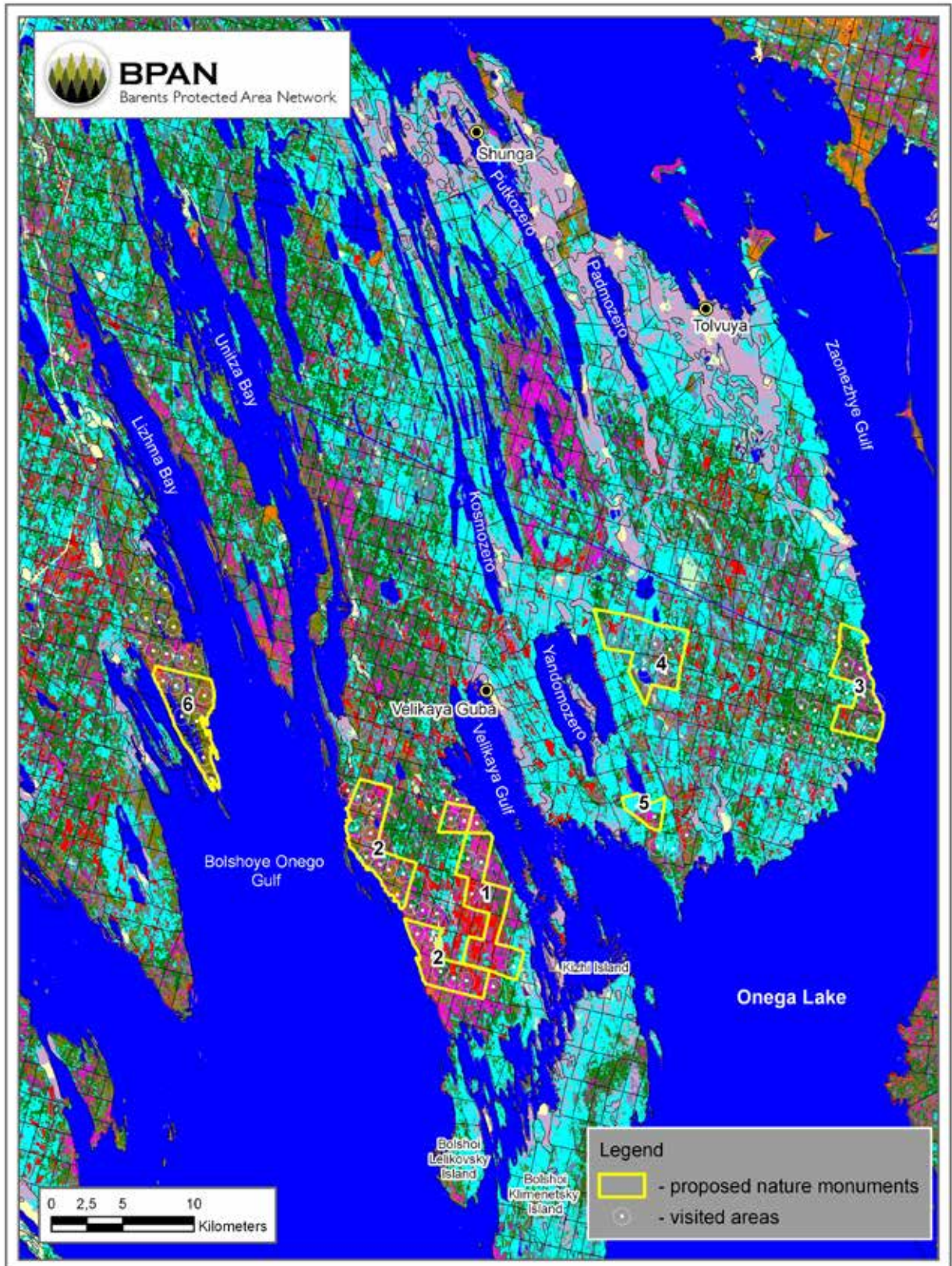


Fig. 3. Intact forest landscapes and mires on Zaonezhye Peninsula and the adjacent areas (after: Kobyakov & Jakovlev (2013), areas visited in 2013 and proposed nature monuments, 1-6.

*Gnatyuk* from the Petrozavodsk State University (vascular plants), *Pertti Uotila* and *Mikko Piirainen* from the Botanical Museum of the Finnish Museum of Natural History in Helsinki (vascular plants); Professor Emeritus *Rauno Ruuhijärvi* from the University of Helsinki (mire vegetation); *Tapio Lindholm* (mire vegetation and vascular plants) and *Jevgeni Jakoblev* (insects) from the Finnish Environment Institute. The following localities were studied:

1. Islands Paleostrov, Rechnoi and Meg-Ostrov near the northern tip of Zaonezhye Peninsula. Different grassland and forest biotopes (old spruce stands, black alder swamps). A large abandoned monastery on Paleostrov Island as well as its old meadows and tree alleys.
2. The southeastern shore of Zaonezhye Peninsula (in the vicinity of the villages of Kuzaranda and Tipinitsy) and the islands of Khedostrov, Shunevsky and Yuzhny Oleniy. High-quality spruce forests with *Tilia cordata* in the undergrowth. Yuzhny Oleniy Island is the only island in the area. It is also one of three islands in Karelia that are entirely formed of dolomite.
3. Bolshoi Klimenty and Bolshoi Lelikovskiy Islands, Cape Radkolye. Old-growth spruce-dominated forests of *Oxalis-Myrtillys* type, spruce mires and forested lowland mires as well as grasslands in previously settled areas. Many regionally rare and threatened species of vascular plants, bryophytes, lichens and insects have been found here.

The members of the expedition concluded that Zaonezhye contains unique biotopes and habitats of threatened species. They recorded a number of vascular plant, bryophyte, lichen and insect species that are considered rare or threatened in the Republic of Karelia and concluded that more detailed research is required.

In the summer of 2013, another international nature expedition was carried out in the southern lowlands of Zaonezhye Peninsula in the framework of the Barents Protected Area Network (BPAN) project. The experts *Alexei Kravchenko*, *Margarita Fadeeva*, *Andrei Humala*, *Alexei Polevoi*, *Boris Rayevsky* and *Anna Ruokolainen* from the KRC RAS, *Jevgeni Jakoblev* and *Kimmo Syrjänen* from the Finnish Environment Institute, *Timo Kuuluvainen* from the University of Helsinki, *Olli-Pekka Tikkanen* from the University of Eastern Finland and *Olli Manninen* and *Jyri Mikkola* from the NGO Finnish Nature League studied natural forests and mires along the southern coast of Zaonezhye Peninsula as well as old-growth forests on Sjar Peninsula on the opposite shore of Lizhma Bay. The expedition aimed to study high conservation value forests (Fig.3) that were identified between 2007 and 2011 within the “Gap analysis in north-west Russia” (Kobyakov & Jakoblev 2013). As a result of this expedition, new nature monuments were proposed (See Fig 3 and Chapter 1.6).

## Conservation activities in Zaonezhye

Currently planned protected areas in the Republic of Karelia cover an area of 59 400 km<sup>2</sup>. However, the status of planned protected area alone does not secure nature values. The establishment of protected areas is a long process and in many cases valuable areas have been lost to forestry before the areas have been protected.

In Zaonezhye, conservation activities began between 1965 and 1969. Initially, old wooden buildings of historical interest were transported to Kizhi Island where the Kizhi state open-air museum of history, architecture and ethnography was established.

Later the federal Kizhi zoological nature reserve (*Kizhskiy zakaznik*) was established (22<sup>nd</sup> September 1989), based on the recommendations of Tatyana Khokhlova and Oleg Kuznetsov from the Institute of Biology of the KRC RAS. Between 1989 and 1998, ten nature monuments were established in Zaonezhye for the protection of mires (Khokhlova et al. 2000). These regional protected areas cover 1 512 hectares, including Lizh Peninsula, and contain both unique and characteristic Eastern European mire ecosystems. They were established on the basis of the recommendations by the Laboratory of mire ecosystems of the Institute of biology of the KRC RAS.

In 1992 KRC RAS produced a feasibility study for the establishment of a nature park with an area of 115 000 ha on Zaonezhye Peninsula (Gromtsev et al. 1992). After detailed field studies, KRC RAS published an assessment of the protected area (Gromtsev 2013). The proposed Zaonezhsky landscape reserve (*zakaznik*) covers 106 373 ha, of which 86 839 ha is on land. At the same time, the Karelian NGO "SPOK" prepared recommendations for the protection of southern and eastern Zaonezhye Peninsula (SPOK 2013) (See Chapter 2.3).

In the Republic of Karelia, protected areas are created only in accordance with programmes approved by the Russian government. Therefore, planning the establishment of new protected areas is feasible only in cases where such plans are already included in the programmes of the Russian government (protected areas of federal importance: strict nature reserves and national parks) or the government of the Republic of Karelia (protected areas of regional importance: nature parks, nature reserves or *zakazniks* and nature monuments).

The list of planned protected areas in the Republic of Karelia is a part of the Land use plan of the Republic of Karelia until 2030, approved by the government of the republic (Scheme 2012; directive № 102-P from 6<sup>th</sup> July 2007). It contains two lists concerning the establishment of new protected areas: The first list includes protected areas that are planned to be established in the first stage before 2020. Regional nature conservation authorities are presented with all necessary background material for the establishment of these protected areas, including detailed information about the area and its borders as well as ecological values, economic and social characteristics, and the proposed protection regime of the planned protected area.

The second list includes perspective new protected areas where red-list species or other natural objects of high conservation value have been recorded. However, the necessary background material for their establishment has not been compiled yet. These protected areas are planned to be established in the second stage between 2020 and 2030.

According to the latest changes to the Land use plan of the Republic of Karelia from July 2014 (Regulation 2014), Zaonezhsky landscape reserve, covering 106 373 ha in the northwestern part of Zaonezhye Peninsula, is included in the list of protected areas to be established before 2020. KRC RAS has prepared the background material necessary for the establishment of this protected area (Gromtsev et al. 2013). Another protected area, Zaonezhye nature park, which has been included in the Land use plan of the Republic of Karelia since 2007, is planned to be established in the second stage between 2020 and 2030. It covers 119 600 ha in the southeastern part of Zaonezhye Peninsula (partly overlapping the Zaonezhsky landscape reserve).

## Threatened species and proposals for their protection

There is more than one concept of biodiversity but it is generally accepted that the basic unit of biodiversity is the species. For that reason, biodiversity studies provide the background for conservation. Records of threatened species, included in the Rus-

sian and regional red data books, are therefore of great importance. Establishing new protected areas or expanding existing ones to cover habitats of rare and threatened species is the main legislative tool to protect species and habitats.

During the expeditions, the southeastern lowlands of Zaonezhye Peninsula were identified as important for the conservation of biodiversity. The list of species recorded during these expeditions is impressive: it includes approximately 130 species that are red-listed in the Republic of Karelia (Ivanter & Kuznetsov 2007), more than 100 indicator species of valuable natural forests (according to Andersson et al. 2009) as well as numerous otherwise interesting or rare species, included in international lists of threatened species, such as the IUCN Red List (2014) and the Red Data Book of European Bryophytes (1995), or the 2010 Red List of Finnish species (Rassi et al. 2010). Furthermore, several species of fungi such as *Ganoderma lucidum*, lichens such as *Lobaria pulmonaria* and *Bryoria fremontii* and vascular plants such as *Littorella uniflora*, *Lobelia dortmanna* and *Isoetes lacustris* are included in the latest Red list of plants and fungi of the Russian Federation (Trutnev 2008). Also, one butterfly species, Clouded Apollo (*Parnassius mnemosyne*), is included in the Red list of animals of the Russian Federation (Danilov-Danilyan et al. 2001). Detailed descriptions of distributions and ecology of threatened species of federal and regional importance are presented in Chapter 3. The identified habitats of these species serve as grounds for the establishment of nature monuments (see Chapter 1.6).

Besides promoting conservation, the purpose of this book is to gather basic knowledge of the nature on Zaonezhye Peninsula and the adjacent islands. This publication consists of 19 articles on paleogeography, geology and geomorphology as well as the soils and hydrology of Zaonezhye Peninsula. It also includes descriptions of the landscapes and main ecosystems in the area, including forests, mires and meadows. In this book we present for the first time full lists of vascular plant, bryophyte, lichen, wood-growing fungi and insect species recorded from the area to date.

## Acknowledgements

This book has been prepared owing to great efforts by several researchers from the Karelian Research Centre of the Russian Academy of Sciences as well as the Finnish Environment Institute, Universities of Helsinki and Eastern Finland. We are grateful for all the researchers who took part in the field work and the preparation of this publication. Professor *Pertti Uotila* from the University of Helsinki has made useful comments about the manuscript.

*Grigory Sokolov* (Petrozavodsk) has translated some of the articles into English and *Minna Hartikainen* (London) has made linguistic corrections to this work. The maps (Fig. 1 and 3) have been prepared by *Denis Dobrynin* from the WWF Russia, Arkhangelsk.

The Finnish-Russian working group on nature conservation, chaired by *Aimo Saano* (Parks & Wildlife Finland, Metsähallitus) and *Tapio Lindholm* (Finnish Environment Institute), financed the field work in 2004. The field studies in 2013 were implemented by the BPAN pilot project, coordinated by *Anna Kuhmonen* and *Jevgeni Jakovlev* (Finnish Environment Institute) in cooperation with the Directorate of regional protected areas of the Republic of Karelia, lead by *Denis Maksimov*.

This book is prepared and published as a part of the BPAN project, financed by the Nordic Council of Ministers, governments of Finland, Sweden and Norway, and WWF-Russia. This support is cordially acknowledged.



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# 1 Geology and physical geography of Zaonezhye Peninsula area

## 1.1 Geological description of Zaonezhye Peninsula

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### Introduction

Geologically, Zaonezhye Peninsula is located in the centre of the synclinorial Paleoproterozoic<sup>1</sup> Onega structure, which is referred to by some authors as the Onega trough. It is confined to southeastern Fennoscandian Shield and rests on an Archean<sup>2</sup> granite gneiss basement. The basement rocks on the peninsula are not exposed. Most of the igneous (effusive and intrusive) and sedimentary rocks (sandstone, siltstone, argillite and carbonate) of the bedrock were formed between 2300–1800 Ma. In the regional Paleoproterozoic stratigraphy these rocks are situated in the Jatulian (2300 – 2100 Ma), Ludicovian (2100 – 1920 Ma) and Kalevian (1920 – 1800 Ma) superhorizons. The positions of the Zaonezhye Peninsula bedrocks in the stratigraphic column of Karelia are shown in Figure 1.

The relief of Zaonezhye Peninsula is affected by a system of predominantly NW-trending faults. (Lake Onega bays are also elongated NW.) The area is formed of a series of gently dipping synclines<sup>3</sup>, separated by narrow anticlines<sup>4</sup> with steeply dipping limbs. These have resulted in seven different zones of folding and faulting zones on the Peninsula (Bulavin 1999), also described as linear anticlinal uplifts with longitudinal folds and faults (Fig. 2). The Paleoproterozoic geological and tectonic structure of the area as well as the types and chemical and mineral composition of its bedrocks are described in detail in literature (Glushanin et al. 2011, Reading... 2013) and are discussed briefly below.

1 Paleoproterozoic – a period in the Earth’s evolution 2.5 to 1.6 Ga; rocks that formed at that time

2 Archean – a period in the Earth’s evolution older than 2.5 Ga; rocks that formed at that time

3 Syncline – a fold of which the core contains stratigraphically younger rocks; generally concave upward

4 Anticline – a fold, generally convex upward, whose core contains stratigraphically older rocks

Acrothem		Eonothema		Superhorizon		Horizon		Absolute age, Ma	Thickness, m	Lithological composition	
Proterozoic	Lower (Karelian)	Vepsian						1650	1500	Sandstone, quartzitic sandstone, siltstone, schist, conglomerates, conglobreccia. Basic sills and lava.	
								1800	1000	Interbedding of graywacke sandstone, siltstone and carbonaceous argillite with fine-pebble conglomerate interbeds.	
		Kalevian							1920	700	Tuffs, tuffites and lava of basalt, microbasalt and metabasalt composition.
									2100	1200	Feldspar-quartz sandstone, siltstone, krivozerite, shungite-bearing siltstone and argillite with dolomite, limestone and lydite interbeds. Basic lava and sills.
		Ludicovian	Suisarian						500	500	Dolomite, marbled limestone, quartz sanstone with dolomite matrix, siltstone, schist, basalt.
									1100	1100	Sandstone, quartzitic sandstone, schist, tuffite, scarce carbonate rock interbeds, conglomerates and basalt.
		Trans-Omega							2300	500	Polymictic and granite conglomerates, arkose, graywacke, lava of andesite-basalt composition.
									2400	500	Conglomerates, tuff conglomerates, gravelstone, arkose, quartz porphyry of dacite-rhyolite composition.
		Omega							2500	1000	Intermediate and felsic volcanic tuffs, schist, iron formations, carbonaceous and carbonate rocks, conglomerates, basalt, komatiite and andesite.
									>3000	>3000	Biotite- and epidote-biotite gneiss, amphibole and kyanite-bearing gneiss and granite gneiss.
		Segozerian							3200	2000	
		Sario-lian									
Sumian											
Archean	Upper (Lopian)										

Fig. 1. General stratigraphic column of Karelia (black line indicates the position of Zaonezhye Peninsula rocks in the column).

**Sedimentary rocks.** *Jatulian superhorizon, Tulomozero suite.* The rocks of the Jatulian superhorizon are the oldest on the Zaonezhye Peninsula. They are only exposed in the centre of the anticlines, which are aligned SE–NW. They occur along the northeast shore of the peninsula and are occasionally encountered as elongated structures along the Tambitsy village–Lake Padmozero line and in the area between Lake Yandomozero and the village of Velikaya Guba. These rocks have also been reported from Yuzhny Oleny Island and northern parts of Svyatukha Bay (Fig. 2).

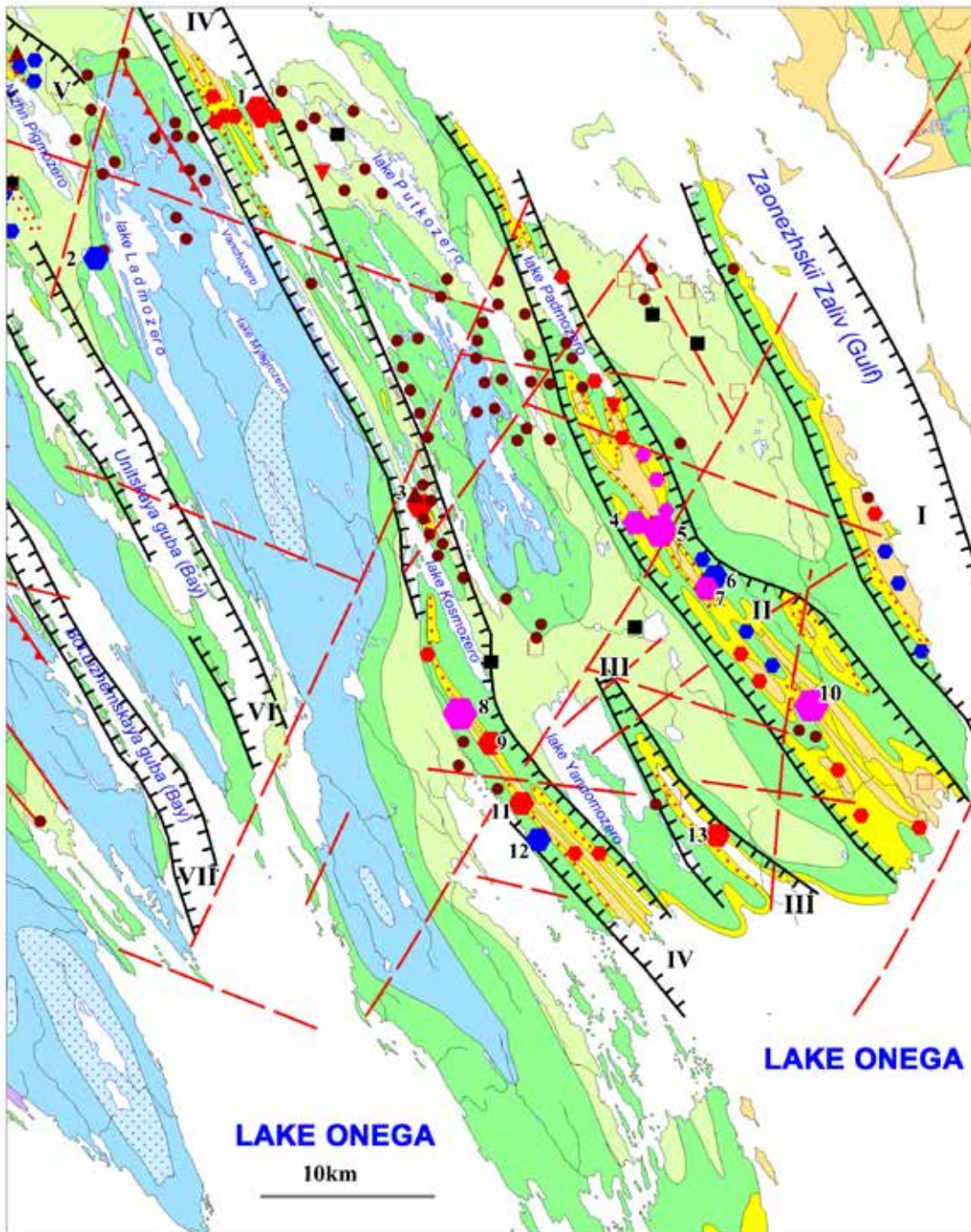














Fig. 2. Diagram of the geological structure of Zaonezhye Peninsula (made using the maps of Sevzapgeologia (Mikhailyuk et al. 1988), and by USSR Ministry of Geology, PGO Nevskgeologia (Bulavin 1999).

**SYMBOLS**










-  Albitized rocks with mica-carbonate alterations (alkaline-carbonate metasomatic rocks)  
Shuya, Vashozero, Besovetz and Munozero suites (Kalevian)
-  Volcanomictic, arkose and calcareous sandstones and siltstones, tuffites, schists and limestones  
Kondopoga, Besovetz and Pados suites (Kalevian)
-  Tuffites, aleuropelitic tuff schists and shungite-bearing tuffs  
Suisari suite (Ludicovian)
-  Plagioclase and pyroxene porphyrites, picrites  
Zaonezhye suite (Ludicovian)
-  Gabbro-dolerites, albitic leucogabbro-dolerites of layered sills and intrusive sheets, basalt flows
-  Shungite-bearing and shungitic tuff schists, tuffites, dolomites, limestones, shungites, lydites, basalts, andesite-basalts
-  Hematite-bearing ("multi-coloured") mica-dolomite schists, schists, dolomites, shungite-bearing siltstones  
Tulomozero suite (Jatulian)
-  Algal and other dolomites (with Butinella Boreale, etc.), dolomitic sandstones, siltstones, schists  
The basement consists of quartz sandstones with pebble conglomerate interbeds
-  Boundaries of different-aged rock units




**Faults, above-fault dislocations:**

-  - established
-  - faults
-  - assumed on the basis of available data

**Folding and faulting zones:**

-  I – Kuzaranda
-  III – Nulitsa
-  V – Pigmozero
-  VII – Lizhma (Kedrozero)
-  II – Tambitsa
-  IV – Svyatukha-Kosmozero
-  VI – Unitsa

Deposits	Ore occurrences	Mineralization points	Ore and ore-bearing formations
			Uraniferous formation in peat
			<b>Copper-uranium-vanadium mineralization with noble-metals in alkaline-carbonate metasomatic rocks, including the subformations:</b> Uranium-vanadium subformation with noble metals in albite-mica-carbonate metasomatic rocks
			Gold-copper-uranium formation in albite-(mica) chlorite-carbonate metasomatic rocks
			Uraniferous gold-copper formation in albite-carbonate-chlorite-quartz metasomatic rocks
			Uraniferous base-metal-pyrite formation in shungite-bearing rocks

-  Sites where uranium ore clasts have been found
-  Amphibole-asbestos occurrences
-  Copper and cobalt mineralization occurrences of uncertain formation

**Numbers of ore deposits and occurrences on the map:**

- 1 - Svyatukha, 2 - Yunoi-Gora, 3 - Cherny Navolok, 4 - Vesenneye, 5 - Srednyaya Padma, 6 - Mednaya Yama, 7 - Verkhnyaya Padma, 8 - Kosmozero, 9 - Yuzhnoe Kosmozero, 10 - Tsarevskoye, 11 - Velikaya Guba, 12 - Kondoberezhskaya, 13 - Nulitsa.



Fig. 3. Mode of occurrence of carbonate rocks, Tulomozero suite, Yuzhny Oleny Island (Photo Vladimir Makarikhin).

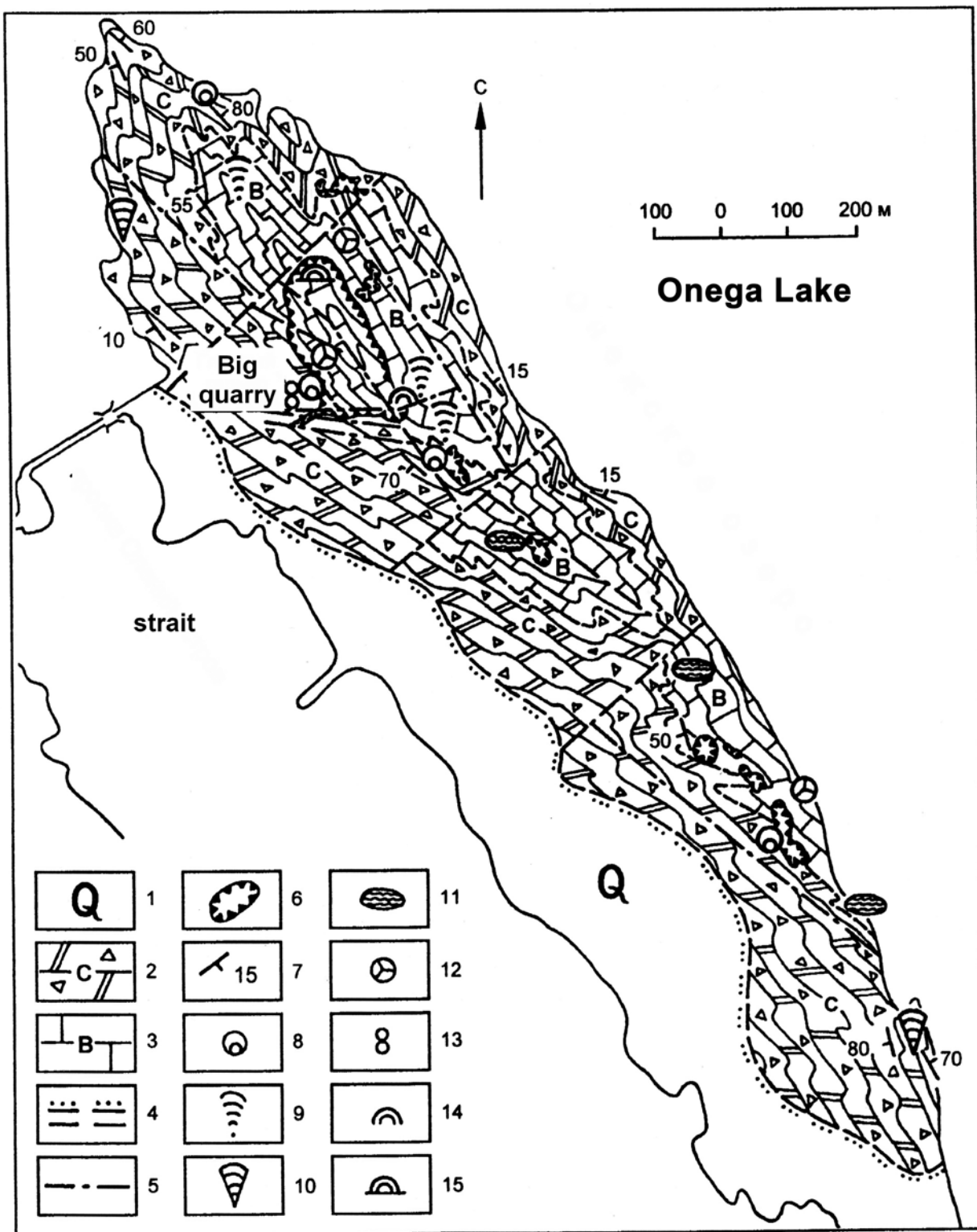


Fig. 4. Diagram of the geological structure of South Oleny Island (6): 1 = Quaternary sediments; 2 = red bed- dolomite unit; 3 = limestone- dolomite unit; 4 = stratigraphic boundaries; 5 = fault lines; 6 = quarry contours; 7 = mode of occurrence; 8-15 = organic residue: 8 = *Klimetia*, 9 = *Butinella*, 10 = *Calevia olenica* (Rjab), 11 = *Stratifera ordinata* Mak., 12 = oncolites, 13 = *Kareliana zonata* Korde, 14 = nodular stromatolites, 15 = *Olenia rasmus* But.





Fig. 5. Limestone kilning furnace, South Oleny Island (Photo Vladimir Makarikhin).



Fig. 6. Carbonate pseudomorphs after gypsum, core sample from the Onega Parametric Borehole. The sample is about 8 cm wide.

At this level the rocks are dominated by partly marbled dolomite interbedded with limestone, sandstone, phyllite and carbonate breccia. Carbonate rocks contain relics of biogenic stromatolites produced by the vital activity of lower organisms, mainly cyanobacteria, and occur now as carbonate or, occasionally, secondarily silicified deposits with different forms of internal layering. A distinctive feature of the rocks that occur in this part of the geological column is the anomalously heavy isotope composition of carbonate carbon  $\delta^{13}\text{C}$  (+10 – +18‰, while the isotope composition of carbon in both old and modern carbonates is commonly about 0‰). It should be noted that this anomaly is considered global and carbonates of similar age, displaying the same anomalous isotope composition of carbon, have been reported from several regions of the earth (Melezhik et al. 2005, Melezhik et al. 2010, Reading...2013).

The largest exposures of Tulomozero carbonate rock can be found on South Oleny Island (with the area of 0.7x2.5 km), which lies 12 km east of Kizhi Island. It is a unique area of geological and archaeological significance (Makarikhin 1992) where quarries and other land use have exposed calcareous-dolomitic rocks that contain an abundance of organic fossils (stromatolites and microphytolites) dating back circa 2 Ga. The carbonate rock deposits are up to 70 m thick, dipping SW and making up the

limb of the NW-trending anticline. In the limb, rocks exhibit small-scale dome-shaped folding. Limestone is commonly confined to the cores of the dome-shaped folds, whereas dolomite constitutes the fold arches. In addition, accumulated dolomite displays small-scale plication (Fig. 3). These rocks have been described in detail in several publications and geological guidebooks (Sokolov & Butin 1961). V.V. Makarikhin and G.M. Kononova (1983) provide the most complete and detailed description of the organic fossils. Bedding patterns and spatial relationships of rocks and organic fossils (old algae) can be seen in the rock exposures on the northeast shore of the island and in the quarry walls in the northern and central parts of the island (Fig. 4). On the southwest shore of the island, one can learn more about limestone kilning carried out before 1956 near the Main Quarry where fragments of two furnaces, filled with raw material for kilning, and other traces of past activities have been preserved (Fig. 5).

The extensive evidence obtained in the last few years shows that the rocks of the Tulomozero suite were formed in an evaporative environment (in a hot, dry climate). Examples include carbonate pseudomorphs, lesser talc and quartz pseudomorphs after gypsum, nodular and cloud-like (chicken-wire) deposits typical of gypsum aggregates (Fig. 6), carbonate beds after gypsum deformed locally by the volumetric effects of gypsum-anhydrite transitions and scarce pseudomorphs<sup>5</sup> after cubic and skeletal halite (rock salt) crystals. Carbonate breccia, which often occurs in this layer, has some features indicating that they have been produced as a result of collapsed salt karst (Melezhik et al. 2005).

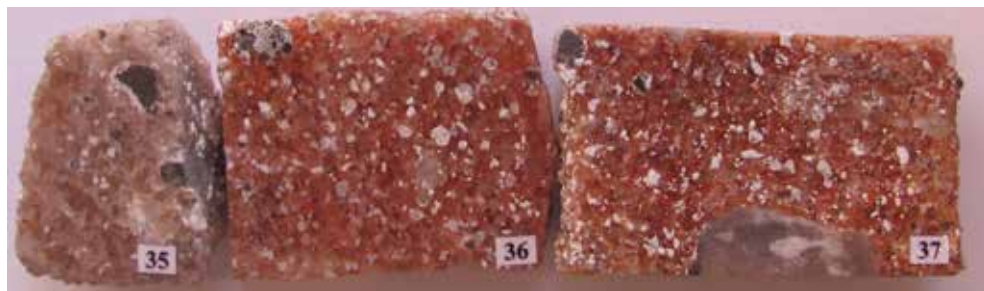


Fig. 7. Rock salt (halite) with anhydrite inclusions (light and grey). Core sample from the Omega Parametric Borehole. The sample is about 5 cm wide.



Fig. 8. Brecciated krivozerites. Lower Zaonezhye subsuite, Svyatukha Bay of Lake Onega (Photo Vladimir Makarikhin).

<sup>5</sup> Pseudomorph is a mineral whose outward crystal form is that of another mineral species; a pseudomorph is described as being after the mineral whose outward form it has, e.g. limonite after pyrite, quartz after fluorite, etc.).

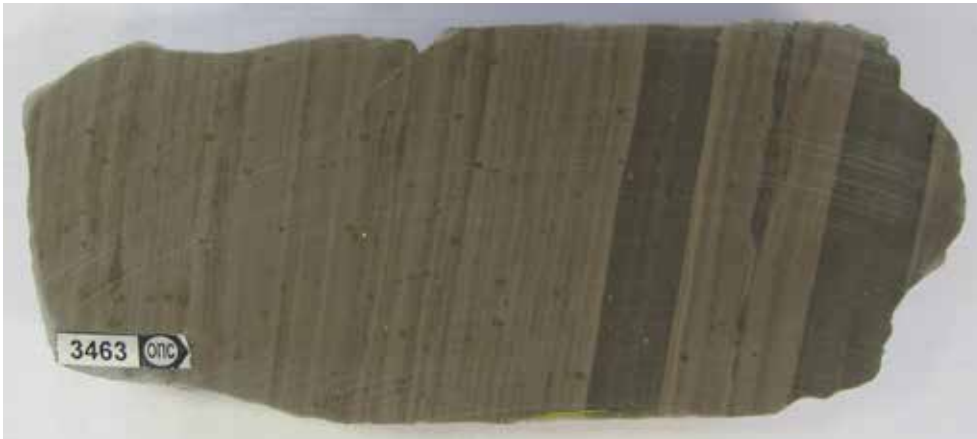


Fig. 9. Krivozerite of the Lower Zaonezhye subsuite, core sample from the Onega Parametric Borehole. The sample is about 8 cm wide.



Fig. 10. Brecciated maksovitite, Berezovets Island (Photo Vladimir Makarikhin).



Fig. 11. Maksovitite pebble beach, Berezovets Island (Photo Vladimir Makarikhin).



Fig. 12. Anthraxolite, village of Shunga. The sample is about 6 cm long.

### Geomorphology and Quaternary deposits of Zaonezhye

At this level the rocks are dominated by partly marbled dolomite interbedded with limestone, sandstone, phyllite and carbonate breccia. Carbonate rocks contain relics of biogenic stromatolites produced by the vital activity of lower organisms, mainly cyanobacteria, and occur now as carbonate or, occasionally, secondarily silicified deposits with different forms of internal layering. A distinctive feature of the rocks that occur in this part of the geological column is the anomalously heavy isotope composition of carbonate carbon  $\delta^{13}\text{C}$  (+10 – +18‰, while the isotope composition of carbon in both old and modern carbonates is commonly about 0‰). It should be noted that this anomaly is considered global and carbonates of similar age, displaying the same anomalous isotope composition of carbon, have been reported from several regions of the earth (Melezhik et al. 2005, Melezhik et al. 2010, Reading...2013).

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The presence of salt-bearing and sulphate beds in this part of the column is indicated by the so-called “grandfather’s salt pits”, located two kilometres north of Velikaya Guba. Salt-rich water accumulates in these man-made pits, which are about 2x2 m in size. Slightly altered sulphate and salt rock beds have been found also at a depth of 2.5-3 km during the drilling of the Onega parametric hole near Ulitina Novinka, Kondopoga District, west of the Onega Peninsula (Fig. 7).

*Ludicovian superhorizon, Trans-Onega suite.* On the Zaonezhye Peninsula the Trans-Onega suite consists of exposed sedimentary, volcanic-sedimentary and volcanogenic rocks. A characteristic feature of these rocks is the presence, from several percent to dozens of percent, of organic matter (shungite) (Filippov et al. 2007). These exposures are confined to the limbs of the anticlines. The Trans-Onega suite falls into two subsuites, lower and upper, that differ in their mineralogical composition.

Rocks of the lower subsuite occur as narrow bands in the northern and southern parts of the peninsula. These bands consist of sandstone, siltstone and argillite interbedded with arenaceous dolomite. In the lower subsuite horizontal bedding is predominant. Occasionally, siltstone and argillite interbeds contain up to 3% (mass) of organic matter. The lower subsuite is characterized by the presence of clay-carbonate and carbonate-clay (marl) rocks with distinctive microrhythmic lamination often referred to in literature as krivozerite (Fig. 8, 9). They occur in all known examples of the lower subsuite of the Zaonezhye suite and can be used as a good marker horizon.

In Zaonezhye, the upper subsuite rocks are far more common than the lower subsuite rocks. However, they are also confined to the limbs of NW-trending anticlines. All the rocks in this subsuite are enriched in various amounts of organic matter (shungite) and are therefore dark gray or black. Their organic matter content varies from less than 1 per cent to 70% (mass). The subsuite consists of dark-gray and black tuffaceous-sedimentary and sedimentary rocks bearing sand-, silt- and pelite-sized shungite with carbonate interbeds and predominantly dolomite lenses, often including disseminated sulphide. Also, lenticular, dome-shaped structures with elevated carbon concentrations (at least 20% mass) are encountered in this part of the geological column (Melezhik et al. 2004). This type of rock, often referred to in literature as maksovite (Fig. 10, 11), is now being queried near the Tolvuya in northeastern Zaonezhye Peninsula. It is used predominantly as a substitute for metallurgic coke but is also commonly used in medicine and as an absorbent in water-purification filters (Filippov et al. 2007).

The rock horizon, referred to in literature as the shungite-lydite-dolomite complex, is well defined in this part of the column of the Paleoproterozoic Onega structure (Melezhik et al. 2009). It is formed of alternating dolomite, lydite and shungite-bearing rock beds (lenses). Dolomite commonly contains organic matter between crystals and within the cores of rhomboid grains. Lydite is a hard dark-gray to black cherty

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<sup>6</sup> Pseudomorph is a mineral whose outward crystal form is that of another mineral species; a pseudomorph is described as being after the mineral whose outward form it has, e.g. limonite after pyrite, quartz after fluorite, etc.).

rock that contains 1-5% (mass) organic matter. There have been attempts to use these rocks as touchstone<sup>7</sup>, but they have been found too fractured and brecciated. The shungite-lydite-dolomite complex also contains veins of metamorphosed natural bitumens known as anthraxolite (Fig. 12, 13).

Practically all the lithotypes of sedimentary rocks in this layer of the column contain fossilized organic remnants such as carbonate rocks – Litophyta (stromatolites and microphytolites); terrigenous, mainly pelite-sized rocks known as acrotarchs; cherty rocks such as styriolite and microfossils; and shungite-bearing rocks termed chemofossils (Makarikhin & Kononova 1983).

*Kalevian superhorizon, Kondopoga suite.* These bedrock exposures cover a large area of up to 10 km wide bands of synclines with gently dipping limbs, extending from southeast to northwest. The column of the Kondopoga suite is a flyschoid sequence in which terrigenous rocks of different particle sizes and mineral compositions (conglomerates, gravelstone, sandstone, siltstone and argillite) are interbedded monotonically to form rhythms, varying from several centimetres to tens of metres in thickness, that are dominated by sedimentary rocks of different particle sizes. Occasionally, also thin carbonate intercalations, lenses and concretions are encountered.

Conglomerates are confined to the base of the elementary rhythms and occur more in the lower part and less in the upper part of the Kondopoga suite. Sandstones are divided into greywacke and polymictic types, depending on their composition. These stones are light gray to dark gray in colour and display parallel, horizontal and minor undulating cross-bedding. Siltstones are predominantly dark gray to black. The incorporated clasts consist of quartz, feldspar, fine-grained chlorite aggregates and lesser carbonates. Argillites are dark gray to black in colour, with a brownish shade, and they are commonly interbedded with siltstone. Like siltstones, argillites display well-defined horizontal and parallel bedding. Also diastems<sup>8</sup>, current folds and intrastratal faults are occasionally encountered.

Rocks of the Kondopoga suite are characterized by the presence of organic matter (several per cent), which imparts a dark colour to the terrigenous sedimentary rocks (Fig. 14). The suite also contains lens-shaped (oblate) anthraxolite<sup>9</sup> aggregates up to dozens of centimeters in diameter and up to 5 cm in thickness.

Cyanobacterial (*Cyathotes nigoserica* Mak.) buildups in terrigenous rocks have been found in the carbonaceous siltstone of the Kondopoga suite. These buildups are morphologically similar to mud cracks and current ripple marks, although different in other features (Makarikhin & Kononova 1983).

*Kalevian superhorizon, Munozero suite.* In the central part of the study area, near Lake Munozero, the bedrock of the Munozero suite is exposed. This is the core of the Munozero syncline. The lower part of the suite consists of dark-gray clastic limestone with thin siltstone and argillite intercalations. The calcite content of these rocks varies from 30 to 80%. The upper portion of the suite contains gray arenaceous dolomite with chert intercalations, siltstone, quartz-feldspathic sandstone with carbonate matrix and arkose. Dolomite commonly displays fine undulation and oblique lamination.

Microphytolites of the genus *Glebosites* (Reitl.) have been found in limestone and oncolites of the genus *Osagia* (Twenh.) have been reported from dolomite (Makarikhin & Kononova 1983).

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7 Touchstone – a black, flinty stone, such as a silicified shale or slate, whose smooth surface was formerly used in testing the purity or fineness of alloys of gold and silver by comparing the streaks left on the stone by rubbing with the metal with the streaks left by an alloy of predetermined composition.

8 Diastem – a relatively short interruption in sedimentation, with little or no erosion before deposition is resumed

9 Anthraxolite – natural bitumen at the metaanthracite stage of coalification

## Igneous rocks, mineralogeny and commercial minerals of Zaonezhye Peninsula

On Zaonezhye Peninsula volcanic rocks can be found in numerous basaltic lava flows and sheets. These dark-gray rocks were produced by volcanic activity (Fig. 15, 16). As a result of paleovolcanological studies of Zaonezhye, areas subjected to the most active volcanism have been identified and described. Lava flows, varying from 5–7 m to 35–40 m in thickness, are divided into fine-grained varieties at the base, medium- and coarse-grained varieties at the centre and fine-to medium-grained amygdaloidal varieties at the top. Rocks in these lava flows are fairly homogeneous in their petrographic composition, texture and structure. Predominantly, basalts consist of fine plagioclase laths and isomorphous tabular pyroxene in strongly chloritized matrix. Commonly the amygdales are filled with chlorite, lesser quartzite and quartz. Flow bedding at the top of lava flows is characterized by an abundance of chlorite and chlorite-calcite amygdales, extending as “layers” for dozens of metres along the strike. Ore minerals are represented by pyrite and leucogenized titanomagnetite and lesser chalcopyrite. Brecciation is occasionally observed at the top of the lava flow; hydrothermal quartz-calcite veins and veinlets evolve in these zones. Due to the highly hematized (oxidized) lava in the area, the colour of its rocks is often brown. Gabbro-dolerite sills represent sub-volcanic rocks. In composition these rocks are identical to lava deposits but differ in their degree of recrystallization and, hence, structure (Golubev & Svetov 1983). Gabbro-dolerite sills form at least 40–45 m thick structures with distinct crystallization, from fine-grained varieties at the margins to coarse-grained and occasionally pegmatoid varieties at the centre of the structure. The rocks are dark gray to brown in colour and fairly dense, often forming a conspicuous relief of high scarps or ridges. They are easily traceable for dozens of kilometres along the strike, folding together with host rocks.

The volcanic breccia on Radkolye Point in the Zaonezhye Peninsula is fairly exotic. The relics of the Radkolye volcanic edifice were mapped in 1972 during paleovolcanological studies on the southwestern shore of Bolshoi Lelikovsky Island (Svetov & Golubev 1978). Due to erosion, only a small portion of the volcanic neck is preserved. Eruptive channel rocks can be found in rocky scarps at its northeastern and southern endocontacts, while its entire western and northern parts are under the Lake Onega water level. The preserved part of the volcanic neck is described as a rocky, two-peaked *roches moutonnée* created by the glacier. It is 8–10 m higher than the surrounding rocks (Fig. 17). Morphologically, the volcanic neck is a round body, presumably about 200 m in diameter.

The base of the volcanic structure on Radkolye Point consists of volcanogenic sedimentary-effusive rocks of the Zaonezhye volcanic complex. It forms a gently dipping syncline with a well-exposed northeastern limb that extends along the southwestern shore of the island. On the island the volcanogenic structure forms a series of narrow and gently dipping anticlines and synclines elongated towards northwest. In southeastern parts of the island, effusive rocks are crosscut by coarse- to medium-grained gabbro-dolerite sill that forms a sheeted body, folded with host rocks. The fold axes generally plunge northwest.

Direct contacts between the neck and the host rocks of the Zaonezhye suite have only been reported from its southern parts, while in the rest of the area the contact zone is buried under deluvial piles of rocks and unconsolidated Quaternary sediments. Near the water's edge, in the steep scarp located in the southern endocontact zone, vertically dipping eruptive breccia cuts gently dipping basaltic lava. The rough contact surface can be traced for over several metres. In both cases, the contact plane dips steeply north to northwest at about 80–85°.

Coarse clastic rocks, morphologically similar to the eruptive breccia described above, have been encountered 3.5 km northwest of Point Radkolye, on one of nameless islands of the Lambinskie Islands. The various rocks of the peninsula are a treasure trove for nature lovers.

Semi-quantitative and quantitative spectral analyses were carried out to study minor elements and their concentrations in the mineralogical composition of the rocks. In addition these analyses determined the genesis, conditions of formation and the position of horizons where nonferrous metals may occur. All the above rock varieties contain low concentrations of ore-bearing elements, carbonate and cherty (lydite-like) rocks containing the lowest concentrations. However, certain elements are confined to certain rock varieties in certain structures, indicating geochemical specialization (Golubev et al. 1984).

Ore-bearing elements of nonferrous metals are present in carbonaceous rocks mainly as sulfides. Although all the rocks of the Zaonezhye suite are contaminated with sulfides, ore matter is confined to second-member rocks, i.e. shungitic tuffites. Depending on the metamorphic grade, ore mineralization is of the pyrite type and ore matter is either pyrite or pyrrhotite. Formation of pyrite with smaller quantities of chalcopyrite, sphalerite and pyrrhotite is characteristic of greenschist facies. Sulfides occur as beds, lit-par-lit intrusions, pockets, concretions, globules, coating around rock and mineral fragments, veins and veinlets. Conditions during their formation determine the mineralization of primary sedimentary and metamorphogenetic-hydrothermal ore in mineralized schist.

Spectral and chemical analyses have shown that the ores contain Zn, Ni, Co and Cu as well as smaller quantities of Ag, Mo, Pb and Au. Nonferrous metal concentrations are at least one order of magnitude higher in concretions than in host tuffites with lit-par-lit ore injections. Studies of sulphide mineralization have shown that *Cu*, *Co*, *Ni*, *Zn*, *Pb*, *Ag* and *Au* are concentrated in secondary sulphide redistribution during epigenesis and metamorphism.

Pyrrhotite mineralization is not characteristic of the carbonaceous rocks in the Onega trough. Pyrrhotite is formed when fine-grained pyrite is recrystallized into massive pyrite interbeds. It also occurs in tectonically active zones where graphite is formed instead of shungite and pyrite is replaced by pyrrhotite.

Volcanic emanations during the three phases of Zaonezhye volcanism are the source of ore matter in Karelian carbonaceous rocks. The hydrothermal field of the most active second phase of Zaonezhye volcanism has been identified by facies and paleovolcanological reconstructions in the active submarine volcanic area of the Onega trough. In the Zaonezhye suite column, this zone consists of shungite rocks as well as overlying shungite tuffs that are most likely to contain nonferrous metals. Among other evidence, correlation between ore-forming processes and volcanic events, sheeted shapes of ore bodies, preserved primary structures of rocks and ores as well as the pattern of sulphide mineralization suggest that ore-forming processes were similar in the black shales of the Zaonezhye complex and the Baltic Shield (Golubev et al. 1984).

Clearly the geochemical characteristics of the study area are affected by structural dislocation and faulting zones, to which complex Cu-U-Mo-V ore deposits are confined. These zones contain from elevated to anomalous concentrations of Cu, Co, Ni, Cr, Zn, Mo, Bi, Au, Ag, Se, Pt, Pd as well as other elements. Ore-forming processes are indicated mainly by near-fault sodium metasomatism, micatization and the above spectrum of anomalous element concentrations. Ore-forming processes are determined by axial faults and shear zones, as well as alternating dolomite, siltstone, schist, basalt and gabbro-dolerite deposits of considerably different physical, mechanical and geochemical properties. Structural dislocation and fault zones are described in detail in A.V. Bulavin's monograph "Metallogeny of Karelia" (Bulavin 1999).



For commercial mining, most promising are the ore-bearing deposits associated with the formation of uranium, noble metal and vanadium in structural dislocation and faulting zones. Such deposits occur in the Kosmozero, Padma and Shulginovskoe ore fields in the Onega Ore Province of the Onega-Belozero mineralogenic zone. During the past few decades Nevskgeologia GGP has discovered vanadium-rich deposits in Srednyaya Padma, Tsarevskoe, Vesenneye, Verkhnyaya Padma and Kosmozero as well as other deposits in metasomatised rocks - the carbonaceous siltstone and schist occurring at the base of the Zaonezhye suite of the Ludicovian superhorizon. The total reserves of vanadium pentoxide in the Onega Ore Province, including prospective reserves of all deposits and occurrences, are estimated at 556 000 tons. Most of these deposits (C1+C2 resources of 332 500 tons), are concentrated in the active reserves of the Padma and Kosmozero ore fields (Bulavin 1999).

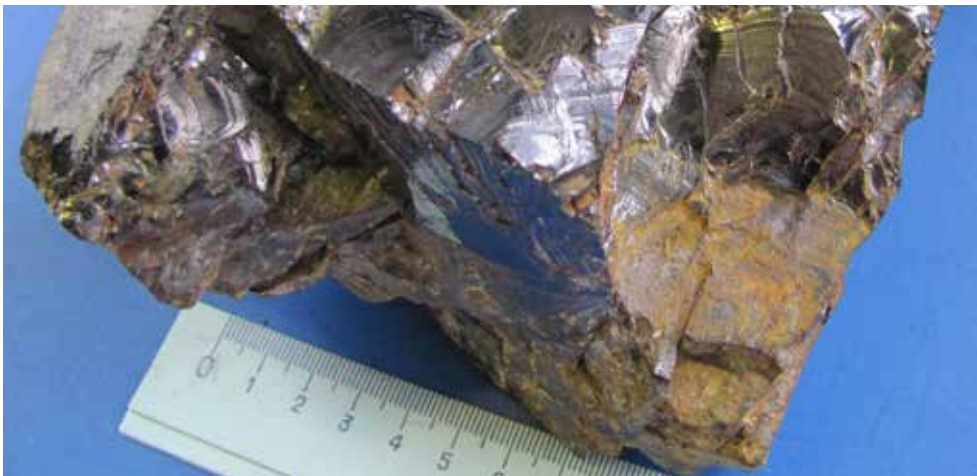


Fig. 13. Anthraxolite, village of Shunga.



Fig. 14. Mode of occurrence of Kondopoga suite rocks, Nigozero quarry (Photo Vladimir Makarikhin).



Fig. 15. Contact between globular-pillow lava (above) and silty sandstone (below). Lambas-Ruchei (Photo Vladimir Makarikhin).



Fig. 16. Globular-pillow unit in lava, Lambas-Ruchei (Photo Vladimir Makarikhin).

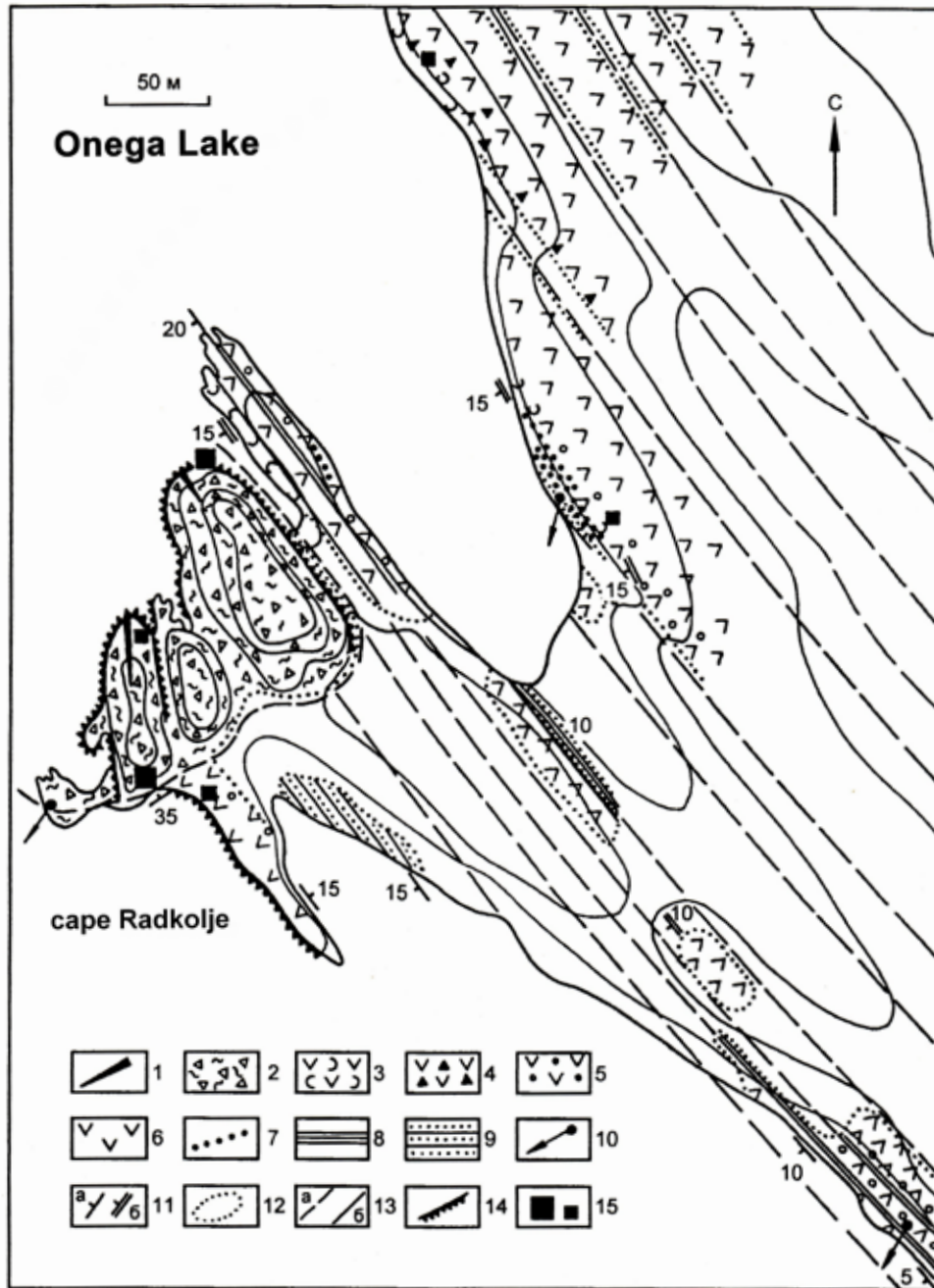


Fig. 17. Diagram of the geological structure of the Radkoila volcanic edifice (14): 1 = plagioclase-pyroxene basalt dykes; 2 = eruptive breccia; 3 = globular-pillow basalt lava; 4 = basalt lava-breccia; 5 = amygdaloidal basalt; 6 = massive chilled basalt; 7 = cluster of amygdales in basalt flows; 8 = tuff siltstone and tuffaceous siliceous schist; 9 = tuffaceous sandstone; 10 = flow direction; 11 = mode of occurrence (a – bedding, b – jointing); 12 = dominant exposure contours; 13 = geologic boundaries (a – assumed, b – traced); 14 = cliff scarps; 15 = sulphide mineralization zones.

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## 1.2 Geomorphology and Quaternary deposits of Zaonezhye

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### Introduction

The geomorphology and Quaternary deposits of Zaonezhye Peninsula have been described extensively in literature (Biske et al. 1971, Lukashov et al. 1993, Demidov & Lavrova 2000, Lukashov 2000, Demidov 2005 a,b,c, Demidov 2006, Shelekhova 2013). Zaonezhye is a unique area that has no equivalent in Karelia, or Russia. The mosaic structure of its crystalline basement and the diverse composition of its bedrock are responsible for its highly rugged topography. The unique tectonic structure of Zaonezhye, together with the multiple advances of glaciers and the distinctive evolution of the area after ice retreat gave rise to genetically and compositionally diverse Quaternary rock complexes and unique landforms – the basis for the biologically diverse landscapes of today.

Precambrian crystalline rocks are covered by thin Quaternary deposits, formed from rocks carried by the last Scandinavian ice sheet during the Late Valdai glaciation (Fig. 1.). Holocene peat, lake, seismogravitational aeolian and alluvial sediments occur locally. Considerable variations in altitude (up to 100 m) are due to the alternation of narrow NW-trending selkä ridges and interridge depressions occupied by lakes, deep bays and bogs. Older Quaternary deposits may have been preserved in these depressions and, if found, should be further studied.

**Glacial deposits**, consisting of moraine covering highly weathered and fractured Precambrian rocks, are widespread in the area. The most common glacial deposits are gabbro-dolerites, crosscut by at least 3–5 m deep fractures. Since fractured gabbro-dolerites are less resistant to glacial erosion, the resulting moraine consists of coarse local clasts. There are two types of moraine in Zaonezhye. Type I is formed of bedrocks poorly resistant to glacial exaration, such as gabbro-dolerite or slightly fractured and mildly weathered schist, occurring in a rugged relief. Coarse clasts make up 85–90% of this local moraine, produced by the destruction and short-distance redeposition of local bedrocks. The distance of glacial transport varies from hundreds of metres to several kilometers. Coarse clastic fractions (> 1 cm) account for at least 40–50%. Type II is schistose moraine, containing 25–40% of coarse clasts, composed of granite, granite-gneiss and other rock clasts. It has been transported by the glacier from the Onega-Segozero watershed and it rests on either bedrock or local coarse clastic moraine. In sand fractions, quartz dominates over feldspar. These deposits are better

sorted than the moraines of Type I. Up to 25–30% of clasts have been transported for over dozens of kilometres. The petrographic, mineralogical and chemical composition of the moraine depends completely on the mineralogical composition of the basement rock. It varies in thickness from dozens of centimeters on top of selkä ridges to 3–10 m in depressions between the selkäs. In spite of its sandy and sandy loam composition, the moraine displays poor filtrating properties. As a result, such areas are paludified.

**Fluvioglacial deposits** consist of well-sorted sand, gravel, pebble and sand. These deposits form esker ridges, fluviglacial deltas and debris cones that indicate the locations of major glacial meltwater systems and periglacial lakes resulting from the deglaciation of the area. Fluviglacial deposits include 10–15 m thick deposits resting on moraine and bedrock, displaced and folded by the movements of the ice margin. Also esker ridges and abraded fluviglacial deltas occur. The mineral and petrographic composition of the fluviglacial deposits reflects the bedrock and moraine from which they have been derived.

**Lacustrine-glacial deposits** are widespread in Zaonezhye and consist of periglacial Lake Onega sediments, including seasonally accumulated varved clay and sandy-silty sediments. As a result of the melting ice sheet as well as the irregular glacial isostatic adjustment of the earth's crust, most of Zaonezhye Peninsula was flooded by the periglacial Lake Onega. During this time, water levels reached altitudes of 100–110 m in northern parts and about 80–90 m in southern parts of the peninsula. Varved clay, unaffected by the washout caused by the stadial drop in the Lake Onega water level in late and post-glacial times, is encountered in topographic lows at altitudes below 50–60 m. In some lakes, e.g. Lake Isaevo, the top of the varved clay lies at an absolute altitude of 80 m. Clay, varying from dozens of centimeters to 7–10 m in thickness, rests on moraine and is often confined to distal portions of fluviglacial deltas (Glinyanoe bog near the village of Bor Pudantsev). Continuous varved clay beds, covering an area of more than 1–2 km<sup>2</sup>, are known from southeastern shores of Lake Kosmozero, south of the village of Lambasruchei, and from the bottoms of all large lakes of Zaonezhye Peninsula. Due to its poor filtration properties and water resistance, clay contributes to the paludification of the area. The mineral and chemical composition of varved clay depends on the composition of the bedrock and the overlying moraine (Demidov 2000, 2005).

**Lacustrine deposits**, consisting of sand, loamy sand and pebble, occur on the shores of Lake Onega at an absolute altitude of 50–60 m. Lacustrine deposits form short beaches, aggradation terraces (Peski special landscape area on the southwest shore of Lake Padmozero) and beach barriers (Lambasruchei). There are also small beaches, composed of older fluviglacial sand and gravel deposits on the shores of Ladmozero, Vanchozero, Padmozero and other lakes.

**Sediments** are accumulated at the bottom of numerous lakes and bays where glacial lacustrine varved clay is covered by a ca. 3-m-thick layer of homogeneous gray silt, followed by sapropel and sometimes diatomites. Organic deposits can be up to 7 m thick (Nizhneye Myagrozero). Also bog iron ore (limonite) has been encountered at the bottom of some lakes. Bottom sediments in lakes located near large-scale paleo-seismic dislocations in bedrocks, such as Lake Putkozero and Svyatukha Bay, display folding caused by post-glacial earthquakes.

Post-glacial earthquakes have also produced seismocolluvial deposits, consisting of coarse clastic talus and collapse. Seismocolluvial deposits occur on a limited scale and are confined to big cliffs of tectonic origin. Some seismic collapses are up to 100 km wide and 10 m thick, extending 2 km.

**Peat-bog deposits** fill up paludified interridge depressions of tectonic origin, which in the past would have formed 2–4 km long and 200–400 m wide lakes or bays with their shores. Peat-bog deposits consist of woody-grass and grass lowland peat that

varies from several metres to over 8 m in thickness. In some lakes, grass and grass-moss bogs occur as floating mats.

**Aeolian deposits** consist of well-sorted fine-to medium-grained sand and occur as small, narrow strips on lakeshores.

As the river network is young and poorly developed, alluvial deposits consist of coarse clastic sand-pebble streambed alluvium.

## Geomorphology

Zaonezhye has a highly diverse relief. Denudation, tectonic, glacial and fluvio-glacial landforms are common. Folding and faulting of crystalline rocks as well as intense neotectonic movements have affected the present-day relief of Zaonezhye. Old structural forms are responsible for the morphology and orientation of elementary surfaces. Elevated surfaces are elongated and exposed, with an orientation parallel to fold and fault structures. Multiple tectonic movements have formed a distinctive, obsequent relief in Zaonezhye. The obsequent relief is a result of the geological structure of Zaonezhye caused by wide-open synclines and narrow, heavily deformed anticlines that are interrupted by longitudinal faults. Synclines form elevated ridges and mountain massifs with relatively high plateaus, while anticlines form valleys occupied by rivers or lakes. Confined to some of the anticlines are structurally complex folding and faulting zones that host uranium-vanadium-rare metal deposits and occurrences (Bilibina et al. 1991). In parts of Zaonezhye Peninsula, individual crustal blocks have been scattered vertically along the faults as a result of neotectonic movements. Therefore, the Zaonezhye relief can be divided into three tiers: upper tier with an absolute altitude of 107–147 m; middle tier with an altitude of 60–100 m; and lower tier with an altitude of 33–60 m (Lukashov 2000). Topographically Zaonezhye can be subdivided into western and eastern parts as well as the elevated Svyatukha Bay – Lake Putkozero watershed.

**Western Zaonezhye** is an elevated massif with a highly rugged surface. Its highest surfaces are narrow, elongated ridges. These linear ridges are 1.6–14 km long and 0.6–1.4 km wide with 5–40 m high scarp-like slopes. Lake basins occupy piedmonts and lowlands. There is a distinctive pattern of topographic tiers: The upper tier occupies the largest area with altitudes of up to 147 m, while the middle and lower tiers form narrow strips at the rims of the elevated massif. Boundaries between these tiers consist of a series of step-like scarps and steep slopes. Western Zaonezhye is characterized by high vertical (67–101 m) and horizontal ruggedness due to the rugged shoreline of Lake Onega basins and bays. There are few river valleys, although lake basins are common. Crystalline rocks occur over a large area. There are no unconsolidated Quaternary sediments, therefore crystalline rocks are covered by a 1–2 cm layer of modern eluvium. In topographic depressions, such as the Lake Kosmozero – Unitsa Bay basin, crystalline rocks are covered by a 1.5–3 m layer of moraine. There is an esker ridge here with a delta extending northwest.

**Eastern parts** of Zaonezhye Peninsula differ substantially from its western parts. There is no upper tier in the relief, while its middle and lower tiers form extensive structures, rather than narrow strips. In southeastern parts of the peninsula, the middle tier occupies an area of about 380 km<sup>2</sup>. Its highest surfaces are located at an absolute altitude of 60–100 m. Vertical ruggedness varies from 44 to 60 m. The middle tier consists of a plain with gently sloping flat-topped ridges without a well-defined foot of the hill. These ridges are 2.8–16.4 km long, 0.8–2.0 km wide and up to 5–15 m high. They are separated by large 1.5–2.5 km wide and 5–10 km long depressions with a flat bottom and indistinct boundaries. The lower and middle tiers cover roughly equal areas, while the lower tier is confined to the coastal zones of the peninsula.

This type of relief is most common in the northern parts of Zaonezhye Peninsula, near Padmozero and Tolvuya villages. In southern parts of Zaonezhye Peninsula, the lower tier is found near Lake Yandomozero. In general, Southern Zaonezhye is characterized by gently undulating plains with gently sloping, poorly defined ridges and bars. Watersheds are located at an absolute altitude of 60 m and vertical ruggedness is 6–18 m. The hydrographic network of eastern Zaonezhye is markedly different from western Zaonezhye. There are only two large lakes here, Putkozero and Padmozero, but river systems are more developed. Crystalline rocks of eastern Zaonezhye, unlike those of western Zaonezhye, are almost completely covered by a 6–10 m thick layer of Quaternary rocks. The middle tier is dominated by moraine, formed of boulder and loamy sand, as well as fluvioglacial esker ridges and deltas, formed of sand, gravel and pebble. In the lower tier, sand, silt and clay form lacustrine-glacial and lacustrine plains.

**The elevated Svyatukha Bay** – Lake Putkozero watershed represents a typical tectonic-denudation selkä landscape, completely lacking Quaternary deposits or covered by up to 1-m-thick moraine. The thickness of the moraine increases to at least 10 m in depressions between selkäs, where it is often covered by varved clay, glacial lacustrine loamy sand or inequigranular sand. Tectonic scarps and seismocolluvial debris cones surround western and eastern parts of the watershed. These cones are up to 2 km long chaotic piles of sharply angular blocks, which vary in size from dozens of centimeters to 5 m along the long axis (e.g. Mount Zimnyaya, Mount Gorodok, Mount Sypun and the Paltega area).

Near Unitsa Bay, towards Kazhma-Velikaya Guba, the area is traversed by fluvioglacial systems of esker ridges and deltas, composed of a circa 20–30 m thick layer of sand and gravel, that extend from northwest to southeast and from north to south near Padmozero-Tipinitsy and Gankovskoe-Kuzaranda. Glacial lacustrine sediments such as varved clay, loamy sand and sand occur along the shores of large lakes and in topographic depressions at absolute altitudes below 70 m. In Velikaya Guba, Yandomozero and Glinyanoe Mire near the village of Bor Pudantsev, varved clay is 6–7 m thick. Beaches, consisting of pre-Holocene fluvioglacial sand and gravel deposits, stretch along the shores of Lakes Ladmozero and Vanchozero.

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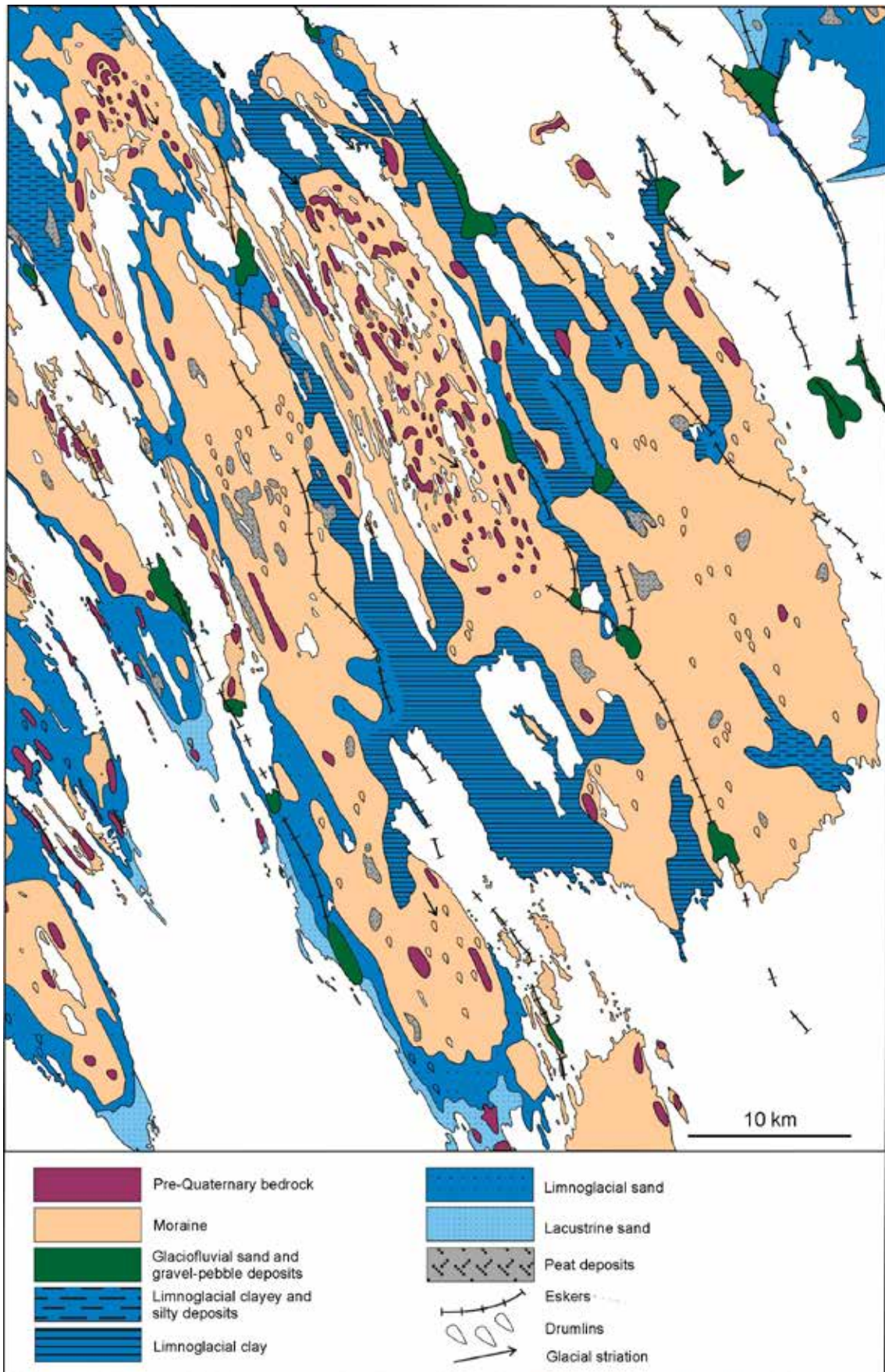


Fig. 1. Quaternary deposits of Zaonezhye Peninsula (Demidov 2005, with minor changes).

### **I.3 Hydrological characteristics of Zaonezhye Peninsula**

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#### **Introduction**

The first fragmentary information about the rivers and lakes of Zaonezhye was obtained in the 1920s and 1940s. In the early 1960s, hydrographic studies of Zaonezhye were carried out by the water problem unit of the Karelian Branch of the USSR Academy of Sciences (now the Institute of Water Problems in the North, Karelian Research Center of Russian Academy of Sciences, KarRC, RAS), including integrated field studies and the first cartographic analysis of the area. The results of the studies were published in the "Problems in the hydrology, limnology and water management of Karelia" (1965) and the "Catalogue of Karelia's Lakes" (Grigoryev & Gritsevskaya 1959) as well as a hand-written catalogue of Karelia's Rivers. Today most of this data is outdated. Morphometric information about the Zaonechye water bodies has subsequently been presented in the "Catalogue of Karelia's Lakes and Rivers" (Filatov & Litvinenko 2001).

Hydrochemical studies and bottom sediment analyses were carried out as a part of monitoring Zaonezhye lakes and rivers in 1991 and between 1999 and 2001. Nevertheless, there is little information available about water bodies in the region. Due to the lack of hydrometeorological stations on Zaonezhye Peninsula, there are no reliable data on the hydrological regimes of the rivers and lakes.

#### **Results**

Geological structures and the relief of the peninsula define the distinctive hydrographic network of Zaonezhye. Alternating long, narrow ridges and long, narrow depressions characterize the topography. Nowadays Lakes and Lake Onega bays (Unitsa, Svyatukha, Lizhma, Velikaya and Keften bays) occupy these depressions (Litvinenko 2000). Practically all the basins are elongated from northwest to southeast. Zaonezhye covers an area of 1900 km<sup>2</sup>. According to inventories conducted in 1950s (Grigoryev & Gritsevskaya 1959), there are 251 lakes in Zaonezhye, covering a total area of 212 km<sup>2</sup> (Freindling & Polyakov 1965). The ratio of total lake surface to

drainage area in Zaonezhye is about 12 %. However, recent inventories have shown even greater values.

The water bodies of Zaonezhye differ considerably in their morphometric and hydrological indices. Most of them are formed by tectonic subsidence, glacial tectonics or other glacial processes (Freindling & Polyakov 1965). Water area of the water bodies varies from less than 0.01 to 30 km<sup>2</sup>. Commonly the basins are highly elongated, sometimes dozens of kilometers long and no more than several hundred metres wide. The index of elongation (ratio of length of the lake to width of the lake) can be up to 43.5 (Lake Kosmozero). Extremely elongated lakes are relatively uncommon, occurring only in northern Scotland, northwestern England (Camberland Plateau) and northwestern Central Siberia (Putoran Plateau) (Semyonov 1993).

The deepest lakes in the study area are Lakes Ladmozero (52 m) and Putkozero (42 m), which form cryptodepressions, i.e. their maximum depth is below sea level (Semyonov 1993).

Because the lake basins in Zaonezhye are typically small, also their watershed values (ratio of basin area to lake area) are low. A specific watershed value describes the volume of solid, liquid and ionic runoff supplied into the water body as well as the amount of heat supplied by tributaries. Therefore it reflects the effects of the watershed on all processes in the water body (Litvinenko 2000). This is a small effect, also indicated by the low water exchange index (ratio of volume of long-term average lake runoff to lake volume), which varies from one year to 10 years (Freindling & Polyakov 1965).

Despite the predominantly tectonic origins of the lake basins and the complex structures of the lake bottoms, littoral zones, mainly occupied by solid sand and gravel sediments with clay lenses, are relatively well developed. Ore deposits mixed with mud are confined to deep layers (Vlasova 1965, Belkina 2005).

The thermal conditions of water bodies are different. Shallow lakes are warmer during the summer months (up to 25° C) when temperatures in their bottom layers may be only 2–3° C colder than the surface layer, whereas deep lakes remain thermally stratified during the summer months: their surface layer may warm up to 26° C while the bottom layer has temperatures of 8–10° C (Semyonov 1993).

Apart from southeastern Zaonezhye, which is dominated by small streams, the hydrographic network is relatively uniform over the entire area. There are only few small rivers on the peninsula. According to inventories in the mid-20th century, there were 56 rivers in Zaonezhye (each over 2 km long) with a combined length of 594 km. Their lake zones were 113 km long. Small rivers and creeks (which are less than 5 km long) make up only 11% of the length and 37% of the number of the rivers. Longitudinally, most streams have a terraced profile, which is most pronounced in the rivers Kuloma, Muna, Putka and Pigmozerka (Nature park...1992). The terraces are formed of rapids, or groups of rapids, separated by deeper slow portions of the rivers.

The hydrographic network of the peninsula is characterized by lake and river systems whose linear ratio of lake area length to total length of the system can be as high as 70%.

The distribution of river runoff throughout the year is affected considerably by the physical and geographical characteristics of Zaonezhye, especially the high ratio of lake surface area to drainage area of the basins as well as the linear ratio of lake surface area to drainage area of the river and lake systems. As the ratio of river area to drainage area decreases, the amount of spring floods declines and the amount of runoff during low-water periods increases. Spring flooding in rivers begins in the second third of April. In rivers with a high ratio of river area to drainage area, spring floods last for 70–100 days, whereas in small rivers flooding continues for 50–70 days. Usually there is one peak runoff during the floods.

In rivers minimum runoff occurs twice a year: during the summer-autumn and winter low-water periods. On average, the long-term minimum runoff for a 30-day period is

over 5 l/s\*km<sup>2</sup> during the summer-autumn low-water period and 2–3 l/s km<sup>2</sup> during the winter low-water period. It increases to 4–5 l/s\*km<sup>2</sup>

in rivers with a high ratio of river area to drainage area (Surface water resources... 1972 a).

The distinctive hydrochemical characteristics of Zaonezhye include elevated mineralization (occasionally up to several hundred mg/l), alkalinity and nutrient supply. There are also low concentrations of predominantly autochthonous organic substances in lakes, but high concentrations in rivers (Maslova 1965, Kharkevich 1965, Startsev 1993, Present condition...1998; Lozovik et al. 2005).

The hydrographic network of Zaonezhye, including the planned Zaonezhsky landscape reserve (zakaznik) is described in more detail in Litvinenko & Bogdanova 2013. In the present paper we discuss the southeastern and southern parts of the area that have not been described previously.

We have divided the study area into four hydrographic regions (Table 1). Lakes form the basis of the hydrographic network. As shown in the 1:50 000 map below, there are 101 water bodies, covering a total area of 1007 km<sup>2</sup>, located in their entirety in the study area (Fig.1).

Table 1. Suggested hydrographic regions.

Hydrographic region		Total lake area, km <sup>2</sup>	Ratio of lake area to drainage area, %	River network density, m/km <sup>2</sup>
Number in Fig. 1	Name			
I	Zaonezhye Peninsula	813	7.2	237
II	Lel Peninsula	119	0.3	361
III	Lizh Peninsula	32	9.9	81
IV	Syar Peninsula	43	9.0	356
	Total	1007	6.6	252

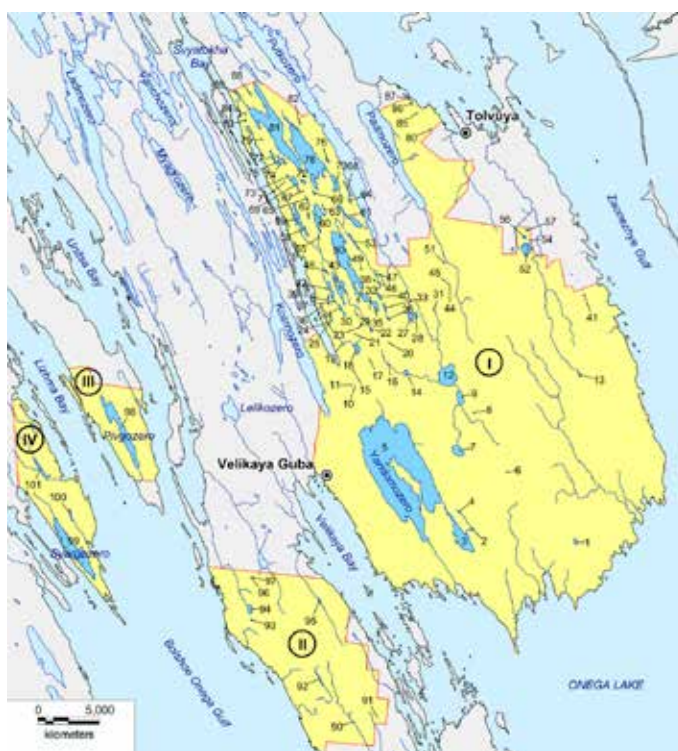


Fig. 1. Water bodies in the study area (lakes are numbered in Table 2).

Table 2. Major lakes in the study area.

Number in Fig. 1	Name of the lake	Lake area, km <sup>2</sup>	Number in Fig. 1	Name of the lake	Lake area, km <sup>2</sup>
<b>I. Zaonezhye Peninsula</b>					
1	Varezh	0.086	45	No name	0.001
2	Munozero	0.040	46	Podmalinnoye	0.012
3	Korbozero	2.000	47	Podberezhnoye	0.008
4	Kalozero	0.021	48	Beloye	0.052
5	Yandomozero	30.654	49	Chernoye	0.014
6	Korytovo	0.005	50	Bolshoye Khmelozero	3.971
7	Limozero	0.625	51	Gagarye	0.007
8	Glukhoye	0.007	52	Gankovskoye	0.526
9	Palevskoye	0.454	53	Kandozero	0.129
10	No name	0.002	54	No name	0.003
11	No name	0.002	55	Maloye Pertozero	0.029
12	Keratskoye	1.969	56	Posulskoye	0.037
13	Kalye	0.033	57	No name	0.045
14	Gahkozero	0.125	58	Shumyacho	0.005
15	No name	0.004	59	Vilozero	0.714
16	No name	0.016	60	Bolshoye Pertozero	0.870
17	No name	0.003	61	Kovshozero	0.549
18	Palozero	0.261	62	Uzkoye	0.029
19	No name	0.003	63	Podcheremushnoye	0.029
20	Matveyevo	0.007	64	Verkhneye Myagozero	0.032
21	No name	0.004	65	Krivoye	0.025
22	Degtozero	0.030	66	Mokhovoye	0.020
23	No name	0.002	67	Glubokoye	0.006
24	Driskozero	0.038	68	Nizhneye Myagozero	0.173
25	No name	0.019	69	Pelekozero	0.259
26	Koryukhozero 3	0.018	70	Gizhozero	0.453
27	Shibrozero	0.232	71	No name	0.002
28	No name	0.077	72	Nikonovo	0.079
29	Kalgozero	0.008	73	No name	0.035
30	Palozero 4	0.034	74	Nizhneye Torozero	0.044
31	Savozero	0.010	75	Sredneye Torozero	0.084
32	No name	0.006	76	No name	0.062
33	Koryukhozero 2	0.082	77	Verkhneye Torozero	0.156
34	Palozero 3	0.060	78	Gahkozero	5.311
35	Maloye Khmelozero	0.250	79	No name	0.008

36	Yasakovo	0.040	80	No name	0.007
37	Palozero 2	0.010	81	Chuzhmozero	6.204
38	Munozero	0.044	82	No name	0.006
39	Zimneye	0.052	83	Karasevo	0.016
40	Koryukhozero I	0.080	84	No name	0.009
41	No name	0.007	85	No name	0.007
42	Palozero I	0.264	86	No name	0.021
43	Kimozero	0.736	87	No name	0.014
44	No name	0.003	88	Khudoye	0.019
			89	Zdvizhenskoye	0.079
<b>II. Lel Peninsula</b>					
90	Vozhmozero	0.009	94	Rugozero	0.223
91	No name	0.004	95	Pizhei	0.054
92	Bezdonnoye	0.105	96	No name	0.003
93	No name	0.006	97	No name	0.009
<b>III. Lizh Peninsula</b>			<b>IV. Syar Peninsula</b>		
98	Pivgozero	3.163	99	Syargozero	3.388
			100	Maloye Syargozero	0.121
			101	Tulozero	0.341

In the study area, the ratio of lake surface area to drainage area is 6.6 %, which is much lower than the average for Karelia (12 %) or the estimate for the Onega and Ladoga lake area in Karelia (21 %) (Litvinenko et al. 1998). Most of the water bodies (93%) are small or very small (lambas), covering an area of less than 1 km<sup>2</sup>. Only seven water bodies are large. The largest lakes are Chuzhmozero (6.2 km<sup>2</sup>), Gahkozero (5.3 km<sup>2</sup>), Bolshoye Khmelozero (4.0 km<sup>2</sup>), Syargozero (2.4 km<sup>2</sup>), Pivgozero (3.2 km<sup>2</sup>) and Keratskoye (2.0 km<sup>2</sup>).

Lake Yandomozero is the largest lake on Zaonezhye Peninsula with a surface area of 30.1 km<sup>2</sup>. It is 11.4 km long. Its maximum width is 4.3 km and its average width is 2.6 km, whereas its maximum depth is 6.0 m and its average depth is 4.3 m. Its shoreline is 47.5 km long. The water volume of the lake is 130 M m<sup>3</sup>. The Lake Yandomozero basin is of glacial origin. Its slopes are low and gradual and its bottom is smooth. The littoral zone of the lake consists of sand and gravel, whereas brown mud is common in the central part of the bottom.

The study area is ajoined by three relatively large lakes: Putkozero (surface area 21.1 km<sup>2</sup>), Kosmozero (20.6 km<sup>2</sup>) and Padmozero (10.0 km<sup>2</sup>). The southern parts of Lake Putkozero border the study area in the northeast. Lake Putkozero has a surface area of 21.1 km<sup>2</sup>. It is 24.2 km long with a maximum width of 2.1 km and an average width of 0.9 km, as well as a maximum depth of 42.0 m and an average depth of 15.6 m. The water volume of Lake Putkozero is 330 M m<sup>3</sup> and the shoreline extends 62.4 km. The lake basin is a deep elongated depression formed by tectonic subsidence. Generally its slopes are steep or moderately steep and up to 20 m high. However, in the western parts of the lake steep slopes can be up to 40–50 m high. The lakeshores are elevated and predominantly stony, or occasionally rocky. There are 16 islands on Lake Putkozero that cover an area of 0.38 km<sup>2</sup>. The bottom of the lake has a mildly rugged relief. Underwater the slope is mostly steep. In the littoral zone, rocky or rocky and sandy ground is common, while muddy ground with small quantities of clay, sand and ore are common in the deep.

The southern parts of Lake Kosmozero adjoin the western boundary of the study area. Lake Kosmozero has a surface area of 20.6 km<sup>2</sup>. It is 30.9 km long with a maximum width of 2.1 km and an average width of 0.7 km as well as a maximum depth of 25.0 m and an average depth of 7.8 m. Its shoreline is 76.6 km long. The lake basin is also been formed by tectonic subsidence. Its slopes are 50–80 m high, steep in the west but low (15–20 m) and gradual in the east and southeast. In the north, the slopes are low and paludified. The shores are predominantly gently sloping and their height varies. There are 10 islands on the lake that cover a total area of 0.56 km<sup>2</sup>. The bottom of the lake is rugged. A deep groove extends across the entire lake. The bottom is muddy in the deep but argillaceous or rocky in the shallow zone. Bog ore is encountered occasionally.

The study area is also adjoined by the eastern shore of Lake Padmozero. The lake has a surface area of 10.0 km<sup>2</sup>. It is 10.1 km long with a maximum width of 2.0 km and an average width of 1.0 km as well as a maximum depth of 14.9 and an average depth of 4.0 m. The water volume of the lake is 40.0 M m<sup>3</sup> and its shoreline is 24.7 km long. Glacial tectonic processes have formed the Lake Padmozero basin. Its slopes are predominantly steep. Most of the slopes are about 10 m high, although the highest slopes are up to 20 m high. Most of the lakeshores are low and rocky, although some shores are gently sloping. The bottom of Lake Padmozero is an elongated depression with a predominantly muddy ground, apart from the sandy and muddy littoral zone. The lake is deepest in its northern parts. (Surface water resources...1972 b).

In the study area, the average density of the river network is 252 m/km<sup>2</sup>, varying from 81 to 361 m/km<sup>2</sup> in parts of the river network (Table 1). It consists of small rivers and creeks as well as short tributaries between lakes. Watersheds of major water systems are shown in Fig. 2 and their basic characteristics are described in Table 3. The largest streams are the rivers Kalei (25.9 km), Padma (24.9 km), Tambitsa (22.1 km) and Putka (21.2 km). Practically all the river basins have been affected by human activities, long-term agricultural development (1960–1980), land reclamation and clear cutting in particular. As a result, there have been changes in their water regimes. The Putka, Padma and Kalei river basins are most heavily affected, while the Tambitsa and Tsarevka river basins are least affected by human activities.



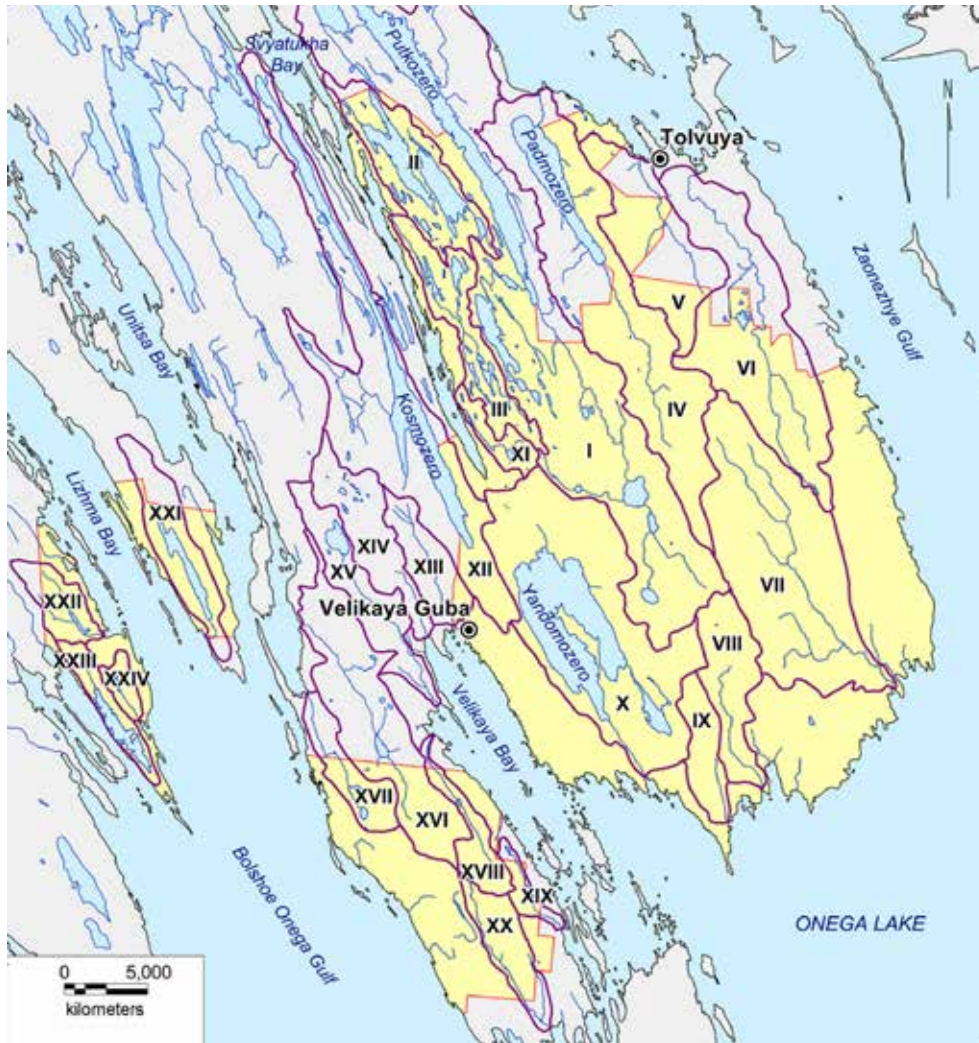


Fig. 2. Major streams in the study area (Major river watersheds are numbered in Table 3).

Table 3. Major rivers in the study area.

Name of the river	Number of the drainage area in Fig. 2	Name of the drainage area	Recognised source	River mouth	Drainage area, km <sup>2</sup>	River length, km	Height of source, m asl	Height of mouth, m asl	Stream gradient, m/km (‰)	Ratio of lake surface area to drainage area, %
Limozerska	I	Putka	Lake Limozero	Polevskoye		4.3				
Blizhnaya	I	Putka	Mire	Polevskoye		5.4				
Spirovsky Creek	I	Putka	Lake Bolshoye Khmelozero	Lake Putkozzero		5.3	119.6	37	15.6	
Putka	I	Putka	Keratskoye	Lake Onega	231.7	21.2	54.6	33	1.02	16.2
No name	I	Putka	Lake Kondozero	Lake Putkozzero		6.8				
No name	I	Putka	Lake Korjuhozero	Putka		2.1				
Chugmuksa	II	Chugmuksa	Lake Chuzhmozero	Lake Onega, Svyatukha Bay	39.7	2.3	56.9	33	10.47	32.3
No name	III	Lake Vilozero	Lake Degtozero	Lake Onega, Svyatukha Bay	29.9	16.1	148	33	7.13	9.8

Pigmarya	IV	Padma				2.9				
Padma	IV	Padma	Padamokh mire	Lake Onega	109.5	24.9	72.4	33	1.58	10.4
Tsarevka	V	Tsarevka	mire	Lake Onega, Karguba Bay	46.5	10.2	60	33	2.66	0.00
Sarandzha	V	Tsarevka	Sarandzha mire	Tsarevka		2.5				
Kalei	VI	Kalei	Kalei	Lake Onega, Tolvuya Bay	85.5	25.9	92.6	33	2.30	0.8
Kurgilov	VII	Tambitsa	mire	Tambitsa		6.4				
Tambitsa	VII	Tambitsa	mire	Lake Onega, Rechnaya Bay	103.2	22.1	72.7	33	1.80	0.00
Nulitsa	VIII	Nulitsa	mire	Lake Onega, Tipinitsy Bay	28.4	9.2	61.6	33	3.10	0.00
Ko-rezhruchei	IX	Ko-rezhruchei	mire	Lake Onega, Tipinitsy Bay	16.1	4.0	46	33	3.22	0.00
Jandoma	X	Jandoma	Lake Jandomozero	Lake Onega	119.9	4.0	42.4	33	2.32	27.3
No name	XI	Lake Palozero	mire	Lake Onega, Svyatukha Bay	9.1	6.5	150	30	18.37	4.1
No name	XII	Lake Kosmozero – Onega	Lake Kosmozero	Lake Onega, Svyatukha Bay	104.1	1.1	38.4	33	4.75	22.4
Karasozerka (Mel-nichnyj)	XII	Lake Kosmozero – Onega	Lake Karasozero	Lake Kosmozero		7.5	98	38.4	7.95	
Sudma	XIII	Sudma	mire	Lake Onega, Velikaya Bay	18.8	8.6	45	33	1.40	0.00
Antonovshchina	XIV	Antonovshchina	mire	Lake Onega, Velikaya Bay	28.3	4.8	50	33	3.52	1.3
Lelrechka	XV	Lelrechka	Lake Lelikozero	Lake Onega, Velikaya Bay	27.5	11.4	86.4	33	4.70	6.0
Chernyj	XVI	Ust-Reka (Lake Matkozero)	Lake Nizhneye Kontozero	Ust-Reka (Lake Matkozero)		2.6				
Ust-Reka (Lake Matkozero)	XVI	Ust-Reka (Lake Matkozero)	Lake Matkozero	Lake Onega, Vegoruksa Bay	61.1	8.3	47.5	33	1.74	1.3
Pizhei	XVII	Pizhei	Pizhei	Lake Onega, Velikaya Bay		4.6				
No name	XVII	Vegoruksa	Lake Rugozero	Lake Onega, Vegoruksa Bay	17.4	8.6	55.5	33	2.62	1.4
No name	XIX	Lake Vekkozero	Lake Vekkozero	Lake Onega	6.4	5.9	68.7	33	6.07	0.9
Vozhmarikha	XX	Vozhmarikha	mire	Lake Onega, Vozhmarikha Bay	19.0	10.8	105.2	33	6.68	0.05
No name	XXI	Lake Pivgozero	Lake Pivgozero	Lake Onega, Bolshaya Lizhemskaaya Bay	26.4	1.8	38.2	33	0.11	12.0

No name	XXII	Lake Tulozero	mire	Lake Onega, Tulguba Bay	13.4	5.3	68	33	6.56	2.5
No name	XXIII	Lake Syargozero	Lake Syargozero	Lake Onega, Ilemguba Bay	12.1	0.02	34.3	33	68.99	28.1
No name	XXIV	Lake Maloye Syargozero	Lake Maloe Syargozero	Lake Onega, Zimnyayya Bay	5.6	2.0	40	33	3.43	2.1

Thus, the hydrographically distinctive Zaonezhye Peninsula is a particularly picturesque area even by Karelian standards. However, due to its high ratio of lake surface area to drainage area, its relatively low drainage density and its diversity of water bodies, the area is particularly sensitive to human impact. Therefore, a strictly protected area is urgently needed on Zaonezhye Peninsula.

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Fig. 3. Lake Bolshoe Khmelozero (Photo Maria Bogdanova).



Fig. 4. Lake Kovshozero (Photo Maria Bogdanova).



Fig. 5. Lake Korytovo (Photo Maria Bogdanova).



Fig. 6. Putka River (Photo Maria Bogdanova).



Fig. 7. Spirovsky Creek (Photo Maria Bogdanova).

## I.4 Soils and their characteristics on Zaonezhye Peninsula

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### Introduction

The soil cover of Zaonezhye Peninsula is very distinctive. It differs considerably from other parts of Karelia due to the unique nature of the region. Soil patterns are mainly determined by a variety of landforms, including high, narrow ridges that alternate with narrow depressions. The macrorelief is also responsible for the climatic conditions in the area: Zaonezhye is protected against northerly winds, which makes its climate milder than in adjacent areas. The unconsolidated Quaternary sediment cover, produced by glacial abrasion, is either thin or completely absent. Soil-forming rocks are represented mainly by basic bedrocks, such as gabbro-diabase and amphibole, overlain by *Leptosols* and *Cambisols* (World reference base.. 2006). Due to widespread shungite schist and schist-enriched moraine, the soils are regionally and globally unique.

### Soil types and their characteristics

The first definition of soils on shungite-bearing, soil-forming rocks was proposed by the academic F.Yu. Levinson-Lessing (Levinson-Lessing 1889) who named them "Olonets black soil". Their place in the Russian soil classification (1997, 2004) as well as in international soil classifications remains a subject of debate. Some researchers consider them as soils with well-developed sod-forming processes, which is inaccurate for several reasons. First, sodden soils develop under meadow plant communities, whereas virgin soils on shungite-bearing soil-forming rocks are formed under forest vegetation with decomposed mull litter. Secondly, in sodden soils humus typically accumulates in the sod horizon and its content in the underlying horizons decreases abruptly. However, in soils formed on shungite-bearing rocks, humus can be traced to a great depth in the profile and occasionally its concentration at the boundary with parent rock can be up to 2%. Thirdly, in the taiga zone, sodden soils are formed in an acid environment, whereas soils resting on shungite-bearing rocks are developed in neutral or subacid environments. Some researchers classify soils formed on shungite

rocks as lithogenic. However, this is also inaccurate since biological processes in these soils are vigorous. Thus, their place in soil classification remains uncertain.

Shungite-bearing rocks include shungite and shungite schist deposits as well as glacial and aqueo-glacial deposits. These deposits have different mechanical compositions but all contain a high percentage of black coaly shale, which gives them their black colour. As a soil-forming rock, shungite differs markedly from other parent rocks in its high carbon and hygroscopic moisture content. It also has a high absorptive capacity due to the presence of fine-grained carbon. The carbon content of shungite rocks varies between 5% and 95%; the higher the carbon content, the more intensely the rocks are eroded and weathered and the higher the mineral nutrient content of the soil. The mechanical compositions of soil-forming rocks are highly diverse, including gravelly sand, loamy sand, loam and fine clay. The silica content (of particles over 1 mm in diameter) can be over 80%.

Genuine shungitic soils are common in areas covered by shungite eluvium-deluvium and shungitic moraine. With increasing distance from shungite deposits, the shungite content of moraine decreases and the moraine acquires a composition in which basic and shungite rocks are mixed with silicate rocks in equal proportions. Shungitic soils are common in such areas. These soils are darker and less acidic than *Cambisols*. They are also enriched with iron and mineral nutrients. Shungitic soils are usually combined with poorly developed Leptosols that are confined to slopes and podzolised *Albic Cambisols*, occupying low landforms.

Soils on shungite-bearing rocks are formed under forest vegetation, dominated by small-leaved forests and a well-developed grass cover. Despite large quantities of plant residues accumulating at the surface, thick forest litter does not form due to the high biological activity of soil animals and microorganisms. Due to the characteristics of the soil-forming rocks as well as the accumulation of plant residues, there is a distinctive pattern of organic soil profile with a high percentage of humus and a homogenous composition of organic matter throughout the soil profile. Despite a high percentage of crushed stone and high water permeability of soils on shungite rocks, humic acids are fixed in the soil profile. This is due to the distinctive chemical composition of the soils, containing low silica and high iron and calcium oxide concentrations. These form strong polymeric complexes with humic acids. The low mobility of organic-mineral complexes in soils formed on shungite-bearing rocks has led to the formation of a texturally undifferentiated profile where organic matter and mineral mass are transformed *in situ* without the migration of substances beyond the soil boundary.

Thus, the main processes that form the above soils are humus formation under neutral or slightly acid environmental conditions and the *in situ* metamorphism of mineral mass with the release of iron, calcium and other oxides. These soil-forming processes are not characteristic of Karelian soils but their occurrence in Zaonezhye is due to unique natural conditions.

Primitive soils, combined with *Leptosols*, are common where crystalline rocks are either exposed or occur near the earth's surface. Primitive soils are subdivided into crustal, organic (sodden, humus, peaty) or detrital soils depending on the degree of soil-forming process. In primitive soils, the layer of unconsolidated material is no more than 10 cm thick and consists of crystalline rock eluvium. Diabase eluvium, which is common in Zaonezhye, contains a large amount of iron (up to 20%) and calcium. Because the unconsolidated sedimentary cover is thin, these soils are poorly fertile. Open pine forests with suppressed growth occupy these soils. In parts of their distribution, they also grow juniper brushwood (alvars).

Leptosols are formed on flat ridge tops or terraced slopes that provide favourable conditions for the accumulation of crystalline rock eluvium and eluvium-deluvium.



These soils often grow moderately dense pine stands with grass in the undergrowth. Also juniper brushwood is occasionally encountered. The soil profile consists of A0-AhBfm-BC-M horizons. The AhBfm horizon displays features characteristic of humus-illuvial and metamorphic horizons. It is hard to divide these soils into genetic horizons because they contain large amount of rocks and crushed stone (particle content varies between 50 and 90%). The entire profile of these soils is saturated with humus.

Podzols are typical of Karelia but scarce in Zaonezhye, which is due to the polymictic composition of unconsolidated sediments that contain considerable quantities of boulders, crushed stone as well as coarse basic and intermediate rocks. Also the abundance of mixed and deciduous open woodland, with a well-developed grass cover, contributes to the accumulation of humus.

The podzolic soils of Zaonezhye are characterized by the poor eluvial-illuvial distribution of silicon, the presence of aluminium and iron oxides along the profile as well as the accumulation of organic elements (phosphorus, calcium, manganese, potassium, magnesium and sulfur) in the forest litter. However, the mineralogical composition of soil-forming rocks has affected the chemical composition of the soils. As a result, almost all of the soils contain much less silica than average in Karelia. These soils are also enriched with iron and often calcium, which has decreased soil acidity. Therefore, podzolic soils with a humus-accumulating horizon (A<sub>1</sub>) and a low level of podzolization are more common in Zaonezhye than podzols.

Histic Podzols are formed on poorly drained plains and in wide depressions, composed of silicate sand and loamy sand, where ground water is near. Normally there is peat-saturated forest litter for at least 10 cm or a 10–30 cm thick peaty horizon. These soils are highly acidic, particularly in the upper part of the profile, and they have a low base saturation. Therefore, the soils are poorly fertile.

Peaty soils are formed in deep depressions and lows between ridges under moisture-loving vegetation. In these conditions there is excess moisture and, therefore, the mineralization of plant residues is delayed. *Fibric Histosols* occupy only a small area in Zaonezhye. They are more common in watershed areas composed of silicate moraine, aqueo-glacial sand and loamy sand. *Terric Histosols* occur in areas where basic crystalline rocks are widespread. There, they occupy mires in old lake basins without outflow, ravines and at the foot of the slopes.

## Conclusions

Zaonezhye consists of diverse areas. The soil contours are clearly aligned from southeast to northwest throughout the area. The distinctive feature of soil cover in Zaonezhye is its unique dark soils formed on carbonaceous rocks (shungite) or glacial deposits that are not encountered in other parts of the world. Although soils formed on shungite-bearing rocks have attracted the attention of many researchers who have described physical, chemical and biological soil properties in their publications, many issues remain poorly understood. Also, their place in soil classification is unclear. Considering that shungite-bearing rocks are highly diverse in their chemical composition and abundance in Quaternary deposits, the genesis of these soils is still largely unknown.

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Mesic grassland in Zaonezhye Peninsula: *Gymnadenia conopsea* among *Melampyrum nemorosum* (Photo Tapio Lindholm).

## 1.5 Paleogeography of Zaonezhye Peninsula

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### Introduction

Zaonezhye Peninsula juts out into Lake Onega, occupying central parts of its northern coast. It is a unique area of diverse Quaternary sediments. Diverse in composition and distribution of the complexes of Quaternary deposits are a result of the complex structure of the crystalline basement, the composition of bedrocks as well as the Late Pleistocene and Holocene evolution. The distribution of Quaternary sediments forms the basis of modern landscapes and biodiversity on the peninsula.

Major relief-forming factors include glacial activity and denudation of surface horizons in Precambrian crystalline rocks. A combination of these factors has resulted in two genetically different landforms: 1) forms composed of crystalline rocks and 2) forms consisting of Quaternary rocks of different genesis (e.g. glacial and glaciofluvial accumulative relief).

The topography of Zaonezhye Peninsula can be divided into two parts: eastern and western. The eastern part is a moraine plain with gently sloping hills. It is a relatively flat area 30–60 m above lake level with paludified depressions separated by gently sloping ridges. The western part of Zaonezhye Peninsula displays a typical selkä relief with a system of NW-trending ridges at an altitude of up to 120 m above lake level. Ridges have steep, stepped slopes and steep scarps. Narrow lake basins and the Lake Onega bays occupy depressions between the ridges. Elevated sites are either covered with thin moraine, or completely devoid of Quaternary sediments. All glacial and aqueoglacial deposits on Zaonezhye Peninsula reflect the composition of the bedrock, eroded by glaciers (Lukashov & Ilyin 1993). Local moraines are widespread on shungite schis and rich in carbon, potassium, nitrogen and trace elements such as Cu, V, Ni, Zn and B. These elements are easily assimilated by plants, thus providing substrate for shungitic “black earth (*chernozem*)”, one of the best soil types for agriculture in Karelia

(Demidov 1993). The topographic characteristics and the composition of Quaternary deposits determine the plant biodiversity of Zaonezhye Peninsula.

Vegetation dynamics have been reconstructed from the Allerød period (~11800 BP) to the present based on palynological, macrofossil and radiocarbon data for the lacustrine deposits of the Lake Putkozero cross-section from central Zaonezhye Peninsula (Lavrova 1999, Demidov & Lavrova 2000) as well as from lake-mire deposits of the Zamoshye and Boyarshchina cross-sections from eastern parts of the peninsula (Elina & Filimonova 1999, Elina et al. 1999, 2000, Elina et al. 2010; Fig. 1). Also, data from coeval deposits in central parts of Lake Onega as well as present-day ponds and mires in its basin have been analysed (Elina 1981, Filimonova 1995, 2010, Elina Filimonova 1996, Lavrova 2004, 2005). Vegetation dynamics are shown against variations in geomorphology (Lukashov & Ilyin 1993, Demidov & Lavrova 2000), climate (Klimanov & Elina 1984, Filimonova & Klimanov 2005) as well as the transgressions and regressions of Lake Onega (Devyatova 1986, Demidov 2005, 2006). In addition, surface pollen and spore spectra from the study area and other regions as well as correction coefficients for tree pollen have been examined (Elina & Filimonova 1999, Filimonova 2007 et al.). Ecological and geographic analyses of identified taxa (after Grichuk et al. 1969) and estimations of pollen concentration in the deposits (after Stokmarr 1972) have been performed to reveal redeposited and remote pollen, which is essential for the study of Late Glacial vegetation.

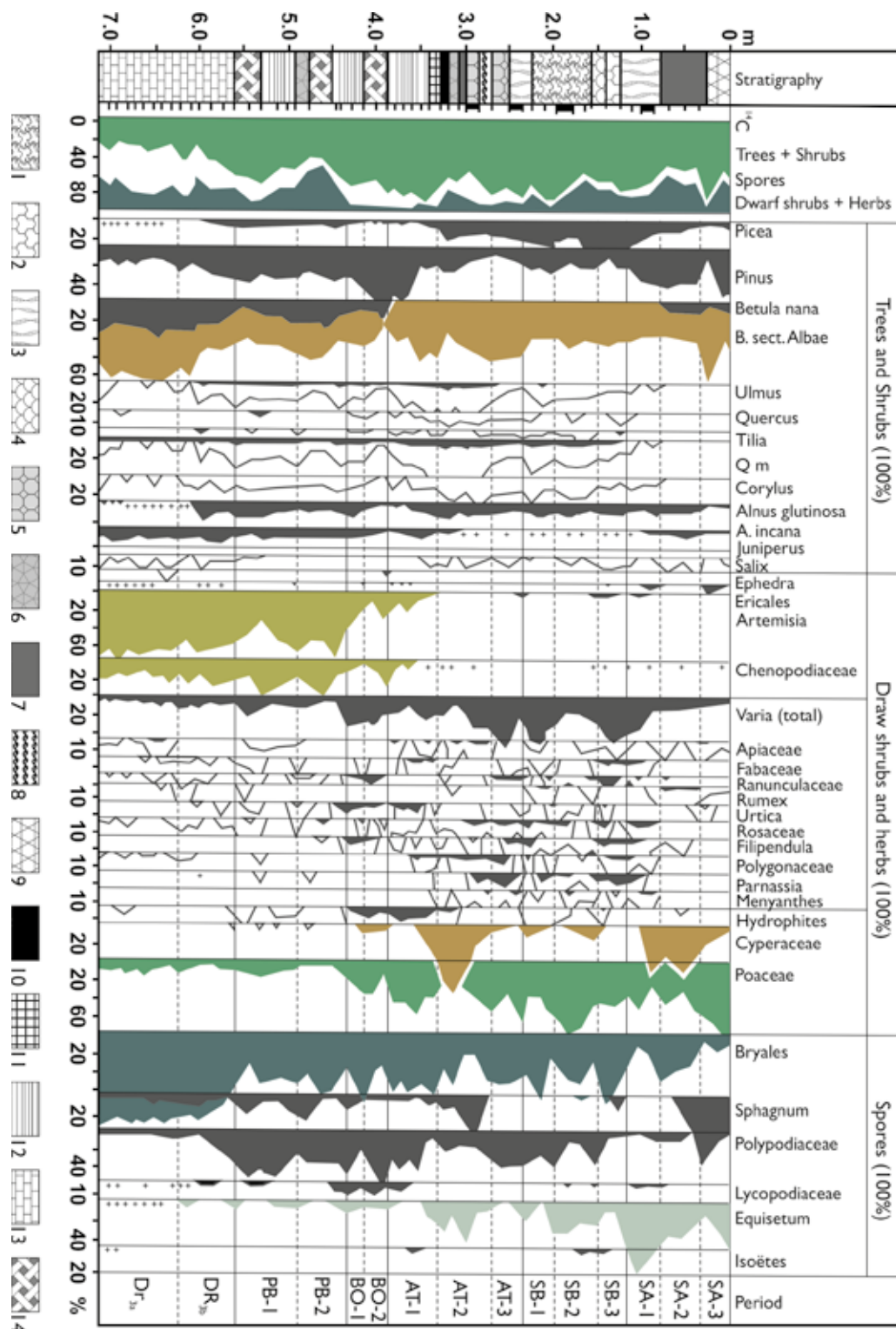


Fig. 1. Pollen diagram for the lake-mire deposits of the Zamoshye cross-section.

(analysed by E. Devyatova and L. Filimonova) [in: Elina and Filimonova 1999]

Left – stratigraphic column: 1–8 = fen peat: 1 – birch, 2 – woody, 3 – woody-reed, 4 – woody-grass, 5 – reed, 6 – grass, 7 – sedge-*Sphagnum*, 8 – *Sphagnum* (*Sphagnum teres*), 9 – transitional *Sphagnum* (*S. centrale*); 10 – sapropele-like peat; 11 – sapropele; 12–14 – clays: 12 – massive, 13 – fine sand lenses, 14 – varved. In the diagram, filled patterns show the pollen and spore content (%) of the taxa indicated; unfilled patterns show the content (%) magnified by 10; concentrations of less than 1% are shown with dots

## Geological Periods

**Late Glacial period (AL, DR3: 11 800–10 300 BP).** Approximately 12 000 years ago, the territory of present-day Lake Onega and its surroundings were occupied by the last glacial ice sheet. During the retreat of the Valdai glaciation, a large periglacial meltwater body formed in the Lake Onega basin and on the adjacent lowlands. Its area and water level varied constantly depending on the position of the ice margin, the glacial isostatic adjustment of the earth's crust and the erosional activity around the lake's margins. After reaching the southern shores of Zaonezhye Peninsula, the glacier retreated relatively rapidly. Large, deep periglacial water bodies such as Lake Onega (which was over 100 m deep), Lake Ladoga and the White Sea contributed to the rapid retreat of the glacier. The periglacial Lake Onega basin, over 100 m deep, was dominated by a type of deglaciation which caused the ascent and destruction of the ice lobe periphery. In this case, the ice margin retreated at a speed of no less than 1–1.5 km/year, while upon deglaciation of frontal type it retreated at a speed of no more than 200–250 m/year. However, on reaching the south shore of the Zaonezhye Peninsula, the glacier retreated fairly rapidly. Active glacier tongues, moving across deep bays and the rugged relief of the peninsula, contributed to the rapid disintegration of the ice lobes. The deglaciation of the Lake Onega basin began around 12 400 BP. By about 11 600 BP the ice had receded completely from the northern parts of Zaonezhye Peninsula (Demidov 2005, 2006, Filatov 2010) (Fig. 2).

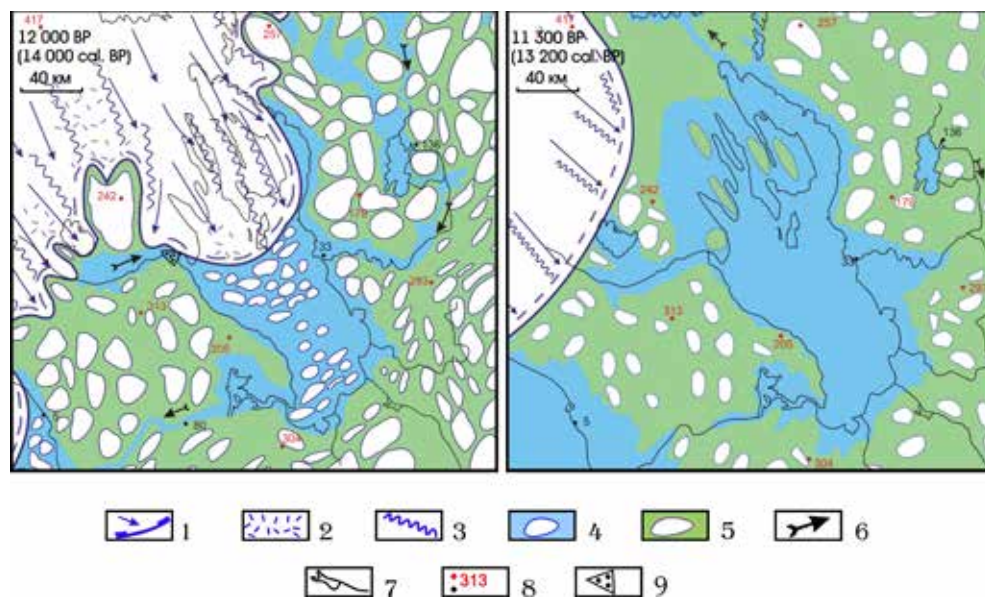


Fig. 2. Deglaciation of Zaonezhye Peninsula [After Demidov 2005, Filatov 2010].

- 1 – Active ice sheet
- 2 – Passive ice sheet
- 3 – Cracks and tunnels in glacier
- 4 – Old water bodies and icebergs
- 5 – Large dead ice massifs
- 6 – Runoff directions
- 7 – Modern hydrographic network
- 8 – Absolute altitudes of modern surfaces
- 9 – Large old deltas

During deglaciation, the water level of the periglacial Lake Onega changed constantly. The periglacial lake started to develop in the lower River Vytegra, on the southern shores of present-day Lake Onega. It is likely to have formed a part of the Upper Volga lake system where the water level was 120–130 m (Kvasov 1976). As a result of the glacial runoff, cutting through the river valley of Oshta, Tuksha and Oyat into the Baltic Sea about 12 500–12 400 BP, the lake's water level dropped to 106 m (Demidov 2006). About 12 300 BP the ice margin retreated from the Svir river valley, and the lake was provided with a new, lower, threshold into the Baltic Sea (Saarnisto & Saarinen 2001). Consequently the water level in its southern parts dropped to 75–85 m (Demidov 2006). As a result of glacier retreat, deglaciation of new areas and glacial meltwaters, the periglacial Lake Onega reached its maximum size by the end of the Allerød (about 11 400 BP) when its water level rose to 115–130 m in the northern part. About 11 300 BP the water level dropped by 20–25 m down to 95–100 m due to isostatic uplift of the earth's crust and the opening of a new threshold into the White Sea. Also another threshold was opened into Lake Ladoga in the northern parts of the Onega-Ladoga watershed and River Vidlitsa before the water level stabilized for a long time. The next large-scale regression of Lake Onega took place at the end of the Late Pleistocene about 10 300 BP due to the renewed runoff into Lake Ladoga through River Svir. At the same time Lake Onega lost its connection with the ice margin, which had retreated to Western Karelia. As a result, its level dropped by about 20 m and large areas were drained (Demidov 2005, 2006).

Varved clay accumulated in the periglacial Lake Onega until 10 700 BP. After the ice margin retreated beyond the lake basin, mass deposition of homogeneous clay and silt in Lake Onega began. As deglaciation proceeded, water- and ice-free areas were colonized by vegetation whose distribution and evolution were determined by climatic, geological and geomorphological factors.

At the final stages of the Valdai glaciation, climatic changes were considerable. Quantitative climatic indices have been estimated for the Late Dryas: mean July temperatures were 3–6° lower, mean January temperatures 8–14° lower, annual temperatures 5–9° lower and precipitation 175–250 mm/year lower than at present (Filimonova & Klimanov 2005; Fig. 3). During the earlier Allerød interstadial warm period, negative temperature and precipitation deviations would have been more substantial on Zaonezhye Peninsula without the huge periglacial water body that made the climate slightly less continental.

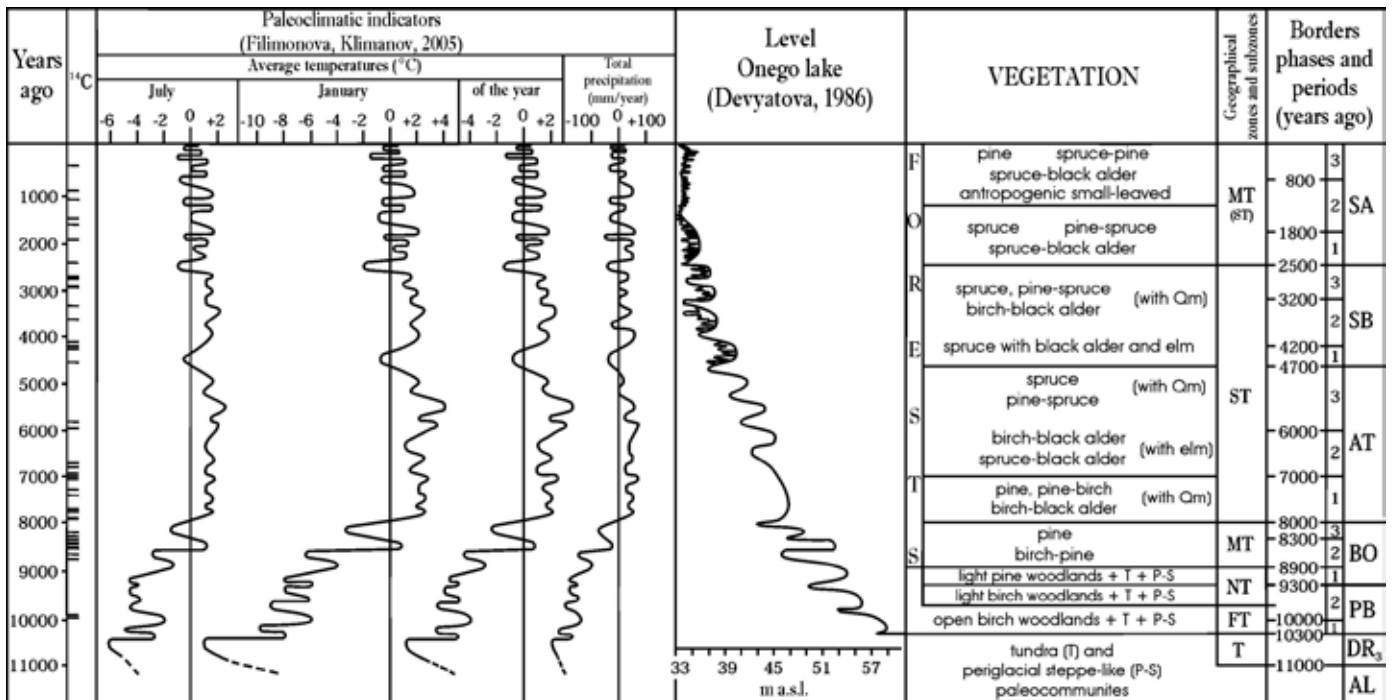


Fig. 3. Dynamics of the climate, of Lake Onega level and vegetation in the Late Glacial and Holocene periods.

Palaeoclimatic characteristics are shown as deviations from present values:  $t_{VI}^o = 16^\circ$ ,  $t_1^o = -11^\circ$ ,  $t_{year}^o = 2^\circ$ , total annual precipitation = 550 m.

Acronyms: T – tundra, FT – forest-tundra, NT – northern taiga, MT – middle taiga, ST – southern taiga, Qm – broad-leaved species and hazel



The evolution of the vegetation in Zaonezhye began after the ice receded and plants started to invade suitable areas, free from the melting ice. First almost the entire Zaonezhye was covered by the periglacial Lake Onega, leaving only some islands, elongated in a near-N-S direction, above the water level (Fig. 4). Plant growth was boosted by the presence of small quantities of mineral nutrients in the substrate, supplied by glacial meltwaters. Lower plants, dominated by algae and lichens, were most probably the first to colonize the study area. These were followed by higher plants (*Botrychium boreale*, *Dryas octopetala*, *Eurotia ceratoides*, *Lycopodium alpinum*, *Thalictrum alpinum*, *Saxifraga oppositifolia*, *Cryptogramma crista*, *Ephedra* and *Saxifraga* species) growing on crushed stones and rocky ground as well as on substrates with an unstructured, disturbed soil cover (*Artemisia* species, *Chenopodium album*, *Ch. polyspermum*, *Ch. rubrum*, *Kochia laniflora* and *K. scoparia*). These species are not sensitive to environmental change. However, they are resistant to temperature variations and water availability. These species grew on the soil-free islands that later turned into mainland of Zaonezhye Peninsula. First, seeds brought by various agents such as wind and water evolved into seedlings that provided the area with more seeds and formed a pioneer community. Later the pioneer species were joined by new species. As the ice retreated, water level in the periglacial lake dropped. While soils began to form on the islands and in adjacent areas, also the plant cover became more complex. It consisted of forest, tundra and steppe communities, comprised of species confined to different environments. Due to the proximity of the retreating ice cover, the weather was dry and the ground was saturated, which created favourable conditions for the growth of xerophytes, mesoxerophytes, mesophytes and hygrophytes. Late Glacial deposits on Zaonezhye Peninsula contain pollen of geographically diverse arctalpine (*Dryas octopetala*, *Diphasiastrum alpinum*, *Saxifraga oppositifolia*, *Thalictrum alpinum*, *Oxyria digyna*, etc.), hypoarctic (*Betula czerepanovii*, *Botrychium boreale*, *Huperzia appressa*, *Lycopodium pungens*, *Rubus chamaemorus*, *Selaginella selaginoides*, etc.), boreal (*Alnus incana*, *Diphasiastrum complanatum*, *Lycopodium clavatum*, etc.) and steppe species (*Ephedra*, *Helianthemum*, *Eurotia ceratoides*, *Kochia scoparia*, *Kochia laniflora*, etc.).

During the Late Glacial period the plant cover was open, as shown by low pollen concentrations and the occurrence of heliophyte pollen (*Hippophae rhamnoides*, *Helianthemum* and *Ephedra*) in the deposits. Pioneer plant groups and bare ground succeeded each other. One of the critical factors limiting the spread of vegetation was long-term permafrost, which prevented the downward growth of roots. Its existence in the study area is supported by the presence of halophytes (*Salsola kali*, *Salicornia herbacea* and *Atriplex nudicaulis*) that found favourable habitats in saline depressions. *Chenopodium album*, *Ch. rubrum*, *Eurotia ceratoides* and *Ephedra* are also resistant to moderate salinity. In the dry continental climatic conditions, salts accumulated in the surface soil layer, while permafrost prevented their transfer into the deeper horizons. Permafrost contributed to the saturation of soils, too, by preventing moisture from penetrating into deeper layers, which in turn led to solifluction. Cold winters with little snow and strong winds were typical of periglacial zones and resulted in soil erosion. Thus, solifluction and erosion created suitable habitats for plants growing in disturbed and unstructured soils (taxa are shown above).

Relief and the composition of Quaternary sediments were essential for the formation and distribution of plant communities. The succession of plains, ridges and hills created diverse conditions for plant growth on clay, loam and inequigranular sand. Some of the hills were completely devoid of Quaternary cover. Elevated areas and slopes were composed of rock debris, occupied by xerophyllous communities (i.e. species of the *Chenopodiaceae* family and the *Artemisia*, *Ephedra* and *Helianthemum* genera, *Dryas octopetala*, *Cryptogramma crista*, *Huperzia appressa*, etc.). Depressions with accumulated snow protected plants against cold winter winds and provided

favourable habitats for tundra-like dwarf birch-green moss communities, consisting of *Selaginella selaginoides*, *Rubus chamaemorus* and *Salix*, *Pedicularis*, *Cyperaceae* and *Poaceae* species, in addition to *Betula nana* and *Bryales*.

One of the factors responsible for the distinctive pattern of the Late Glacial vegetation was the permanent exposure of the earth's surface after the glacier retreat and the lowering of the periglacial lake level. As a result, paleocommunities of unstructured soils existed for a long time.

The presence of algae of the genus *Pediastrum* (*Pediastrum boryanym* var. *boryanum*, *P. integrum* var. *integrum*, *P. kawraiskyi*, *P. primum*) indicates that the periglacial Lake Onega was cold, deep and oligotrophic. Such conditions halted the spread of aquatic and littoral aquatic plants.

The growth of woody species in the late glacial period poses a complex and ambiguous question. On one hand the pollen content of the deposits from the late glacial period is high (Fig. 1). On the other, most pollen seems to have been transported by wind and redeposited, as indicated by the low pollen concentration of woody plants. At the same time, favourable habitats provided good conditions for some woody plants, e.g. *Betula pubescens*, *B. czerepanovii*, *Alnaster fruticosus* and *Alnus incana*. These species differ considerably in their adaptability to low temperatures, cold soils and permafrost. It is likely that there were favourable habitats for open communities of woody plants or individual trees at least at the end of the Allerød.

Another significant cooling event triggered the advance of the glacier in the Late Dryas (Fig. 3). Due to cold winters and thin snow cover, solifluction, erosion and weathering of the unstable ground increased. As a result, areas covered by crushed stone, rocky ground and plant communities on disturbed soils (*Artemisia*, *Chenopodiaceae* species, etc.) expanded. While the contribution of woody communities in the plant cover decreased, the tundra dwarf birch-green moss communities were survived in favorable habitats (Fig. 3, Fig. 4). In general the floristic composition of the Late Glacial vegetation remained practically unchanged.

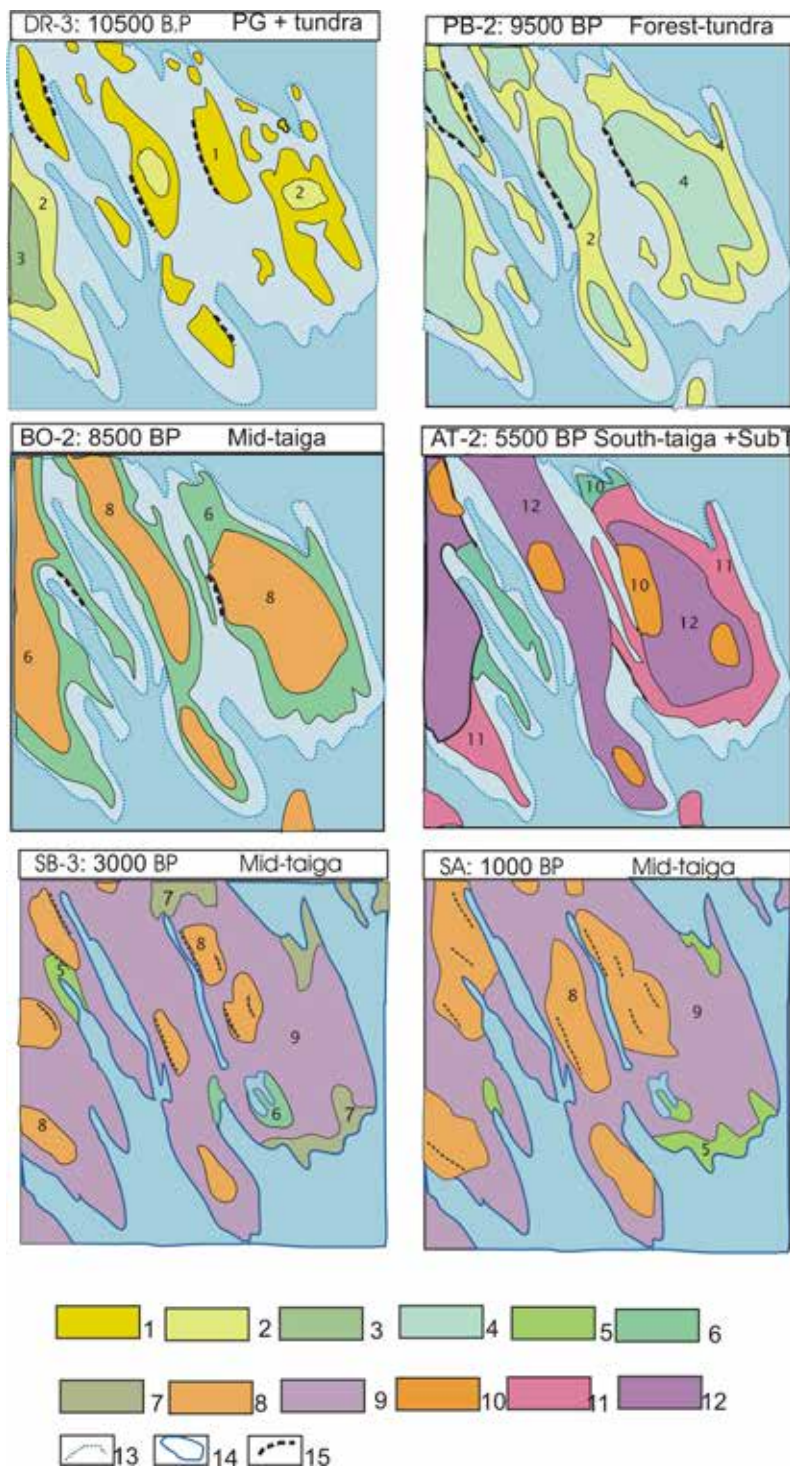


Fig. 4. Palaeovegetation maps of Zaonezhye Peninsula (10 500, 8500, 7500, 5500, 3000 and 1000 BP) [After Elina et al. 2010].

**1, 2 – Periglacial palaeocommunities (pc):** 1 – *Artemisia*-Chenopodiaceae, 2 – *Artemisia*-Chenopodiaceae with herbs; **3 – Tundra pc:** *Betula nana*-Bryales pc; **4 – Forest tundra pc:** open *Betula* woodland; **5–9 – Middle taiga pc:** 5 – *Betula*-herbs, 6 – *Betula*-*Alnus*-herbs, 7 – *Pinus*-*Betula* with *Alnus*, 8 – *Pinus*-Ericales-Bryales-Lichenes, 9 – *Picea*-Ericales-Bryales; **10–12 – Southern taiga pc:** 10 – *Pinus*-herbs and *Pinus*-herbs-Bryales, 11 – *Alnus glutinosa*-*Picea*-herbs, 12 – *Picea*-*Ulmus*-herbs; **13 – Past shoreline; 14 – Shoreline at present; 15 – Shore scarps**

### The Holocene (10 300 BP – Present)

During the Holocene, the greater availability of heat and moisture triggered an irreversible change in plant cover dynamics. As a result, the treeless ecosystems of Late Dryas were succeeded by open birch woodland and, more recently, taiga forests.

**The Preboreal period (PB: 10 300–9 300 BP)** began with a substantial warming of the climate to a temperature maximum ca. 10000 BP when July temperatures were 2°C lower, January temperatures 6°C lower and annual temperatures 4°C lower than at present. Also precipitation was lower by 150 mm/year. Then, in PB-2 (10 000–9 300 BP), the climate became more unstable and colder, especially in the winter months. The deviation of the above parameters was 4–4.5°, 6–9°, 5–7° and 150–200 mm/year, respectively (Filimonova & Klimanov 2005; Fig. 3).

The water level of Lake Onega continued to decrease, while transgressions and regressions succeeded one another (Fig. 3). Cross-sections have been studied from the massive clay deposits of Zamoshye and Boyarshchina on Zaonezhye Peninsula (Elina, Filimonova et al. 1999, Elina et al. 1999, 2000, Elina et al. 2010). Consequently, varves of fine sand found in the clay clearly correlate with the regressions: first varve at the DR<sub>3</sub>/PB contact, second varve in the middle of PB and third varve at the end of PB (Fig. 1, Fig. 3).

As the water level of Lake Onega declined, islands jutted out of the water and merged to form larger islands. Water-free areas were colonized by *Artemisia*, *Chenopodiaceae* (including *Chenopodium album*, *Ch. hybridum*, *Ch. foliosum*, *Ch. glaucum*, *Ch. polyspermum*, *Ch. rubrum*, *Eurotia ceratoides*, *Salicornia herbacea*, *Salsola kali*) and other pioneer plants. It looks as if these plant groups followed the retreating lake water and remained widespread until the end of the Preboreal period. At the beginning of the period, a large part of the area was occupied by dwarf birch-green moss tundra with *Sphagnum*, dwarf birch and willow thickets, occurring along the creeks. Birch continued to spread, although its contribution in the plant cover decreased. The tundra communities confined to fragmented stones and rocks on the tops and slopes of ridges, high above sea level, persisted longer than other communities. The considerable contribution of wormwood-goosefoot-motley grass (*Artemisia-Chenopodiaceae-Varia*) paleocommunities during the Preboreal period was due to the cold and dry climate (Fig. 3), the cooling effect of Lake Onega and the formation of new land areas after the lowering of the lake's water level. In the parts of Karelia, farther from large water bodies these communities were more typical during DR<sub>3</sub>, whereas in the PB-period their contribution in the plant cover decreased (Elina 1981, Filimonova 1995, 2014, Lavrova 2005, 2006).

In the early Preboreal period open birch woodland (*Betula czerepanovii*, *B. pubescens*) spread on plains, ridge tops and ridge slopes. The ground cover was composed of *Betula nana*, *Salix*, *Ericales*, *Poaceae*, *Bryales* and *Lycopodiaceae*, presumably with a small percentage of *Pinus sylvestris* (Fig. 3, Fig. 4). Moist habitats were dominated by tall-grass open birch forests with *Alnus incana*, while depressions with good water flow and ground cover of clay and loam were colonized by birch-alder and alder grass-fern communities with *Filipendula ulmaria*, *Geum rivale* and *Angelica sylvestris*. In the late PB-2 (approximately 9 700 BP onwards), birch forests (*Betula pubescens*) and open pine-birch forests, similar to northern taiga forests, became more abundant (Fig. 3). Alder grew in tall-grass birch forests and formed alder groves.

During the Preboreal period the number of xerophytes, halophytes and species typical of unstructured and disturbed grounds decreased, together with arctic, arctalpine, hypoarctic and steppe flora. At the same time boreal species, especially mesophytes and hydrophytes became more abundant. Grasses were represented by *Apiaceae*, *Asteraceae* (*Aster*, *Tanacetum* type), *Brassicaceae*, *Caryophyllaceae*, *Ephedra*, *Fabaceae*, *Galium*,

*Lamiaceae* (including *Mentha*), *Myosotis*, *Polygonaceae* (including *Bistorta officinalis*, *Rumex*), *Ranunculaceae* (including *Thalictrum alpinum*), *Rosaceae* (including *Dryas octopetala*, *Filipendula ulmaria*), *Scrophulariaceae*, *Urtica*, *Cyperaceae*, *Poaceae* and *Polypodiaceae* (including *Polypodium vulgare*). *Lycopodiaceae* included *Diphasiastrum alpinum*, *D. complanatum*, *Huperzia apressa* and *Lycopodium pungens*. The formation of shallow bays made possible the growth of wetland plants (*Myriophyllum spicatum*, *Sparganium*, *Parnassia palustris*, *Phragmites australis*, *Typha angustifolia*, *T. latifolia*, *Cyperaceae*, *Isoetes*, *Equisetum*, *Bryales* and *Sphagnum*).

During the Preboreal period, nature and climate were generally unfavourable for human livelihood, although temporary settlements may have been established on the shores of shallow bays during warmer periods.

**The Boreal Period (BO: 9300–8000 BP)** is characterized by the some climate warming. It began with cold conditions but reached maximum temperatures around 8500 BP when air temperatures were either close to, or above present values in the Lake Onega basin (Elina et al. 1984, Devyatova 1986, Filimonova & Klimanov 2005). In BO-3 (8300–8000 BP) the climate cooled and around 8200 BP July temperatures decreased by 1.5°C, January temperatures by 3.5°C and annual temperatures by 2.5°C. The amount of precipitation were by 25 and 75 mm/year lower than at present, respectively (Fig. 3). Thus, the climate was drier during the Boreal period than at present.

In the BO-period, the water level in Lake Onega varied as transgressions were succeeded by regressions (Fig. 3). During the last regression, the water level dropped to 43 m above sea level. As a result, island area increased significantly.

The vegetation responded to the changes in nature and climate, changing from northern taiga in the first third of the Boreal period to middle taiga thereafter. Pine, birch-pine-green moss and grass-motley grass forests became predominant in the central parts of the islands (Fig. 4). Birch and alder tall-grass forests with *Poaceae*, *Polypodiaceae* (including *Dryopteris linnaeana*, *D. phegopteris* and *D. thelypteris*) and motley grasses, e.g. *Apiaceae*, *Fabaceae*, *Liliaceae*, *Polygonaceae* (including *Bistorta officinalis*), *Ranunculaceae* (including *Thalictrum*), *Rosaceae* (including *Filipendula ulmaria*), *Rumex*, *Urtica* grew at lower altitudes in shallow, well-flowing topographic depressions

The presence of *Artemisia* and *Chenopodiaceae* pollen in the deposits (Fig. 1) indicates that more extensive areas became water-free during the Boreal period. Furthermore, habitats responded to the new environmental conditions. Late Glacial deposits contain pollen of *Hippophae rhamnoides* and *Ephedra* as well as *Dyphasiastrum alpinum* spores. Also the abundance of the *Lycopodiaceae* spores (*Dyphasiastrum complanatum*, *D. tristachium*, *D. alpinum*, *Huperzia selago*, *Lycopodium pungens*, *L. annotinum* and *L. clavatum*) is characteristic of the Boreal period. Club mosses are characteristic of open woodlands and open, treeless areas, including exposed, rocky grounds. The increased abundance of pollen and spores of aquatic (*Myriophyllum spicatum*, *Nymphaea*, *Potamogeton*, *Sparganium* and *Isoetes*) and coastal-aquatic plants (*Alisma*, *Parnassia palustris*, *Phragmites australis*, *Typha angustifolia*, *T. latifolia* and *Cyperaceae*) indicate an abundance of shallow bays.

During the Boreal period Lake Onega retreated, more areas became water-free and the climate became milder. As a result, conditions for human livelihood became more favorable. Around the lake, people picked mushrooms and berries as well as fished and hunted for elk, reindeer, bear, hare and other animals, including waterfowl (geese, ducks, etc.)

**The Atlantic period (AT: 8000–4700 BP)** was a period of a climatic optimum as well as considerable changes in hydrology and vegetation. Air temperature were higher than at present throughout the entire period: 1–2.5°C warmer in July and 1–4°C warmer in

January. In general, mean annual precipitation was higher by 50–75 mm/year. But it decreased in the late AT-3 (especially around 5200 BP) when air temperatures were relatively high (Fig. 3). As the results, the climate became drier in this time.

During AT-1 (8000–7000 BP), the natural complexes of the Lake Onega basin were affected by the warm, humid climate as well as the considerable (over 3 m) transgression of Lake Onega (Fig. 3). Also, the water levels in small and medium-sized water bodies rose, as well as the groundwater in mires (Filimonova, 2010 et al.). In the middle of AT-2 (7000–6000 BP), the climate became less humid and the crystalline Baltic Shield continued to ascend. As a consequence, the Lake Onega water level dropped by 5 m. Its subsequent variations were smaller, in accordance with humid and dry periods (Fig. 3).

Peat accumulation began here about 6700–6600 BP, during the Mid-Atlantic regression of Lake Onega. The mire has never been flooded by lake water since (Elina & Filimonova, 1999). As a result of regression that preceded the AT-period, the depression, occupied now by Zamoshye Mire, separated from Lake Onega, and a shallow, overgrowing water body was formed there. This is supported by the greater occurrence of the pollen and spores of aquatic and mire plants and the formation of 10 cm thick sapropel and sapropel-like peat layers in the central portion of the mire in the late AT-1. Peat accumulation began there about 6700–6600 BP, when the Mid-Atlantic regression of Lake Onega took place.

A warmer and more humid climate supported the spread of broad-leaved species (*Ulmus laevis*, *U. glabra*, *Quercus robur*, *Tilia cordata*, *Acer platanoides*), *Corylus avellana* and *Alnus glutinosa*. These species became most abundant in Zaonezhye during AT-2, as shown by the radiocarbon date 6580±80 BP. During the AT-period, the vegetation acquired southern taiga features. At the beginning of the period, pine and birch-pine forests continued to dominate. However, also grass-green moss spruce forests were spreading (Fig. 3, Fig. 4). These communities became more prevalent since AT-2 (~7000 BP). Depressions with fertile soils, saturated by flowing water, grew birch-black alder and spruce-black alder forests with elm and hazelnut, as well as lush grasses (*Angelica sylvestris*, *Fillipendula ulmaria*, *Bistorta officinalis*, *Fabaceae*, *Geum rivale*, *Humulus lupulus*, *Liliaceae*, *Urtica*, *Polypodiaceae*, etc.). Also *Alnus incana*, *Sorbus aucuparia*, *Viburnum opulus*, *Frangula alnus*, *Lonicera*, *Ribes* and *Salix* have been encountered in these forest communities. The birch took part in coniferous forests and formed post-pyrogenic birch forests as well as birch-grass-moss communities, growing on eutrophic mires. Fires affected pine forests especially in dry habitats, as indicated by the Zamoshye pollen diagram (Fig. 1): The percentage of *Pinus sylvestris* pollen decreased, whereas the percentage of *Betula* sect. *Albae* pollen increased. Also pollen of *Chamaenerion angustifolium* and coal particles is occasionally encountered.

Shallow-water zones continued to be overgrown by aquatic and mire plants (*Hydrocharis Nuphar*, *Triglochin* and *Menyanthes trifoliata* were added to the taxa identified earlier). At first shallow reed and reed-sedge mires were common close to the shoreline; later they were succeeded by grass-*Sphagnum* fens.

Atlantic period was the most favorable time for people's lives. This contributed to the presence of many kilometers of shoreline with high, dry ridges, as well as an abundance of plant resources, game animals, birds and fish.

**The Subboreal period (SB: 4900–2500 BP)** began with an abrupt cooling event, with a drop in humidity to a minimum around 4500 BP. It determined the course of subsequent environmental change. According to climatic reconstructions from seven pollen diagrams for the Lake Onega basin, July temperatures were 0.5–1° lower, January temperatures 1–2° lower and precipitation 50 mm/year lower than at present (Elina et al., 1984, Filimonova & Klimanov 2005). Since SB-2 (4200 BP) temperatures

began to rise again, within the same range as during SB-1. However, mean annual precipitation was smaller. Climate was the driest during SB-1 (4700–4200 BP) and after 3900 BP (Fig. 3).

The regression of Lake Onega as well as smaller water bodies is consistent with the cooling and decreased precipitation during the early SB-period. At the same time, there was a drop in groundwater levels, including in the mires, where woody communities became common. During the middle-Subboreal transgression, moisture-loving plants reappeared, as indicated by the peat stratigraphy of Zamoshye Mire (Elina & Filimonova 1999, Elina et al. 1999).

The overall reduction of water level in the Lake Onega has led to an increase in land area. A significant cooling and reducing the humidity of the climate caused the gradual replacement of southern taiga forests on middle-taiga forests.

During the Subboreal period, spruce and pine-spruce green moss forests were common (Fig. 3, Fig.4). They occupied lacustrine glacial plains and selkä slopes. Broad-leaved species were present, although they were more common in moist birch-black alder and spruce-black alder forests. By the end of the period, their contribution to the forest composition had decreased. *Corylus avellana*, *Populus tremula*, *Sambucus racemosa*, *Sorbus aucuparia*, *Viburnum opulus* and *Ribes* occurred in the undergrowth. Pine forests with dwarf shrub, green moss and lichen grew on rocky ridges. Birch took part in coniferous forests, although it formed post-pyrogenic birch forests and played a leading role in the afforestation of mires.

Distinguished in the grass cover are several floristic groups characteristic of forests and forest edges with moist and fertile soils (*Urtica*, *Thalictrum* and *Polypodiaceae*), moist communities growing at the periphery of mires (*Filipendula ulmaria*, *Bistorta officinalis* and *Geum rivale*) and meadow-like moist (*Parnassia palustris* and *Cyperaceae*) and dry communities (*Chamaenerion angustifolium*, *Galium*, *Potentilla*, *Ranunculaceae*, *Fabaceae* and *Liliaceae*).

Eutrophic grass mires, one of which is 2770±60 years old, succeed coastal aquatic and wetland plant thickets. Mires became common towards the end of the period. The development of meadows and meadow-like communities is indicated by the considerable amount of grass pollen and the pollen content in the pollen diagrams (see Fig. 1).

Climate, the formation of new territories and the abundance of various food resources and forests with a variety of useful plants were favorable for living and the establishment of permanent settlements.

During the **Subatlantic period (SP: 2500 BP – Present)** the shoreline of the Zaonezhye Peninsula acquired its modern shape and landscapes. These landscapes have been affected by both natural and anthropogenic factors. During the SA-period the climate became colder than in the two previous periods. In the beginning, July temperatures were 1°C lower, January temperatures 2°C lower and precipitation 50 mm/year lower than at present. Both the temperature and the precipitation fluctuated simultaneously (Fig. 3). The most considerable warming event took place during the SA-2 (1800–800 BP) in the Viking epoch, especially around 1800 BP and during the Little Climatic Optimum in the Middle Ages (1100–1000 BP) when July temperatures were 1.5°C higher, January temperatures 2°C higher and precipitation 75 and 50 mm/year higher, respectively. The SA-3 (the past 800 years) began with a global cooling. In their coolest, around 700 BP, July temperatures were 1–1.5° lower, January temperatures 1–2°C lower than at present. Precipitation was as it is today or smaller by 50 mm/year. Other cooling events occurred around 500 BP, 200 BP and a little more than 100 BP, while warming events took place around 600 BP, 300 BP and 170–150 BP. The lat-

est warming event began towards the middle of the 20<sup>th</sup> century (Klimanov & Elina, 1984, Filimonova & Klimanov 2005).

A rise in atmospheric humidity caused increased of groundwater level, including in the mires. At that time the moisture-loving mire communities became more common, peat accumulation rate increased and the degree of peat decomposition decreased (Elina & Filimonova 1999, Kuznetsov et al. 1999).

During the first part of SA-period, middle taiga spruce forests dominated (Fig. 3), especially those were widespread on the gently sloping moraine plains of selkä Zaonezhye Peninsula (Fig. 4). Pine forests were more common in the western esker area. Black alder and black alder-spruce forests with a lush grass cover grew between selkäs and in topographic depressions with good stream moistening. Birch took part in the above forests. It also formed tall-grass and pyrogenic birch forests as well as played a part in the afforestation of mires. Broad-leaved species (*Acer*, *Ulmus* and *Tilia*) grew on more fertile soils.

In the second part of SA-period, especially during the past 1000 years, the amount of coniferous forests has decreased and the amount of small-leaved forests has increased. Especially spruce forests have declined (Fig. 3). This has been largely due to agricultural development. Spruce forests growing on fertile soil were cut and burned for use as farmland. Pine has been used as building material and firewood as well as for charcoal. As a result of intensive human activities, most primeval forests have disappeared and been replaced by settlements, meadows, pastures, arable land and secondary forests. Abandoned agricultural land is now overgrown with birch, aspen and grey alder (*Alnus incana*).

The effects of human activities are reflected in the spore and pollen diagrams. There is a decrease in the proportion of pollen from coniferous plants, especially *Picea*, as well as an increase in the amount and diversity of grass pollen. Also coal particles are present. Pollen of species adapted to secondary habitats (*Chenopodium album*, *Ch. rubrum*, *Ch. polyspermum*, *Chamaenerion angustifolium*, *Potentilla*, *Ranunculus*, *Artemisia* and *Poaceae*) has become more common. Pollen of ruderal plants (*Rumex*, *Urtica*, *Potentilla*, *Galium*, *Plantago*, *Apiaceae*, *Geraniaceae* and *Chenopodiaceae*), segetal weeds (*Asteraceae*, *Centaurea*, *Cichoriaceae*, *Fabaceae*, *Caryophyllaceae* and *Lamiaceae*) and cereals (*Cerealia*) also occurs. These changes in the spore and pollen spectra suggest that agricultural activities on Zaonezhye Peninsula began about 1100-900 BP. This conclusion is also supported by the radiocarbon dates 1140±50 BP and 950±110 BP obtained from the Moshguba and Shlyamino Mire deposits (Lavrova et al., 2007). Obtained data are in good agreement with the date 1060±60 BP for the beginning of agriculture in the vicinities of Essoila village, Syamozero Lake, on the Onega-Ladoga isthmus (Ekman & Zhuravlev 1986).

According to reconstructions from Alleröd to the present, the dominant vegetation on Zaonezhe Peninsula follows the sequence: **periglacial steppe-like** (*Artemisia*, *Chenopodiaceae*, *Poaceae*, etc.) and tundra (*Betula nana*, *Salix*, *Ericales*, *Dryas*, *Saxifraga*, *Carex*, *Bryales*) **palaeocommunities** (PC) [AL, DR3: 11800–10300 BP] → **forest-tundra**: open birch woodlands (with some pine and alder) combined with dwarf shrub moss tundra and *Artemisia-Chenopodiaceae-Varia* PC [PB-1,2: 10300–9700 BP] → **northern taiga**: light birch and pine-birch forests [PB-2: 9700–9300 BP] → light birch-pine and pine forests [BO-1: 9300–8900 BP] → **mid taiga**: pine and birch-pine forests [BO-2,3: 8900–8000 BP] → **southern taiga**: pine, pine-birch and birch-black alder forests with broad-leaved species and hazel (Qm), spruce [AT-1: 8000–7000 BP] → spruce, pine-spruce, birch- and spruce-black alder forests with Qm [AT-2,3: 7000–4700 BP] → spruce, pine-spruce, birch-black alder forests with Qm and spruce forests with black alder and elm [SB: 4700–2500 BP] → **mid taiga** (with elements of the south taiga): spruce, pine-spruce-pine and spruce-black alder forests with present of Qm [SA-1,2:



2500–1300 BP] → pine, spruce-pine and spruce-black alder forests with present of elm and lime, as well as secondary forests dominated with birch and grey alder [SA-2,3: 1300 BP – 0 yrs].

The diversity natural patterns of Zaonezhye are a result of its geological evolution and climate history. Its carbonate and shungite rocks, diverse landforms and Quaternary deposits of various grain sizes have provided diverse habitats for species and communities in different light, moisture, heat and mineral conditions. These and other natural features of Zaonezhye contributed preserving individual species and communities (spruce and lime forests, black alder fens, and fens with black alder and spruce) that existed during the period of climatic optimum. *Tilia cordata*, *Ulmus laevis* and *U. scabra* are encountered on mainland Zaonezhye and on the islands of Zaonezhye. Nemoral, herbaceous plant species grow in areas with fertile soils (e.g. Kuznetsov 1993, Kravchenko et al. 1993).

Relicts of the cold Late Glacial period include *Helianthemum nummularium*, which is found on Bolshoi Lelikovsky Island (Kuznetsov 1997). In Karelia, pollen of *Helianthemum nummularium* occurs in Late Glacial deposits of some sections (Demidov & Lavrova 2001, Lavrova 2011). Nowadays the northern limit of the species' distribution extends from the Åland Islands to the southwestern coast of Finland. Only five *Helianthemum nummularium* habitats are known to the north or east: two in Finland, two in Russian Karelia (northern shore of Janisjärvi Lake and Zaonezhye) and one in Cape Tury, Kola Peninsula (Vasari & Vasari 1999, Kravchenko 2007).

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Black alder swamp in Klimentyevsky Island (Photo Tapio Lindholm).

## 1.6 Nature protected areas in Zaonezhye

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### Introduction

At present there are three regional nature reserves and 19 regional nature monuments on Zaonezhye Peninsula with a total area of 2500 ha (Table 1). In addition, the federal Kizhi zoological reserve (*zakaznik*) covers 50 000 ha in the southeastern part of the peninsula. Within its boundaries lie the Kizhi open-air museum and its buffer zone as well as the regional nature monuments “Yuzhniy Oleniy Island”, “Wetland by the village of Boyarschina”, “Wetland by Petrikov’s Bay” and “Wetland Zamoshye”.

### Overview of protected areas in Karelia

On the whole there are 137 regional protected areas in the Republic of Karelia (as of 1<sup>st</sup> November 2014). These protected areas cover 391 600 ha, or 2.17% of the republic, and include the Valaam nature park (24 700 ha) as well as 31 nature reserves (*zakazniks*) and 105 nature monuments. The nature reserves consist of 15 landscape reserves (242 800 ha), one marine reserve (72 900 ha), 11 botanical reserves (2 100 ha) and four hydrological reserves (6 700 ha), while the nature monuments comprise 64 protected mires (31 600 ha), nine hydrological monuments (over 6 000 ha), 10 geological monuments (2 400 ha), three landscape monuments (2 300 ha) and 19 botanical monuments (over 100 ha). Overall nature reserves (75% of which are landscape reserves) constitute 82.86% of the total area of regional protected areas in the Republic of Karelia, whereas nature monuments make up 10.83% and nature parks 6.31%.

Buffer zones have been designated around the protected areas. By imposing restrictions to land use, these zones shield protected areas from negative human impact. In the Republic of Karelia, 33 regional protected areas (with a total area of 78 000 ha) are

accompanied by 5 600 ha of buffer zones on land. For 15 protected areas, the extent of the buffer zones has not been specified.

In the Republic of Karelia, regional protected areas are established in accordance with the Regional land-use plan of the Republic of Karelia, approved by the government of the republic (Scheme 2012, Regulation 2014). In justification materials to this document, there are two lists of new protected areas to be established by 2030: A list of planned protected areas, for which the necessary documents have been prepared (Annex 1), and a list of perspective protected areas (Annex 2).

The first list consists of protected areas to be established in the first stage. For these protected areas, the necessary ecological and economical impact assessments have been prepared and presented to the regional authorities. These assessments include detailed descriptions of ecological, social and economic impacts of the protected areas as well as their borders, areas and proposed protection regimes. At present there are eight planned protected areas with a combined area of 264 890 ha, or 1.5% of the total area of the Republic of Karelia. These include the nature reserves Chukozero, Gridino (in Loukhi municipality), Maslozero, Varozero, Yangozero, Yupauzhsuo and Zaonezhsky as well as the Vargachnoe-Korbozerskoe nature monument. Two regional protected areas were established in 2013: Gridino landscape reserve (8 400 ha; Kemi municipality) and Kumi-Porog nature monument (3 400 ha; Kalevala municipality). In addition, the Institute of Biology of the Karelian Research Centre of the Russian Academy of Sciences has conducted field studies on the mire systems of Yupauzhsuo and Kepasuo (Kalevala municipality) and prepared the necessary documents for the establishment of the Yupauzhsuo nature reserve.

The second list consists of perspective protected areas. These areas have high conservation value, for example habitats of regionally or nationally red-listed species. However, more detailed information is needed for the establishment of these protected areas. In the Regional land use plan there are altogether 49 perspective protected areas that cover a total area of 1 192 900 ha.

With the aim of developing the network of protected areas in Karelia and the Barents Euro-Arctic Region, in 2012 the Karelian Research Centre of the Russian Academy of Sciences conducted field studies and an ecological impact assessment of the landscapes, flora and fauna on Zaonezhye Peninsula, with funding from the Ministry of Natural Resources and Environment of the Republic of Karelia. Based on these studies as well as existing information, the Karelian Research Centre has prepared the ecological impact assessment of the Zaonezhskiy landscape reserve (*zakaznik*).

## Protected areas on Zaonezhye Peninsula and its adjacent islands

The Klim-Gora nature monument is the largest existing regional protected area on the peninsula. It is one of the most picturesque parts of Zaonezhye Peninsula where Mount Klim rises 90 m above Lake Onega. The nature monument was established for the preservation of glaciofluvial landforms in their natural state, as well as for tourism and recreation.

Another geological monument worth mentioning is the Shunga outcrop, which is the only large outcrop of shungite rocks in the world. It is part of the Kizhi Skerries group of geological monuments, 12 km east of the Kizhi Islands, which also includes Yuzhniy Oleniy Island in northwestern Lake Onega.

Hydrological nature monuments include two water seeps: Tri Ivana and Solyanaya Yama. The Tri Ivana water seep is first mentioned in literature in 1861. It is located two kilometres north of the abandoned village of Karasozero, 22 km from the village of Velikaya Guba. The water seep resembles a funnel, 1-1.5 m in diameter and 0.5-0.7 m in depth, from where approximately one litre of water flows out every second.

It is near a small chapel, fenced with a stone dyke, and it has been covered with a wooden construction.

The Solyanaya Yama water seep is unique for Karelia. It is located in the backswamp depression of the river Sudma, two kilometres north of the village of Velikaya Guba. In the past, local people collected water from the seep to make salt. A wooden construction has been built inside the well. However, nowadays the wooden construction is dilapidated and the 6-m-deep well is half full of silt. The water's salt concentration is 4 g/l at the surface and it increases deeper in the well. Due to the large quantities of hydrogen sulfide (32 mg/l), sodium chloride water is used as medicinal mineral water.

Nature reserves have been created to preserve unique plantations of broadleaf trees, including the state nature reserve "Highly productive stands of larch and common alder" as well as the nature monuments "Natural stands of small-leaved lime and Scotch elm (*Ulmus glabra*)", "Natural stands of Scotch elm (*Ulmus scabra*)", "Plantation of Siberian pine – 64" and "Plantation of Siberian pine – 65". Scotch elm, small-leaved lime and *Acer platanoides* reach their northern limits in Zaonezhye. Protected areas on the peninsula also include the Anisimovschina botanical reserve, created in 1984. This reserve is a unique natural refugium for the curly (Karelian) birch, which is a calling card of both the peninsula and Karelia as a whole.

Wetlands cover only 5% of the total area of forest land on Zaonezhye Peninsula (See Chapter 2.3). However, nearly half of the protected areas in Zaonezhye are wetlands. These nature monuments represent wetlands of different type and genesis. In addition, wetland ecosystems are home to berries as well as rare and red-listed plant species.

## Planned protected areas on Zaonezhye Peninsula

Several regional protected areas are planned to be established on Zaonezhye Peninsula. In 2009 the Karelian Research Centre of the Russian Academy of Sciences carried out a scientific feasibility study for the development of the protected area network in the Republic of Karelia (Feasibility study 2009). However, its first priority was the establishment of another planned protected area, the Zaonezhskiy nature reserve, which covers nearly 110 000 ha of unique esker landscapes in the northern part of the peninsula. In 2011 the Karelian Research Centre proposed a preliminary area and borders for the Zaonezhskiy nature reserve, which were included in the final version of the Land-use plan of the Republic of Karelia (Scheme 2012).

The nature conservation NGO "SPOK" is proposing the largest protected area in Zaonezhye, the Zaonezhsky nature park. It covers the entire southeastern part of the Zaonezhye Peninsula as well as parts of the peninsulas Sjar and Lizzh – altogether 115 000 ha. An alternative way to protect rare, red-listed and indicator species in the southeastern part of the peninsula is to establish six nature monuments, covering 14 500 ha (Fig. 1). These areas were identified during a multidisciplinary expedition, arranged by the Barents Protected Area Network (BPAN) project (Lindholm et al. 2014)

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**Table 1. Regional protected areas on Zaonezhye Peninsula**  
**Category: NR – Nature reserve, NM - Nature monument**

№	Name of protected area	Category	Profile	Area, ha	Date of establishment
1	Highly productive larch and common alder stands	NR	Botanical	110.4	15/06/1976
2	Lake Kovshozero	NR	Botanical	60	20/07/1984
3	Anisimovschina	NR	Botanical	5.4	20/07/1984
4	Yuzhny Oleniy Island	NM	Geological	75	29/07/1981
5	Shunga outcrop	NM	Geological	10	29/07/1981
6	Plantation of Siberian pine – 64	NM	Botanical	2.4	29/07/1981
7	Plantation of Siberian pine – 65	NM	Botanical	1.9	29/07/1981
8	Natural stands of small-leaved lime and Scotch elm ( <i>Ulmus scabra</i> )	NM	Botanical	5	29/07/1981
9	Natural stands of Scotch elm ( <i>Ulmus scabra</i> )	NM	Botanical	23	29/07/1981
10	Solyanaya Yama water seep	NM	Hydrological		20/07/1984
11	Tri Ivana water seep	NM	Hydrological	125	21/10/1993
12	Wetland Konye №402	NM	Wetland	86.2	24/05/1989
13	Wetland Razlomnoe	NM	Wetland	39	24/05/1989
14	Wetland Pigma №390	NM	Wetland	525	24/05/1989
15	Wetland Pala №400	NM	Wetland	204	24/05/1989
16	Wetland Kalegubskoe №3061	NM	Wetland	168	29/12/1997
17	Wetland by Lake Lelikozero №3063	NM	Wetland	200	29/12/1997
18	Wetland by River Lel-rechka	NM	Wetland	95	29/12/1997
19	Wetland Zamoshye №483	NM	Wetland	178	29/12/1997
20	Wetland by Petrikov's Bay	NM	Wetland	43	29/12/1997
21	Wetland by the village of Boyarschina	NM	Wetland	24	29/12/1997
22	Klim-Gora	NM	Landscape	617	21/10/1993



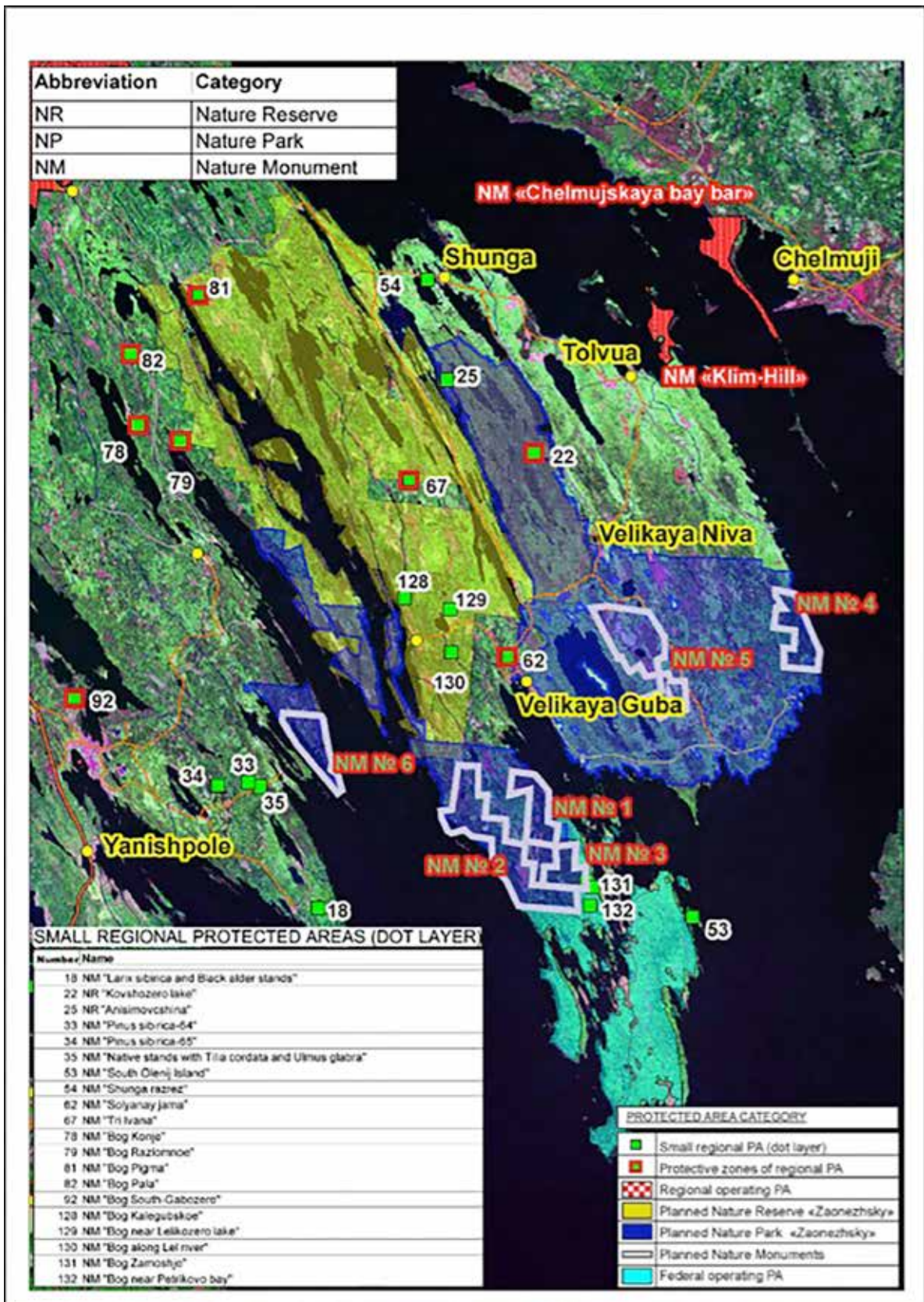


Fig 1. Location of the existing and planned protected areas of Zaonezhye Peninsula.



## 2 Biomes and biogeography of Zaonezhye Peninsula area

### 2.1 Modern landscapes of Zaonezhye Peninsula

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Zaonezhye is located on the northern shore of Lake Onega. It includes Zaonezhye Peninsula and the adjacent Kizhi Archipelago. According to the biogeographical classification of Northwest Russia, Zaonezhye belongs to the Karelian middle taiga region of the Eastern European taiga zone (A. Isachenko 2008). Selkä terrain, plains and drained and cultivated peatland dominate the landscape. The selkäs are elongated ridges of consolidated crystalline rocks, whereas the plains consist of boulder, sandy loam and loam or boulder-free sand and loam.

In the course of the history, a succession of human communities with different economic activities, agricultural practices and socioeconomic conditions exerted a considerable influence on the modern landscapes of the region. I have divided the landscape history of Zaonezhye into eight stages from the Mesolithic period to the present, based on the analysis of available data (Bogdanova 2011).

To assess the present landscapes of Zaonezhye, basic features of the landscape are divided based on landscape dynamics into site features (relatively stable properties of relief and underlying rocks) and long-term states (more dynamic characteristics of vegetation and soils). Landscape areas are described using three basic indices: 1) landform or morphological features of the relief, 2) composition of underlying (soil-forming) rocks in the uppermost (1 m) layer and 3) moisture regime (drainage conditions). Natural processes as well as human activities have influenced the landscape dynamics, which consists of different states of different lengths (G. Isachenko 1998, 2007).

The landscapes of Zaonezhye were studied between 2005 and 2013. Basic landscapes were described during field studies. The resulting 1050 landscape descriptions formed the basis for the database "Landscape structure of the Zaonezhye hydrographic province, Republic of Karelia" (Bogdanova 2014). Large-scale maps show key areas of the most representative landscapes.

I have developed a classification of basic landscapes in Zaonezhye and prepared a 1:200 000 scale landscape map. The map shows 775 contours and 32 different types of landscapes, including 16 landscape combinations. Contrasting landscapes are combined if the map scale is too large to show small-scale differences when landscapes succeeded one another at determined intervals. In addition to natural landscapes

(unaffected by human activities), the map shows 14 types of landscapes modified by long-term agricultural use and/or drainage as well as three artificial landscapes. The total area studied is 1964 km<sup>2</sup>, including the inland water bodies and islands of Zaonezhye Peninsula (but excluding Bolshoi Klimenetsky, Yernitsky and Bolshoi and Maly Lelikovsky Islands).

The landscape map provides a reliable tool for describing the spatial distribution of natural complexes in Zaonezhye and assessing their present condition. The spatial distribution of the landscapes and their long-term vegetation and soil types are shown in Table 1. When vegetation and soil cover are fragmented and diverse, only dominant vegetation and soil types are described.

Table 1. Landscape classification in Zaonezhye.

Landscape sites	Long-term states		Area	
	Dominant vegetation	Dominant soil types	km <sup>2</sup>	%
<b>Combinations of selkä ridges and depressions</b> (The elongated selkä ridges consist of Proterozoic crystalline rocks, such as gabbro-dolerite, shungite shale, tuff schist and tuffite, covered by moraine and deluvium. The depressions between the ridges are covered by boulder, sandy loam and loam, or a thin layer of peat.)				
1. High selkä ridges (relative height 40–90 m) with flat tops and stepped slopes, covered by a layer of eluvium-deluvium and moraine (up to 1.0–1.5 m) and peat (up to 1 m). Rocky scarps are up to 30 m high and their lower parts are covered by coarse clastic material.	Pine- and spruce-dominated <i>Vaccinium myrtillus</i> - <i>Calamagrostis arundinacea</i> forests on the ridge tops and slopes; Spruce-dominated forests with a large proportion of pine, birch and aspen; Aspen-dominated forests with spruce, birch, <i>Vaccinium myrtillus</i> and green moss; Bogs in depressions and on the slopes	Primitive soils, Leptosols, Cambisols, Peat bog, Soil absent	75.0	3.8
2. High, rugged selkä ridges (relative height 30–80 m) with numerous rock exposures and cliffs (relative height 30 m). The ridge tops and slopes are covered by a layer of discontinuous eluvium-deluvium and moraine (up to 0.5 m).	Sparse pine forests with <i>Vaccinium vitis-idaea</i> and lichen, as well as rocky wasteland on the ridge tops; Birch- or pine-dominated forests with green moss, <i>Vaccinium myrtillus</i> , <i>V. vitis-idaea</i> and lichen on the slopes; Bogs in depressions	Primitive soils, Leptosols, Peat bog, Soil absent	85.5	4.4
3. Poorly structured selkä ridges (relative height up to 20 m) with few rock exposures and a layer of discontinuous eluvium-deluvium and moraine (up to 0.5 m)	Sparse pine forests with green moss, <i>Vaccinium vitis-idaea</i> , dwarf shrubs and lichen, as well as rocky wasteland on the ridge tops;	Primitive, Leptosols, Soil absent	37.5	1.9
<b>Combinations of contrasting landscape sites, dominated by drained slopes with mineral soils, where differences in elevation are more than 10 m</b>				
4. Hills and ridges consisting of sandy loam and boulder (relative height up to 20 m), combined with plains formed of sand, clay and boulder and sandy loam, as well as thin peatlands	Pine-, spruce- or birch-dominated forests with green moss, <i>Vaccinium myrtillus</i> , dwarf shrubs and <i>Calamagrostis arundinacea</i> ; Former clearcut areas covered by <i>Calamagrostis arundinacea</i> and secondary mixed forests, developed through natural succession; Different types of mires from bogs to fens in depressions	Leptosols, Cambisols, Peat bog	86.3	4.4

5. Hills and ridges consisting of sandy loam and boulder, often with crystal-line rock exposures, combined with undulating plains formed of consolidated boulder, sand and sandy loam, as well as thin peatlands	Sparse pine forests with dwarf shrubs, green mosses and lichen on tops of eskers; Spruce-, aspen- or birch-dominated forests with pine, green mosses, <i>Vaccinium myrtillus</i> , dwarf shrubs and <i>Calamagrostis arundinacea</i> ; Clearcut areas covered with <i>Calamagrostis arundinacea</i> , <i>Rubus idaeus</i> and <i>Chamaenerion angustifolium</i> ; Secondary mixed forests, developed through natural succession of former clearcut areas on the slopes and in depressions; Transitional and raised bogs in depressions	Leptosols, Cambisols, Peat bog	46.5	2.4
6. Elongated hills and ridges consisting of sand and pebble or sand and boulder, combined with peatlands in depressions. Often there are also plains consisting of boulder, pebble and sand.	Birch- or pine-dominated forests with dwarf shrubs and green moss; Clearcut areas in different stages, covered with <i>Calamagrostis arundinacea</i> and <i>Chamaenerion angustifolium</i> ; Fens and transitional bogs in depressions	Podzol, Surface podzol, Peat bog	16,9	0.9
Combinations of contrasting landscape sites, dominated by drained slopes with cultivated mineral soils, where differences in elevation are more than 10 m				
7. Cultivated hills and ridges consisting of sandy loam and boulder (relative height up to 20 m), commonly combined with plains formed of sand and clay or boulder, sand and loam, as well as thin peatlands	Grassland ( <i>Poaceae</i> and herbaceous meadows), arable land and abandoned meadows, which have become overgrown with trees; Young birch, aspen and pine forests with herbaceous plants and spruce; Fens and transitional bogs in depressions	Cambisols- old arable soils, Peat bog	21.1	1.1
8. Cultivated hills and ridges (eskers) consisting of shungitic and shungite-bearing pebble, boulder and sand, combined with cultivated plains formed of boulder, pebble and sand, as well peatlands in depressions	Grass and herbaceous meadows, arable land, overgrown meadows; Young birch, aspen and pine forests with herbaceous plants; Fens and transitional bogs in depressions	Shungite cambisols- old arable soils, Peat bog	45.5	2.4
Drained plains, dominated by mineral soils				
9. Plains formed of boulder-free sand and sandy loam	Pine-dominated forests with dwarf shrubs and green moss; Birch-dominated forests with spruce, <i>Vaccinium myrtillus</i> and <i>Calamagrostis arundinacea</i>	Surface podzol	6.5	0.3
10. Plains formed of small boulder, pebble and sand, often combined with thin peatlands	Birch- or pine-dominated forests with spruce, <i>Calamagrostis arundinacea</i> , dwarf shrubs and green moss; Fens and transitional bogs	Podzols, Surface podzol, Peat bog	103.43	5.3
11. Undulating plains and gently sloping ridges on consolidated boulder, sand and sandy loam, often combined with thin peatlands	Birch- or aspen-dominated forests with pine, spruce, dwarf shrubs, <i>Calamagrostis arundinacea</i> and green moss; Young mixed forests with herbaceous plants; Clearcut areas covered with <i>Calamagrostis arundinacea</i> and <i>Chamaenerion angustifolium</i> fens and transitional bogs	Leptosols, Cambisols, Peat bog	357.2	18.2
Cultivated drained plains, dominated by mineral soils				
12. Cultivated, undulating plains and terraces formed of boulder-free sand and sandy loam (lacustrine-glacial and glacial)	Grass and herbaceous meadows, arable land, overgrown meadows; Young mixed forests, dominated by birch or aspen, with herbaceous plants and pine	Soddy old arable soils	37.7	1.9

13. Cultivated, undulating plains formed of small boulder, pebble and sand (fluvioglacial deposits)	Grass and herbaceous meadows, arable land, overgrown meadows; Mature mixed forests, dominated by birch or aspen, with herbaceous plants and pine; Young mixed forests, dominated by spruce, birch or aspen with herbaceous plants and <i>Calamagrostis arundinacea</i>	Cambisols-old arable soils	22.4	1.1
14. Cultivated, undulating plains and gently sloping ridges on consolidated boulder, sand and sandy loam (moraine)	Grass and herbaceous meadows, arable land, overgrown meadows; Young forests dominated by birch, common alder ( <i>Alnus glutinosa</i> ) and bird cherry ( <i>Padus avium</i> ) with herbaceous plants; Mature spruce or aspen dominated forests with pine, herbaceous plants and <i>Calamagrostis arundinacea</i>	Cambisols-old arable soils	120.9	6.2
<b>Combinations of plains with different soil moisture contents</b>				
15. Permanently saturated plains, covered with boulder-free sand, quite often with a thin layer of peat, with a mildly undulating and gently sloping relief. These landscapes also include small peatlands.	Forests dominated by pine, birch and common alder with herbaceous plants, sedges, horsetail and <i>Sphagnum</i> ; Fens and transitional bogs	Humic gley, Peaty gley, Peat bog	9.9	0.5
16. Permanently saturated plains, covered with boulder-free clay and sandy loam, quite often with a thin layer of peat, with a mildly undulating relief. These landscapes also include small peatlands.	Birch-, aspen- or pine-dominated forests with common alder, herbaceous plants and <i>Vaccinium myrtillus</i> ; Birch-, pine- or common alder-dominated forests with herbaceous plants, sedges and <i>Sphagnum</i> ; Birch forests with meadowsweet ( <i>Filipendula</i> ) and sedges; Lowland fens and transitional bogs	Humic gley, Peaty gley, Peat bog	88.6	4.5
17. Saturated plains, covered with boulder and sandy loam, quite often with a thin layer of peat. These landscapes also include small peatlands and hills, consisting of sand and boulder.	Birch, pine and spruce forests with herbaceous plants, <i>Vaccinium myrtillus</i> and <i>Sphagnum</i> ; Birch, pine and dwarf shrub forests on the hills; Fens and transitional bogs in depressions	Cambisols, Gley cambisols, Peaty gley, Peat bog	69.6	3.5
18. Drained peatland and artificially drained plains with a thin layer of peat (up to 0.5 m); often combined with drained plains	Birch and pine forests or birch, pine and spruce forests with dwarf shrubs, <i>Sphagnum</i> and herbaceous plants of moist soils	Peaty gley, Humic gley, Cambisols	10.3	0.5
<b>Combinations of cultivated sites with different soil moisture contents (plains and low hills)</b>				
19. Predominantly cultivated, saturated plains, covered with boulder-free clay and sandy loam, quite often with a thin layer of peat. These landscapes include small peatlands and cultivated hills of sand and boulder.	Meadowsweet ( <i>Filipendula</i> ) and sedge-meadowsweet meadows, including those overgrown with willow and birch; Meadows with herbaceous plants, sedges and <i>Sphagnum</i> ; Young deciduous forests with herbaceous plants and pine; Grass and herbaceous meadows and deciduous forests with pine growing on the hills; Fens and transitional bogs in depressions	Humic gley, Peaty gley, Peat bog, Cambisols-old arable soils	14.2	0.7
20. Cultivated plains and gently sloping ridges, covered with boulder, shungite-bearing and shungitic sandy loam, often combined with shallow peatlands	Arable land, grass and herbaceous meadows, overgrown meadows; Young grey alder and birch forests; Birch- or aspen-dominated forests with pine or spruce, herbaceous plants, <i>Vaccinium myrtillus</i> and green moss; Fens and transitional bogs	Shungite cambisols-old arable soils, Peat bog	227.4	11.6

21. Cultivated, drained plains and gently sloping ridges covered with boulder and shungitic sandy loam, with crystalline rock exposures. These are often combined with plains formed of boulder-free, sandy loam.	Grass and herbaceous meadows, arable land, overgrown meadows; Young small-leaved forests with herbaceous plants; Birch and aspen forests with herbaceous plants, pine and spruce; Meadows of herbaceous plants and sedges, mixed with birch forests with herbaceous plants and sedges of moist soils	Cambisols-old arable soils, Humic gley	34.3	1.7
22. Cultivated, artificially drained plains, covered with boulder-free clay and sandy loam, as well as paludified plains with a thin layer of peat. Occasionally there are also cultivated hills of sand and boulder.	Grass, tall grass and herbaceous meadows, including overgrown meadows; Meadows with sedges and <i>Sphagnum</i> ; Small-leaved forests with herbaceous plants and pine; Fens and transitional bogs	Soddy humic gley, Peaty gley, Peat bog, Cambisols-old arable soils	30.8	1.6
<b>Peatland with a peat layer of more than 0.5 m</b>				
23. Oligotrophic raised bogs (peat over 1.5 m thick)	Pine-covered <i>Sphagnum</i> -cotton-grass-dwarf shrub bogs	Raised bog soils	24.8	1.3
24. Drained oligotrophic raised bogs	Pine-covered <i>Sphagnum</i> -cotton-grass-dwarf shrub bogs	Drained raised bog soils	3.3	0.2
25. Meso-oligotrophic and mesotrophic peatland (varying thicknesses of peat)	Herb-sedge- <i>Sphagnum</i> bogs, often covered with birch and pine; Moist birch- or pine-dominated forests with herbaceous plants, sedges and <i>Sphagnum</i>	Mesotrophic bog soils	40.3	2.0
26. Drained meso-oligotrophic and mesotrophic peatland	Herb-sedge- <i>Sphagnum</i> bogs, often covered with birch and pine; Moist birch- or pine-dominated forests with herbaceous plants, sedges and <i>Sphagnum</i>	Drained mesotrophic bog soils	5.00	0.3
27. Drained, cultivated meso-oligotrophic and mesotrophic peatland	Grass and herbaceous meadows; Moist meadows with herbaceous plants and sedges following the cessation of agriculture; Moist meadows with herbaceous plants and sedges, including those with birch undergrowth; Birch forests with moist herbaceous plants	Drained mesotrophic bog soils and cultivated bog soils	16.0	0.8
28. Mesoeutrophic and eutrophic peatland in lotic depressions; varying thicknesses of highly mineralized peat	Sedge and herb-sedge bogs with willow, birch and black alder; Black alder and birch forests with moist herbaceous plants; Reed thicket	Boggy fen peat and bog-gley soils	5.5	0.3
29. Drained, cultivated mesoeutrophic and eutrophic peatland	Grass and herbaceous meadows; Meadows with moist herbaceous plants and sedges following the cessation of agriculture; Birch scrub forests; Birch forests with moist herbaceous plants	Drained and cultivated boggy fen peat and bog-gley soils	122.1	6.2
<b>Sites with relief and grounds transformed by human activities</b>				
30. Former peat production areas	Peat wasteland in areas affected by fires; Burned moorland with heather Young birch forests	Soil absent	3.6	0.2
31. Sand- and gravel-pits	Only sparse vegetation during quarrying; Young pine and small-leaved forests after the cessation of quarrying	Soil absent	0.5	<0.1

32. Shungite rock quarries	Only sparse vegetation during quarrying; Young small-leaved forests after the cessation of quarrying	Soil absent	0.3	<0.1
<b>Inland water bodies on the peninsula, excluding Lake Onega bays</b>			<b>194.3</b>	<b>10.3</b>
<b>Total</b>			<b>1964</b>	<b>100</b>

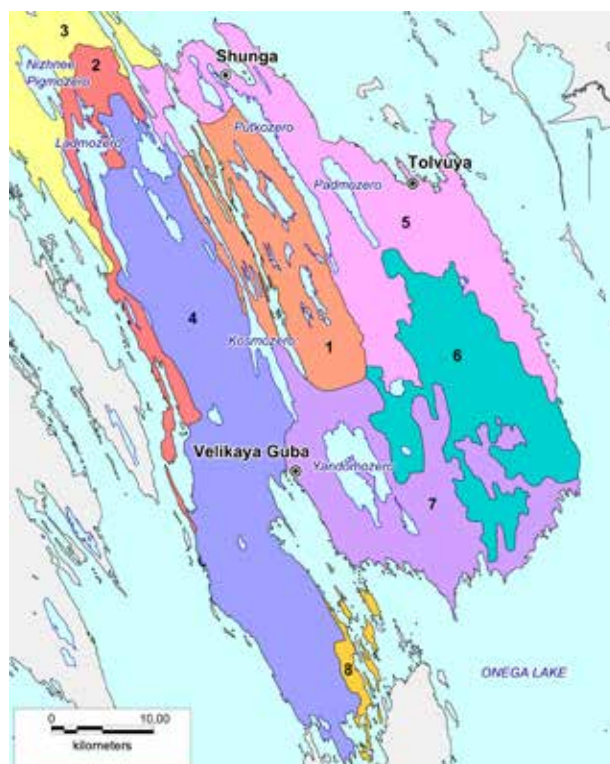


Fig.1. Landscape areas of Zaonezhye Peninsula.

Numbers indicate 1 andscape areas:  
 1. Kosmozero-Putkozero;  
 2. Dianogorsko-Mizhostrov;  
 3. Pigmozero;  
 4. Myagrozero-Lelikovo;  
 5. Shunga-Kuzaranda;  
 6. Limozero-Gankovo;  
 7. Velikaya Guba-Tambitsy;  
 8. Kizhi

Due to the characteristics of the geological structure, the landscape pattern of Zaonezhye is fragmented, including a mosaic of small-scale landscapes. Its landscape contours are typically elongated from northwest to southeast. In Zaonezhye, a total of eight landscape areas are identified based on recurrent combinations of landscapes (Fig. 1):

1. Kosmozero-Putkozero area, dominated by selkä ridges, cultivated plains and hills
2. Dianogorsko-Mizhostrov area, dominated by selkä ridges
3. Pigmozero area, dominated by fluvio-glacial sand plains and peatland
4. Myagrozero-Lelikovo area, dominated by moraine plains and peatland
5. Shunga-Kuzaranda area, dominated by cultivated land on shungite and shungite-bearing rocks, as well as drained and cultivated plains and peatland
6. Limozero-Gankovo area, dominated by moraine plains, covered with a thin layer of peat, as well as peatland and drained peatland
7. Velikaya Guba-Tambitsa area, dominated by cultivated plains on moraine, and peatland
8. Kizhi area, dominated by cultivated land on shungite and shungite-bearing rocks.



Cultivated land makes up a large proportion of the landscapes in Zaonezhye. In the past, it has been one of the most agriculturally developed areas in Karelia. Agricultural development in Zaonezhye began in the 9<sup>th</sup> and 10<sup>th</sup> centuries, although natural complexes were most significantly transformed in the 19<sup>th</sup> century. By the end of the 19<sup>th</sup> century, agricultural development had reached its peak with about 30% of the peninsula cultivated for arable crops or hay. Old arable land is characterized by a well-defined soil horizon, even if the land is no longer cultivated. Normally the horizon is over 15 cm thick. On old arable land, speckled alder, birdcherry and mountain ash dominate the forest cover, whereas the ground cover is characterised by meadow species.

The agricultural development of Zaonezhye is characterized by the cultivation of bouldery (moraine and fluvioglacial) plains, ridges and hills as well as gently sloping selkäs and relatively steep slopes of (up to 50–70%) crushed stone. Boulders were removed and stored for future use. Local people called these piles *rovnitsas*. *Rovnitsas* are a part of the cultural landscape of Zaonezhye, reminding of its agricultural history. It was not until the late 20<sup>th</sup> century that people began draining bogs here. Until then only small parts of paludified plains and lowland bogs had been used for cultivating hay.

During the past centuries unique cultural landscapes have formed in Zaonezhye where plains, selkä ridges, coniferous and small-leaved forests, dry valley forests, arable land and lakes coexist. Wooden architecture is an inseparable part of the region's landscape. There are several well-preserved old wooden buildings in Zaonezhye, including 96 architectural monuments (including the famous churches of Kizhi Island), of which 65 are listed buildings. The best example of wooden architecture in Zaonezhye is the Kizhi Pogost with the Church of the Intercession and the Church of the Transfiguration. Kizhi Pogost is included in the UNESCO list of World Heritage Sites.

Zaonezhye landscapes are transforming: Coniferous and small-leaved forests are maturing. Agricultural land has become overgrown. Cutting areas and abandoned quarries grow scrub forests. Over 20 different dynamic processes have been identified in different types of landscapes. The following trends are most typical for the region:

- The composition and growing stock of pine and spruce forests on selkä ridges have stabilized.
- The phytomass and growing stock of young and middle-aged small-leaved coniferous forests in cutting areas have increased.
- The phytomass and growing stock of young and middle-aged small-leaved forests and small-leaved coniferous forests on former agricultural land have increased.
- Secondary paludification of reclaimed land is accompanied by the appearance of mesohygrophytes and hygrophytes in the vegetation cover. Vegetation cover is actively overgrown by scrub forests.
- Meadows are declining and secondary small-leaved forests are increasing as former agricultural land becomes overgrown with speckled alder, birch, aspen and pine.
- Grass and herb-grass communities are succeeded by tall grass-chervil (*Anthriscus sylvestris*) and tall grass-raspberry (*Rubus idaeus*) communities.

If Zaonezhye landscapes are left without human intervention, the area of both young and mature mixed small-leaved forests as well as small-leaved coniferous for-

ests will increase in the next 50 years. Also the portion of young small-leaved forests on overgrown meadows is expected to increase.

A wide range of landscapes on Zaonezhye Peninsula needs protection, including the rapidly disappearing cultural landscapes. Protected areas with different protection regimes should be established to promote nature conservation and environmental tourism in the area.

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Fig. 2. Flat top of the selkä ridge (Landscape sites I, Table I) (Photo Maria Bogdanova).



Fig. 3. Stepped slope of the selkä ridge (Landscape sites I, Table I) (Photo Maria Bogdanova).



Fig. 4. Rugged top of the selkä ridge (Landscape sites 2, Table I) (Photo Maria Bogdanova).



Fig. 5. Slope of the sellkä ridge (Landscape sites 2, Table I) (Photo Maria Bogdanova).



Fig. 6. Cliff of the selkä ridge (Landscape sites 1 and 2, Table 1) (Photo Maria Bogdanova).



Fig. 7. Poorly structured low selkä ridge (Landscape sites 3, Table I) (Photo Maria Bogdanova).



Fig. 8. Cultivated ridge (esker) consisting of pebble, boulder and sand (Landscape sites 8, Table I) (Photo Maria Bogdanova).



Fig. 9. Arable land on esker, consisting of shungitic pebble and sand (Landscape sites 8, Table I) (Photo Maria Bogdanova).



Fig. 10. Plain formed of boulder-free sand (Landscape sites 9, Table I) (Photo Maria Bogdanova).





Fig. 11. Plain on consolidated boulder, sand and sandy loam (moraine) (Landscape sites 11, Table 1)  
(Photo Maria Bogdanova).



Fig. 12. Cultivated plain formed of boulder-free sand (Landscape sites 12, Table 1)  
(Photo Maria Bogdanova).



Fig. 13. Plain formed of small boulder, pebble and sand (fluvioglacial deposits) (Landscape sites 13, Table 1) (Photo Maria Bogdanova).



Fig. 14. Cultivated plain on consolidated boulder, sand and sandy loam (moraine) (Landscape sites 14, Table 1) (Photo Maria Bogdanova).



Fig. 15. Overgrown arable land on consolidated boulder, sand and sandy loam (moraine) (Landscape sites 14, Table I) (Photo Maria Bogdanova).



Fig. 16. Plain covered with boulder-free clay and sandy loam (Landscape sites 16, Table I) (Photo Maria Bogdanova).



Fig. 17. Cultivated, artificially drained plain, covered with boulder-free clay and sandy loam (Landscape sites 22, Table I) (Photo Maria Bogdanova).



Fig. 18. Oligotrophic raised bog (Landscape sites 23, Table I) (Photo Maria Bogdanova).



Fig. 19. Mesotrophic peatland (Landscape sites 25, Table I) (Photo Maria Bogdanova).



Fig. 20. Eutrophic peatland (Landscape sites 28, Table I) (Photo Maria Bogdanova).



Fig. 21. Former peat excavations (Landscape sites 30, Table I) (Photo Maria Bogdanova).



Fig. 22. Sand- and gravel-pit (Landscape sites 31, Table I) (Photo Maria Bogdanova).



Fig. 23. Shungite rock quarry (Landscape sites 32, Table I) (Photo Maria Bogdanova).



## 2.2 Landscape structure of Zaonezhye Peninsula

**Vladimir Karpin**

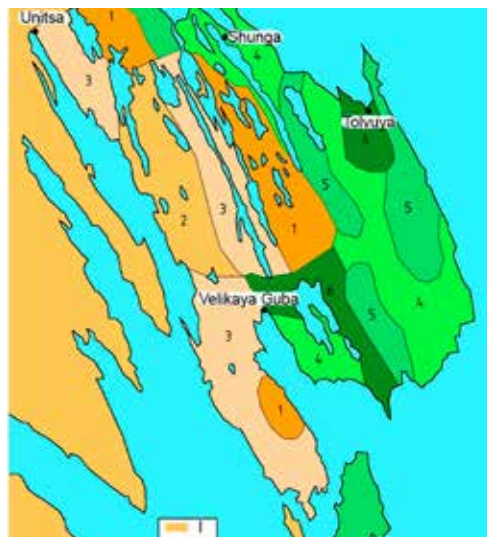
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### Introduction

Zaonezhye Peninsula is characterised by a complex landscape structure as well as a diverse forest cover. According to Volkov et al. (1990), Gromtsev (2008) and Gromtsev (2013), there are two contrasting types of geographical landscapes on Zaonezhye Peninsula (Fig.1): (1) Paludified lacustrine and lacustrine-glacial plains occur in the east, where forests are dominated by spruce (II in Fig 1), while (2) paludified tectonic-denudation ridge (selkä) landscapes occur in the west, where forests are dominated by pine (I in Fig.1).

The landscape structure of Zaonezhye consists of large geomorphological areas, or geographical terrains. These geomorphologically uniform areas cover approximately 10 000 hectares (or over 90 % of the area). The geographical terrains have a homogeneous composition of Quaternary sediments as well as uniform hydrographic and soil conditions. As a consequence, they show a constant succession of forest and mire complexes on the mesoscale, covering areas of 10–100 ha (Gromtsev 2000, 2008).

Fig. 1. Geographical terrains of Zaonezhye Peninsula. Image and map viewing software.



## Results

The tectonic-denudation landscape of Zaonezhye varies at the sub-landscape level (Selkä landscapes 2013). Three types of geographical terrains have been identified:

*Moderately paludified tectonic-denudation ridge terrain, dominated by pine habitats (No. 1 in Fig. 1)*

This dominant terrain type covers 40 % of the area (Fig. 2). Its relief is a result of multiple tectonic movements that have created a system of northwest-trending subparallel folds, comprising ridges (selkäs), steep slopes and step-like scarps. The long and rocky ridges correspond to synclines, whereas the straight, narrow and shallow basins and bays of Lake Onega are consistent with the anticlines. The fold structure is broken by a system of stepped strike-slip faults. Quaternary sediments are represented by a thin moraine cover. On the ridge tops, moraine is either dozens of centimeters thick or completely absent, while on the slopes and in the depressions between the ridges moraine can be up to 2 m thick. Altitudes range from 33 m to 202 m, while altitudes of adjacent landforms vary between 20 m and 50 m above sea level. Overall, mires cover less than 20% of the terrain. Open mires account for 5%. Mires are predominantly mesotrophic or oligotrophic. Hydrographically, the percentage of lakes is relatively high (28%). The network of rivers and lakes shows a pattern of small streams and small lakes, which contributes to the fragmentation of the forest cover.

The soil cover is dominated by two soil types: Primitive, poorly developed soils cover bedrock exposures on ridgetops and rocky shores. These soils are infertile and susceptible to erosion. More fertile, humus-rich soils known as Leptosol are common on ridge slopes. The dissected topography, disrupted with tectonic dislocations, is responsible for a distinctive microclimate. Conditions are favourable for more southern flora and fauna on south-facing slopes, which receive more sunlight and are protected against cold, northerly winds. More northern higher vascular plant and moss species occur on north-facing slopes and in narrow crevasses. Considerable variations in altitude (up to 200 m) at this latitude (62–63°N) have resulted in altitudinal zoning. As a consequence, frosts occur 10–30 days earlier in the elevated areas. Also the numerous lakes have a substantial effect on the microclimate. The forest cover has been considerably transformed by selective and clear cutting. However, most of the forest communities have survived or recovered due to the relatively small number of trees removed as well as the natural dynamics of the forests. In contrast with the rest of Zaonezhye, there is practically no agricultural development in this terrain.

In this geographical terrain (No. 1 in Fig. 1), the forest cover consists mainly of pine forests, growing on rocky ground, and pine-dominated forests of *Myrtillus* type, growing on tectonic blocks that are covered by a thin layer of unconsolidated sediments. Other predominant forest types include mesic, pine- or spruce-dominated stands of *Myrtillus* type on the slopes and in the depressions between the ridges. These forests are characterized by diverse ground vegetation and complex plant communities. Birch-dominated stands make up less than 5% of the area covered by forests of *Myrtillus* type. However, their ground vegetation is diverse, including combinations of herbaceous species, motley grass and *Myrtillus* patches. On average, these plant communities are restricted to relatively small areas.

*Paludified glacial terrain of hills and ridges, dominated by pine habitats (No. 2 in Fig. 1)*

This terrain type covers 30% of the tectonic-denudation landscapes (Fig. 3). Its glacial relief comprises of plains, intersected by gently sloping, flat-topped ridges

without a well-defined foot of the hill. Altitudes vary between 60 and 120 m above sea level and vertical ruggedness is 30–40 m. Quaternary sediments consist mainly of moraine that forms a 4–7 m layer, covering 70–80% of the crystalline basement and evening out the rugged bedrock. In parts of the terrain, also moraine drumlins contribute to the ridge pattern. Overall, mires cover approximately 20% of the terrain and open mires 8%. These eutrophic and mesotrophic mires contain a diverse flora and a variety of plant communities. The hydrographic network is well developed and uniform. The largest rivers are between 10 km and 30 km long. Lakes account for approximately 7% of the terrain. The soil cover is dominated by acidic, sandy loam and loamy burozems (Cambisols). These highly fertile soils are zonal and provide good conditions for a relatively high biological diversity for Karelia. With the exception of the western parts of the terrain, the gently sloping landscape and the minor variations in altitude have created a uniform microclimate. In the western parts, Lake Onega evens out considerable variations in temperature.

Vegetation has been markedly transformed by long-term slash-and-burn farming of fertile land as well as continuous selective and clear cutting. However, forest regeneration has been successful over most of the area and plant communities have largely been restored to their original state. Nowadays, the forest cover is characterised by a mosaic of fresh pine and spruce forests of *Myrtillus* type with nemoral elements in the ground vegetation. Other common vegetation types include birch forests of *Myrtillus* type as well as herbaceous birch forests, growing on abandoned agricultural land. Also these forests have nemoral elements in the ground vegetation. Grey alder (*Alnus incana*) forests with a large proportion of mountain ash (*Sorbus aucuparia*) and European birdcherry (*Padus racemosa*) often grow on the most fertile sites. Spruce is absent in these stands. Some *Sphagnum* habitats are occupied by low-productive secondary spruce and birch stands. The average contour of the plant communities is 120 m long.

*Paludified lacustrine-glacial hill terrain, dominated by pine stands (No.3 in Fig. 1)*

The relief of this terrain has been affected by the regression of Lake Onega (Fig.4). It makes up 30% of the tectonic-denudation landscapes. Its gently sloping, undulating plain is formed through accumulation and abrasion (of former lake bottom). Active movement along crystalline faults has produced small ridges, although they are not characteristic of this terrain. Absolute altitudes of watersheds are no more than 60 m above sea level and vertical ruggedness is 5–20 m. Overall, mires make up 20% of the terrain. Open mires account for 6% of the terrain. Due to their lacustrine origin, mires are predominantly mesotrophic or eutrophic. Usually peat is underlain by sapropel, lake clay and silt. These features have resulted in diverse plant communities and a rich flora.

Long and narrow lakes, confined to fault zones, determine the hydrographic conditions of the terrain. Lakes cover no more than 10 % of the area (excluding Unitsa Bay and a small portion of Lihma Bay). Small streams that are less than 5 km long are distributed evenly throughout the area. The diverse soil cover consists of dark, acidic sandy loam and loam burozem on shungite, marshland humus gley and lowland peat soils. These fertile soils provide good conditions for a variety of species and plant communities. In addition, the microclimate is uniform across the terrain. However, the area has been heavily affected by human activities, including forest cutting and agriculture. There is an increasing amount of highly fertile soils (on land formerly used for agriculture), covered by secondary forests or secondary forest and meadow communities. The forest cover is a mosaic of fresh pine and birch forests with a diverse ground cover (motley grass, motley grass-bilberry, grass-bilberry, etc.). Also pine forests with *Sphagnum* are widespread. Spruce forests make up only a

small percentage of the area, but their ground cover is diverse. Birch communities are mostly confined to abandoned agricultural land. All these forest types host a variety of woody and shrub species, including nemoral species such as lime, elm and currant. The average contour of the plant communities is 120 m long.

**Normally paludified lacustrine and lacustrine-glacial plains, dominated by spruce, have indistinct boundaries, although their core areas are well defined. This landscape type comprises the following geographical terrains:**

*Paludified terrain of moraine plains, dominated by spruce habitats (No. 4 in Fig. 1)*

This is the dominant terrain type, covering 50% of the paludified landscapes of lacustrine and lacustrine-glacial plains (Fig. 5). Its glacial relief consists of a plain with gently sloping hills and flat-topped ridges that lack a well-defined foot of the hill. Altitudes vary between 50 and 90 m above sea level and vertical ruggedness is 10–30 m. Quaternary deposits consist of a 4–7 m thick layer of moraine, which covers 90–100% of the crystalline basement and smoothes the ruggedness of the bedrock. In parts of the terrain, a ridge relief is formed by moraine drumlins. Mires make up about 50% and open mires 15% of the terrain. These eutrophic and mesotrophic mires contain a diverse flora and a variety of plant communities. The hydrographic network is well developed and uniform. Rivers are between 10 km and 30 km long and there are practically no lakes. The soil cover is dominated by acidic, sandy loam and loamy burozems. The gently sloping landscape and the minor variations in altitude have created a uniform microclimate. However, Lake Onega evens out considerable variations in temperature in its vicinity. Vegetation has been considerably transformed by long-term slash-and-burn cultivation of fertile land as well as continuous selective and clear cutting. However, forest regeneration has been successful over most of the area and plant communities have largely been restored to their original state. Nowadays, the forest cover is characterised by a mosaic of fresh bilberry spruce forests that grow on the enriched ground. Other common vegetation types include bilberry, bilberry-grass and wide-grass aspen and birch forests. The most fertile soils host plant communities, consisting of speckled alder as well as extensive mountain ash and European birdcherry stands. In these communities, spruce is absent in the undergrowth. Some *Sphagnum* habitats are occupied by low-productive secondary spruce and birch stands. The average contour of the plant communities is 120 m long.

*Moderately paludified, topographically complex aqueo-glacial terrain, dominated by pine stands (No.5 in Fig 1)*

This terrain type makes up approximately 20 % of the landscape area (Fig. 6). Fluvio-glacial landforms include radial ridges (eskers), associated with fluvio-glacial deltas. The terrain extends for over 30 km from northwest to southeast. Altitudes vary between 5 m and 15 m. Absolute altitudes of watersheds are no more than 80 m above sea level. Overall, mires cover up to 20% of the terrain, while open mires account for 5% of the terrain. Raised bogs with low mineral concentrations are common. There are no lakes in the terrain, and streams are less than 5 km long creeks. Microclimatic conditions remain more or less the same throughout the terrain. The soil cover consists of podzols and leptosols. More fertile sites include clasts of local basic and shungite-bearing rocks. Ridges and wide delta-like areas are used for agriculture. The forest cover is considerably transformed. It shows a mosaic pattern (Fig.) of pine, aspen and birch stands, growing in fresh bilberry habitats with diverse ground

vegetation (motley grass, motley grass-bilberry, grass-bilberry, etc.). Often speckled alder grows on abandoned agricultural land. Wet habitats are occupied by *Sphagnum*. Spruce stands are few. The undergrowth consists of currant, lime, buckthorn and birdcherry. The average contour of the plant communities is 70 m.

*Highly paludified lacustrine-glacial terrain of plains, dominated by spruce habitats (No. 6 in Fig. 1)*

This terrain type makes up 30% of the landscapes (Fig. 7). Its relief consists of a plain with gently sloping hills. Absolute altitudes are estimated at no more than 80 m above sea level and vertical ruggedness is 5–20 m. Structural denudation landforms are completely covered by unconsolidated sediments, which are dominated by a 6–7 m thick layer of varved clay. Overall, mires make up 70% of the area, while open mires account for 30% of the area. Mires are predominantly eutrophic and mesoeutrophic and their flora consist of both marshland and forest species. Streams are less than 5 km long and lakes cover no more than 5 % of the terrain. The microclimate is uniform across the terrain. Well-drained eluvial, surface and gley loam soils support highly productive forests. However, the forest cover has been totally transformed by selective and clear cutting as well as agriculture. Nowadays, secondary forests dominate most of the area, including abandoned agricultural land. The most common forests are aspen, birch and speckled alder stands of bilberry and horsetail types. These forests have succeeded spruce stands, which are characteristic of the terrain. Black alder communities are encountered on stream-irrigated sites. Paludified sites are dominated by pine stands with sedge and *Sphagnum*. The average contour of the plant communities is 150 m.

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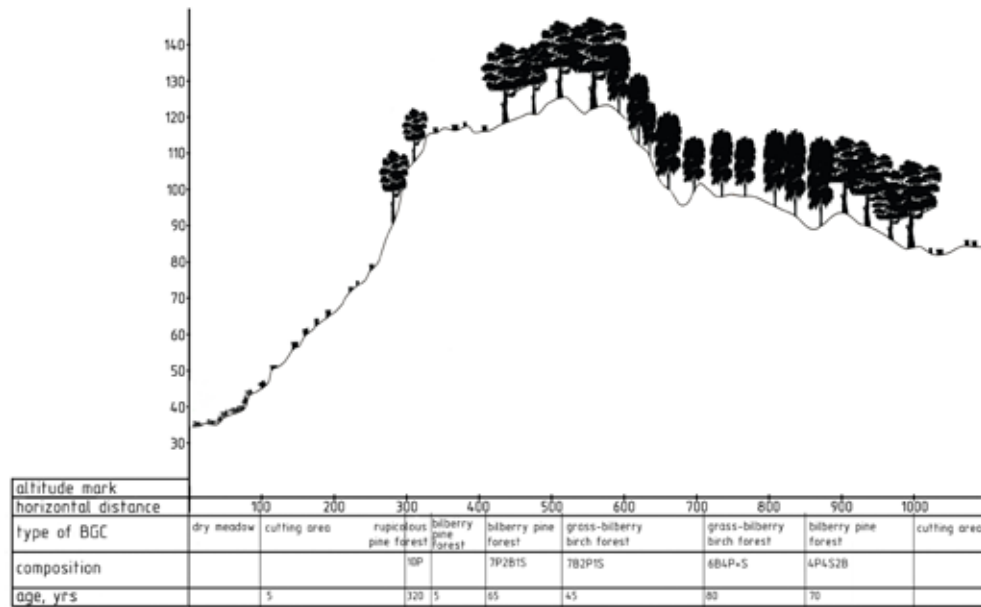


Fig .2 Forest structure in a mildly paludified denudation-tectonic ridge terrain dominated by pine habitats (fragment).

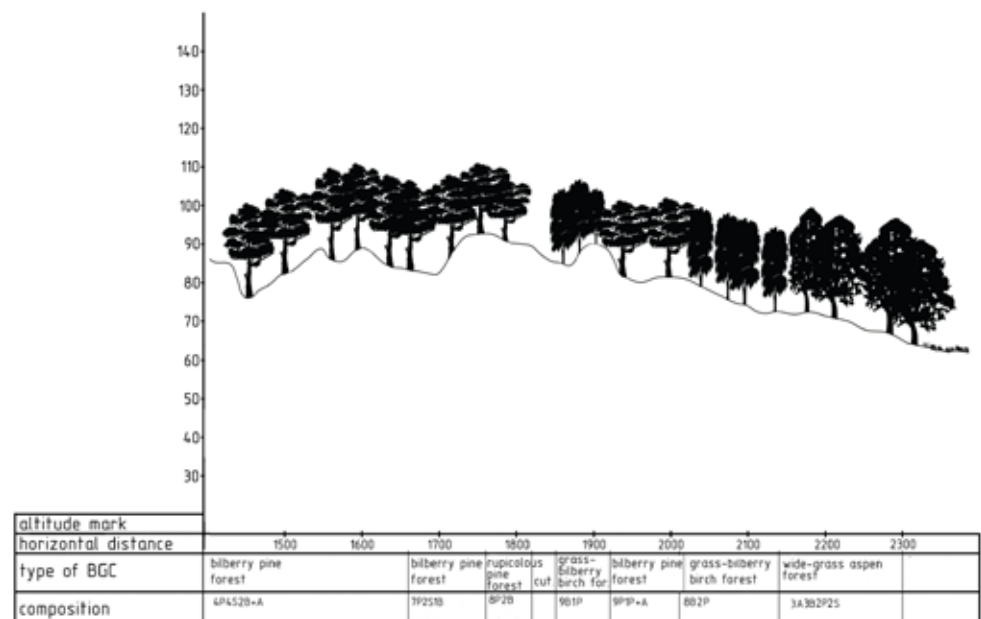


Fig. 3 Forest structure in glacial hilly-ridge mid-paludified terrain dominated by pine habitats (fragment).

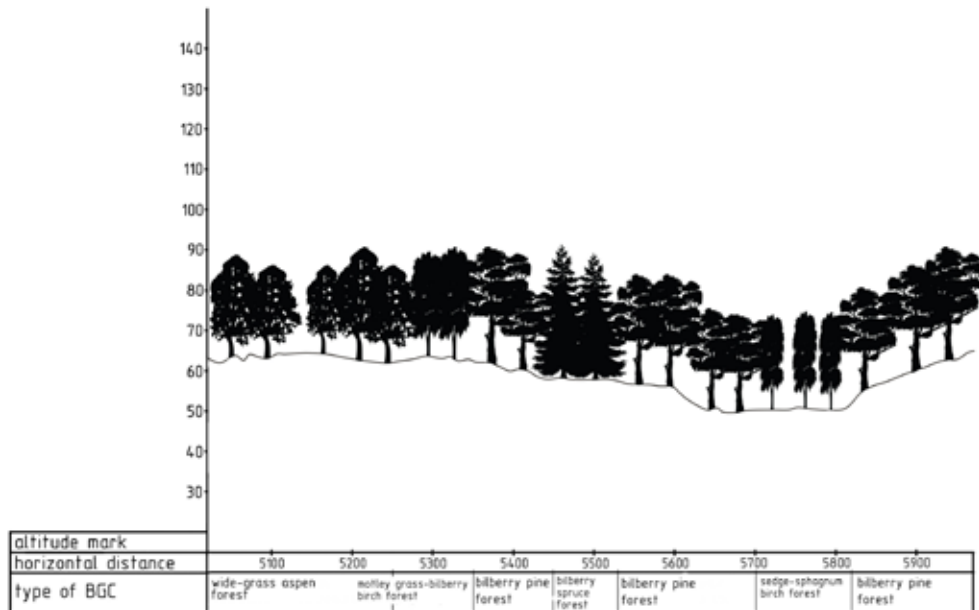


Fig. 4 Forest structure in lacustrine-glacial hilly mid-paludified terrain dominated by pine stands (fragment).

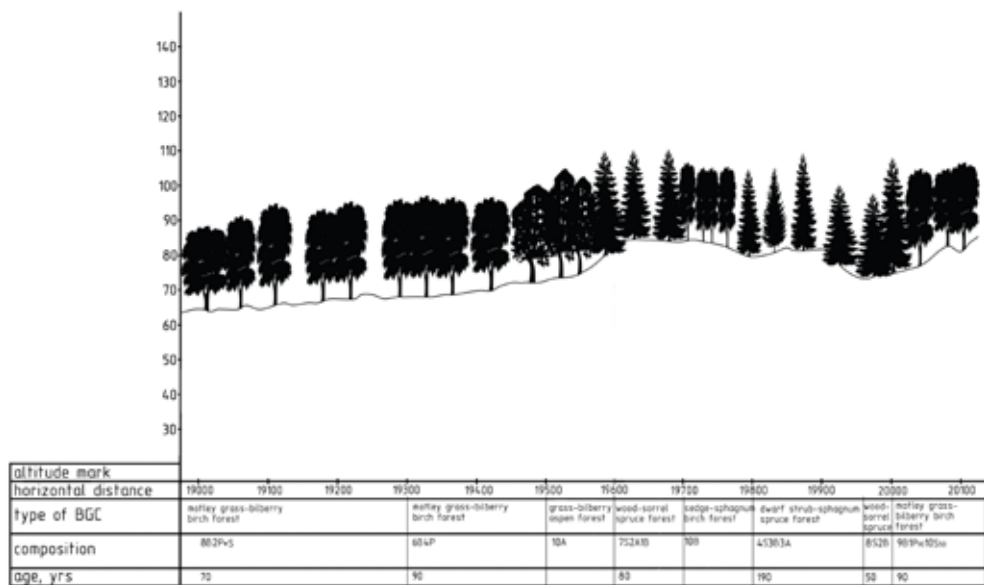


Fig. 5 Forest structure in mid-paludified morainic plain terrain dominated by spruce habitats (fragment).

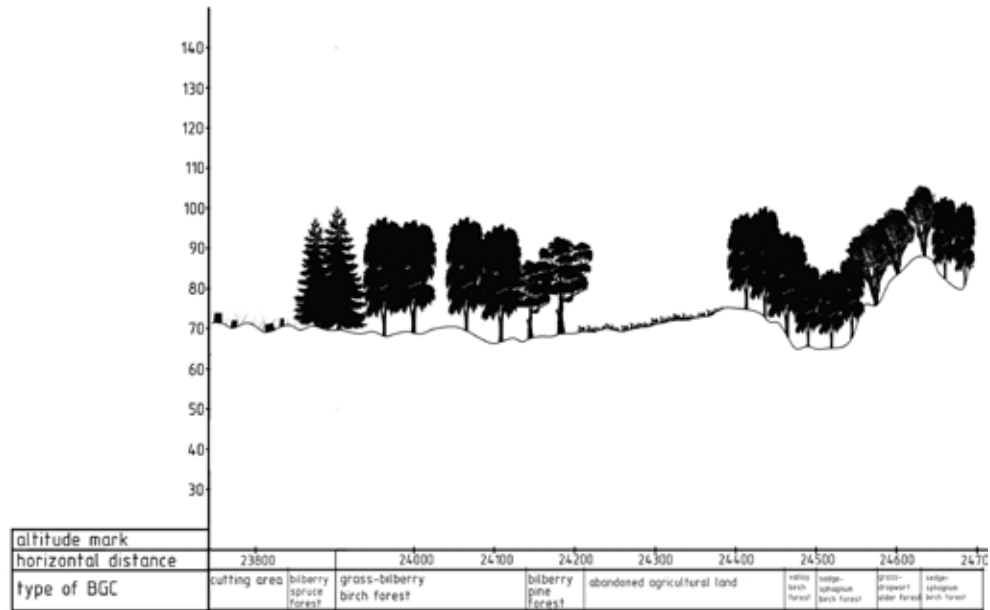


Fig. 6. Forest structure in aqueo-glacial topographically complex mildly paludified terrain dominated by pine stands (fragment).

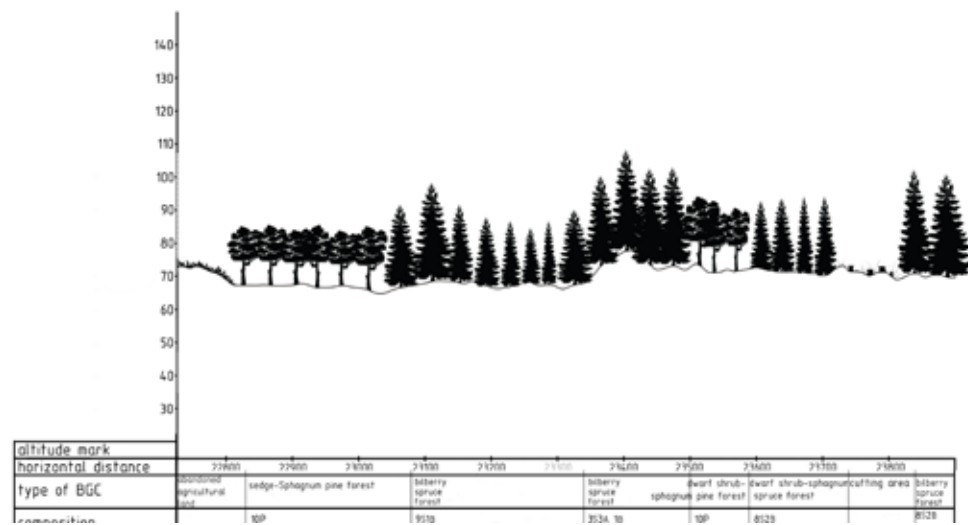


Fig. 7 Forest structure in highly paludified lacustrine-glacial plain terrain dominated by spruce habitats (fragment).



## 2.3 The structure of forest land and forest stands in Zaonezhye Peninsula

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### Introduction

Zaonezhye Peninsula (Zaonezhye) is known both inside and outside of Russia as an exceptionally valuable natural and cultural territory. Currently there is a clear trend towards the intensification of the exploitation of forest and mineral resources as well as increased recreational pressure in Karelia, particularly in Zaonezhye. Therefore, the creation of a protected area network, aiming at preserving the most valuable objects under different threats, becomes of paramount importance. At present there are 22 regional protected areas in the peninsula, covering 2500 ha. The largest among them is the Klim-gora landscape nature monument (approximately 600 ha). Kizhi federal zoological reserve (*zakaznik*), which covers 50 000 ha, is located southeast of the peninsula. The main objectives of this reserve are to preserve natural values of the Kizhi skerries and to protect nesting places of waterfowl (Figure 1). The Kizhi open-air museum and its buffer zone are within the boundaries of the reserve and they cover a large proportion of it. The open-air museum is characterized by landscapes that have been under a heavy human influence.

### Results

Forest ecosystems are the most dynamic components of natural landscapes due to their biological and ecological characteristics as well as their economic value. Therefore, forests require special protection. The establishment of a large-scale protected area on Zaonezhye is crucial for the conservation of forest communities; primarily pine forests, which are most valuable from ecological, biological and recreational point of view.

In 2013, Karelian Research Center published a monograph which summarized research data concerning esker landscapes situated in the middle part of Zaonezhye Peninsula (Gromtsev 2013). The authors have used the results of the publication as scientific arguments for the establishment of the Zaonezhye landscape reserve. In 2013 the NGO "SPOK" also developed arguments for the establishment of the Zaonezhye nature park (Documentations... 2013; see Figure 1).

According to modern knowledge, Zaonezhye is located within the Fennoscandian middle taiga subzone. Its area is divided into western and eastern parts that differ clearly in their landscape features. The transition zone between them divides two contrasting types of geographical landscapes in line with the villages of Velikaya Guba, Velikaya Niva and Shunga. Areas to the west of these villages are dominated by moderately paludified denudation-tectonic esker landscapes; whereas areas to the east are dominated by moderately waterlogged lacustrine and lacustrine-glacial lowland landscapes. Pine habitats prevail in the west, while spruce habitats dominate in the east (Gromtsev 2013). The landscape reserve (LR), proposed by the Karelian Research Centre, covers a total area of 106 373 ha. It is located in its entirety within the boundaries of the former landscape type. On the contrary, the nature park (NP) proposed by the NGO "SPOK", which covers 107 862 ha, lies mostly within the boundaries of the latter landscape type. Together these planned protected areas cover roughly two thirds of Zaonezhye Peninsula. According to the Ministry of nature management and environment of the Republic of Karelia (1/1/2012), forests cover 81,9% and 87,5% of the protected areas respectively. The planned landscape reserve and nature park share 25% of their territories and 22% of their forest areas. Comparative analysis of the structure of forest land (*lesnoi fond in Russian*) shows the level of anthropogenic transformation in the two protected areas. It also suggests that characteristics of intact forest communities are preserved mainly in pine stands.

Analysis of the land categories of forest land in LR and NP (Table 1) shows that the proportion of forest areas is relatively high: 79,4% and 86,9% respectively. In the Karelian context, this suggests, first and foremost, moderate or low paludification of the territory. Wetlands cover no more than 5% of the area. Practically all of the forest areas are covered by forests (99,0% in LR and 96,4% in NP). At the same time, the proportion of forest plantations is higher in LR (19,7%) than in NP (13,4%). This suggests that artificial reforestation has been widely used on the peninsula at least since the middle of the 20<sup>th</sup> century.

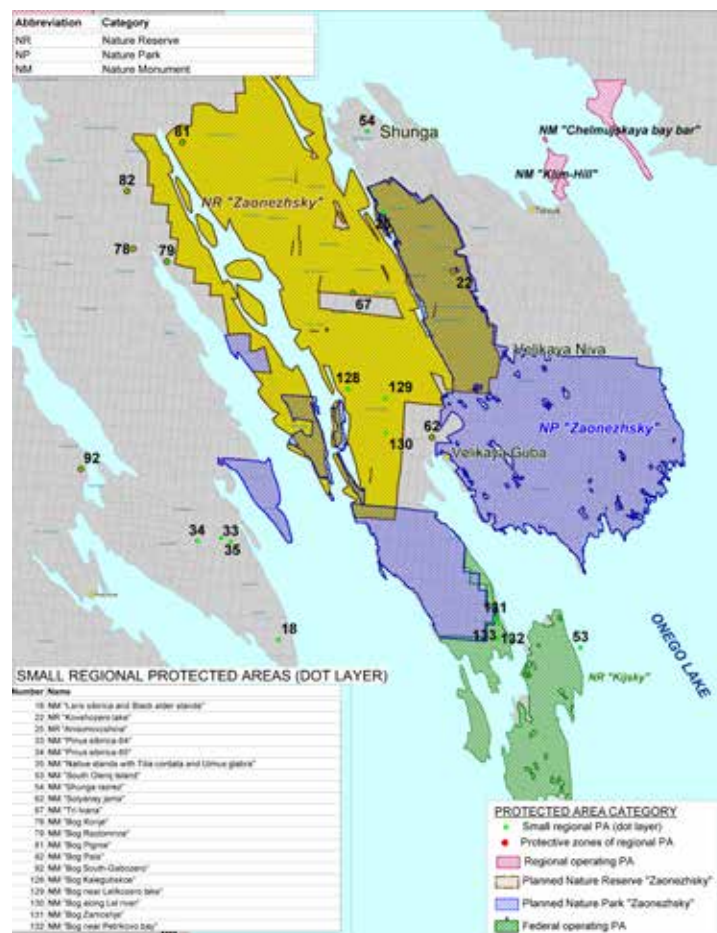


Fig. 1. Protected areas of Zaonezhye peninsula.

Table. I. Distribution of different land categories of forest land (*lesnoi fond*) in the planned protected areas\*.

Land category	Landscape reserve		Nature park	
	Area, ha	Structure, %	Area, ha	Structure, %
<b>Total area of forest land (<i>lesnoi fond</i>)</b>	<b>87138</b>	<b>100</b>	<b>94422</b>	<b>100</b>
<b>Total forest area, including:</b>	<b>69227</b>	<b>79.4 (100)</b>	<b>82025</b>	<b>86.9 (100)</b>
Forest-covered areas	68520	78.6 (99.0)	79067	83.7 (96.4)
Forest plantations	13518	15.5 (19.7)	10998	11.6 (13.4)
<b>Total of bare forest land, including:</b>	<b>705</b>	<b>0.8 (100)</b>	<b>2956</b>	<b>3.1 (100)</b>
Open plantations	147	0.2 (20.9)	964	1.0 (32.6)
Forest nurseries and seed orchards	99	0.1 (14.0)	–	–
Open stands	–	–	–	–
Fire sites	3	–	7	–
Dead plantations	9	–	30	0.03 (1.0)
Felling areas	447	0.5(63.4)	1955	2.1 (66.1)
Forest clearings and waste-land	–	–	–	–
<b>Total of non-forest areas, including:</b>	<b>17912</b>	<b>20.6 (100)</b>	<b>12397</b>	<b>13.1 (100)</b>
Arable land	–	–	–	–
Hay meadows	88	0.1 (0.5)	270	0.3 (2.2)
Pastures	–	–	–	–
Water area	12873	14.8 (71.9)	8246	8.7 (66.5)
Gardens and berry fields	–	–	–	–
Roads and clearings	243	0.3 (1.4)	281	0.3 (2.3)
Buildings	–	–	43	–
Wetlands	4355	5.0 (24.3)	3295	3.5 (26.6)
Sand	–	–	–	–
Other non-forest areas	353	0.4 (2.0)	264	0.3 (2.1)

\* The proportion of sub-categories within the land categories of forest land is shown in parentheses.

Felling areas predominate the structure of bare forest land in both territories (63,4 and 66,1%) but their area is four times larger in NP than in LR. Felling areas also occupy a considerable proportion of bare forest land within the total forest land.

The proportion of non-forest areas is less than 21% of the total forest land in the examined protected areas. Water areas and wetlands dominate their structure. The proportion of water objects in the total structure of the forest land roughly corresponds to the average figure in Karelia (approximately 10%), whereas the proportion of mires is considerably lower than average for the paludified forest land of Karelia (23,7%).

In general, structural analysis of the forest area indicates relatively extensive exploitation and anthropogenic transformation of the nature park in comparison with the landscape reserve.

Forests dominated by coniferous species cover 68,4% and 59,3% of forest-covered areas in LR and NP respectively (Table 2).

Table 2. Distribution of forest-covered areas, based on the dominant species.

Dominant species	Landscape reserve		Nature park	
	Area, ha	%	Area, ha	%
Pine ( <i>Pinus sylvestris</i> )	28693	41.9	21188	26.8
Spruce ( <i>Picea x fennica</i> )	18105	26.4	25678	32.5
Larch ( <i>Larix sibirica</i> )	33	0.05	41	0.1
Birch ( <i>Betula</i> spp.)	18308	26.7	23962	30.3
Speckled alder ( <i>Alnus incana</i> )	1264	1.8	3427	4.3
Black alder ( <i>Alnus glutinosa</i> )	–	–	66	0.1
Aspen ( <i>Populus tremula</i> )	2117	3.1	4705	6.0
Total	68520	100.0	79067	100.0

A high proportion (90% or more) of forests, dominated by coniferous species, is typical for intact taiga forests. A higher proportion of deciduous stands, dominated by birch, alder and aspen, indicate both moderate human influence and relatively high soil fertility in the area. Pine dominates in the landscape reserve while spruce dominates in the nature park, which reflects the characteristics of the aforementioned landscapes. Siberian larch is present in forest plantations. Next, we will use a set of parameters to examine the distribution of forest stands in the main coniferous structures.

Coniferous stands show a particular age class distribution (Table 3). For coniferous species, each age class equals 20 years. Approximately 68% of coniferous stands in LR and 51% of pine and spruce stands in NP fall into age classes I-V. For intact taiga forests, the opposite is true. In these forests, more than 70% of forest stands belong to age classes VIII-XII. In the planned protected areas, the proportion of stands in these age classes is no more than 17%. Thus, the distribution of age classes is a certain sign of considerable anthropogenic transformation of Zaonezhye forests.

Table 3. Age class distribution of coniferous forests.

Age class	Landscape reserve				Nature park			
	Pine, ha	%	Spruce, ha	%	Pine, ha	%	Spruce, ha	%
1	925.7	3.2	1240.9	6.8	411.6	2.1	4389.8	18.6
2	3950.2	13.9	5493.6	30.0	842.7	4.3	4334.9	18.3
3	4903.5	17.2	1220.5	6.7	2065.2	10.6	184.2	0.8
4	4749.3	16.7	2311.5	12.6	2442.8	12.5	628.7	2.7
5	4740.8	16.6	2203.4	12.0	3828	19.6	2868.6	12.1
6	2671.7	9.4	1887.9	10.3	3731.5	19.1	3839.1	16.2
7	2349.6	8.2	1637.8	8.9	2965.8	15.2	3944.9	16.7
8	2104.3	7.4	1293.2	7.1	1807.7	9.2	2138.8	9.0
9	1678.9	5.9	952	5.2	1035.7	5.3	1276.8	5.4
10	313.8	1.1	96.9	0.5	387.5	2.0	44.6	0.2
11	76.1	0.3	–	–	34.6	0.2	–	–

12	41.6	0.1	–	–	–	–	–	–
<b>TOTAL</b>	<b>28505.5</b>	<b>100.0</b>	<b>18337.7</b>	<b>100</b>	<b>19553.1</b>	<b>100.0</b>	<b>23650.4</b>	<b>100.0</b>

According to species or group of species dominating either within the ground cover layer or in the undergrowth, different forest types are being distinguished (Table 4). Forest type is a site in the forest which is characterized by uniform forest-growing conditions, similar species composition and ground cover and which demands the same silvicultural methods (Sukachev & Zonn 1961).

Table 4. Forest types that are common in pine dominated forests of Zaonezhye peninsula.

Forest type	Indicatory species
<i>Cladonia</i>	lichens of genus <i>Cladonia</i> spp.
Rocky	<i>Cladoniaceae</i> spp. and mosses on outcrops of cliffs
<i>Vaccinium</i>	<i>Vaccinium vitis-idaea</i>
<i>Myrtillus</i>	<i>Vaccinium myrtillus</i>
<i>Oxalis</i>	<i>Oxalis acetosella</i>
Long mosses	<i>Polytrichum</i> spp.
Herbal on bogs	Various herbs in waterlogged forests
Meadowsweet	<i>Filipendula ulmaria</i>
Sedge-Sphagnum	<i>Cyperaceae</i> spp. and <i>Sphagnum</i> spp.
<i>Sphagnum</i>	<i>Sphagnum</i> spp.
<i>Ledum</i>	<i>Ledum palustre</i>

The ecological spectrum of coniferous forests in Zaonezhye seems relatively normal. Here, coniferous forests are represented by seven main forest types, as well as a separate type of drained stands (Table 5.)

Table 5. Distribution of coniferous forests by forest type.

Forest type	Landscape reserve				Nature park			
	Pine, ha	%	Spruce, ha	%	Pine, ha	%	Spruce, ha	%
<i>Cladonia</i>	676	2.4	–	–	379	1.8	–	–
<i>Vaccinium</i>	3576	12.5	4	0.02	2608	12.3	46	0.2
<i>Myrtillus</i>	16700	58.2	12036	66.5	7147	33.7	16420	63.9
<i>Oxalis</i>	2888	10.1	4598	25.4	3376	15.9	5820	22.7
Long mosses	1142	4.0	1324	7.3	746	3.5	2002	7.8
Herbal on bogs	35	0.1	47	0.3	80	0.4	178	0.7
<i>Sphagnum</i>	3507	12.2	81	0.4	6220	29.4	1212	4.7
Drained stands	170	0.6	14	0.1	633	3.0	2	0.01
<b>TOTAL</b>	<b>28694</b>	<b>100</b>	<b>18104</b>	<b>100</b>	<b>21189</b>	<b>100</b>	<b>25680</b>	<b>100</b>

Normally spruce forests are dominated by the *Myrtillus* type. In forest inventories, these types are referred to as mixed-herb *Myrtillus*, *Myrtillus* and moist *Myrtillus* forests. It is commonly known that during natural reforestation spruce is a more demanding species. Therefore, it occupies relatively homogenous habitats with the most favourable conditions. Meanwhile, pine is ecologically more flexible and dominates less favourable habitats with more diverse habitat conditions. The characteristics of

Zaonezhye forests include the relatively unvaried typological spectrum of pine and spruce. Also, the proportion of *Myrtillus* pine forests in denudation-tectonic landscapes is high – nearly as high as the proportion of spruce forests - indicating that there are relatively highly fertile mineral soils in the landscape reserve. The proportion of waterlogged forests (49.4%) within the nature park is twice as large as within the landscape reserve (25.0%), which is typical for lacustrine-glacial lowland landscapes.

The forests of the peninsula show a distinctive distribution pattern of site quality classes (Table 5). The productivity of coniferous stands varies from classes I to Va and Vb, which is relatively common in Karelia. Characteristically, a particularly high proportion of pine stands belong to class III. These stands constitute nearly half of all pine forests in the landscape reserve. Pine stands cover 1.7 times larger area than spruce stands.

Table 6. Distribution of coniferous forests by site quality class (bonitet).

Site class	Landscape reserve				Nature park			
	Pine, ha	%	Spruce, ha	%	Pine, ha	%	Spruce, ha	%
I	58	0.2	–	–	114	0.5	3	0.01
II	3422	11.9	491	2.7	1579	7.5	763	3.0
III	13229	46.1	7902	43.7	8637	40.8	12085	47.1
IV	6167	21.5	7432	41.1	3244	15.3	8081	31.5
V	4425	15.4	2280	12.6	4006	18.9	4507	17.6
Va	1392	4.9	–	–	3520	16.6	231	0.9
Vb	–	–	–	–	89	0.4	8	0.03
<b>TOTAL</b>	<b>28693</b>	<b>100</b>	<b>18105</b>	<b>100</b>	<b>21189</b>	<b>100</b>	<b>25678</b>	<b>100</b>
<b>Average index</b>	<b>III.5</b>	<b>–</b>	<b>III.6</b>	<b>–</b>	<b>IV.0</b>	<b>–</b>	<b>III.7</b>	<b>–</b>

Uneven-aged forest stands are a typical feature of primeval forests in the taiga zone of the European part of Russia. Normally these forest stands dominate coniferous stand structures of intact forests. In general, uneven-aged forest stands provide a dynamic balance between growth and dieback processes.

Forest inventory data is crucial for detecting primeval forests in existing and planned protected areas as well as calculating certain parameters of their natural age structure. We have used the classification of S. Zyabchenko (1984) as the methodical basis for analyzing the pine forests of Zaonezhye. We have only analyzed pine-dominated stands in age classes VII and higher. A forest stand is considered absolutely uneven-aged when the following conditions are met: a) there is a minimum of two generations of pine; b) the growing volume of the structure is no more than 40%; c) the oldest generation is at least 180 years old; d) there should be a difference of more than three age classes between generations. In younger age classes, as well as when the proportion of growing volume in one generation is at least 50%, forests are considered relatively uneven-aged. If there has been only one generation of pine, the stand is considered potentially even-aged. The results of the classification of pine stands in the landscape reserve and the nature park are presented in Tables 6, 7 and 8. We have used the following abbreviations: P – pine; S – spruce; L – larch; B – birch; As – aspen; Ali – speckled alder (*Alnus incana*); Alg – black alder (*Alnus glutinosa*). The ages of the elements are described in subscript.

Table 7. Distribution of pine stands in the Zaonezhye landscape reserve by age structure, forest type and site quality class.

No	Forest type	Site class	Composition and structure (in tenth parts of growing volume)	Growing volume, m <sup>3</sup> /ha	Total area, ha	%
<b>Absolutely uneven-aged</b>						
1	<i>Myrtillus</i>	III	3P <sub>190</sub> 2P <sub>90</sub> 3S <sub>170</sub> 1B <sub>90</sub> 1As <sub>90</sub>	270	53.0	<b>80.5</b>
2	Sedge-Sphagnum	V	3,7P <sub>190</sub> 2,7P <sub>100</sub> 1,3S <sub>140</sub> 2,3B <sub>70</sub>	84	5.7	<b>8.7</b>
11	Long mosses	V	4CP <sub>190</sub> 2P <sub>90</sub> 2S <sub>170</sub> 2B <sub>80</sub>	120	3.2	<b>4.9</b>
12	<i>Ledum</i>	V	4P <sub>190</sub> 3P <sub>90</sub> 1S <sub>170</sub> 2B <sub>70</sub>	111	3.9	<b>5.9</b>
	TOTAL				65.8	100.0
<b>Relatively uneven-aged</b>						
1	<i>Myrtillus</i>	II	4P <sub>130</sub> 3P <sub>110</sub> 2B <sub>80</sub> 1As <sub>80</sub>	330	2.1	<b>0.1</b>
2	<i>Myrtillus</i>	III	5,3P <sub>170</sub> 2,2P <sub>90</sub> 1S <sub>130</sub> 1,5B <sub>90</sub> /As <sub>90</sub>	253	332.8	<b>18.4</b>
3	<i>Myrtillus</i>	IV	5,7P <sub>170</sub> 2P <sub>70</sub> 2S <sub>70</sub> 2B <sub>70</sub> 1As <sub>70</sub>	183	234.8	<b>13.0</b>
4	<i>Myrtillus</i>	V	3P <sub>130</sub> 2,9P <sub>100</sub> 0,5S <sub>90</sub> 0,9B <sub>90</sub> /As <sub>90</sub>	155	35.0	<b>1.9</b>
3	<i>Vaccinium</i>	IV	5,7P <sub>150</sub> 3,1P <sub>90</sub> 0,8S <sub>120</sub> 0,4B <sub>80</sub> /As <sub>80</sub>	194	142.5	<b>7.9</b>
4	<i>Vaccinium</i>	V	5,8P <sub>160</sub> 3,7P <sub>100</sub> 0,5B <sub>90</sub> /S <sub>90</sub> /S <sub>90</sub>	133	154.5	<b>8.6</b>
5	Rocky	V	6,5P <sub>170</sub> 2,8P <sub>90</sub> 0,7S <sub>90</sub> /B <sub>80</sub> /As <sub>80</sub>	72,4	126	<b>7.0</b>
6	Rocky	Va	6,4P <sub>160</sub> 2,9P <sub>90</sub> 0,7S <sub>150</sub> /B <sub>90</sub>	67	27.5	<b>1.5</b>
7	Sedge-Sphagnum	V	6,5P <sub>170</sub> 3P <sub>100</sub> 0,3S <sub>130</sub> 0,2B <sub>70</sub>	113	227.6	<b>12.6</b>
8	Sedge-Sphagnum	Va	4,3P <sub>170</sub> 5,3P <sub>110</sub> 0,4B <sub>80</sub> /S <sub>70</sub>	83	179.1	<b>9.9</b>
9	Long mosses	IV	5P <sub>150</sub> 4P <sub>90</sub> 1B <sub>40</sub>	111	10.1	<b>0.6</b>
10	<i>Ledum</i>	V	6,3P <sub>170</sub> 3,2P <sub>110</sub> 0,4S <sub>170</sub> 0,1B <sub>80</sub>	121	66.6	<b>3.7</b>
11	<i>Ledum</i>	Va	5P <sub>150</sub> 5P <sub>70</sub>	42	3.7	<b>0.2</b>
12	<i>Sphagnum</i>	V	6,8P <sub>170</sub> 2,6P <sub>90</sub> 0,6S <sub>110</sub> /B <sub>70</sub>	77	87.5	<b>4.8</b>
13	<i>Sphagnum</i>	Va	6,9P <sub>160</sub> 3P <sub>110</sub> 0,1S <sub>110</sub> /B <sub>80</sub>	76	143	<b>7.9</b>
	TOTAL				1805.8	100.0
<b>Potentially even-aged</b>						
1	Herbal on bogs	II	4P <sub>130</sub> 1,5S <sub>110</sub> 4,5B <sub>90</sub> /As <sub>90</sub>	345	17.1	<b>0.4</b>
2	Herbal on bogs	III	5,4P <sub>130</sub> 1,5S <sub>120</sub> 3,1B <sub>90</sub> /As <sub>90</sub>	320	210.5	<b>5.2</b>
3	<i>Oxalis</i>	II	5P <sub>130</sub> 3S <sub>130</sub> 1,5B <sub>90</sub> /As <sub>90</sub> 0,5S <sub>60</sub>	331	5.5	<b>0.1</b>
4	<i>Oxalis</i>	III	5,1P <sub>130</sub> 2,5S <sub>110</sub> 2,3B <sub>90</sub> /As <sub>90</sub> 0,8S <sub>90</sub>	318	63	<b>1.6</b>
5	<i>Oxalis</i>	IV	5,7P <sub>130</sub> 2P <sub>110</sub> 2,3B <sub>90</sub> /As <sub>90</sub>	264	70.6	<b>1.7</b>
6	<i>Myrtillus</i>	II	3P <sub>130</sub> 3S <sub>110</sub> 2As <sub>90</sub> 2B <sub>90</sub>	362	4.7	<b>0.1</b>
7	<i>Myrtillus</i>	III	5,9P <sub>140</sub> 2,3S <sub>130</sub> 1,8B <sub>90</sub> /As <sub>90</sub>	278	951.4	<b>23.5</b>
8	<i>Myrtillus</i>	IV	6,2P <sub>140</sub> 2,1S <sub>110</sub> 1,7B <sub>90</sub> /As <sub>90</sub>	190	370	<b>9.2</b>
9	<i>Vaccinium</i>	III	7P <sub>130</sub> 1S <sub>90</sub> 2B <sub>90</sub> /As <sub>90</sub>	185	13.9	0.3
10	<i>Vaccinium</i>	IV	8,1P <sub>130</sub> 1S <sub>90</sub> 1B <sub>70</sub> /As <sub>70</sub>	178	397	9.8
11	<i>Vaccinium</i>	V	8,6P <sub>140</sub> 1S <sub>90</sub> 0,4B <sub>80</sub> /As <sub>80</sub>	141	319	7.9
12	Rocky	V	9,5P <sub>140</sub> 0,5S <sub>140</sub> /B <sub>80</sub>	99	81.9	2.0
13	Rocky	Va	9P <sub>140</sub> 1S <sub>150</sub> /B <sub>60</sub>	71	23.5	0.6
14	Meadowsweet	IV	5P <sub>140</sub> 2S <sub>130</sub> 3B <sub>90</sub>	186	8.7	0.2
15	Meadowsweet	V	5,5P <sub>140</sub> 1,5S <sub>140</sub> 2,5B <sub>70</sub>	128	7	0.2

16	Sedge-Sphagnum	V	6,7P <sub>160</sub> 2S <sub>150</sub> 1,3B <sub>80</sub>	131	482	11.9
17	Sedge-Sphagnum	Va	8,3P <sub>150</sub> 1S <sub>130</sub> 0,7B <sub>90</sub>	65	34.7	0.9
18	Long mosses	IV	5,8P <sub>140</sub> 2,6S <sub>140</sub> 1,6B <sub>80</sub>	142	123	3.0
19	Long mosses	V	5P <sub>150</sub> 2,7S <sub>140</sub> 2,3B <sub>90</sub>	121	148	3.7
20	Ledum	V	9,5P <sub>150</sub> 0,4S <sub>150</sub> 0,1B <sub>90</sub>	143	124	3.1
21	Ledum	Va	9P <sub>140</sub> 1S <sub>110</sub> +B <sub>90</sub>	95	31	0.8
22	Sphagnum	V	9,2P <sub>140</sub> 0,5S <sub>150</sub> 0,3B <sub>90</sub>	94	167	4.1
23	Sphagnum	Va	7,5P <sub>140</sub> 1,5S <sub>140</sub> 1B <sub>90</sub>	65	390	9.6
<b>TOTAL</b>					<b>4043.5</b>	<b>100.0</b>

Table 8. Distribution of pine stands in the Zaonezhye nature reserve by age structure, forest type and site quality class.

No	Forest type	Site class	Composition and structure (in tenth parts of growing volume)	Growing volume m <sup>3</sup> /ha	Total area, ha	%
<b>Absolutely uneven-aged</b>						
1	Myrtillus	III	3P <sub>190</sub> 2P <sub>90</sub> 3S <sub>170</sub> 1B <sub>90</sub> 1As <sub>90</sub>	270	53.0	<b>73.8</b>
4	Vaccinium	V	4P <sub>200</sub> 2P <sub>130</sub> 2S <sub>190</sub> 2As <sub>110</sub>	129	6.8	<b>9.5</b>
8	Sedge-Sphagnum	Va	4P <sub>190</sub> 4P <sub>90</sub> 2B <sub>60</sub> +S <sub>150</sub>	71	12	<b>16.7</b>
<b>TOTAL</b>					<b>71.8</b>	<b>100</b>
<b>Relatively uneven-aged</b>						
1	Myrtillus	III	5,7P <sub>180</sub> 2,3P <sub>100</sub> 2B <sub>90</sub> /As <sub>90</sub>	237	100.9	<b>6.9</b>
2	Myrtillus	IV	5,8P <sub>170</sub> 2,8P <sub>120</sub> 1,4B <sub>90</sub>	226	135.5	<b>9.3</b>
3	Vaccinium	IV	5,9P <sub>160</sub> 2,3P <sub>120</sub> 1S <sub>90</sub> 0,8B <sub>90</sub> /As <sub>90</sub>	204	259.1	<b>17.7</b>
4	Vaccinium	V	6,5P <sub>190</sub> 2,5P <sub>120</sub> 1B <sub>100</sub>	156	84.7	<b>5.8</b>
5	Rocky	V	8P <sub>150</sub> 1,3S <sub>140</sub> 0,7B <sub>90</sub>	133	61.3	<b>4.2</b>
6	Rocky	Va	9P <sub>130</sub> 1S <sub>130</sub> +B <sub>80</sub>	133	12	<b>0.8</b>
	Oxalis	III	3P <sub>170</sub> 2P <sub>120</sub> 2,5S <sub>130</sub> 2,5B <sub>90</sub>	215	31.0	<b>2.1</b>
7	Oxalis	IV	5,8P <sub>180</sub> 2,6P <sub>100</sub> 1,6S <sub>100</sub> /B <sub>90</sub>	218	34.1	<b>14.1</b>
8	Herbal on bogs	III	6P <sub>130</sub> 2P <sub>180</sub> 1B <sub>90</sub> 1As <sub>90</sub>	244	14	<b>1.0</b>
9	Meadowsweet	V	5P <sub>150</sub> 2P <sub>210</sub> 3B <sub>100</sub>	168	6.2	<b>0.4</b>
10	Sedge-Sphagnum	V	5,7P <sub>160</sub> 3P <sub>90</sub> 1,3B <sub>80</sub> +S <sub>130</sub>	99	166.1	<b>11.3</b>
11	Sedge-Sphagnum	Va	5,7P <sub>150</sub> 3,5P <sub>90</sub> 0,7B <sub>80</sub> 0,1S <sub>150</sub>	71	269.4	<b>18.4</b>
12	Long mosses	IV	3P <sub>170</sub> 2P <sub>120</sub> 2,5S <sub>130</sub> 2B <sub>90</sub> 0,5Ali <sub>100</sub>	169	12.7	<b>0.9</b>
13	Ledum	V	7P <sub>190</sub> 3P <sub>105</sub>	94	6.8	<b>0.5</b>
13	Sphagnum	V	5,7P <sub>160</sub> 2,7P <sub>130</sub> 1,6S <sub>130</sub> /B <sub>80</sub>	85	31.7	<b>2.2</b>
14	Sphagnum	Va	6P <sub>140</sub> 4P <sub>90</sub> +S <sub>130</sub>	53	66.4	<b>4.5</b>
<b>TOTAL</b>					<b>1464.3</b>	<b>100</b>
<b>Potentially even-aged</b>						
1	Herbal on bogs	III	6P <sub>130</sub> 2,1S <sub>120</sub> 1,9B <sub>90</sub> /As <sub>90</sub>	268	165.6	<b>3.2</b>
2	Oxalis	II	3P <sub>130</sub> 3S <sub>130</sub> 3As <sub>90</sub> 1B <sub>90</sub>	336	2.6	<b>0.1</b>
3	Oxalis	III	5,5P <sub>150</sub> 2S <sub>140</sub> 2,5B <sub>90</sub> /As <sub>90</sub>	257	144.9	<b>2.8</b>
4	Oxalis	IV	6,5P <sub>160</sub> 2,2S <sub>100</sub> 1,3B <sub>90</sub>	236	277.9	<b>5.4</b>
5	Myrtillus	II	3P <sub>130</sub> 3S <sub>110</sub> 2As <sub>90</sub> 2B <sub>90</sub>	362	4.7	<b>0.1</b>



6	<i>Myrtillus</i>	III	5,4P <sub>140</sub> 2,3S <sub>130</sub> 2,3B <sub>90</sub> /As <sub>90</sub>	266	1088.3	21.0
7	<i>Myrtillus</i>	IV	6,7P <sub>150</sub> 2,1S <sub>140</sub> 1,2B <sub>90</sub> /As <sub>90</sub>	213	97.7	1.9
8	<i>Vaccinium</i>	III	7,3P <sub>160</sub> 1,5S <sub>130</sub> 1,2B <sub>90</sub>	264	23.6	0.5
9	<i>Vaccinium</i>	IV	8,3P <sub>130</sub> 1,1S <sub>120</sub> 0,6S <sub>80</sub> /B <sub>80</sub>	201	297	5.7
10	<i>Vaccinium</i>	V	9,1P <sub>140</sub> 0,7S <sub>110</sub> 0,3B <sub>80</sub> /As <sub>80</sub>	176	608.4	11.7
11	Rocky	V	8P <sub>150</sub> 1,3S <sub>140</sub> 0,7B <sub>90</sub>	133	61.3	1.2
12	Rocky	Va	9P <sub>130</sub> 1S <sub>130</sub> +B <sub>80</sub>	133	12	0.2
13	Meadowsweet	IV	4,7P <sub>140</sub> 1,7S <sub>130</sub> 3B <sub>90</sub> 0,6As <sub>90</sub> /Ali <sub>90</sub>	183	16.3	0.3
14	Sedge-Sphagnum	V	6,1P <sub>140</sub> 2,2S <sub>130</sub> 1,6B <sub>80</sub> 0,1Alg <sub>80</sub>	122	522.4	10.1
15	Sedge-Sphagnum	Va	6,4P <sub>140</sub> 2,1S <sub>130</sub> 1,5B <sub>80</sub>	79,4	1306.6	25.2
16	Long mosses	IV	6P <sub>140</sub> 2,5S <sub>140</sub> 1,1B <sub>80</sub> 0,4As <sub>90</sub> /Ali <sub>90</sub>	183	43.9	0.8
17	Long mosses	V	6,4P <sub>150</sub> 2,2S <sub>140</sub> 1,3B <sub>90</sub> 0,1As <sub>75</sub> /Alg <sub>60</sub>	150	151.5	2.9
18	<i>Ledum</i>	V	8,9P <sub>150</sub> 1,1S <sub>150</sub> /B <sub>90</sub>	113	41.8	0.8
19	<i>Ledum</i>	Va	10P <sub>130</sub>	95	14	0.3
20	<i>Sphagnum</i>	V	7,9P <sub>150</sub> 0,9S <sub>140</sub> 1,2B <sub>80</sub>	93	79.5	1.5
21	<i>Sphagnum</i>	Va	7,6P <sub>140</sub> 1,4S <sub>140</sub> 0,9B <sub>90</sub> 0,1Alg <sub>100</sub>	72	229.6	4.4
<b>TOTAL</b>					<b>5189.6</b>	<b>100</b>

Table 9. The composition and structure of Zaonezhye pine stands, based on the type of age structure.

Type of age structure	Composition and structure (in tenth parts of growing volume)	Average age class	Growing volume, m <sup>3</sup> /ha	Total area, ha	%
<b>Landscape reserve</b>					
Potentially even-aged	6,7P <sub>140</sub> 1,8S <sub>110</sub> 1,5B <sub>80</sub> /As <sub>80</sub>	7.5	184	4043.5	68.4
Absolutely uneven-aged	3,2P <sub>190</sub> 2,1P <sub>90</sub> 2,7S <sub>170</sub> 2B <sub>90</sub>	10	237	65.8	1.1
Relatively uneven-aged	6P <sub>160</sub> 3,3P <sub>100</sub> 0,7S <sub>110</sub> /B <sub>90</sub> /As <sub>90</sub>	8	145	1805.8	30.5
<b>TOTAL</b>				<b>5915.1</b>	<b>100</b>
<b>Nature park</b>					
Potentially even-aged	6,4P <sub>140</sub> 2S <sub>110</sub> 1,6B <sub>90</sub> /As <sub>90</sub> /Ali <sub>90</sub> /Alg <sub>90</sub>	7.7	168	5189.6	77.2
Absolutely uneven-aged	3,3P <sub>190</sub> 2,3P <sub>90</sub> 2,7S <sub>150</sub> 1,7Ali <sub>110</sub>	10	223	71.8	1.1
Relatively uneven-aged	5,8P <sub>160</sub> 3P <sub>110</sub> 0,5S <sub>130</sub> 0,7B <sub>80</sub>	8.5	158	1464.3	21.7
<b>TOTAL</b>				<b>6725.7</b>	<b>100</b>

After analysing Tables 7, 8 and 9, we have come to the following conclusion: Absolutely uneven-aged stands represent the smallest share, amounting to only 1,1% of all types of age structures in both the landscape reserve and the nature park. Consequently, these forest-covered areas are least preserved from anthropogenic transformation. The absolutely uneven-aged *Myrtillus* pine stands of III site quality class indicated in Tables 6 and 7 are located in the forest compartment (*kvartal*) 117 of the Velikaya Guba forest district (*lesnichestvo*). The proportion of relatively uneven-aged stands is

30,5% in the landscape reserve and 21.7% in the nature park. Potentially even-aged pine stands dominate both planned protected areas, totaling 68.4% of the landscape reserve and 77.2% of the nature park.

The formation of potentially even-aged pine stands depends on a set of natural and anthropogenic factors. Natural factors include large fires and vast windfalls. The natural reforestation of potentially even-aged pine stands is expected within 20–40 years after these catastrophic events. The main anthropogenic factor is intensive felling, namely clear cutting, followed by natural or artificial reforestation. In the two planned protected areas, anthropogenic factors play a bigger part due to the long history of agriculture and high population density in Zaonezhye. According to Zyabchenko (1984), relatively uneven-aged pine stands appear after 60–80 years of natural afforestation of pine stands in open areas, namely fire sites. Alternatively, they can be formed under the influence of intensive selective logging. The latter is true for Zaonezhye. On the whole, anthropogenic transformation is more pronounced in the planned nature park than in the landscape reserve.

After analyzing Tables 6 and 7, we have come to the conclusion that the proportion of pine in the stand structure increases when the site quality class decreases. The biggest proportions of spruce are typical for highly productive, potentially even-aged pine stands of the *Oxalis* and *Myrtillus* types. Even though the two planned protected areas are located in different geographical landscapes their pine stands are characterized by similar structures (Table 9).

According to our analyses, the pine-dominated boreal forests of Zaonezhye Peninsula have been highly productive in the past. These forests have supplied quality construction material for the outstanding monuments of wooden architecture, for which Zaonezhye is famous. Despite the extent of anthropogenic transformation of ecosystems, there are still small areas of old-growth pine stands of high conservation and recreational value. As shown in Figures 2 and 3, nearly all of these areas are already located within protective forests. Average indicators for the planned landscape reserve and nature park are shown in Table 10. At present, a significant proportion of coniferous forests in the planned protected areas (LR – 50.5% and NP – 39.7%) are located in protective forests where clear cutting is prohibited. In general, the average indicators for these forests are higher than for commercial forests. There is a special interest in the forest compartments (*kvartal*) of the Tolvuya and Velikaya Niva forest districts (*lesnichestvo*), which are included in both the landscape reserve and the nature park.

Table 10. Average indicators for coniferous forests in the planned landscape reserve and nature park, based on inventories.

Dominant species	Area, ha	Average age, years	Site class	Relative stand density	Growing volume, m <sup>3</sup> /ha	Average composition and structure
Landscape reserve						
Protective forests						
Pine	15443.2	96	III.5	0.67	181	6P2BISIAs+L, Ali, Alg
Spruce	8184.8	93	III.7	0.70	173	5P2P2BIAs+Ali, Alg
Larch	16.1	36	III.9	0.81	109	5B3LISIP
<b>TOTAL</b>	<b>23644.1</b>	<b>95</b>	<b>III.6</b>	<b>0.68</b>	<b>178</b>	<b>5P2S2BIAs+L, Ali, Alg</b>
Commercial forests						
Pine	13249.8	72	III.5	0.66	131	5P3BISIAs+Ali, Alg

Spruce	9919.8	63	III.6	0.70	135	5S2BIPiAs+Ali+Alg
Larch	16.4	47	III.0	0.74	144	4L3P2BIS
<b>TOTAL</b>	<b>23186.0</b>	<b>68</b>	<b>III.6</b>	<b>0.68</b>	<b>133</b>	<b>4P3S2BIAAs+L, Ali, Alg</b>
Nature park						
Protective forests						
Pine	10860.0	106	III.5	0.69	198	6P2BISiAs+Ali, Alg
Spruce	7772.2	110	III.4	0.72	217	6S2BIPiAs+Ali, Alg
Larch	1.0	46	II.0	0.70	170	5B3LIPIS
<b>TOTAL</b>	<b>18633.2</b>	<b>108</b>	<b>III.5</b>	<b>0.70</b>	<b>206</b>	<b>4P3S2BIAAs+L, Ali, Alg</b>
Commercial forests						
Pine	10328.3	96	IV.4	0.61	128	6P2BISiAs+Ali, Alg
Spruce	17906.0	76	III.8	0.67	147	6S2BIPiAs+Ali, Alg
Larch	40.0	42	II.5	0.80	141	4B3LISiPIAs
<b>TOTAL</b>	<b>28274.3</b>	<b>83</b>	<b>IV.0</b>	<b>0.65</b>	<b>140</b>	<b>4S3P2BIAAs+L, Ali, Alg</b>

On the whole, when it comes to protecting forest ecosystems, the two proposed protected areas complement each other to some extent. However, the denudation-tectonic landscape of the landscape reserve seems more promising in terms of structure. Following the creation of a strict protected area (where cutting of dead and damaged stands is allowed only under exceptional circumstances), we would expect over 120-year-old pine stands to acquire features of intact pine forests within the next 50 years.

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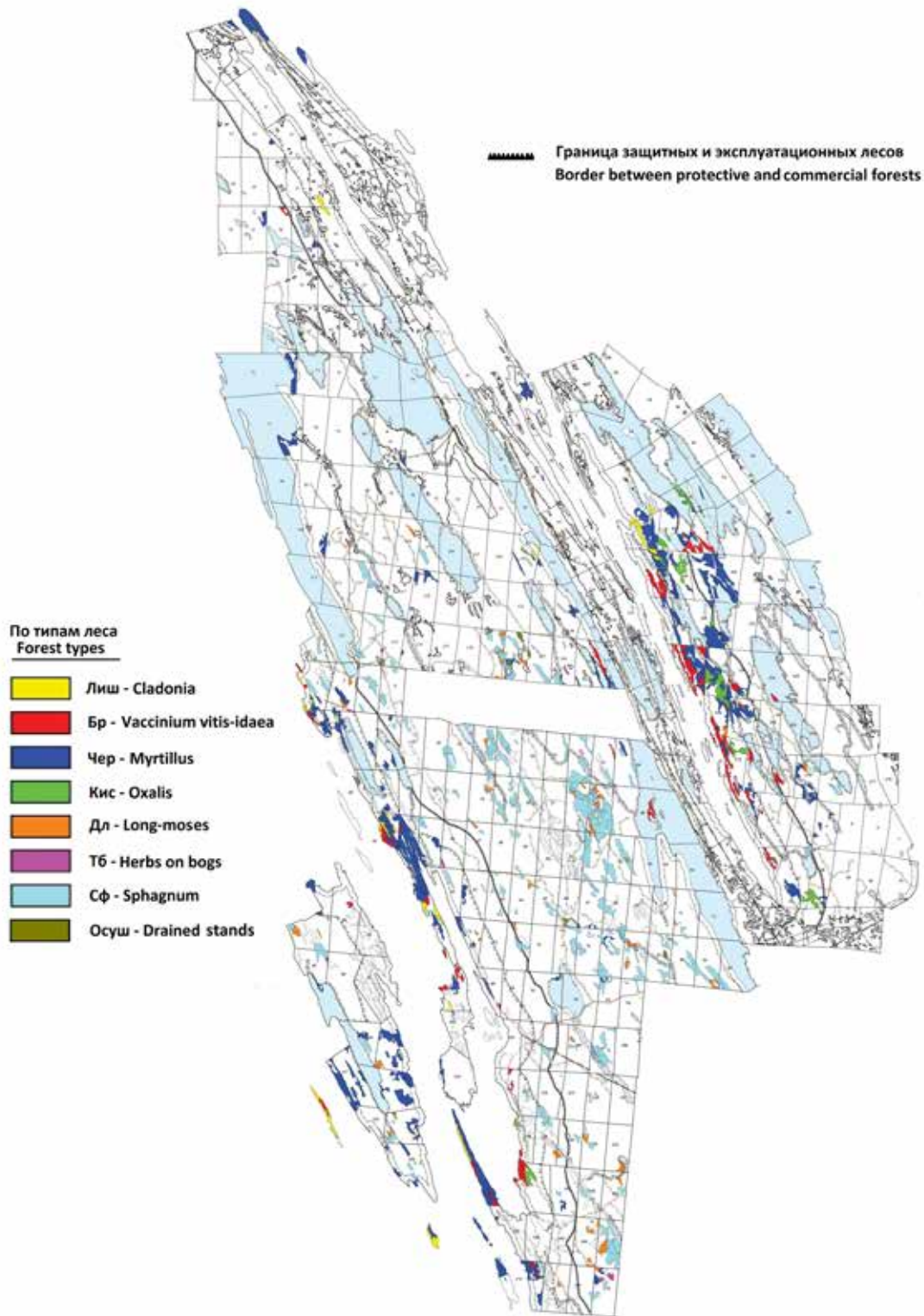


Fig. 2. Spatial distribution of old-growth (older than 120 years) pine-dominated forests in planned Zaonezhye Nature (landscape) Reserve, northern part of Zaonezhye Peninsula.

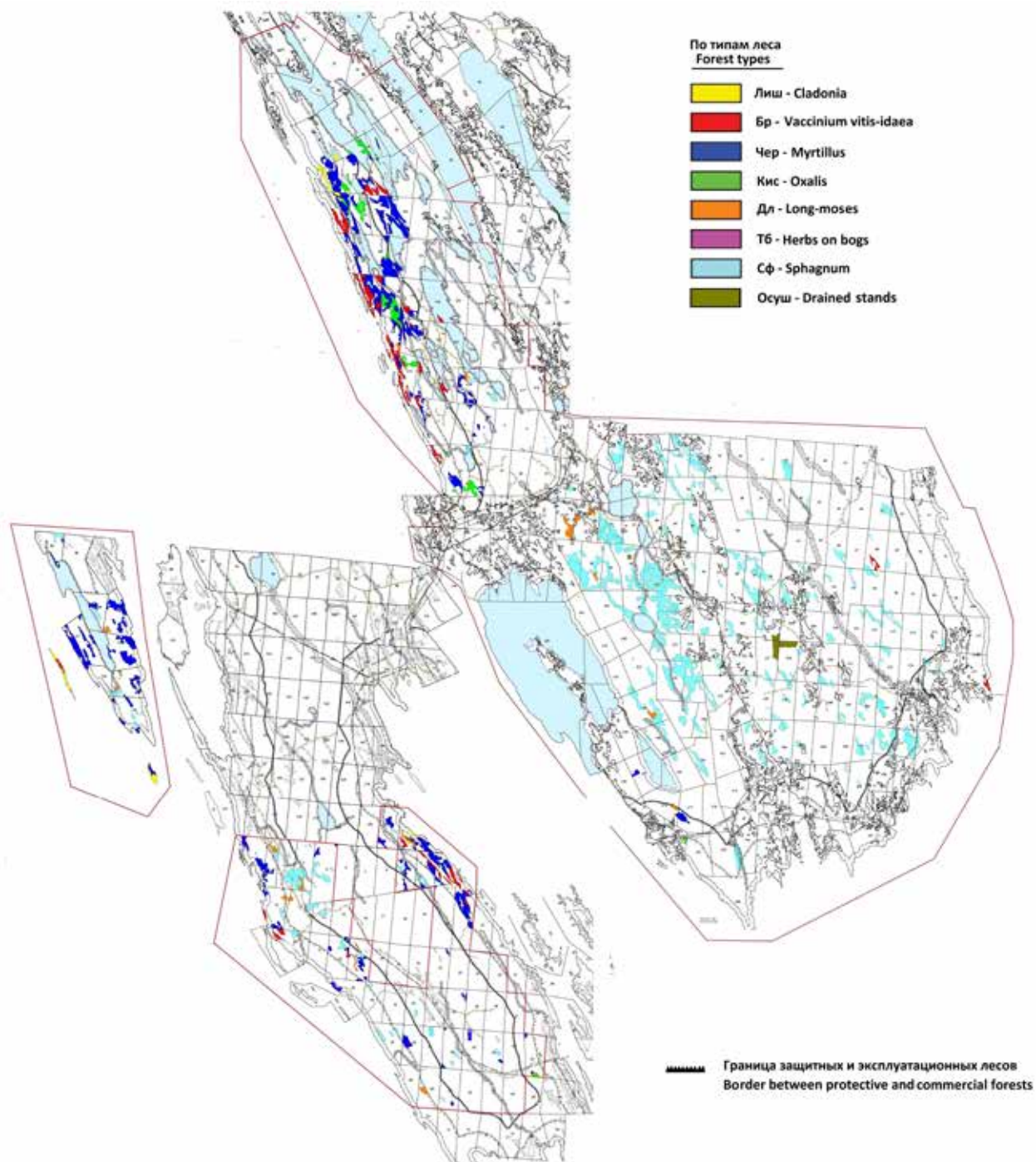


Fig. 3. Spatial distribution of old-growth (older than 120 years) pine-dominated forests in planned Zaonezhye Nature Park, southeastern part of Zaonezhye Peninsula.



Old growth spruce-dominated forest in Zaonezhye (Photo Boris Rayevsky).

## 2.4 Forest structures and human impact on Zaonezhye Peninsula: a classification and case studies

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### Introduction

Human population history and past land use has a profound and diverse effect on current forest landscapes and forest structures within them (Brumelis et al. 2011). In eastern Fennoscandia, transformation of forests to agricultural land and use of wood for construction and heating has created open cultural landscapes in surroundings of villages (Huttunen 1980, Tikkanen et al. 2014). In Karelia, the landscapes around the old villages are now, after their abandonment, recovering towards more natural stage (Tikkanen et al. 2014, Tikkanen & Chernyakova 2014).

Further away from the villages, slash and burn agriculture and other human activities have increased fire frequency, which has favored presence of pine and deciduous trees in forest landscapes and suppressed spruce (Huttunen 1980, Tikkanen & Chernyakova 2014). As a result, we can find a gradient of human impact with increasing naturalness as a function of increasing distance from villages (Tikkanen et al. 2014).

Zaonezhye peninsula has a long population history and it is has historically been more densely populated than many other areas in the Karelian Republic. In addition, industrial forestry has changed forest structure in many parts of the peninsula (see 2.3. in this volume). High intensity in forest use is known to lead to declining naturalness of forest structures including the amount and diversity of dead wood (Rouvinen et al. 2002). This is detrimental to many rare forest species, which are found in pristine forests and require abundance, diversity and long continuum of dead wood (Martikainen et al. 2000, Similä et al. 2003, Penttilä et al. 2004, Junninen et al. 2006). From the point of view of conservation of biodiversity and planning of conservation area networks it is critically important to ask 1) what effect has past human impact on modern day forest

structures and, especially, 2) can we still find primeval forests, which are potential habitats of rare species in Zaonezhye peninsula.

## Methods

For this study, field inventories and forest structure measurements were carried out in August 2013 using the circular plot method. Each inventory plot had a radius of 15 m (0.07 ha). Plots were chosen subjectively to be representative of the studied forests area (see map, Fig. 1). All living and dead trees with a diameter of more than 10 cm were measured. A vertex device was used to examine trees along the plot borders to accurately define the plot size.

## Results and discussion

According to the field observations and inventories, forests of Zaonezhye Peninsula can be roughly divided into three classes: (A) high-quality primeval forests with negligible human impact, (B) forests with high conservation potential, which are no longer utilized and which are rapidly developing natural values and (C) successional, mostly deciduous, forests growing on abandoned fields or forests pastures. These forests retain important natural values as well due to a large amount of living and dead deciduous trees, as well as the natural succession that has occurred here for dozens of years. Examples of structure, tree volume and species composition in the three classes of forests are given in Tables 1–3 and in Figures 2–5. However, we would like to emphasize that although we made an effort to select representative examples, there is considerable variation in forest structures and composition within these broad classes, which is not fully reflected in these examples.

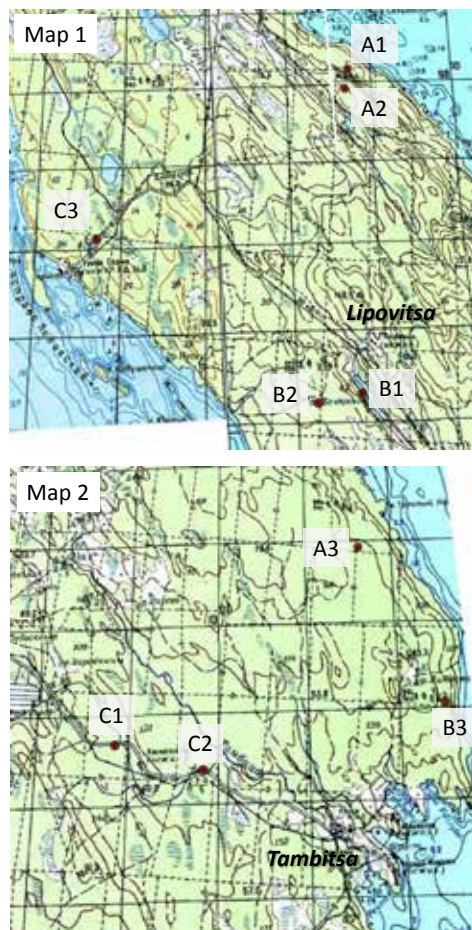


Fig. 1. Locations of the sample plots in Table 1.



The first group (class A) is high-quality primeval forests. These forests exhibit all the qualities of old, intact natural forests, including diverse tree species composition, big trees and complex stand structure as well as a large amount, diversity and continuity of dead wood. There are very few signs of human influence, if any. Examples of structural features of these forests of the highest conservation priority are given in Table 1 and in Figures 2 and 3. At these sites the amount of dead wood ranged from 94 to 248 m<sup>3</sup>/ha and living tree volumes from 113 to 539 m<sup>3</sup>/ha. Not surprisingly, these forests were found from the most remote sites, which were visited; several kilometers from the closest larger settlements.

Table 1. Examples of tree volumes (m<sup>3</sup>/ha) in three plots of the class A primeval forests. Tree volumes are presented for different tree species as well as living and dead trees separately. Coordinates for the plots are given in parenthesis (latitude/longitude). See Figure 1 for plot locations.

Plot	Pinus	Picea	Betula	Populus	Sorbus	Alnus	Total
A1 (62°10'33.11", 35°3'39.88")							
- Living	1.4	110.5	-	54.2	-	59.8	225.9
- Dead	24.7	66.4	7.4	13.1	-	15.7	127.3
<b>- Total</b>	<b>26.1</b>	<b>176.9</b>	<b>7.4</b>	<b>67.4</b>	-	<b>75.6</b>	<b>353.2</b>
A2 (62°10'15.85", 35° 3'32.15")							
- Living	8.7	103.8	-	-	-	-	112.6
- Dead	-	222.8	24.7	-	-	-	247.5
<b>- Total</b>	<b>8.7</b>	<b>327.6</b>	<b>24.7</b>	-	-	-	<b>360.1</b>
A3 (62°17'17.93", 35°33'53.45")							
- Living	-	150.5	52.6	335.5	-	-	538.5
- Dead	-	79.7	-	14.0	-	-	93.7
<b>-Total</b>	-	<b>230.2</b>	<b>52.6</b>	<b>349.5</b>	-	-	<b>632.3</b>



Fig. 2. Primeval forest with a significant amount of large aspens in plot A1 (see Table 1) (Photo Timo Kuuluvainen).



Fig. 3. Primeval forests in plot A2 (see Table 1). In this plot we found the rare fungi species *Pycnoporellus alboluteus* (Photo Timo Kuuluvainen).

The second group (class B) is forests that have been utilized in the past for selective cutting, slash-and-burn cultivation or forest pastures. However, after the cessation of human activities, these forests have developed for dozens of years under natural processes. Therefore, they are rapidly regaining natural structures and they already contain important features of natural forests, such as large trees, layered canopies and a rapidly increasing amount of coarse dead wood. These forests, although still showing signs of past human utilization, can still be considered as forests of high conservation potential. This is the case especially when they are located close to class A forests of the highest conservation priority. Together class A and B forests can form more representative and functional conservation areas. Examples of the composition of forests with high conservation potential are given in Table 2 and in Figure 4. In the study plots, the amount of dead wood ranged from 71 to 193 m<sup>3</sup>/ha and living tree volumes from 180 to 395 m<sup>3</sup>/ha. In Finland, these quantities of coarse woody debris has been found sufficient to support very high number of species depended on dead wood (Martikainen et al. 2000, Similä et al. 2003, Penttilä et al. 2004, Junninen et al. 2006).

Table 2. Examples of tree volumes (m<sup>3</sup>/ha) in three plots of the class B forests with high conservation potential. Tree volumes are presented for different tree species as well as living and dead trees separately. Coordinates for the plots are given in parenthesis (latitude/longitude). See Figure 1 for plot locations.

Plot	Pinus	Picea	Betula	Populus	Sorbus	Alnus	Total
B1 (62° 6'20.58", 35° 3'19.98")							
- Living	57.9	109.3	13.6	-	-	-	180.9
- Dead	25.8	167.7	-	-	-	-	193.4
<b>- Total</b>	<b>83.7</b>	<b>277.0</b>	<b>13.6</b>	-	-	-	<b>374.3</b>
B2 (62° 6'15.45", 35° 2'11.61")							
- Living	10.6	152.9	20.9	-	-	-	184.4
- Dead	-	80.0	-	-	-	-	80.0
<b>- Total</b>	<b>10.6</b>	<b>232.8</b>	<b>20.9</b>	-	-	-	<b>264.4</b>
B2 (62°15'15.91", 35°35'48.08")							
- Living	-	259.6	7.5	127.6	-	-	394.7
- Dead	-	47.1	20.2	2.9	0.8	-	71.0
<b>- Total</b>	-	<b>306.7</b>	<b>27.7</b>	<b>130.5</b>	<b>0.8</b>	-	<b>465.7</b>



Fig. 4. An example of forest with high conservation potential that has clear signs of past human use but also rapidly developing natural values, such as coarse woody debris (Photo Timo Kuuluvainen).

The forests of the third group (class C) are typically located near old, abandoned villages. These forests have been under intensive human influence but are now, after the cessation of human activities, in the early or middle stages of natural forest succession. These are former fields, slash-and-burn sites or pastures near abandoned villages. These forests vary greatly in structure and composition, reflecting different histories of land use as well as the length of time since the area has last been affected by human activities. These successional forests include dense self-thinning alder stands and mixed deciduous stands with alder, birch and (often large) aspen, sometimes spruce in the undergrowth. There are also spruce-dominated stands among the successional forests. These forests provide important habitats for species thriving on living and dead deciduous trees. Examples of the structure and composition of forests with high conservation potential are given in Table 3 and in Figure 5. Even in these secondary forests, the amount of dead wood was relatively high compared to that of intensively managed forests of western Fennoscandia (Fridman & Walheim 2000, Ihalainen & Mäkelä 2009).

Table 3. Examples of tree volumes (m<sup>3</sup>/ha) in three plots of the class C forests, characterized by intensive human influence in the past. Tree volumes are presented for different tree species as well as living and dead trees separately. Coordinates for the plots are given in parenthesis (latitude/longitude). See Figure 1 for plot locations.

Plot	Pinus	Picea	Betula	Populus	Sorbus	Alnus	Total
C1 (62°14'59.28", 35°27'22.18")							
- Living	12.1	175.0	82.8	-	-	1.0	258.8
- Dead	-	42.0	23.3	-	-	-	65.3
<b>- Total</b>	<b>12.1</b>	<b>217.0</b>	<b>106.1</b>	<b>-</b>	<b>-</b>	<b>1.0</b>	<b>324.1</b>
C2 (62°14'38.37", 35°29'35.54")							
- Living	-	132.4	95.9	78.4	0.3	-	306.9
- Dead	-	35.6	3.6	94.2	1.2	-	134.7
<b>- Total</b>	<b>-</b>	<b>168.0</b>	<b>99.5</b>	<b>172.5</b>	<b>1.6</b>	<b>-</b>	<b>441.6</b>
C3 (62° 8'24.90", 34°56'29.94")							
- Living	101.5	137.4	99.8	20.4	0.3	-	359.6
- Dead	-	2.6	10.0	-	-	-	12.6
<b>- Total</b>	<b>101.5</b>	<b>140.0</b>	<b>109.8</b>	<b>20.4</b>	<b>0-3</b>	<b>-</b>	<b>372.2</b>



Fig. 5. An example of a successional, deciduous (class C) forest, developing on an abandoned field (Photo Timo Kuuluvainen).

Overall, we conclude that the past human impact on the current forest structures on the Zaonezhye peninsula can be clearly seen, but also primeval forests of negligible human impact can be found in more remote locations. The cessation of major human influence some dozens of years ago have led to large scale recovery and restoration of natural forest features in many areas. This together with the occurrence of primeval forests of highest conservation priority and culturally modified habitats, opens up promising prospects for designing efficient forest conservation area networks for protection of biodiversity on the Zaonezhye peninsula.

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## 2.5 Mires of the Zaonezhye Peninsula

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### Introduction

Mire ecosystems play an essential role in the boreal zone, both in landscape functioning and in biodiversity conservation. Since the mid-20<sup>th</sup> century, mires in the southern parts of the Republic of Karelia have been extensively drained for forestry and agriculture. Due to these practices, there has been a need for special research and decision making to protect the diversity of wetland ecosystems in the republic (Antipin & Kuznetsov 1998). Since 1950, the Mire Ecosystems Laboratory of the Institute of Biology of the Karelian Research Centre Russian Academy of Sciences has carried out multidisciplinary studies on wetland vegetation, stratigraphy, dynamics and natural resources, as well as their management and protection in the European North of Russia and adjacent regions (Kuznetsov 2003, Elina & Kuznetsov 2006, Elina et al. 2010). For nearly 30 years, the Mire Ecosystems Laboratory has been studying wetland diversity in eastern Fennoscandia as well as mire conservation issues in collaboration with colleagues from Finland (Heikkilä et al. 1997, 2001, Kuznetsov et al. 2012).

Zaonezhye Peninsula lies between two long bays in the northern part of Lake Onega. Its nature is quite different from other parts of eastern Fennoscandia. First, the vegetation is highly diverse owing to the mineral-rich bedrock and soils. Secondly, the dissected terrain and the small size of mires have spared them from large-scale draining. Even though Zaonezhye has been influenced by human activities already for a millennium, there are still substantial areas of undisturbed nature, which are of high conservation value for the entire Northern Europe. Different types of mires are the best-preserved ecosystems in Zaonezhye. Therefore, special research on mire ecosystems has been carried out within the project “Barents Protected Area Network, BPAN”, resulting in proposals for biodiversity conservation in Zaonezhye.

## Study area

Zaonezhye Peninsula features two contrasting landscapes: highly dissected tectonic-denudation ridge landscape in the northwestern and central parts, and glacial lacustrine plain landscape in the eastern and southeastern parts of Zaonezhye. The contrasting landscapes have shaped the patterns of paludification as well as the distribution of mire types in the peninsula. The Mire Ecosystems Laboratory of the Institute of Biology of the Karelian Research Centre RAS has carried out botanical and stratigraphic surveys on some of the mires since 1951. A part of the results have been published (Kozlova 1971, Antipin et al. 1993, 1994, Dyachkova et al. 1993, Kuznetsov & Khokhlova 1994, Elina et al. 1999, Kuznetsov et al. 1999, 2000, 2013, Maksimov 2005). These results have also been used in preparing this paper.

## Material and methods

Satellite imagery and *in situ* surveys revealed 642 undrained mires, covering an area of 15 000 ha. In Zaonezhye, small mires (0.5–10 ha) are widespread, whereas large mires (more than 200 ha) are few. In general, large mires represent mire systems that consist of several massifs, sometimes including different types of mires (Tab. 1, Fig. 1). In the Russian tradition of mire research, a mire massif has been the main object of research. According to this research tradition, individual mires develop in individual depressions. As depressions are filled with peat and expand, individual massifs become connected in mire systems.

Mire massifs are classified based on the composition and structure of plant cover in the central part, as well as the distribution of plant communities along the centre-to-margin gradient of the mire massif (Tsinzerling 1938, Elina et al. 1984, Yurkovskaya 1992). According to Yu.D. Tsinzerling (Tsinzerling 1938), aapa mire massifs also include minerotrophic fens where the central part consists of string-flark or hummock-flack systems. There is a sparse cover of herbs or herbs and mosses on the wet flarks, and peat accumulation has either slowed down or ceased (Kuznetsov 1986, 2003). In this study, peat types were determined according to Russian classification (Tyuremnov 1976), which includes distinctive features for Karelia (Elina et al. 1984). Vegetation dynamics of mires were reconstructed by analysing the botanical composition of peat. Samples were analysed microscopically (with 5% precision) and plant macrofossils were identified (Korotkina 1939). Based on these data, diagrams were plotted to determine paleocommunities, determined by the dominant plant species in each stratum. Computer programme “Korpi” was used to draw these diagrams (Kutenkov 2013 a).

Mire types with similar ecological properties, as well as those difficult to identify in satellite images, were grouped together. Thus, type V (Fig. 1) comprises herbaceous mires on lakeshores as well as herbaceous and herb-moss mires in depressions, which have a pronounced herbaceous cover despite not being associated with lakes.

## Results and discussion

Mapped mires cover 7.6% of the peninsula. Nearly a half of the mires are minerotrophic, forested mires. The tree stands consist of different species and their canopy closure is 40% or higher. There are also areas of paludified forests (with less than 30-cm-thick peat deposits) that raise the degree of paludification on the peninsula to around 10%.

A large amount of mires in the eastern and southeastern parts of the peninsula have been drained and converted into farmland. Altogether 38 drained mire massifs with a combined area of 3207 ha were identified from cartographic materials (Peatland ...

1979) and satellite images (Fig. 2). There has been hardly any drainage for forestry, which has affected no more than 300 ha in the northern part of the peninsula.

In Zaonezhye, mires occupy tectonic and glacial depressions, as well as overgrow bays of Lake Onega and other inland waterbodies. As a result, mires have a NW-SE orientation, which can be clearly seen in Figure 1. The mires of Zaonezhye were formed at different times. In higher parts of the peninsula, where the waters of Lake Onega retreated earlier, mires began forming 8000–9000 BP; whereas in the Lake Onega bays, mire formation occurred 3000–5000 BP (Elina et al. 1999, Kuznetsov et al. 1999). These mires are of both terrestrial and lacustrine origin. In tectonic depression, lacustrine-paludal deposits are often five to seven (or nine) metres, and sapropel deposits one to several meters thick. In one herbaceous mire on the southern shore of Lake Karasozero, there is over eight metres of sapropel, with a metre of quagmire peat on top. There are also mires in depressions, resembling gullies, with four to six metres of peat deposits of terrestrial origin. Examples of peat stratigraphy and formation of massifs are given below. In moraine and lacustrine sediments, as well as in the Lake Onega bays, peat deposits are thinner (between one and three metres).

Table I. Types of mire massifs on Zaonezhye Peninsula.

Type of mire massif Number	Number	Area, ha (%)	Min. and max. area of massif, ha	Min. and max. area of massif, ha
Ombrotrophic ridge-hollow bogs (raised bogs) (I)		Average area of massif, ha	238	61 – 358
Ombrotrophic pine-dwarf shrub-cotton-grass- <i>Sphagnum</i> bogs (pine bogs) (II)		Min. and max. area of massif, ha	12	0.5 – 200
Mesotrophic tree-grass- <i>Sphagnum</i> mires (III)		1730 (12)	14	0.5 – 184
Mesoeutrophic string-flark aapa mires (IV)	7	326 (2)	82	1 – 168
Mesoeutrophic and eutrophic herb-moss and herb mires (V)	118	2003 (13)	15	0.5 – 330
Minerotrophic forested mires (VI)	105	7378 (49)	77	2– 586
Undetermined mire type (VII)*	82	367 (3)	4	0.5 – 19
<b>Total</b>	<b>642</b>	<b>15064 (100)</b>	<b>24</b>	<b>0.5–586</b>

\*These include small mires whose plant cover could not be determined.

Zaonezhye Peninsula is characterized by basic and ultrabasic bedrock, whose clasts are found also in Quaternary sediments. As a consequence, groundwater discharge to mires is highly mineralized and minerotrophic mires are widespread (Tab. 1). It has made little sense to drain mires in the ridge landscape due to the topography and the small size of mires. Therefore, nearly all mires on the peninsula remain intact. As a result, the mires of Zaonezhye feature a high diversity at several levels of ecosystem organization.

The mires of Zaonezhye contain around 240 vascular plant species, which is over 70% of the entire mire flora in Karelia (Kuznetsov 2012). There are several regionally red-listed species (Ivanter & Kuznetsov 2007), including *Epipactis palustris*, *Malaxis monophyllos* and *Dactylorhiza traunsteineri*, as well as a number of Siberian species at the western limit of their distribution that are relatively rare in Fennoscandia, including *Ligularia sibirica* and *Rubus humulifolius*. The moss flora of the Zaonezhye mires is also relatively comprehensive. There are around 90 species, which account for more than 60% of the moss flora of Karelian mires. Also rare species occur, some of which are at the limit of their range, including *Sphagnum pulchrum*, *S. lindbergii*, *S.*

*aongstroemii*, *Hamatocaulis vernicosus* and *Loeskyppnum badium* (Boyчук & Kuznetsov 2000, Maksimov & Syrjanen 2014).

Also, the plant communities of Zaonezhye mires are highly diverse. They represent more than a half of known syntaxa of mire vegetation in Karelia (Kuznetsov, 2003, 2012). Especially noteworthy is the wide range of eutrophic communities of herbaceous and herb-moss mires as well as tree-herb-moss mires. These mires are of high conservation value for the whole of Northern Europe. Below we give a short description of plant cover and formation patterns of the main types of mire massifs in Zaonezhye.

**Ombrotrophic ridge-hollow *Sphagnum* bogs** occupy 956 ha (6%) and comprise several relatively large mire systems (Yuno, Pivgozerskoe, and Koybozerskoe) in Zaonezhye. Their central parts are characterized by a ridge-hollow or hummock-hollow microtopography (Fig. 3). Dwarf shrub-*Sphagnum* communities with *Sphagnum fuscum* (sometimes *S. magellanicum*) and the occasional pine grow on the ridges, whereas the hollows are dominated by *Sphagnum balticum* and *Eriophorum vaginatum*, sometimes *Scheuchzeria palustris*. These mires may also have narrow water tracks, occupied by mesotrophic sedge-*Sphagnum* communities (*Carex rostrata* – *Sphagnum fallax*). The mire margins are covered by pine-cottongrass-dwarf shrub-*Sphagnum* communities, which are also habitats of cranberry and cloudberry. Among these mires, of particular conservation value is the Koybozerskoe mire, where moss species rare for Zaonezhye have been found, including *Sphagnum pulchrum*, *S. lindbergii* and *S. aongstroemii* (Kuznetsov et al. 2000).

**Ombrotrophic pine-dwarf shrub-cottongrass-*Sphagnum* bogs** occupy ca. 2300 ha (15%) in Zaonezhye. These mires are represented by a large number of small mire massifs, ranging from 0.5 to 10 ha, and only a few mires larger than 100 ha. Their tree stands are sparse (with a canopy closure of 0.2–0.4%) and their tree layers are 4–10 m (sometimes 12–14 m) tall. The ground cover is dominated by *Rubus chamaemorus*, which is a common dwarf shrub on wetlands. Also *Eriophorum vaginatum* is often present. There is a continuous moss cover, comprising *Sphagnum angustifolium*, *S. magellanicum*, *S. russowii*, *S. fuscum*, *S. capillifolium* and *Pleurozium schreberi* in different proportions. There is little variation in microtopography, although dwarf shrubs are more abundant in elevated areas around tree trunks.

These mires are usually relatively shallow (2–3 m thick). In most cases their formation began with minerotrophic stages. A profile of this type of mire is shown in Figure 4. Its formation began with a eutrophic horsetail-*Sphagnum* community (Borehole 2), which was soon replaced by a cottongrass-*Sphagnum* mesotrophic community, followed by an ombrotrophic stage. Peat bog deposits in the mire are two metres thick. At the margins (Boreholes 1 and 3) the mire has not gone through a minerotrophic stage.

**Aapa mires** occupy 326 ha (2%) of the peninsula. These mires are confined to narrow depressions and abundantly fed by groundwater from the mineral banks. They form a part of a number of mire systems, together with other types of mire massifs. Central parts of aapa mires are characterized by string-flark and hummock-flark complexes, with herbaceous or herb-*Hypnum* flarks. The formation of these complexes in the aapa mires of Zaonezhye began relatively recently. Therefore, the strings are low (10–20 cm) and the herbaceous cover of the flarks is relatively dense. These complexes occupy 20–30% of the area of the massifs. Owing to highly mineralized groundwater and a high flow rate, the vegetation of the complexes is eutrophic or mesoeutrophic. Microtopographic elevations are covered by herb-*Sphagnum* (*Sphagnum centrale*, *S. warnstorffii*, *S. subfulvum*, *S. teres*) communities. The field layer is dominated by *Carex lasiocarpa* and *Molinia caerulea*, with frequent *Potentilla erecta* and *Trientalis europaea*, as well as *Juniperus communis* and short pines. The flarks host herbaceous and herb-*Hypnum* (*Warnstorfia exannulata*, *Scorpidium scorpioides*) communities, sometimes with



*Sphagnum subsecundum* and *S. teres*. The field layer consists of sedges (*Carex lasiocarpa*, *C. limosa*, *C. livida*, *C. chordorrhiza*), *Menyanthes trifoliata*, *Equisetum fluviatile* and *Utricularia intermedia*. Most of the area in aapa mires is occupied by herb-moss eutrophic and mesoeutrophic communities, and there is little variation in microtopography. The rims of aapa mires are covered by mesotrophic tree-herb-*Sphagnum* communities. Due to this feature, aapa mires in Zaonezhye are similar to herb-moss mires, which makes identifying these two types in satellite images and *in-situ* surveys problematic.

**Kalegubskoe mire** (№ 15, Fig. 1) illustrates the formation of aapa mires. It covers 168 ha in a deep and narrow tectonic depression, which is over 5 km long, and its waters discharge to Lake Onega. The peat deposits of Kalegubskoe mire are 5.5 metres thick (Fig. 5, 6). Its formation began with eutrophic birch-reed communities (stage I, Fig. 6). These communities persisted for several millennia, during which the mire underwent changes in herb and moss cover composition (stages II, III). As a result, there are four metres of woody and woody-herbaceous fen peat deposits on Kalegubskoe mire. The central part of the mire is covered by 1.5 metres of sedge fen peat deposits from sedge-moss communities (stage IV). This is a typical situation for aapa mires, which have been developing since the early sub-Atlantic period (ca. 2500 BP) (Kuznetsov, 1986). A cooling climate and increased moisture were the driving forces in the formation of these mires, causing a rise in water level and water retention. In this specific mire, trees have been replaced by wet herb-moss aapa complexes.

**Eutrophic and mesoeutrophic herb-moss mires** develop in basins with an ample groundwater feed, sometimes from springs. These and mires on lakeshores together make up 13% of all the mires on the peninsula. Herb-moss mires feature a relatively diverse plant cover. The field layer consists of various sedge species with several wetland herbs. The moss cover is composed of both Sphagna (*Sphagnum obtusum*, *S. subsecundum*, *S. teres*, *S. centrale*), and Bryidae (*Warnstorfia exannulata*, *Hamatocaulis vernicosus*, *Cynclidium stygium*, *Campylium stellatum*, *Paludella squarrosa*, *Scorpidium scorpioides*, *Tomentypnum nitens*). The microtopography of the mires is indistinct, and the peat accumulation rate is high. There are only a few woody plants. Among them, *Picea x fennica* with drooping tops usually grow around hummocks, associated with groundwater springs. The flora of these mires comprises a number of rare and calciphile species, including *Epipactis palustris*, *Malaxis monophyllos*, *Bistorta major*, *Rumex fontanopaludosus*, *Ligularia sibirica* and *Dactylorhiza traunsteineri*.

**Dlinnoe mire** (№ 7, Fig. 1) is a system of several herb-moss mire massifs, formed in narrow tectonic depressions. It consists of small ombrotrophic dwarf shrub-*Sphagnum* mires that are not flooded by groundwater. At the centre of one of the mire massifs is Lake Chelozero. A stratigraphic profile has been established 100 metres south of the lake (Fig. 7). In this part, the depth of the mire is up to 6.5 metres. The lower strata of the deposit are made up of woody and woody-reed fen peat, suggesting that the mire developed from birch-reed communities on land. (Fig. 8, stage I). In this part of the mire, the lake has fluctuated and its waters have spilled (as the lake has expanded) onto the mire surface more than once over the history of the mire. As a result, there are 0.5–1.5 m thick water lenses in the peat deposit (Fig. 7, boreholes 4, 5; Fig. 8, stages II, V). The analysis of plant succession from borehole 4 (Fig. 8) revealed a 75 cm water lens (II), suggesting that soon after 0.5 m of woody-reed peat was deposited, the mire was flooded again (stage 1). Subsequently, a eutrophic reed-*Sphagnum* community (III) was formed, soon replaced by a meso-oligotrophic cottongrass-*Sphagnum* community (IV) with *Sphagnum angustifolium*. This succession means that there was no longer groundwater supply to the central part of the mire. Another two-metres-thick water lens (V) indicates yet another flooding of the site. Eventually, the waterbed was covered with a floating mat, consisting of a mesotrophic *Scheuchzeria-Sphagnum* community with *Sphagnum obtusum* (VI), followed by a me-

so-oligotrophic cottongrass-*Sphagnum* community (VII) with *Sphagnum magellanicum*. In the deposit, the transition to an ombrotrophic stage (VIII) with *Sphagnum fuscum* is visible at the depth of one metre. This small (ca. 30 m wide) dwarf shrub-cottongrass-*Sphagnum* community in the centre of the mire has no influx of groundwater. It is surrounded on all sides by eutrophic herb-moss communities. The vegetation dynamics of a sedge-*Sphagnum* community (borehole 3 in Fig. 7) are shown in Fig. 9. Also this part of the mire began with a tree-reed community (stage I), which was replaced by reed-*Sphagnum* communities (stages II, III). These communities persisted several millennia, resulting in 3.5-metre deposits of herb-*Sphagnum* fen peat. In the top 25 cm of the peat deposit, there is evidence of a recent rise in water content and reduction in flow rate, which have driven plant succession at the site (stage IV). As a result, the hydrophilous *Sphagnum subsecundum* has increased, whereas reeds have nearly disappeared.

On lakeshores, communities of herbaceous mires dominated by *Carex elata* spp. *omskiana*, *C. diandra*, *C. cespitosa*, *C. vesicaria*, *Phragmites australis*, *Equisetum palustre*, *Comarum palustre* and *Menyanthes trifoliata* are widespread (Fig. 10). These communities consist of over 100 vascular plant species, including a number of semi-aquatic plants that are not found in any other types of mires. Depending on the duration of spring and summer floods, the moss cover is either poor or completely missing in these mires. Their relatively shallow (1–2 m) peat deposits consist of herbaceous peat with high ash content (Kuznetsov et al. 2000).

**Mesotrophic tree-grass-*Sphagnum* mires** cover 1730 ha (12%) in Zaonezhye. These small mire massifs occupy depressions of different genesis. Their tree layer consists of pine and birch stands that are between 3–4 and 6–8 metres high, with a canopy closure of 0.2–0.3. The field layer is made up of sedges, wetland herb species and occasionally reeds. In addition, hummocks around tree trunks are often covered with wetland dwarf shrubs. There is also a continuous moss cover, dominated by *Sphagnum angustifolium*, with *Sphagnum centrale*, *S. russowii*, *S. magellanicum* and *S. teres*.

**Forested mires** account for half of the total area of mires in Zaonezhye. Forested mires occur on moraine plains as well as in depressions in the ridge terrain. These mire massifs range in size from two to several hundred hectares, and nearly all of them are minerotrophic. The mires are of different genesis and their lacustrine-paludal deposits range from 0.5–1 to 5.5 metres in depth. Forested mires have a highly diverse plant cover, consisting of a wide range of tree-grass and tree-grass-moss communities. The tree stands are between 10–12 to 20–22 metres tall and their canopy closure is 0.4–0.7%. There are single-species as well as mixed stands of pine, spruce, downy birch and black alder on these mires (Kutenkov 2013 b). Forested mire communities either form separate mire massifs, or occur at the margins of other mires. Eutrophic spruce, birch and black alder stands are widespread. Their herbaceous field layer is dominated by *Filipendula ulmaria*, sometimes *Phragmites australis*, sedges (*Carex cespitosa*, *C. vesicaria*, *C. rostrata*) and *Calla palustris*. The microtopography of these mires is characterized by wet microdepressions and high hummocks around tree trunks. Due to the high diversity of microhabitats, there is also a high diversity of plant communities: Up to 57 vascular plant species and 20 moss species have been found from one site. In forested mires, the moss cover is discontinuous and consists of a number of eutrophic species, including *Sphagnum warnstorffii*, *S. squarrosum*, *S. teres*, *S. centrale*, *Tomentypnum nitens*, *Campylium stellatum*, *Scorpidium revolvens*, *Calliergon cordifolium*, *Pseudobryum cinclidioides*, *Plagiomnium ellipticum* and *Calliergonella cuspidata*. *Sphagnum angustifolium*, *S. russowii* and other forest bryophytes grow on the hummocks around tree trunks, together with dwarf shrub and herb species, associated with forests. Of special interest are eutrophic herb-*Sphagnum* pine mires, where *Molinia caerulea* dominates the field layer. These mires are associated with carbonaceous bedrock and

contain a number of calciphile species. Their moss layer is dominated by *Sphagnum warnstorffii*, although other eutrophic species are also present.

In Zaonezhye, mesotrophic grass-*Sphagnum* pine mires as well as bilberry-*Sphagnum* and horsetail-*Sphagnum* spruce mires are rare and small. Also ombrotrophic dwarf shrub-*Sphagnum* pine mires are rare. Overall, the flora of forested mires in Zaonezhye consists of 155 vascular plant species and 68 moss species. Due to their species diversity, the mires of Zaonezhye are of high conservation value (Kutenkov 2013 b).

## Mires conservation in Zaonezhye

The Kizhy federal nature reserve was established to protect the diverse ecosystems of the skerries in the southeastern part of Zaonezhye. There are also herbaceous mires on the lakeshores within the boundaries of the reserve. In addition, seven regional mire nature monuments have been established on Zaonezhye Peninsula (Tab. 2, Fig. 1). Also a number of other, both representative and unique, mires merit a conservation status (Tab. 2; Fig. 1). A feasibility study that has been carried out for the Zaonezhye landscape reserve and is under discussion at the Ministry of Nature Use and Environment of the Republic of Karelia (Gromtsev 2013). If the landscape reserve is established, all these mires will be protected and the biodiversity of mire ecosystems in Zaonezhye will be conserved.

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Table 2. Protected and nominated mires.

No in Fig. 1	Name	Area, ha	Type of mire massif	Conservation status
1	Pigma	365	Mire system of M* tree-grass- <i>Sphagnum</i> and ME herb mire massifs	NM****
2	Lan'	30	M tree-grass- <i>Sphagnum</i>	RC*****
3	Maloe Unitskoe	31	M tree-grass- <i>Sphagnum</i>	RC
4	Mire near Nizhnee Pigmosero Lake	101	O** pine bog	RC
5	Yuno	249	O raised bog	RC
	near village Mikheeva Selga	79	O pine bog	RC
6	Syarg	118	M tree-grass- <i>Sphagnum</i>	RC
7	Dlinnoe	330	Mire system of ME herb-moss mire massifs	RC
8	Lovosinskoe	26	O pine bog	RC
9	near Nizhnee Munosero Lake	75	ME*** herb mire	RC
10	Munoserskoe	28	ME herb mire	RC
11	Cherkoserskoe	23	O pine bog	RC
12	Koiboserskoe	331	Mire system of O raised bog and M tree-grass- <i>Sphagnum</i> massifs	RC
13	Troinoe 3	46	ME aapa mire	RC
14	Troinoe 6	64	O raised bog	RC
15	Kalegubskoe	168	Mire system of ME aapa mire and ME herb-moss mire massifs	NM
16	near Lake Lelikosero	200	O pine bog	NM
17	along Lel'rechka River	95	M tree-grass- <i>Sphagnum</i>	NM
18	near Lake Kosmosero	10,6	ME aapa mire	RC
19	Zamoshye	178	ME herb mire	NM
20	near Petrikovo Bay	43	ME herb mire	NM
21	Near village Bojarschina	24	ME herb mire	NM
22	Kosmoserskoe	379	ME forested mire	RC

\* M –mesotrophic, \*\*O –ombrotrophic, \*\*\*ME – mesoeutrophic,

\*\*\*\*NM - nature monument,

\*\*\*\*\* RC –recommended for conservation

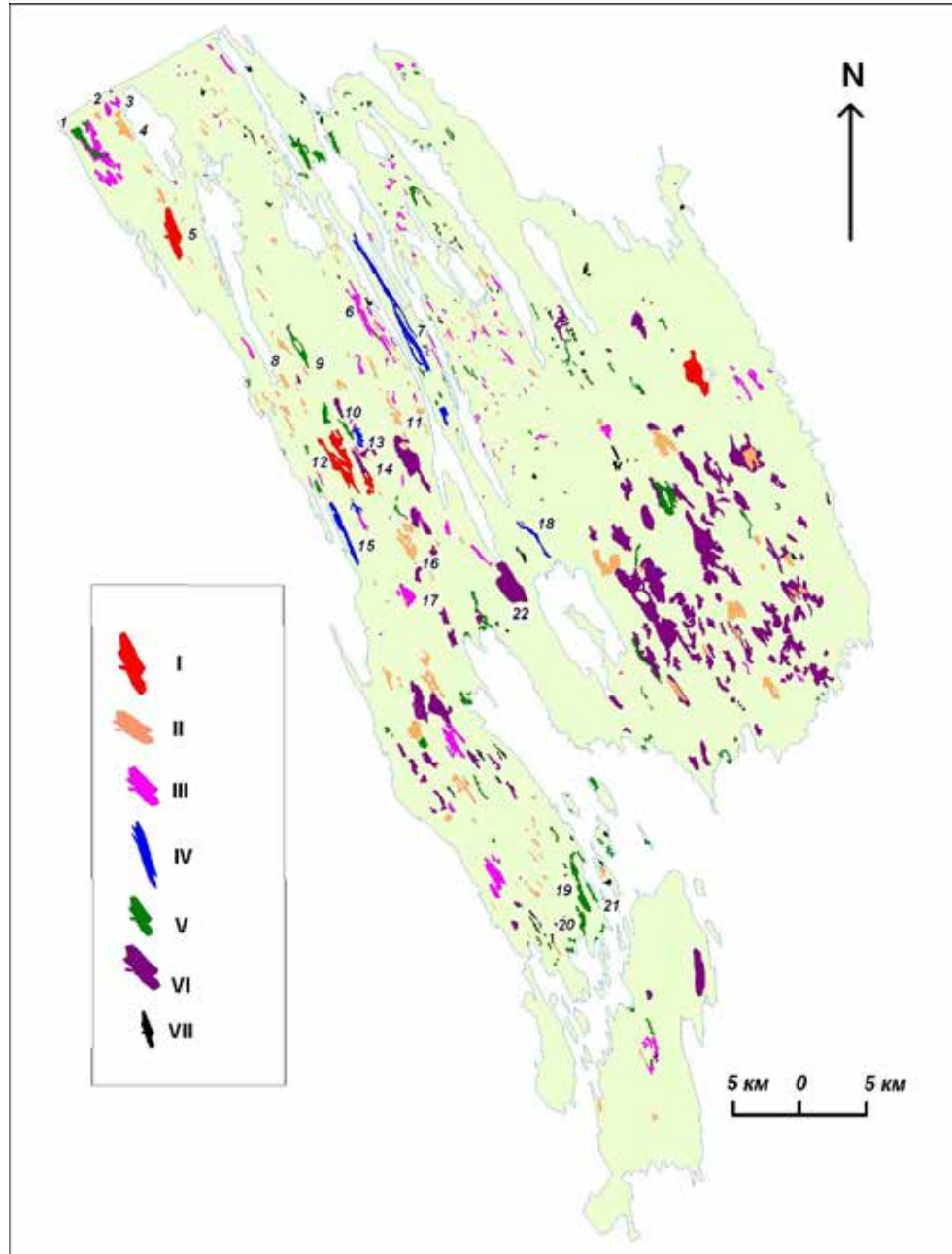


Fig. 1. Undisturbed mires in Zaonezhye.

I – VI – Types of mire massifs: I – Ombrotrophic ridge-hollow bog (raised bog), II – Ombrotrophic pine-dwarf shrub-cottongrass-*Sphagnum* bog (pine bog), III – Mesotrophic tree-grass-*Sphagnum* mire, IV – Mesoeutrophic string-flark aapa mire, V – Mesoeutrophic and eutrophic herb-moss and herb mire; VI – Minerotrophic forested mire, VII – Small mires of undetermined type. 1-22 – Protected and nominated mires.

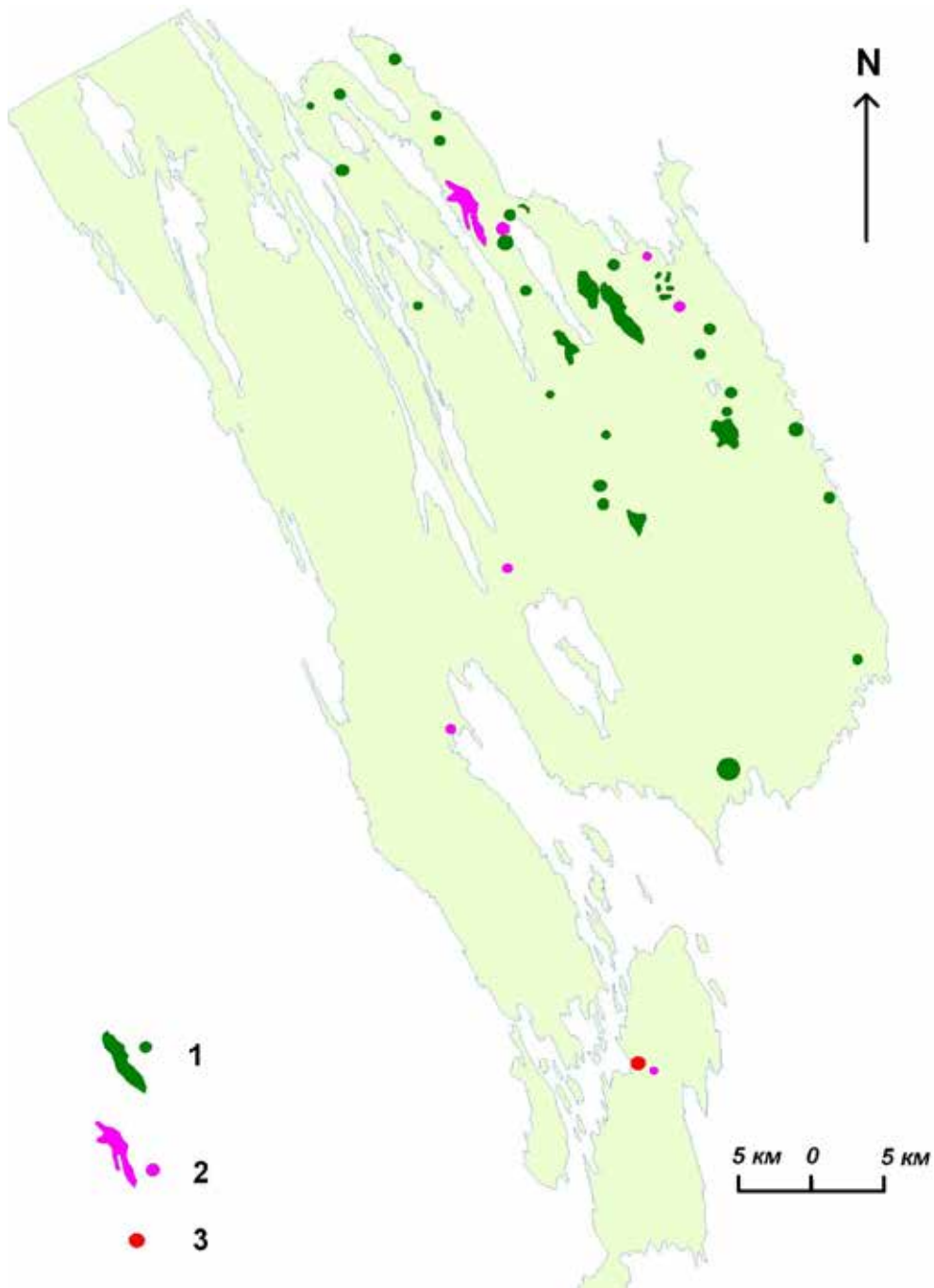


Fig. 2. Mires drained for agriculture in Zaonezhye.  
 1 - eutropic, 2 - mesotrophic, 3 - ombrotrophic



Fig. 3. Central part of an ombrotrophic ridge-hollow bog. (Photo Pavel Tokarev).

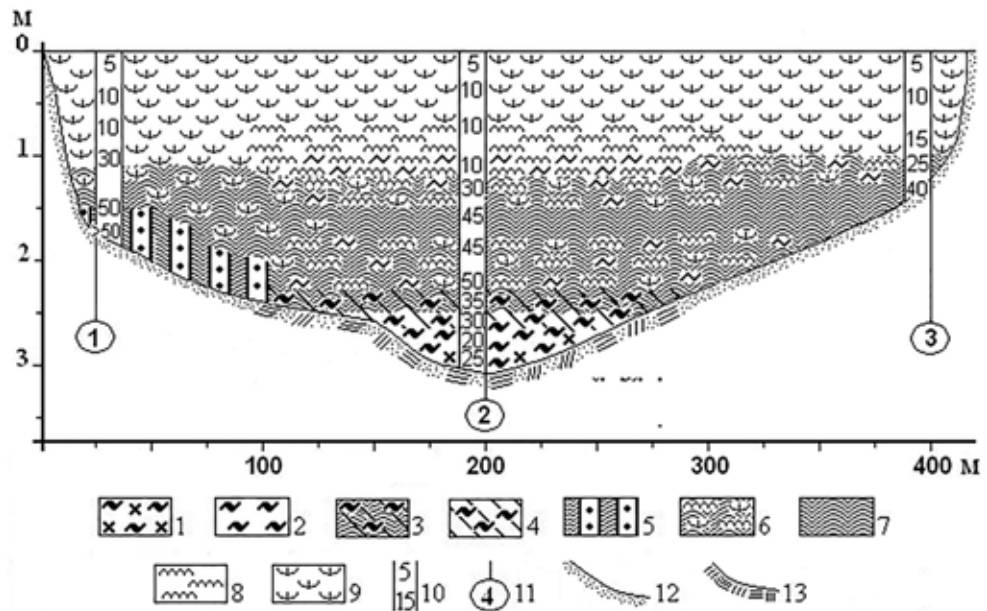


Fig. 4. Stratigraphic profile of the pine-dwarf shrub-*Sphagnum* mire.

Abbreviations: peat types: eutrophic (1-2): 1- *Equisetum-Sphagnum*, 2- *Sphagnum*, mesotrophic (3-4): 3- cottongrass-*Sphagnum*, 4- *Sphagnum*, ombrotrophic (5-9): 5- pine-cottongrass, 6- cottongrass- *Sphagnum*, 7- cottongrass, 8- *magellanicum*, 9- *angustifolium*; 10- degree of decomposition (%), 11- borehole number, 12- till, 13- clay



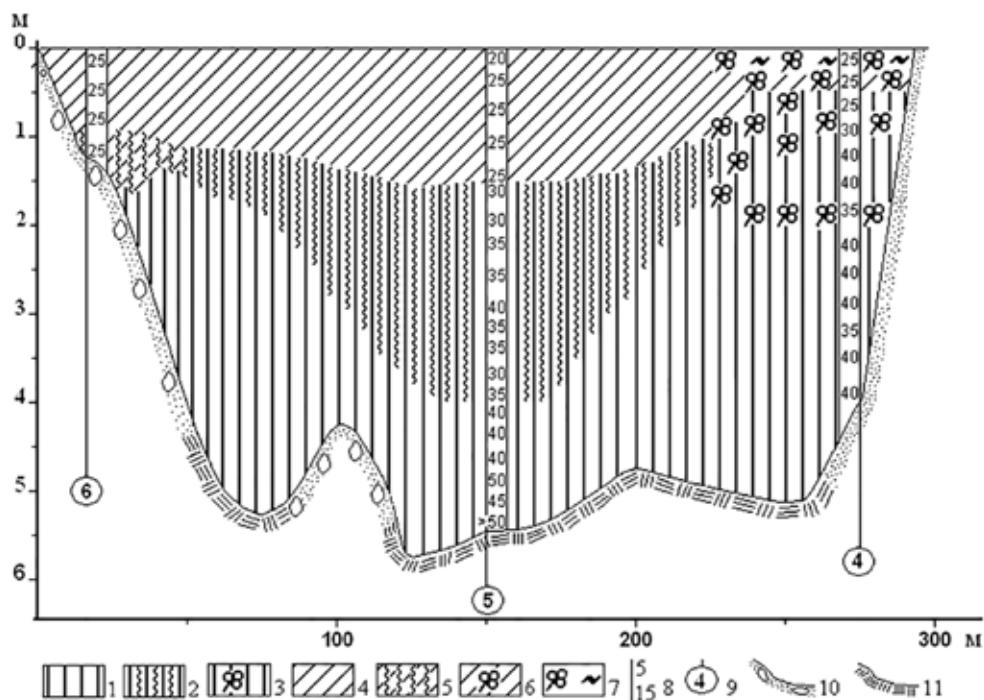


Fig. 5. Stratigraphic profile of the Kalegubskoe aapa mire.

Abbreviations: peat types (1-7): fen types: 1- woody, 2- woody-reed, 3- woody-*Menyanthes*, 4- sedge, 5- *Hypnum*-reed, 6- sedge-*Menyanthes*, 7- *Menyanthes*-*Sphagnum*; 8- degree of decomposition (%), 9- borehole number, 10- till, 11- clay.

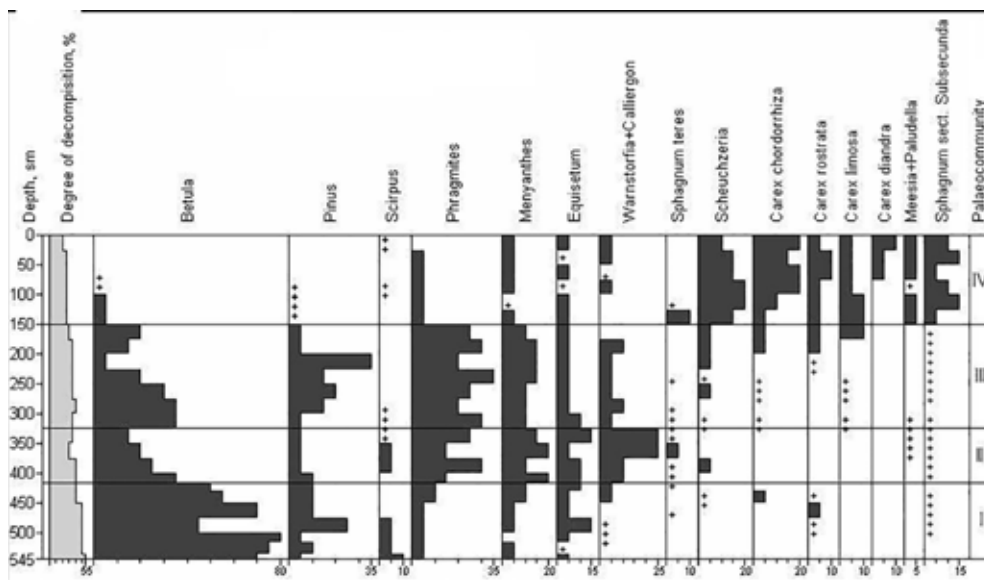


Fig. 6. Plant succession in the central part of the Kalegubskoe mire (borehole 5).

Palaeocommunity (stage): I - *Betula*+*Pinus* - *Phragmites*+*Equisetum*, II - *Betula* - *Phragmites*+*Menyanthes* - *Warnstorfia* sp.+*Calliergon* sp., III - *Betula*+*Pinus* - *Phragmites*+ *Menyanthes*, IV - *Carex* (*chordorrhiza*+*limosa*+*rostrata*+*diandra*)+*Scheuchzeria palustris* - *Sphagnum* sect. *Subsecunda*.

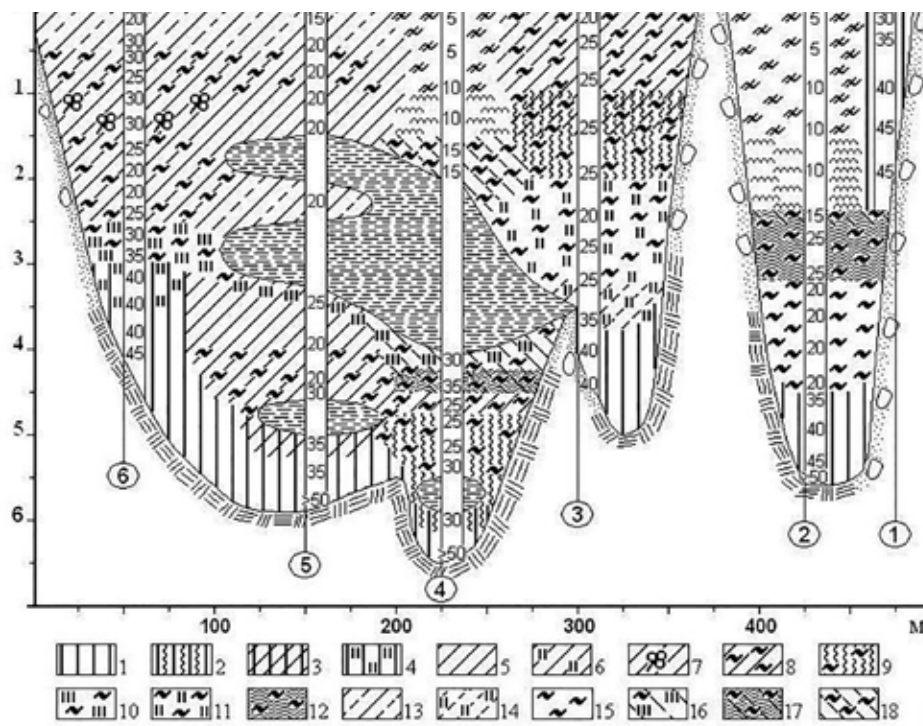


Fig.7. Stratigraphic profile of the Dlinnoe mire.

Abbreviations: peat types: eutrophic (1-15): 1- woody, 2- woody-reed, 3- woody-sedge, 4-woody-grass, 5- sedge, 6- sedge-grass, 7- *Menyanthes*-sedge, 8- sedge-*Sphagnum*, 9- reed-*Sphagnum*, 10- *Scheuchzeria*-*Sphagnum*, 11- grass-*Sphagnum*, 12- cotton grass-*Sphagnum*, 13- sedge-Bryales, 14- grass-Bryales, 15- *Sphagnum*, mesotrophic (16-18): 16- *Scheuchzeria*-*Sphagnum*, 17- cottongrass-*Sphagnum*, 18- *Sphagnum*, ombrotrophic (19-20): 19- *fuscum*, 20- *magellanicum*; 21- water, 22- degree of decomposition (%), 23- borehole number, 24- till, 2- clay

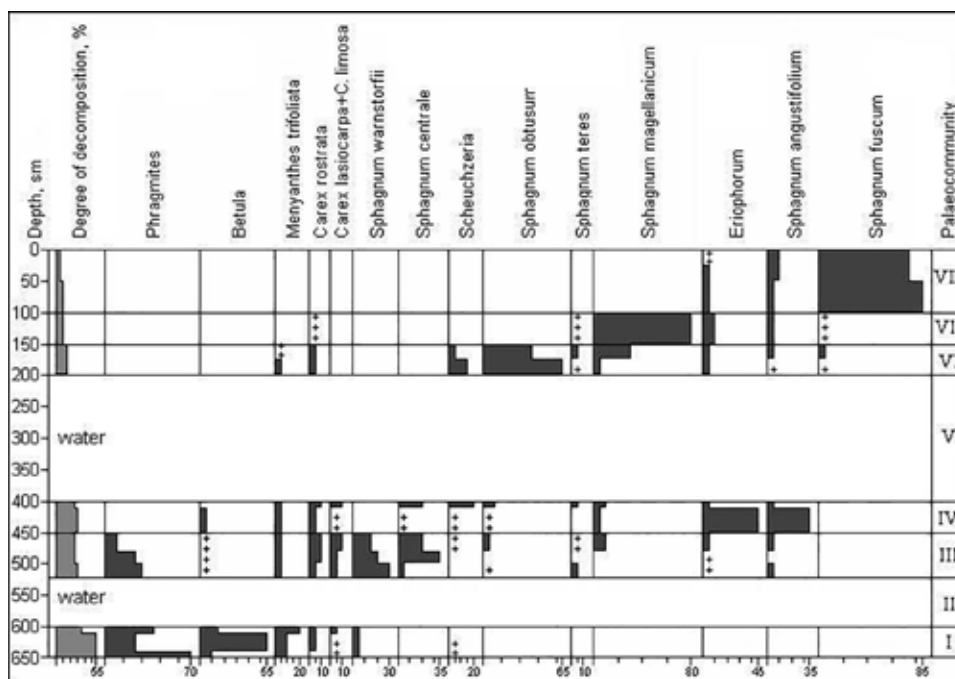


Fig. 8. Plant succession in the central part of the Dlinnoe mire (borehole 4).

Palaeocommunity (stage): I – *Betula* – *Phragmites*, II – water, III – *Phragmites* + *Sphagnum warnstorffii*+*S. centrale*, IV – *Eriophorum* – *Sphagnum angustifolium*, V – water, VI – *Scheuchzeria palustris*+*Carex rostrata* – *Sphagnum obtusum*, VII – *Eriophorum* – *Sphagnum magellanicum*, VIII – *Eriophorum* – *Sphagnum fuscum*.

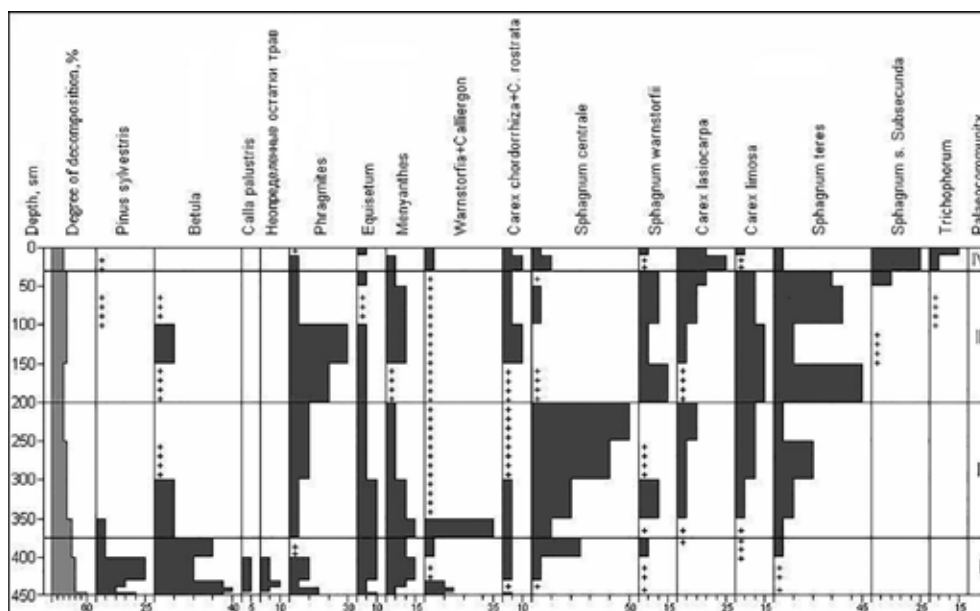


Fig. 9. Plant succession in the eutrophic part of the Dlinnoe mire (borehole 3).

Palaeocommunity (stage): I – *Betula*+*Pinus* – *Phragmites*, II – *Phragmites*+*Equisetum*+*Menyanthes* – *Sphagnum centrale*+*S. teres*, III – *Phragmites*+*Carex lasiocarpa* – *Sphagnum teres*+*S. warnstorffii*, IV – *Carex lasiocarpa*+*Trichophorum* – *Sphagnum* sect. *Subsecunda*.



Fig. 10. Mesoeutrophic herbaceous mire (Photo: V.L. Mironov).

## 2.6 Meadows in Zaonezhye

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### Introduction

Zaonezhye Peninsula, or Zaonezhye, is one of the most important grassland areas in Karelia. The total area of seminatural grasslands in Zaonezhye is estimated at 70 km<sup>2</sup> (excluding abandoned, reclaimed fields), or approximately 3.5% of the total area. This amount of seminatural grassland is approximately nine times more than the average for Karelia (0.39% by 2012). 90% of the grasslands are located in the eastern lowlands of Zaonezhye that historically have been more suitable for agriculture and, therefore, human settlements. However, since the middle of the 20th century even this part of the region has not been able to meet the needs of modern intensive agriculture. People have moved out of villages, livestock has been drastically decreased and arable land has been abandoned. The decrease in cattle farming has caused a decline in hay meadows and pastureland. As a result, local grasslands have been reforested. At the same time grassland area has slightly increased due to the growth of grassland vegetation on abandoned fields. These processes became even more drastic during the 1990s economic crisis. Large cattle farms almost disappeared, while small private farms became increasingly unprofitable due to cheap dairy and meat products, imported from other regions. Nowadays extensive meadow landscapes can be found in the vicinity of the Tolvuya village (over 1000 hectares in total), in the Kizhi archipelago (ca. 1000 ha) and near the Kuzaranda village (ca. 800 hectares). Large grassland areas (over 100 ha) are located also close to settlements, including Lambasruchey, Velikaya Guba, Putka and Padmozero.

## History of the study of the Zaonezhye' grasslands

The grasslands of Zaonezhye are probably the best studied in the Republic of Karelia. In the middle of the 20th century, Marianna Ramenskaya conducted research in the former Zaonezhye municipality. Discoveries made by her group are included in the monograph 'Meadow vegetation of Karelia' (Ramenskaya, 1958). This publication is still considered the basic work on Karelian grasslands. Biogeographically, the grasslands of Zaonezhye are a part of the Zaonezhye subprovince of the Southeastern grassland province. The subprovince also includes western parts of Medvezhegorsk and eastern parts of Kondopoga municipalities. On the whole, Zaonezhye is one of the most favorable areas for agriculture and also meadow vegetation in Karelia. First, the geological diversity of the region, especially its carbon-rich shungite mineraloids, provides dark and fertile soils. These soils maintain a better thermal regime during the long, light subpolar summer months. Secondly, the warm and humid climate of Zaonezhye is favourable for agriculture. The mean annual temperature is even higher here than in northern Ladoga. As a consequence, Zaonezhye has become one of the most important agricultural centres in the Russian North.

As a result of traditional agricultural practises, grassland vegetation is well developed in Zaonezhye. In her monograph, Marianne Ramenskaya describes the rich vegetation of uncultivated areas in Zaonezhye as follows: "There is indeed a rich vegetation on the dark-coloured, gravel-rich uncultivated soils of Zaonezhye. Uncultivated land is exceptionally abundant, as stony soils are being abandoned due to difficulties in their mechanical treatment." (p. 55). Unfortunately, the chapter on uncultivated land does not include information about its vegetation structure. Ramenskaya described in general terms six groups of grassland vegetation from dry to mesic meadows, three of which were found in Zaonezhye.

In the 1980s and 1990s, Valentina Yudina studied meadows in Zaonezhye and later published the results on meadow vegetation on the islands of Kizhi and Volkostrov (Yudina 1999) as well as on mainland Kizhi (Yudina 2000). Yudina divided seven or eight associations of mesic grassland vegetation using the dominant approach. Syntaxa were named after their dominant vegetation type, e.g. "herb-rich" or "leguminous herb-rich".

During the late 1990s and early 2000s, Sergey Znamenskiy carried out field studies on the Kizhi archipelago as well as in the vicinity of Tolvuya and Kuzaranda. As a result of these studies, Znamenskiy described five vegetation associations based on ecology and topography. Different vegetation associations have different soil features, including soil nitrogen level and grain size. Each association is characterized by an ecologically uniform group of indicator species occurring in certain environmental conditions. In 2012 Znamenskiy also studied meadows of the western selkä area of Zaonezhye. Consequently, the classification of grasslands in southern boreal Karealia now consists of four associations of dry and mesic meadows.

**Nitrofilous tall-weed associations of *Antriscetum sylvestris*** (Fig. 1) are one of the most widely distributed grassland associations in Zaonezhye. These associations occupy a large part of abandoned fields and hay meadows where the cessation of agriculture has resulted in the accumulation of dead litter, combined with the eutrophication of soils. A very low species density (on average 12-14 species/m<sup>2</sup>) and a large amount of nitrophilous species characterize these communities. Indicator species include *Anthriscus sylvestris* (L.) Hoffm., *Artemisia vulgaris* L., *Heracleum sibiricum* L., *Dactylis glomerata* L., *Elymus repens* (L.) Gould and *Urtica dioica* L., which are also dominant species in these communities. Depending on the history of the grassland vegetation, species from other ecological groups also occur as subdominant or satellite species. Also Siberian Hogweed (*Heracleum sibiricum*) is characteristic of

the *Antriscetum* communities in Zaonezhye. However, Siberian Hogweed is mainly found in the eastern parts of the region, while *Anthriscus sylvestris* is more common in the western parts of Zaonezhye, as well as in southern boreal Karelia in general.

As mentioned previously, the biodiversity of the *Antriscetum* communities is very low. However, their species pool can consist of up to 60-70 species of vascular plants. Therefore, *Antriscetum* communities can be turned into normal grassland with a few years of habitat management.

Mesic meadows in Zaonezhye are divided into two associations that share a proportion of mesophytic plant species, including *Achillea millefolium* L., *Campanula patula* L., *Galium album* L., *Hypericum maculatum* Crantz., *Lathyrus pratensis* L., *Phleum pratense* L., *Ranunculus acris* L., *Trifolium pratense* L., *Vicia cracca* L. and *Veronica chamaedrys* L.

In the mesic meadows of Zaonezhye, Brown Knapweed (*Centaurea jacea* L.) is common, whereas Wig Knapweed (*C. phrygia* L.) is relatively rare, unlike in the rest of southern boreal Karelia. Also a third knapweed species, Greater Knapweed (*C. scabiosa* L.), occurs more frequently here than in neighbouring parts of Karelia.

**Tall grass association *Magnograminetum*** (Fig. 2, 2a) occurs mainly on moderately humid clay soils on lacustrine plains and flat-topped eskers. This association is particularly common on the eastern plains of Zaonezhye. Indicator species include *Carex ovalis* Gooden., *Cerastium fontanum* Baumg., *Festuca pratensis* Huds., *Leontodon autumnalis* L. and *Ranunculus repens* L. Wood Cudweed (*Gnaphalium sylvaticum* L.) is practically absent here, unlike in the *Magnograminetum* grasslands of the Olonets and Pryazha municipalities. Nitrophilous species, characteristic of *Antriscetum sylvestris* associations (particularly *Anthriscus sylvestris* and *Dactylis glomerata*), can form a large part of the community. Sometimes these species can even become subdominant.

One ecological variation of the *Magnograminetum* association is the tall grass vegetation of lacustrine clay deposits, with codominant Tussock grass (*Deschampsia caespitosa* (L.) Beauv.). In this variation, characteristic species are generally the same but the species density is lower than in the *Magnograminetum* association (13-14 in comparison with 19-20 species/m<sup>2</sup>).

Another association of mesic meadows in Zaonezhie is more rare but much more biologically diverse: **Forb-rich association *Varioherbetum*** (Fig. 3) occurs on sandy soils on fluvioglacial deposits and moraines. These associations grow on stony soils on steep slopes where mechanical soil treatment is difficult. Therefore, these sites have been soon abandoned and their vegetation has become rare. At present forb-rich meadows can only be found on small pastures near old villages. Nowadays there is almost no permanent population in smaller villages and, thus, no livestock. As a result, meadows are declining drastically as they turn into forests or nitrophilous tall-weed vegetation. Characteristic species for this association include *Campanula glomerata* L., *Carum carvi* L., *Dianthus deltoides* L., *Festuca rubra* L., *Fragaria vesca* L., *Knautia arvensis* (L.) Coult., *Pimpinella saxifraga* L., *Plantago lanceolata* L. and *Plantago media* L. Even though Rough Hawkbit (*Leontodon hispidus* L.) is a common indicator species of the *Varioherbetum* association in southern boreal Karelia, it is absent in Zaonezhye. However, Spotted Cat's-ear (*Hypochoeris maculata* L.) is relatively common. There is also a wide range of satellite species in the association, including a number of meadow and forest plant species. This association is of crucial importance to grassland biodiversity in Zaonezhye. The species pool of *Varioherbetum* communities can include up to 70-80 species of vascular plants. (There are 100-130 species within a single community in some *Varioherbetum* sites of southern Karelia.) The average species density is ca. 18-22 species/m<sup>2</sup>.

A relatively rare **association *Deschampsietum flexuosae*, or rocky meadows** (Fig. 4), represents dry grasslands. These associations occur on shallow soils that cover neutral or slightly acidic bedrock outcrops. These meadows have a relatively high

species diversity (17-20 species/m<sup>2</sup> and 70-80 vascular plants in the species pool). In addition to Wavy Hair-grass (*Deschampsia flexuosa* (L. Trin.), characteristic species include plants of rocky vegetation and boreal forests, such as *Antennaria dioica* (L.) Gaertn., *Festuca ovina* L., *Luzula multiflora* L., *Rumex acetosella* L., *Vaccinium vitis-idaea* L., *Vaccinium myrtillus* L. and *Veronica officinalis* L. Another important species is Mat-grass (*Nardus stricta* L.), which used to be a common species in Karelia half a century ago but is now becoming increasingly rare. Currently it occurs as a subdominant species in *Deschampsietum flexuosae* meadows only. Rare species such as orchids can grow on more or less basic rocks (e.g. dolomites).

## Future of grasslands in Zaonezhye

The grasslands of Zaonezhye are declining rapidly. Between 1946 and 2000 grassland area in Karelia decreased 3-4 times (Znamenskiy 2000) and it continues to decrease now. Moreover, grasslands are becoming less diverse. Unmanaged meadows are turning into species-poor tall-weed communities that nowadays occupy more than 80% of the grassland area. One of the most endangered meadow associations is the forb-rich association, which is the main source of floristic diversity in Zaonezhye. Also rocky meadows also important, although these meadows are less endangered due to periodic droughts. The droughts regulate the regrowth of trees, which makes grassland vegetation more sustainable. However, even these communities need cattle grazing and mowing, which have nearly ceased as local villages have been converted into summer cottage communities. Nowadays traditional agriculture has concentrated on the outskirts of large villages, such as Velikaya Guba, Tolvuya or Kuzaranda, while the rest of the area is characterized by irregular land use.

Unfortunately the future of grasslands in Zaonezhye does not look good. Even the development of protected areas does not help grasslands since meadow protection requires regular traditional agricultural activities. At present, agricultural activities are not allowed in the management plans of protected areas and even if they were, it would be difficult to arrange grazing and mowing there in practice. At the moment, the only opportunities for meadow protection exist on Kizhi Island where mowing is carried out regularly within the territory of the Kizhi open-air museum. However, local population should be encouraged to practice part-time small-scale farming part. In addition, regulations on small pastures and hay meadows within protected areas should be simplified in order to protect at least some of the grassland biodiversity in Zaonezhye. Restoration of forest and tall-weed communities into meadows has not been studied enough and could be problematic.

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Fig. 1. Nitrofilous tall-weed associations of *Anthriscetum sylvestris* (Photo Sergey Znamenskiy).



Fig. 2. Tall grass association *Magnograminetum* (Photo Sergey Znamenskiy).



Fig. 3. Forb-rich association *Varioherbetum* (Photo Sergey Znamenskiy).



Fig. 4. *Deschampsietum flexuosae* association, (rocky meadow) (Photo Sergey Znamenskiy).

## 3 Flora and fauna in Zaonezhye Peninsula area

### 3.1 Vascular plant flora of Zaonezhye Peninsula

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#### Introduction

Zaonezhye Peninsula is located in the *Zaonezhye floristic district* of Karelia (Ramen-skaya 1960, 1983) as well as in the biogeographic province of *Karelia onegensis* (Kon), according to the biogeographic division of the Grand Duchy of Finland and adjacent Russia, developed by 19th century Finnish botanists and zoologists. Earlier the whole Karelia east of the Grand Duchy had been treated as a single region called Russian Karelia or *Karelia rossica* (Nylander & Saelan 1859). *Karelia onegensis* was delineated on the map for the first time in the first volume of *Conspectus Florae Fennicae* (Hjelt 1888) and the second edition of *Herbarium Musei Fennici* (Saelan et al. 1889). Since then its boundaries have been relatively stable compared to the boundaries of other provinces where there have been sometimes considerable changes (for Kola Peninsula, see Uotila 2013). The system of biogeographic provinces of East Fennoscandia has been regularly used in both publications and herbarium labels by northern European naturalists from the late 19<sup>th</sup> century up to the present day.

Finnish botanist and phytogeographer Johan Petter Norrlin was a key person in developing the biogeographic division of East Fennoscandia. In 1870 he studied the vast territory of Zaonezhye (in its broad sense) up to Lake Segozero in the north, Petrozavodsk in the south and the border between the Olonets Province and the Grand Duchy of Finland in the west (i.e. practically the whole catchment area of River Suna). Norrlin provided a lot of information on the flora and vegetation of the territory. As a result, substantial differences between Zaonezhye and neighbouring territories

became evident (Norrlin 1871), which served as the background for recognizing the region as a separate biogeographic province.

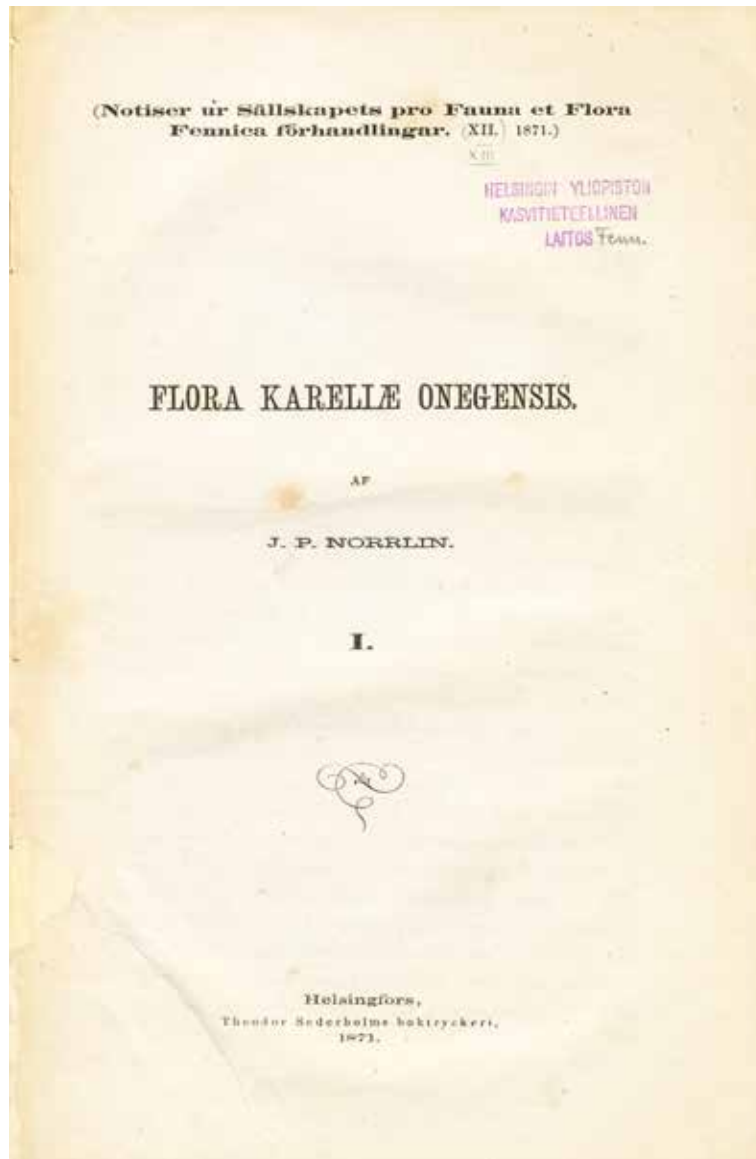


Fig. 1. The title page of Norrlin's flora.

On the basis of Norrlin's inventories and subsequent studies by other Finnish botanists, Marianna L. Ramenskaya (1960, 1983) developed the floristic division of Karelia. The boundaries of her *Zaonezhye floristic district* coincide to a great extent with the boundaries of *Karelia onegensis*. Due to the natural border formed by Lake Onega, there is no difference between the eastern boundaries of the biogeographic province and the floristic district. Also the northern and southern boundaries are very similar. However, the western boundaries of *Karelia onegensis* and *Zaonezhye floristic district* differ substantially. Ramenskaya did not include the upper and middle parts of the Suna river basin in the *Zaonezhye floristic district*. These areas belong to the West Karelian Highlands that have a rather weak relation to *Zaonezhye* (in both its broad and narrow sense). According to the division of Karelian nature, developed by

Afanasiy I. Marchenko (1956), the western boundary of the *Zaonezhye nature district* is even further east, roughly along the 64° E longitude.

## History of floristic studies on the peninsula

### The nineteenth century

Alexander K. Günther, who was a pharmacist at the Aleksandrovsk iron factory and later became the chief state forester of Olonets Province, carried out the first studies in Zaonezhye Peninsula in 1863. There is a large amount of data collected, relating to the northernmost part of Zaonezhye as well as Kizhi and Kliment'skiy islands. Günther (1867, 1880) published his observations of the flora of Obonezhie (i.e. the area around Lake Onega, including Zaonezhye in its broad sense). The few herbarium specimens he collected are deposited partly in the herbarium of St. Petersburg University (LECB), partly in the Botanical Museum of the University of Helsinki (H). In the same year 1863, the area was studied by two Finnish botanists, lecturer August Kullhem and student Theodor Simming (Norrlin 1871). They collected a lot of herbarium specimens, including some very rare species that have not been discovered since. Unfortunately, Kullhem and Simming did not publish their results. Their collections are located in H.

J. P. Norrlin studied Zaonezhye for the whole summer of 1870. He made a few journeys together with Günther who called him «...my dear fellow researcher of the area» (Günther 1880: 11). Norrlin's results, together with the data collected by Günther, Kullhem and Simming, were presented in general terms in the classic monograph of the flora of *Karelia Onegensis* (Norrlin 1871); the general part of the flora was also his doctoral thesis in botany. It included an annotated list of species of vascular plants and it was the first detailed flora of any region in Karelia. The flora was divided into three areas – western, central and eastern – that were usually indicated in the list of taxa. The eastern area corresponds with Zaonezhye. For rare and phytogeographically or otherwise interesting species also localities were listed and features in variation, ecology and phytogeography were given. However, Norrlin only visited the surroundings of Velikaya Guba, Tolvuya and Shunga villages on the peninsula. Despite of its limitations, his work remains the main source on the flora of Zaonezhye for more than hundred years. Norrlin collected a large amount of herbarium specimens, which are deposited in H.

At the end of the 19<sup>th</sup> century, also other Finnish scientists visited the area. In 1888 Norrlin's student Alfred Oswald Kihlman (later Kairamo), better known for his expeditions to the Kola Peninsula and his later work in plant ecology, studied the surroundings of Kyappyaselkya, Kuzaranda and Shunga villages during his travel across the peninsula to Petrozavodsk (Virtanen 2014). Kihlman got advice on his excursion from Günther. In 1896 Bertil R. Poppius, a Finnish entomologist, made an entomological excursion to *Karelia onegensis* (see Jakovlev et al. 2014) and collected dozens of herbarium specimens especially from Zaonezhye Peninsula. Kihlman and Poppius visited localities that had been studied before by Norrlin, and collected some very rare species. Their studies can be considered one of the first examples of monitoring flora. Unfortunately, only very little was published (Kihlman 1888, 1890). However, important findings by Kihlman and Poppius as well as previous researchers were published in Hjelt's *Conspectus* (Hjelt 1888–1926). The specimens collected by Kihlman and Poppius are in H.

In 1898 Aimo Kaarlo Cajander (another student of Norrlin, who later became professor of silviculture and three times Prime Minister of Finland) and Johan Ivar Lindroth (later Liro; who became professor of plant pathology in Helsinki) visited the southeastern corner of the territory, namely Kizhi, Kliment'skiy (village of Sennaya Guba), Uima and Yuzhnyi Oleniy Islands. They collected large number of specimens,

which are deposited in H. In addition to a brief report on their travel (Cajander & Lindroth 1900), there is a manuscript with a list of sites where observations and collections were made in the Archives of Botanical Museum, Helsinki (Kravchenko et al. 2005; Ahti & Boychuk 2006).

## The following century

At the beginning of the 20<sup>th</sup> century, Saint Petersburg Society of Naturalists initiated a floristic study of Obonezhie. Petrozavodsk was the starting point of the long expedition of Eduard K. Bezays and A. Verdi in 1907 that ended in Povenets. They visited several places in the eastern shores of Zaonezhye Peninsula and the western shores of Unitsa Bay. The results of the excursion were soon published (Bezays 1911); in addition to the flora of each place studied, even environmental conditions such as landscape, relief, soils and features of land use were described in detail. Unfortunately, some published records are unreliable due to erroneous identifications. The rich collections are kept in Komarov Botanical Institute in St. Petersburg (LE).

In 1927 Valentina A. Koroleva studied weeds in South Karelia and visited ca. 30 villages in Zaonezhye Peninsula. In the paper appeared very soon (Koroleva 1927–1928) she listed the main weeds of different crops as well as provided an annotated list of weeds of the entire region, where places in Zaonezhye were mentioned for some rather rare species. Specimens are stored in Herbarium of the N.I.Vavilov Institute of Plant Industry, St. Peterburg (WIR).

The next period of floristic studies in Zaonezhye was during the Second World War. In 1941, on the initiative of the Geographical Society of Finland, the Executive committee on research of natural resources of East Karelia (i.e. Republic of Karelia) was established. Besides other natural resources, the flora and vegetation of the region were subjects of the study (Kravchenko & Uotila 1995). The floristic studies focused mainly on settlements and their surroundings, especially along roads.

Thus, in 1942 the Swedish botanist Benkt Sparre, who served as a volunteer in the Finnish army, studied the flora of Azhepnavolok village and its vicinities (Sparre 1945). He gave exact localities for the most interesting species and collected 160 specimens from the area. In the same year, Aarno Kalela (son of A. K. Cajander and later professor of botany in Helsinki) visited Unitsa village where he collected a small number of herbarium specimens. The specimens collected by Sparre are housed in the Swedish Museum of Natural History, Stockholm (S), with a few duplicates in H, and the specimens collected by Kalela are housed in H.

In 1943 two Finnish botanists, Lars Fagerström (later curator at the Botanical Museum, Helsinki) and Hans Luther (later professor of botany in Helsinki), visited the villages of Shunga, Tolvuya, Velikaya Niva and Velikaya Guba (and areas between the villages, including minor settlements) as well as Bolshoy Klimenetskiy Island. Even though they studied the area for only five days, Fagerström and Luther prepared a detailed article on their excursion (Fagerström & Luther 1946), in which the most interesting findings were reported with their exact localities. They also presented an overview of previous inventories of the area. Furthermore, Luther, an aquatic plant botanist, prepared a special publication on the rare *Caulinia flexilis* (as *Najas flexilis*; Luther 1945), which was found from Velikaya Guba. Their herbarium collections are in H. During the same summer, Viljo Kujala (later professor of forest biology at the Forest Research Institute, Helsinki) travelled in the area and stayed longer, especially in Velikaya Guba. He collected several specimens and wrote a manuscript of his observations on plants; these specimens and the manuscript are in H.

The next stage of studies in the area refers to the work of M. L. Ramenskaya, who in her time was a key figure in Karelian botany. She prepared the first manual on the

flora of Karelia (Ramenskaya 1960; see also Ramenskaya 1983; Ramenskaya & Andreeva 1982) and she also published a monograph on the meadows in Karelia with an enormous amount of relevés (Ramenskaya 1958). In the period between 17<sup>th</sup> August and 3<sup>rd</sup> September 1952, together with her pupil Vera A. Zaykova, Ramenskaya studied the northern part of Zaonezhye; the localities include minor settlements around the villages of Kuzaranda (Al'fimovo, Koshkino and Shirokie Polya), Tolvuya (Adrianovskaya, Belokhino (Belokhinskaya), Voronino (Voroninskaya), Zagor'e, Kar-navolok, Padmozero and Pikalevskaya), Shunga (Bor Pudantsev, Deriguzovo, Enina Gora, Zagorskoe, Karpin Navolok, Krestnaya Gora, Putkozero and Seleznevo), and also the village of Velikaya Niva. A large number of relevés were studied, and a lot of specimens were collected. According to her notebook (preserved in the archives of the Karelian Research Centre of the Russian Academy of Sciences), they collected 143 (!) specimens in one day (18th August) only. Even though Ramenskaya worked for the Karelian Research Centre, the collected material is now in the herbarium of the Petrozavodsk State University (PZV). In 1964 Ramenskaya's specimens – altogether more than 20 000 of them (including many duplicates from LE) – were moved from the Karelian Research Centre – from an unequipped and wet room without heating – to the University. Thus, the collection has been rescued (Gnatyuk 1995; Zaykova et al. 1995). Nevertheless, some specimens have been lost (Zaykova et al. 1995).

After Ramenskaya, there was a long break in floristic research in Zaonezhye. Only Eugenia A. Klyukina studied the aquatic flora of few lakes (Valgomozero, Vangozero, Vikshezero, Kosmozero, Padmozero and Putkozero) in 1961 (Klyukina 1965). However, some records are unreliable and the determinations cannot be verified in lack of voucher specimens. In 1979, Nina I. Ronkonen visited the northeastern part of the territory. She collected information mainly about species that are very rare and potentially in need of protection; the obtained data were taken into account when preparing the first Red Data Book of Karelia (Volkov & Lapshin 1985). Ronkonen's collections are kept in the herbarium of the Karelian Research Centre in Petrozavodsk (PTZ).

## Recent decades

Alexei V. Kravchenko studied a number of sites throughout Zaonezhye in 1983, 1988, 1989, 1993, 1998, 1999 (together with M. Kashtanov), 2002–2004, 2007, 2010, 2012 and 2013 (Kravchenko & Sazonov 1992, Kravchenko 1993, Kravchenko et al. 2000 a, Kravchenko & Timofeeva 2012; for the trips in 2004 and 2013 see below). A large number of specimens were collected and later deposited in PTZ.



Fig. 2. Alexei Kravchenko on dry meadow near Kuzaranda village, July 2004 (Photo Tapio Lindholm).

Floristic research on the islands of the peninsula continued in the 1980s, mainly within the boundaries of the protected area of Kizhskiy Reserve. As a result, lists of vascular plants of Kizhi Island (Shtan'ko & Lantratova 1985, Kravchenko & Sazonov 1992) as well as the other islands of the area (Kuznetsov 1993, 1997) were published. The largest amount of information was collected from Kizhi Island as well as adjacent islands and the mainland shore by Oleg L. Kuznetsov and his student Elena S. Drosdova. Numerous specimens are kept in PTZ. At the time, also the most important nature protection areas, including botanical sites, were designated (Khokhlova & Semina 1988, Antipin et al. 1994, Kuznetsov & Khokhlova 1994, Khokhlova & Kuznetsov 1996, Kravchenko et al. 2000 a, b, Kuznetsov et al. 2000).

After more than a 30-year break, the study of meadows continued in 1985–1987 (Drozдова 1987). At that time, mires in the vicinities of Lambasruchey and Karasozero villages were studied (Dyachkova et al. 1993, Antipin et al. 1994). All the results were documented and some specimens were stored in PTZ.

In 1997–2000, a postgraduate student Maksim V. Kashtanov studied the northern part of the peninsula as well as its islands (Kashtanov 1997, 1998 a, b, 1999 a, b). Kashtanov also studied Azhepnavolok village and obtained new data on the flora of the village, studied ca. 60 years earlier by Sparre (Kashtanov 1999 b). Furthermore, he compiled lists of species for 18 islands of the peninsula. Kashtanov collected a great number of specimens, which are kept mainly in PTZ, but also in PZV.

Within the framework of several projects sponsored by the Finnish Ministry of the Environment, including an inventory of biological diversity of Zaonezhye Peninsula, further research in the area was carried out in 1998 and 1999. During this time, Oksana A. Butskikh, Alexander M. Kryshen' and Vera V. Timofeeva visited the vicinities of Kosmozzero village, Lakes Kalozero and Chelozero as well as the southern part of Svyatukha Bay of Lake Onega. Collected specimens are kept in PTZ. Within the framework of the last project in 1999, O. L. Kuznetsov and Natalia V. Stoykina studied mires and collected mire plants (Kuznetsov et al. 2000). In addition, Stanislav A. Kutenkov studied paludified forests in 2002 and 2012 (Kutenkov 2006, 2013). The few collected specimens are kept in PTZ.

From 1998 to 2004 Natalia V. Markovskaya studied the distribution and population age structure of orchid species on the islands (Dyachkova & Markovskaya 2003, Markovskaya & Dyachkova 2003, Markovskaya 2004, 2005, Markovskaya et al. 2007). A small number of samples were deposited in PZV.

A Russian-Finnish expedition was arranged to the area in 3<sup>rd</sup>–6<sup>th</sup> July 2004. Participants from Russia included Elena P. Gnatyuk, A. V. Kravchenko, A. M. Kryshen' and O. L. Kuznetsov; and from Finland Tapio Lindholm, Mikko Piirainen, Rauno Ruuhijärvi and Pertti Uotila. They visited several islands: Bolshoi Klimenetsky (Klimetsky Nos Cape and Lukovo Cape), Bolshoi Lelikovsky (Radkolye Cape), Megostrov, Paleostrov, Rechnoy, Shunevskiy and Yuzhnyi Oleniy islands, and also the mainland shores in the neighbourhood of Kuzaranda and Tipinitsy villages. A relatively large number of specimens were collected; specimens collected by the Russian participants were deposited in PTZ, and those by the Finnish participants in H.

Since 1999 the study of meadows has continued, mainly on Kizhi Island but also on other islands (Yudina 1999, 2000; Znamenskiy 1999, 2000, 2005 a, b, 2010, 2013; Yudina & Stoykina 2005; Timofeeva 2013; Znamenskiy & Timofeeva 2013). As a result, relevés as well as extensive lists of meadow species have been provided. Collections (which are not rich) are in PTZ. In 2009 and 2010, teachers and students of the Petrozavodsk State University studied the shores of Kizhi Island and some other islands (Morozova et al. 2010, 2011); the collected material is kept in PZV.

Vera V. Timofeeva studied the mainland opposite Kizhi Island in 2011 (Timofeeva & Nikolaeva 2012), and Unitsa Bay in 2013. In addition, she carried out inventories of



plants in several lakes (Verkhnee Myagrozero, Gizhozero, Kovshozero, Kondozero, Lelikozero) in 2011–2013. Relatively abundant collections are stored in PTZ.

In 2013, two Russian-Finnish expeditions were arranged as pilot projects in the framework of BPAN project led by Finnish Environment Institute. During these expeditions, surroundings of Kaskoselga, Lipovitsy, Oyatevstchina, Polya, Tambitsy, Tipinitsy, Vegaruksa, Velikaya Guba, Uzkaya Salma and Zubovo villages, and Lake Rugozero were visited. The participants of the expedition included botanists, zoologists and ecologists. A number of floristic observations were made mainly by A. V. Kravchenko and Kimmo Syrjänen, although botanical data were collected also by Timo Kuuluvainen, Olli Manninen, Jyri Mikkola, and Olli-Pekka Tikkanen. The collected specimens are deposited mainly in PTZ, but also in the herbarium of the University of Turku (TUR).

During the last two decades rich floristic material, including ca. 2000 herbarium specimens and a great amount of floristic field notes, has been collected from Zaonezhye. However, although many papers have been published, detailed data have been included in only a few of them, mainly dealing with red-listed species (Kravchenko et al. 2000 a) and the flora of the planned Zaonezhye Landscape Reserve (Kravchenko & Timofeeva 2013). Information from Zaonezhye was also taken into account in the preparation of the Red Data Book of Republic of Karelia (Ivanter & Kuznetsov 2007).



Fig. 3. Pertti Uotila, Elena Gnatyuk and Margarita Boychuk on dry meadow near Kuzaranda village, July 2004 (Photo Tapio Lindholm).

## Present knowledge

Despite the long history of botanical studies in Zaonezhye, floristic knowledge of this fairly limited territory is still variable. There is relatively comprehensive data available from the southeastern islands, so called Kizhi Skerries (Kizhi Island and numerous surrounding islands as well as a narrow strip of the mainland), and from the northeastern part of Zaonezhye (Tolvuya – Shunga area), as well as from areas along the main roads. However, less data are available from the northwestern part of Zaonezhye. Nevertheless, it is assumed that indigenous species are relatively well known because very few indigenous species have been found since Norrlin's studies. However, according to available data, many indigenous species are considered rare. But this is rather an artefact, and their distribution will be clarified in the future.

In total, ca. 530 indigenous species have been discovered from Zaonezhye Peninsula (excluding microspecies of *Ranunculus auricomus*, *R. cassubicus*, *R. fallax*, *Hieracium Pilosella*, and *Taraxacum*). In earlier studies (Norrlin 1871; Fagerström & Luther 1946), a relatively large number of species were considered unique for Zaonezhye (in its broad sense). However, at present only one of them, *Polemonium boreale*, is only known in Karelia from the area. Other extremely rare species include *Caulinia flexilis*, which is known in Karelia from only three localities, two of which are in Zaonezhye; and *Helianthemum nummularium*, which is known from two localities in Karelia, one of which is in Zaonezhye. Many other species are more frequent in Zaonezhye than in any other region of Karelia, namely *Ulmus laevis*, *Myosoton aquaticum*, *Cotoneaster antoninae*, *C. melanocarpus*, *Chaerophyllum aromaticum*, *Cuscuta europaea*, *Pseudolysimachion spicatum*, *Lycopus europaeus*, *Eupatorium cannabinum*, *Potamogeton friesii*, *P. rutilus*, *Carex muricata*. The majority of these species belong to thermophilous species. About 60 species in Zaonezhye have a mainly southern distribution. Many of them grow near the northern limits of their distribution areas. Some, like *Carex muricata*, *Chaerophyllum aromaticum*, *Odontites vulgaris* and *Cuscuta europaea*, occur here in their northernmost known localities in Russia; while others, like *Dracocephalum ruyschiana* and *Pseudolysimachion spicatum*, are in their northernmost localities in Fennoscandia. In Karelia, Zaonezhye provides the northernmost known localities for species, including *Stellaria alsine*, *Ulmus laevis*, *Corydalis bulbosa*, *Myosoton aquaticum*, *Chaerophyllum aromaticum*, *Cuscuta europaea*, *Pseudolysimachion spicatum*, *Glyceria maxima* and *Scolochloa festucacea*.



Fig. 4. *Rubus humulifolius* (Photo Kimmo Syrjänen).



Fig. 5. *Eupatorium cannabinum* (Photo Kimmo Syrjänen).

There is a number of southern species that are not rare in Zaonezhye and often play a significant part in the composition of plant communities. These species include woody plants *Tilia cordata*, *Ulmus glabra*, *Alnus glutinosa*, *Lonicera xylosteum*, *Daphne mezereum* and *Solanum dulcamara* as well as several herbs, like *Polygonatum odoratum*, *Iris pseudacorus*, *Campanula persicifolia*, *Viola mirabilis* and *Chaerophyllum aromaticum*.

There is also a small number of northern species, including *Woodsia alpina*, *Cerastium alpinum*, *Saxifraga nivalis* and *Poa alpina*, occupying outcrops of bedrock, sometimes together with southern species. In addition, *Astragalus subpolaris* and *Oxytropis sordida* have been found from dry pine forests. In Zaonezhye, all northern species are very rare, in contrast to northern Lake Ladoga where a small number of northern species are known from several, sometimes dozens of localities; see, e.g., Heikkilä et al. (1999).

Some eastern («Siberian») species, e.g., *Atragene sibirica*, *Lonicera pallasii*, *Aconitum septentrionale*, *Viola selkirkii*, *Rubus humulifolius*, *Ligularia sibirica* and *Saussurea alpina*, can be found from Zaonezhye close to the western limit of their distribution areas. Without certain features of the region, the number of species with mainly eastern distribution could be higher. First, Lake Onega forms a natural barrier to the east. Secondly, if species have managed to jump over or get around the lake, they cannot move further west because of the rivers running east towards Lake Onega and the watershed blocking them in the west. River basins play an essential role in spreading many species. Good examples include *Atragene sibirica* and *Rubus humulifolius* that are common especially on the shores of water bodies east of Lake Onega.



Fig. 6. *Carex rhynchophysa* (Photo Kimmo Syrjänen).



Fig. 7. *Diplazium sibiricum* (Photo Kimmo Syrjänen).

Sandy beaches are sometimes inhabited by a few species typical for seashores, including *Lathyrus aleuticus*, *Calamagrostis meinshausenii*, *Festuca arenaria* and *Leymus arenarius*.

Long-term land use has enriched the flora with alien species; their total number in Zaonezhye is ca. 220 (ca. 30% of the vascular flora). The composition of alien flora

has changed during the course of the past decades. Some weeds, such as *Apera spica-venti* and *Centaurea cyanus*, that were common and abundant decades ago have totally disappeared. At the same time, many newcomers have appeared during recent decades, including aggressive invasive species such as *Heracleum sosnowskyi* and *Impatiens glandulifera*.

In the future, many new species – mainly escapees of ornamental, edible and medicinal plants – are likely to be recorded in the area. Such species have been discovered during the past five years from, for instance, the villages of Lambasruchey, Pod’elniki, Ruch’i, Shunga, Tolvuya and Velikaya Guba.

The large numbers of threatened species and their localities, as well as the number of indicators of biologically valuable forests demonstrate the value of Zaonezhye Peninsula for the flora of Karelia. On the basis of several relatively common and widespread indicator species, all the forests on the peninsula could be considered biologically valuable. This means that practically the whole peninsula, which is more or less covered by forests, is biologically valuable.

Table I. The richest plant families in *Karelia onegensis*\*, in Zaonezhye Peninsula, and in two protected areas inside the Zaonezhye Peninsula: Kizhi Federal Zoological Reserve (Kizhi Skerries), and the planned Zaonezhye Landscape Reserve. Note that the status indigenous/introduced (alien) was revised for the flora in Kravchenko (2007), thus the numbers of indigenous species given in Gnatyuk et al. (2003 b), which is not revised here, can in few families exceed those for the whole Zaonezhye Peninsula.

Province / Area	<i>Karelia onegensis</i> *		Zaonezhye Peninsula		Kizhi Federal Zoological Reserve **		Planned Zaonezhye Landscape Reserve ***	
<b>Acreage</b>	ca. 30 000 km <sup>2</sup>		ca. 3 000 km <sup>2</sup>		500 km <sup>2</sup>		1100 km <sup>2</sup>	
<b>Family</b>	Number of indigenous species / (%)	Ordinal number	Number of indigenous species / (%)	Ordinal number	Number of indigenous species / (%)	Ordinal number	Number of indigenous species / (%)	Ordinal number
<i>Cyperaceae</i>	69 (10.2)	1	56 (10.4)	1	45 (9.7)	1	42 (9.8)	1
<i>Poaceae</i>	60 (8.9)	2	42 (8.0)	2	35 (7.5)	2	37 (8.5)	2
<i>Asteraceae</i> ****	44 (6.5)	3	41 (7.6)	3	32 (6.9)	3	37 (8.5)	2
<i>Rosaceae</i>	35 (5.2)	4	24 (4.5)	6	28 (6.0)	4	18 (4.1)	5
<i>Ranunculaceae</i>	29 (4.3)	5	25 (4.6)	4	21 (4.5)	5	18 (4.1)	5
<i>Scrophulariaceae</i>	29 (4.3)	5	25 (4.6)	4	18 (3.9)	6	21 (5.0)	4
<i>Caryophyllaceae</i>	27 (4.0)	7	24 (4.5)	6	17 (3.6)	7	18 (4.1)	5
<i>Orchidaceae</i>	27 (4.0)	7	18 (3.3)	8	15 (3.2)	8	15 (3.5)	8
<i>Polygonaceae</i>	19 (2.8)	9	15 (2.8)	9	14 (3.0)	10	9 (2.1)	.
<i>Brassicaceae</i>	17 (2.5)	10	7 (1.3)	.	9 (1.9)	.	7 (1.6)	.
<i>Lamiaceae</i>	15 (2.2)	.	13 (2.4)	.	15 (3.2)	8	10 (2.3)	.
<i>Juncaceae</i>	14 (2.1)	.	15 (2.8)	9	8 (1.7)	.	11 (2.5)	9
<i>Salicaceae</i>	16 (2.4)	.	11 (2.0)	.	10 (2.1)	.	11 (2.5)	9
<b>Total number in the ten richest families / (%)</b>	356 (52.8)		287 (53.2)		240 (51.6)		228 (52.5)	
<b>Total number of indigenous species</b>	674		539		465		434	

\* Gnatyuk et al. (2003 a); \*\* Gnatyuk et al. (2003 b); \*\*\* Kravchenko & Timofeeva (2013).

\*\*\*\* As to *Hieracium* and *Pilosella*, all microspecies of each section have been counted as one (collective) species, 4 in *Hieracium* and 4 in *Pilosella*.

## List of vascular plant species of Zaonezhye, with annotations for threatened and indicator species

### Explanations

The nomenclature mainly follows Kravchenko (2007), and some important synonyms have been given in parentheses.

The red-listed and indicator species as well as aliens have been marked with symbols in front of the species name.

\* red-listed species.

\*\* indicator of biologically valuable forests for Northwest Russia (Andersson et al. 2009).

<sup>a</sup> alien.

Each species is provided by an estimation of frequency (printed in bold italics) in Zaonezhye according to the following scale: *rr* (very rare), *r* (rare), *str* (fairly rare), *p* (here and there), *stfq* (fairly frequent), *fq* (frequent and very frequent).

For red-listed and indicator species, as well as for some other interesting species, the documentation is given by listing localities with herbarium specimens and related publications. A herbarium specimen is indicated by the year of collecting and collector's surname (in italics). For the herbaria in which the specimens are kept, see the paragraph History of floristic studies. In a few cases the relevant herbarium is mentioned in the list.

Frequencies and localities given by Norrlin (1871) are given within parentheses. An asterisk means that the frequency is given by Norrlin for the whole *Karelia onegensis* (including Zaonezhye Peninsula), not separately for Zaonezhye Peninsula and Kizhi = Svyatnavolok.

The threat categories according to 3 different sources are given at the end of the relevant species descriptions:

RDB RF = Red Data Book of Russian Federation (Trutnev et al. 2008), the respective IUCN categories given in parenthesis:

1 – находящиеся под угрозой исчезновения [under the risk of extinction] (= critically endangered)

2 – сокращающиеся в численности [number of individuals is declining] (= endangered)

3 – редкие [rare] (this category covers part of IUCN vulnerable + near threatened)

RDB RK = Red Data Book of Republic of Karelia (Ivanter & Kuznetsov 2007), the respective IUCN categories given in parenthesis:

1 – находящиеся под угрозой исчезновения [under the risk of extinction] – 1 (CR, critically endangered),

2 – сокращающиеся в численности [number of individuals is declining] – 2 (EN, endangered)

3 – редкие [rare] – 3 (VU) + 3 (NT) + 3 (LC) (= vulnerable + near threatened + least concern)

4 – с неопределенным статусом [category unknown] – 4 (DD, data deficient)

Note that for the categories given in Red Data Book of Karelia, the erroneous category 3 (LC) is corrected to 3 (NT).

RDB EF = Red Data Book of East Fennoscandia (Kotiranta et al. 1998):

- 1 – Endangered,
- 2 – Vulnerable
- 3 – Rare
- 4 – Declining
- ? – Data Deficient

**Note.** Special attention as source of information must be paid to the maps in Hultén (1971). These are handmade maps, for Karelia mainly completed in Helsinki, where information about specimens, literature and archives were added by pencil to the maps of the first edition of Hultén (1950). At the time, there was no demand for detailed documentation of each dot and the work was done in a short time, using not very detailed maps. As a result, there may be inaccuracies in the locations of the dots, and the maps should be understood more as indicators of general distributions than exact locations of single findings. On the other hand, V. Kujala, one of the persons who commented on the maps and added information especially about Karelia, may have added dots from primary data unknown from other sources, due to his extensive travels in *Karelia onegensis* during the war.

Dubious and erroneously recorded species are given at the end of the list.

- Huperzia selago* (L.) Bernh. ex Schrank & Mart. – **Str.** (Norrlin 1871: \**Stfq.*)
- Diphasiastrum complanatum* (L.) Holub – **Str.** (Norrlin 1871: \**Fq.*)
- Lycopodium annotinum* L. – **Fq.** (Norrlin 1871: \**Fq.*)
- Lycopodium clavatum* L. – **Stfq.** (Norrlin 1871: \**Stfq.*)
- Selaginella selaginoides* (L.) P. Beauv. ex Schrank & Mart. – **Str.** (Norrlin 1871: *Fq* in NW part.)
- \**Isoëtes echinospora* Durieu – **P**, but **fq** in Kizhi Skerries: more than 30 registered localities. (Norrlin 1871: Shunga, V. Guba, etc.) – RDB RF: 2, RDB RK: 3 (LC)
- \**Isoëtes lacustris* L. – **P**: more than 30 registered localities. (Norrlin 1871: *Stfq.*) – RDB RF: 3, RDB RK: 3 (LC)
- Equisetum arvense* L. – **Fq.** (Norrlin 1871: \**Fq.*)
- Equisetum fluviatile* L. – **Fq.** (Norrlin 1871: \**Fqq.*)
- Equisetum hyemale* L. – **Str.** (Norrlin 1871: *Str*: Shunga, etc.)
- Equisetum palustre* L. – **Fq.** (Norrlin 1871: \**Fq-fqq.*)
- Equisetum pratense* Ehrh. – **Fq.** (Norrlin 1871: \**Stfq-fq.*)
- Equisetum scirpoides* Michx. – **Rr**, recent records: Rechnoy Isl. (2004 *Kravchenko*). (Norrlin 1871: Azhepnavolok, *fq* in Padmozero.)
- Equisetum sylvaticum* L. – **Fq.** (Norrlin 1871: \**Fq-fqq.*)
- Equisetum variegatum* Schleich. ex F. Weber & D. Mohr – **Rr**. Ashepnavolok (1870 *Norrlin*, 1896 *Poppius*); Tambitsy – Kaskoselga (2013 *Syrjänen*).
- \**Botrychium boreale* Milde – **Rr**: Azhepnavolok (1996 *Kashtanov*; *Kravchenko et al.* 2000 a). – RDB EF: 3, RDB RK: 3 (LC)
- \**Botrychium lanceolatum* (S. G. Gmel.) Ångstr. – **Rr**: Kuzaranda (Hultén 1971); B. Klim., Motalovo (1999 *Kravchenko & Kashtanov*; *Kravchenko et al.* 2000 a). – RDB EF: 4, RDB RK: 3 (NT)
- Botrychium lunaria* (L.) Sw. – **Str.** (Norrlin 1871: *P-stfq.*)
- Botrychium multifidum* (S. G. Gmel.) Rupr. – **R**: between Prosevskaia and Bol Zarevo villages (Fagerström & Luther 1946); Azhepnavolok (Sparre 1945); Medvedevo (1979 *Ronkonen*); Verkhnee Myagrosozero (2012 *Bogdanova PTZ*; 2012 *Timofeeva*). – RDB EF: 3
- Ophioglossum vulgatum* L. – **R**: Okatovstchina (1952 *Ramenskaya & Zaykova*); between Voroninskoe and Tolvuyskiy Bor villages (1952 *Ramenskaya*, obs.); Tolvuya (Hultén 1971);

Kizhi area (Hultén 1971); Lichkov Isl. (1998 *Kashtanov*; Kravchenko et. al. 2000 a); Bol. Klim, Kosel'ga (1999 *Kravchenko & Kashtanov*; Kravchenko et. al. 2000 a); V. Guba (2010 *Kravchenko*). – RDB EF: 3

*Pteridium latiusculum* (Desv.) Hieron. ex Fr. (*Pteridium pinetorum* C. N. Page & R. R. Mill, *P. aquilinum* L., s. lat.) – **Stfq.** (Norrllin 1871: *Fq.*)

*Thelypteris palustris* Schott – **R.**

*Phegopteris connectilis* (Michx.) Watt – **Fq.** (Norrllin 1871: *Fq.*)

*Dryopteris carthusiana* (Vill.) H. P. Fuchs – **Fq.** (Norrllin 1871: *Fq.*; incl. *D. expansa*)

*Dryopteris cristata* (L.) A. Gray – **R:** ca. 10 current records.

\*\* *Dryopteris expansa* (C. Presl) Fraser-Jenk. & Jermy – **Str-stfq.**

*Dryopteris filix-mas* (L.) Schott – **Fq.** (Norrllin 1871: *Fq.*)

*Athyrium filix-femina* (L.) Roth. – **Fq.** (Norrllin 1871: *Fq.*)

*Cystopteris fragilis* (L.) Bernh. – **Stfq.** (Norrllin 1871: *Stfq.*)

\*\* *Diplazium sibiricum* (Turcz. ex G. Kunze) Sa. Kurata – **Rr:** recent records B. Lelik. Isl. (2004 *Kravchenko*); Rechnoy Isl. (2004 *Kravchenko, Piirainen*); Paleostov Isl. (2004 *Uotila*); Lipovitsy (2013 *Syrjänen*). (Norrllin 1871: Dianova Gora.)

*Gymnocarpium dryopteris* (L.) Newman – **Fq.** (Norrllin 1871: *\*Fqq.*)

\* *Woodsia alpina* (Bolton) Gray – **Rr:** Gizhozero (2012 *Timofeeva*; Kravchenko & Timofeeva 2013). – RDB EF: 3, RDB RK: 3 (VU)

*Woodsia ilvensis* (L.) R. Br. – **Stfq.** (Norrllin 1871: Suoyarvi, Shunga.)

\*\* *Matteuccia struthiopteris* (L.) Todaro – **Str.** (Norrllin 1871: *R.*)

\*, \*\* *Asplenium septentrionale* (L.) Hoffm. – **Str:** ca. 16 localities Tolvuya – Klim Nos and between Butenevo and Zaselezhye villages (Fagerström & Luther 1946); Tel'pozero (1952 *Ramenskaya & Zaykova* PTZ, PZV); Spirovka (1979 *Ronkonen*, 2012 *Timofeeva*); Fomino (1988 *Kravchenko*, obs.); Lake Kozmozero, Sil'nyi Isl. (1999 *Butskih, Kryshen & Timofeeva*); Kosmozero (1999 *Butskih, Kryshen & Timofeeva*); Paleostrov (1999 *Kravchenko & Kashtanov*, 2004 *Uotila*); B. Klim., Pervye Garnitsy & Vtorye Garnitsy (1999 *Kravchenko & Kashtanov*; Kravchenko et al. 2000 a), Lukovyi Cape (2004 *Kravchenko, Uotila*); Rechnoy Isl (2004 *Lindholm* PTZ); B. Lelik. (2004 *Kravchenko*); Vanchozero (2006 *Talbonen* PTZ, 2012 *Kravchenko*; Kravchenko & Timofeeva 2013); Vekhkozero (2012 *Kravchenko*); Unitskaya Bay, Severnyi Sokoliy Isl. (2013 *Timofeeva*). (Norrllin 1871: *Vegoruksa.*) – RDB EF: 4, RDB RK: 3 (LC→NT)

\*\* *Asplenium trichomanes* L. – **R:** ca. 9 localities Azhepnavolok (Sparre 1945); Svyatukha Bay, Zimmaya Mt. (1989 *Kravchenko*); Kosmozero (1999 *Timofeeva, Rudkovskaya & Kryshen*); V. Niva (1999 *Timofeeva & Rudkovskaya* PTZ); B. Lelik. (2004 *Kravchenko, Uotila*); Lake Ladmozero (2012 *Kravchenko*, 2012 *Rudkovskaya* PTZ); Vekhkozero (2012 *Kravchenko*); Unitskaya Bay, mainland at Sokoliy Isl. (2013 *Timofeeva*). (Norrllin 1871: *Shunga.*)

*Polypodium vulgare* L. – **Fq.** (Norrllin 1871: *Stfq-fq.*)

*Picea abies* (L.) Karst. – **R.** (Norrllin 1871: *\*Fqq.*; incl. *P. × fennica.*)

*P. × fennica* (Regel) Kom. (*P. abies* × *obovata*) – **Fq:** the most common taxon of *Picea* in Zaonezhye and the entire Karelia.

*P. obovata* Ledeb. (*P. abies* subsp. *obovata* (Ledeb.) Domin) – **Str.** (Norrllin 1871: V. Guba.)

*Pinus sylvestris* L. – **Fq.** (Norrllin 1871: *\*Fqq.*)

*Juniperus communis* L. – **Fq.** (Norrllin 1871: *\*Fqq.*)

*Nuphar lutea* (L.) Sibth. & Sm. – **Fq.** (Norrllin 1871: *Fq.*)

*Nuphar pumila* (Timm) DC. – **Str.**

*Nuphar × spenneriana* Gaudin (*N. lutea* × *pumila* (Timm) DC.) – **R.** (Norrllin 1871: V. Guba.)

*Nymphaea × borealis* Camus (*N. alba* × *candida*) – **R.**

*Nymphaea candida* J. Presl & C. Presl – **Fq.** (Norrllin 1871: *Fq* in V. Guba, as *N. alba* L. s. lat.)

*Ceratophyllum demersum* L. – **Rr:** Putkozero (Shunga) (1952 *Ramenskaya & Zaykova*; 2012 *Kravchenko*); Padmozero (Klyukina 1965). (Norrllin 1871: *Shunga.*)

³ *Aconitum × cammarum* auct. (*A. × stoerkianum* Koelle) – **Rr:** V. Guba (2010 *Kravchenko*); Tolvuya (2011 *Timofeeva*).



**\*\**Aconitum septentrionale*** Koelle (*A. lycoctonum* L. subsp. *septentrionale* (Koelle) Korsh.) – **Fq.** (Norrlin 1871: *Fq.*)

**\*\**Actaea erythrocarpa*** (Fisch.) Kom. – **Str:** Azhepnavolok (1996 *Kashtanov*); Bukolnikovskiy Isl. (1999 *Kashtanov*); Kolgostrov (1986 *Kuznetsov*); Lake Chelozero (1999 *Rudkovskaya & Timofeeva*); Megostrov Isl. (2004 *Kravchenko*); Paleostrov Isl. (1999 *Kravchenko & Kashtanov*); Rechnoy Isl. (2004 *Kravchenko*); Volkostrov (1996 *Kuznetsov*). In communities dominated by *Pinus sylvestris*, *Picea abies*, *Alnus incana* and *A. glutinosa*, both in old-growth and middle aged forests (in two localities the measured age of trees was ca. 60 years).

*Actaea spicata* L. – **Stfq.** (Norrlin 1871: *Stfq.*)

*Anemonoides nemorosa* (L.) Holub (*Anemone nemorosa* L.) – **Str:** mainly in Kizhi Skerries and in up to 5–10 m wide narrow stripe along the shores of Lake Onega. (Norrlin 1871: B. Klim. (Simming, Günther).)

<sup>a</sup>*Aquilegia vulgaris* L. – **Rr:** V. Guba (2012 *Kravchenko*, obs.).

**\*\**Atragene sibirica*** L. (*Clematis alpina* (L.) Mill. subsp. *sibirica* (Mill.) Kuntze) – **R:** Kuzaranda (no date *Günther* H; 1896 *Poppius*); Fomino (1988 *Kravchenko*; *Kravchenko et al.* 2000 a); Spirovo (2001 *Shelekhov* PTZ); Regimatka (2012 *Kravchenko*); Tambitsy – Kaskoselga (2013 *Syrjänen*). Collected from secondary forests dominated by conifers or aspen. The species is fairly common east of Lake Onega, as well as on islands between Zaonezhye and E shore of Lake Onega which are formed of moraine or sand deposits (almost all of these islands lie outside the Zaonezhye are delimited here). In Karelia it is very rare also on the W shores of Lake Onega, but in NNW the area extends up to Lake Segozero (Hultén 1971). – RDB EF: 3

**\**Batrachium confervoides*** Fr. (*B. eradicatum* (Laest. ex Nyman) Fr., *Ranunculus confervoides* (Fr.) Fr., *R. eradicatus* (Laest. ex Nyman) F. Johansen) – **R:** Putkozero (Klyukina 1965); Shiltya (1999 *Butskikh, Kryshen & Timofeeva*; *Kravchenko et al.* 2000 a); Rogostrov Isl. (1999 *Kashtanov*; *Kravchenko et al.* 2000 a); Kazhma (2012 *Kravchenko*; *Kravchenko & Timofeeva* 2013). Rare throughout Karelia, more common in the north-westernmost part (e.g. in the Paanajärvi area). – RDB RK: 3 (LC→NT)

*Batrachium dichotomum* (Schmalh.) Trautv. (*Ranunculus peltatus* Schranck, s. lat.) – **Stfq.**, especially in Kizhi Skerries. (Norrlin 1871: *\*Fq.*)

*Caltha palustris* L. – **Fq.** (Norrlin 1871: *\*Fqq.*)

<sup>a</sup>*Consolida regalis* Gray – **Rr:** Tolvuya (Günther 1880; Koroleva 1927–1928; Fagerström & Luther 1946; 1952 *Ramenskaya & Zaykova* PTZ, PZV; 1993 *Antikainen* PTZ); Padmozero (Bezais 1911; 1979 *Ronkonen*.)

<sup>a</sup>*Delphinium × cultorum* Voss. – **R:** B. Klim., Sennaya Guba (1998 *Kashtanov*; *Kravchenko* 2007).

<sup>a</sup>*Delphinium elatum* L. – **Rr:** Unitsa (1942 *Kalela*; Hultén 1971). – RDB EF: 3, RDB RK: 3 (VU)

<sup>a</sup>*Ficaria verna* (L.) Huds. – **Rr:** B. Klim., Sereodka (1988 *Kuznetsov*; *Kuznetsov* 1993). – RDB EF: 3, RDB RK: 3 (LC→NT)

<sup>a</sup>*Myosurus minimus* L. – **Rr:** Vtorye Garnitsy (1998 *Kashtanov*); Kuzaranda (2004 *Kravchenko & Kuznetsov*).

*Ranunculus acris* L. – **Fq.** (Norrlin 1871: *\*Fqq.*)

*Ranunculus auricomus* L. aggr. – **Fq.** (Norrlin 1871: *\*Fq.*)

*Ranunculus cassubicus* L. aggr. – **Rr:** B. Klim., Lake Obozero (1997 *Kashtanov*; *Kravchenko et al.* 2000 a); Unitskaya Bay, mainland at Gavostrov Isl. (2013 *Timofeeva*). (Norrlin 1871: B. Klim. (Kullhem).) – RDB RK: 3

*Ranunculus fallax* (Wimm. & Grab.) Sloboda aggr. – **Rr:** Kizhi (*Kuznetsov* 1993, no specimens available).

*Ranunculus flammula* L. – **R:** mainly in Kizhi Skerries. (Norrlin 1871: Svyatojnos (Simming); Kizhi (Günther).)

*Ranunculus lingua* L. – **Stfq.** (Norrlin 1871: V. Guba *stfq.*; Shunga.)

*Ranunculus polyanthemus* L. – **Stfq.** (Norrlin 1871: between V. Guba and Vegoruksa.)

*Ranunculus repens* L. – **Fq.** (Norrlin 1871: *Stfq.*)

*Ranunculus reptans* L. – **Fq.** (Norrlin 1871: \*Fq.)

*Ranunculus sceleratus* L. – **Stfq.** (Norrlin 1871: Stfq.)

\*\**Ranunculus subborealis* Tzvel. (*R. acris* subsp. *borealis* (Regel) Nyman) – **Rr:** Lipovitsy (2013 *Kravchenko*).

\**Thalictrum aquilegifolium* L. – **R:** Kuzaranda (Hultén 1971); Tolvuya (Hultén 1971); Krokhiino (1952 *Ramenskaya & Zaykova*; Kravchenko et al. 2000 a); between V. Niva and Vegoruksa (1896 *Poppius*); Chpozzero (1896 *Poppius*); Kazhma (2013 *Kravchenko*); Lipovitsy (2013 Syrjänen, obs.); Tambitsy (2013 Syrjänen, obs.). – RDB EF: 3, RDB RK: 3 (NT)

*Thalictrum flavum* L. – **Fq.** (Norrlin 1871: Fq.)

*Thalictrum simplex* L. – **R:** Shunga (Norrlin 1871); Azhepnavolok (Sparre 1945); Kuzaranda (Hultén 1971); Telyatnikovo (Kuznetsov 1997); Kizhi (Kuznetsov 1993; 2007 *Znamenskiy PTZ*); Volkostrov (1996 *Kuznetsov*; Kuznetsov 1997); Rechnoy Isl. (2004 *Kravchenko*). – RDB EF: 4

*Trollius europaeus* L. – **Fq.** (Norrlin 1871: Fq.)

<sup>a</sup>*Chelidonium majus* L. – **R.** Kizhi (Norrlin 1871: Svyatnavolok (Simming, Günther).)

<sup>a</sup>*Papaver pseudoorientale* (Fedde) Medw. – **Rr:** Kizhi (2011 *Timofeeva*.)

<sup>a</sup>*Papaver somniferum* L. – **Rr:** Tolvuya (2011 *Timofeeva*); V. Guba (2011 *Timofeeva*); Kazhma (2012 *Kravchenko*).

\*\**Corydalis solida* (L.) Clairv. – **R:** mainly in Kizhi Skerries, Kizhi and few adjacent islands and mainland (Kuznetsov 1993), as well as Berezovets Isl. by Klim Nos in the North (1988 *Kuznetsov*).

<sup>a</sup>*Fumaria officinalis* L. – **Str.** (Norrlin 1871: Fq.)

\**Ulmus glabra* Huds. – **R:** Tolvuya (Hultén 1971); Ladmozero, Sypun Gora (1989 *Kravchenko*, obs.; Kravchenko et al. 2000 a); Oyatevstchina (1992 *Kuznetsov*; Kuznetsov 1993); B. Klim. (Hultén 1971), B. Klim., Kosel'ga (1999 *Kravchenko & Kashtanov*; Kravchenko et al. 2000 a) and Vorob'i (2007 *Kravchenko*); Nizhnee Myagrozero (2012 *Kravchenko*; Kravchenko & Timofeeva 2013); Lipovitsy, Lake Bezdonoie (2013 *Syrjänen*). – RDB EF: 3, RDB RK: 3 (LC→NT)

\**Ulmus laevis* Pall. – **Stfq.** on Lake Onega shores in Kizhi Skerries (known from at least 30 localities); outside shores only V. Niva (Hultén 1971). (Norrlin 1871: Svyatnavolok (Kizhi).) – RDB EF: 3, RDB RK: 3 (LC→NT)

<sup>a</sup>*Humulus lupulus* L. – **Rr:** Paleostrov (1999 *Kravchenko & Kashtanov*; Kravchenko et al. 2000 a). – RDB EF: 3, RDB RK: 3 (NT); cultivated and escaped in the area, and these occurrences are not protected.

*Urtica dioica* L. – **Fq.** (Norrlin 1871: Fq.)

<sup>a</sup>*Urtica urens* L. – **Rr**, the only recent record: V. Guba (1999 *Timofeeva*). (Norrlin 1871: \*Fq.)

*Alnus glutinosa* (L.) Gaertn. – **Stfq.** (Norrlin 1871: Fq in Tolvuya – V. Guba – Vegoruksa area, also Dianova Gora.)

*Alnus* × *hybrida* Gaertn. (*A.* × *pubescens* Tausch) – **R.** (Norrlin 1871: V. Guba.)

*Alnus incana* (L.) Moench – **Fq.** (Norrlin 1871: \*Fqq). Var. *argentata* Norrlin (*A. argentata* (Norrl.) Tzvel.) described by Norrlin (1871: 168) on the basis of the material collected from the area (Shunga, Azhepnavolok & V. Guba).

*Betula nana* L. – **Fq.** (Norrlin 1871: \*Fq-fqq.)

\**Betula pendula* Roth – **Fq.** (Norrlin 1871: \*Fq.) \*Var. *karelica* (Merckl.) Hämet-Ahti is known from the entire Zaonezhye (Sokolov 1950; Atlas., 1973), and the number of known trees was estimated to be ca. 3 500 (Laur 1997). However, nowadays this race is under threat to disappear from the peninsula due to negative ecological and genetic factors and illegal cuttings (Vetchinnikova et al. 2013). – RDB RK: 2 (EN)

*Betula pubescens* Ehrh. – **Fq.** (Norrlin 1871: \*Fqq.)

*Montia fontana* L. – **Rr**, only in Kizhi Skerries: Boyarstchina (Kuznetsov 1993); B. Lelik. (1998 *Kashtanov*); Zubovo (2012 *Kravchenko*); Pod'elniki (2012 *Kravchenko*, obs.). (Norrlin 1871: \*Stfq-fq.)

<sup>a</sup>*Agrostemma githago* L. – Only old records: Kizhi (Hultén 1971).

<sup>a</sup>*Alsine media* L. (*Stellaria media* (L.) Cirillo) – **Fq.** (Norrlin 1871: \**Fqq.*)  
*Arenaria serpyllifolia* L. – **Fq.** (Norrlin 1871: *Fq.*)  
\**Cerastium alpinum* L. – **Rr:** Meloiguba (Hultén 1971); B. Klim., Sennaya Guba (1898 Lindroth & Cajander) and Gryznavolok Cape (1999 *Kravchenko & Kashtanov*; Kravchenko et al. 2000 a). (Norrlin 1871: Shunga). – RDB RK 3: (NT)  
*Cerastium holosteoides* Fr. (*C. fontanum* Baumg. subsp. *vulgare* (Hartm.) Greuter & Burdet) – **Fq.** (Norrlin 1871: \**Fqq.*)  
*Cerastium scandicum* (H. Gartner) Kuzen. (*C. fontanum* subsp. *fontanum*) – **R.** (Norrlin 1871: Azhepnavolok and Vegoruksa; as *C. alpestre* Hartm.)  
*Coccyganthe flos-cuculi* (L.) Rchb. (*Lychnis flos-cuculi* L.) – **Fq.** (Norrlin 1871: \**Fq-fqq.*)  
\**Dianthus arenarius* L. s. str. – **Rr:** B. Lelik., Radkol'e Cape (1988 *Kuznetsov*: Kuznetsov 1997). – RDB RK: 3 (LC→NT)  
<sup>a</sup>*Dianthus barbatus* L. – **R:** few records after 2007.  
*Dianthus deltoides* L. – **Fq.** (Norrlin 1871: *Stfq.*)  
*Dianthus superbus* L. – **Rr:** Tolvuya (Hultén 1971).  
*Hylebia nemorum* Fourr. (*Stellaria nemorum* L.) – **Str.**  
<sup>a</sup>*Melandrium album* (Mill.) Garcke (*Silene latifolia* Poir. subsp. *alba* (Mill.) Greuter & Burdet) – **Fq.** (Norrlin 1871: *Fqq.*)  
<sup>a</sup>*Melandrium dioicum* (L.) Coss. & Germ. (*Silene dioica* (L.) Clairv.) – **R:** few records after 1999.  
*Moehringia trinervia* (L.) Clairv. – **Stfq.** (Norrlin 1871: V. Guba.)  
*Myosoton aquaticum* (L.) Moench. – **Stfq.** in Kizhi Skerries: first recorded from Kizhi Isl. (1898 *Cajander & Lindroth*; *Cajander & Lindroth* 1900); numerous recent collections (Kuznetsov 1997; Kravchenko et al. 2000 a). – RDB EF: 3  
<sup>a</sup>*Oberna behen* (L.) Ikonn. (*Silene vulgaris* (Moench) Garcke) – **Fq.** (Norrlin 1871: \**Stfq-fq.*)  
<sup>a</sup>*Psammophiliella muralis* (L.) Ikonn. (*Gypsophila muralis* L.) – Only old records: between Tolvuya and Kosmozero (Norrlin 1871).  
*Sagina nodosa* (L.) Fenzl – **Str.** (Norrlin 1871: *Stfq* in NE (Azhepnavolok – Padmozero).)  
*Sagina procumbens* L. – **Stfq.** (Norrlin 1871: \**Fq.*)  
<sup>a</sup>*Saponaria officinalis* L. – **Rr**, few records after 2010.  
*Scleranthus annuus* L. – **Str.**  
*Scleranthus polycarpus* L. – **Fq.**  
\**Silene nutans* L. – Only old records: Mizhostrov (Bezays 1911); Kuzaranda (H; Bezays 1911); Harlovo (Hultén 1971). – RDB RK: 3 (LC→NT)  
<sup>a</sup>*Spergula sativa* Boenn. (*S. arvensis* L. subsp. *sativa* (Mert. & W. D. J. Koch) Čelak.) – **P.** (Norrlin 1871: \**Fq*, as *S. arvensis* s. lat.)  
<sup>a</sup>*Spergularia rubra* (L.) J. Presl & C. Presl – **P.** (Norrlin 1871: Shunga.)  
*Stellaria alsine* Grimm – **Rr:** Klim Nos and Vegoruksa (Hultén 1971); Turastamozero (2012 *Kravchenko*).  
*Stellaria crassifolia* Ehrh. – **Rr:** Kaskoselga (2013 Syrjänen, obs.); Tambitsy (2013 Syrjänen, obs.).  
*Stellaria fennica* (Murb.) Perfil – **R:** Tipinitsy, Varnavolok (2004 *Piirainen*); B. Klim., Konda (2004 *Uotila*), Vorob'i (2007 *Kravchenko*); Rechka (2012 *Kravchenko*); Verkhnee Myagrozzero (2012 *Kravchenko*); Lake Rugozero (2013 *Kravchenko*).  
*Stellaria graminea* L. – **Fq.** (Norrlin 1871: \**Fqq.*)  
*Stellaria holostea* L. – **Rr:** B. Klim., Klimentitsy (2004 *Kravchenko*, 2004 *Piirainen*).  
*Stellaria longifolia* Mühl. ex Willd. – **Rr:** Padmozero (1993 *Kravchenko*); Rechnoy Isl. (2004 *Kravchenko*); V. Guba (2013 *Kravchenko*).  
*Stellaria palustris* Hoffm. – **Stfq.**  
*Viscaria viscosa* (Scop.) Aschers. (*Lychnis viscaria* L.) – **R.**  
<sup>a</sup>*Amaranthus retroflexus* L. – **Rr:** Shunga (2011 *Timofeeva*).  
<sup>a</sup>*Atriplex prostrata* Boucher ex DC. (*A. latifolia* Wahlenb.) – **Rr:** V. Niva (1999 *Timofeeva & Rudkovskaya*).  
<sup>a</sup>*Atriplex patula* L. – **R.**  
<sup>a</sup>*Chenopodium album* L. – **Fq.** (Norrlin 1871: \**Fqq*; incl. *C. suecicum*.)

<sup>a</sup>*Chenopodium glaucum* L. – **R**.  
<sup>a</sup>*Chenopodium polyspermum* L. – **R**.  
<sup>a</sup>*Chenopodium suecicum* Murr – **Str**.  
*Bistorta officinalis* Delarbre – **Str**. (Norrlin 1871: Shunga, Tolvuya.)  
*Bistorta vivipara* (L.) Delarbre – **R**. (Norrlin 1871: \*Fqq.)  
<sup>a</sup>*Fallopia convolvulus* (L.) Á. Löve – **Fq**. (Norrlin 1871: \*Fq.)  
<sup>a</sup>*Fallopia dumetorum* (L.) Holub – Only old records: V. Guba (Fagerström & Luther 1946).  
*Persicaria amphibia* (L.) Gray – **Fq**. (Norrlin 1871: Fqq.)  
*Persicaria hydropiper* (L.) Spach – **Stfq**. (Norrlin 1871: Fq.)  
*Persicaria lapathifolia* (L.) Gray – **Str**. (Norrlin 1871: Fq.)  
*Persicaria minor* (Huds.) Opiz – **Fq**. (Norrlin 1871: Fq; as *Polygonum mitis* Schrank.)  
<sup>a</sup>*Persicaria tomentosa* (Schrank) Bicknell (*Persicaria lapathifolia* subsp. *pallida* (With.) S. Ekman & T. Knutsson) – **Fq**. (Norrlin 1871: Shunga.)  
<sup>a</sup>*Polygonum arenastrum* Boreau (*P. aviculare* subsp. *microspermum* (Jord. ex Boreau) Beher) – **R**.  
<sup>a</sup>*Polygonum aviculare* L. – **Fq**. (Norrlin 1871: \*Fqq.)  
<sup>a</sup>*Rheum rhabarbarum* L. – **Rr**: Kizhi Isl. (1998 *Kravchenko*; Kravchenko 2007).  
*Rumex acetosa* L. – **Fq**. (Norrlin 1871: \*Fqq.)  
*Rumex acetosella* L. – **Fq**. (Norrlin 1871: \*Fqq.)  
*Rumex maritimus* L. – **Rr**: only old records: V. Guba. – RDB EF: 3  
*Rumex aquaticus* L. – **Stfq**. (Norrlin 1871: \*P.)  
*Rumex crispus* L. – **R**.  
*Rumex fontanopaludosus* Kalela (*R. acetosa* var. *fontanopaludosus* (Kalela) Hyl.) – **Rr**: Shunga (1942 *Kalela*).  
*Rumex longifolius* DC. – **Fq**. (Norrlin 1871: \*Fqq.)  
<sup>a</sup>*Rumex obtusifolius* L. – **Rr**: Kizhi Isl. (2007 *Kravchenko*).  
*Rumex pseudonatronatus* Borbás – **Str**.  
*Rumex rossicus* Murb. (*Rumex maritimus* L. subsp. *rossicus* (Murb.) Kryl.) – **Rr**: without exact locality (Borodina 1977: map; no voucher in LE).  
*Rumex thyrsoiflorus* Fingerh. – **Stfq**.  
*Hypericum maculatum* Crantz – **Fq**. (Norrlin 1871: \*Fq.)  
<sup>a</sup>*Hypericum perforatum* L. – **R**: only in Kizhi Skerries, where for the first time recorded at B. Klim., Garnitsy (Fagerström & Luther 1946); later also Gryz Isl. (1988 *Kuznetsov*; Kuznetsov 1993; 1999 *Kravchenko & Kashtanov*); Bukol'nikovskiy Isl. (1999 *Kashtanov*); B. Lelik Isl. (2004 *Kravchenko* H); Orozh Isl. (1999 *Kravchenko & Kashtanov*; Kravchenko et al. 2000 a); Yam Isl. (1998 *Kashtanov*). [Erroneously from Radkolye Isl. (Kravchenko et al. 2000 a).] – RDB EF: 3, RDB RK: 3 (LC→NT)  
*Elatine hydropiper* L. – **Str**: V. Guba (1870 *Norrlin*; Norrlin 1871; 2000 *Timofeeva & Rudkovskaya*; 2010 *Kravchenko*); Kanev Isl. (1999 *Kashtanov*); B. Klim., Garnitsy Bay (1999 *Kravchenko & Kashtanov*), Kurgenitsy and Vorob'i (both 2007 *Kravchenko*); Bolnichnyi (2010 *Kravchenko*); Kazma (2012 *Kravchenko*).  
<sup>a</sup>*Elatine triandra* Schkuhr. – **Rr**: Azhepnavolok (Sparre 1945); V. Guba (1870 *Norrlin*; Norrlin 1871; 2010 *Kravchenko*); Vegoruksa area (Hultén 1971). – RDB EF: 3, RDB RK: 3 (VU)  
<sup>a</sup>*Viola arvensis* Murray – **Str**. (Norrlin 1871: \*Fq.)  
*Viola canina* L. – **Rr**: Mikkovo (1999 *Timofeeva, Rudkovskaya & Kryshen*); V. Guba (2010 *Kravchenko*). [Norrlin (1871) did not separate *V. canina* from *V. nemoralis*, see below].  
<sup>a</sup>*Viola collina* Besser – **Rr**: Padmozero (1986 *Kuznetsov*; Kravchenko et al. 2000 a). – RDB EF: 3, RDB RK: 3 (LC→NT)  
*Viola epipsila* Ledeb. – **Fq**. (Norrlin 1871: \*Fq–fqq.)  
*Viola mirabilis* L. – **Stfq**. (Norrlin 1871: \*Stfq.)  
*Viola nemoralis* Kütz. (*V. montana* auct. non L.) – **Fq**. (Norrlin 1871: \*Fq, as *V. flavicornis* (Sm.) Norrlin (1871), as well as several recent authors (e.g., Marcussen 2010) do not separate *V. nemoralis* from *V. canina*.  
*Viola palustris* L. – **Fq**. (Norrlin 1871: \*Fq–fqq.)

*Viola rupestris* F. W. Schmidt – **Str.** (Norrlin 1871: *Fq* in Shunga and Tolvuya).  
*Viola riviniana* Rehb. – **Fq.** (Norrlin 1871: \**Fq.*)  
*Viola selkirkii* Pursh ex Goldie – **Str.** (Norrlin 1871: *P.*)  
*Viola tricolor* L. – **Fq.** (Norrlin 1871: *Fq.*)  
<sup>a</sup>*Helianthemum nummularium* (L.) Mill. – **Rr:** B. Lelik., Radkol’e Cape (1988 *Kuznetsov*; *Kuznetsov* 1993, 1997; numerous recent specimens in H and PTZ). Only one more locality in Karelia, at Lake Yanisjarvi in *Karelia ladogensis*. – RDB EF: 2, RDB RK: 2 (EN)  
*Arabidopsis thaliana* (L.) Heynh. – **Stfq.** (Norrlin 1871: Sennaya Guba (Simming).)  
<sup>a</sup>*Armoracia rusticana* G. Gaertn., B. Mey. & Scherb. – **Rr.**  
<sup>a</sup>*Barbarea arcuata* (Opiz ex J. Presl & C. Presl) Rehb. (*Barbarea vulgaris* R. Br. var. *arcuata* Opiz ex J. Presl & C. Presl) Fr. – **Fq.**  
*Barbarea stricta* Andrz. – **Stfq.** (Norrlin 1871: \**Stfq.*)  
<sup>a</sup>*Brassica campestris* L. (*B. rapa* L. subsp. *campestris* (L.) A. R. Clapham) – **Str.**  
<sup>a</sup>*Bunias orientalis* L. – **R.**  
<sup>a</sup>*Camelina alyssum* (Mill.) Thell. – Only old records: *stfq* in Shunga (Norrlin 1871).  
<sup>a</sup>*Capsella bursa-pastoris* (L.) Medik. – **Fq.** (Norrlin 1871: \**Fqq.*)  
<sup>\*\*</sup>*Cardamine amara* L. – **R.** but *stfq* in Kizhi Skerries.  
*Cardamine dentata* Schult. (*C. pratensis* L. subsp. *paludosa* (Knaf) Čelak.) – **Fq.** (Norrlin 1871: R; Shunga, V. Guba.)  
*Descurainia sophia* (L.) Webb. ex Prantl – **R.**  
*Draba nemorosa* L. – **Rr:** Kuzaranda, Vitsino (1998 *Kravchenko*); B. Klim., Longasy (1987 *Kuznetsov*); Megostrov Isl. (2004 *Kravchenko*). – RDB EF: 4  
<sup>a</sup>*Erophila verna* (L.) Chevall. – **Rr.** Azhepnavolok (Sparre 1945); Kizhi area (Hultén 1971). – RDB EF: 3  
<sup>a</sup>*Erysimum cheiranthoides* L. – **Fq.** (Norrlin 1871: \**Fq.*)  
*Erysimum strictum* G. Gaertn., B. Mey. & Scherb. – **Rr:** only old records: Shunga (Norrlin 1871); Kuzaranda (Günther 1880).  
<sup>a</sup>*Hesperis matronalis* L. – **Rr.**  
<sup>a</sup>*Lepidium ruderales* L. – **Rr.**  
<sup>a</sup>*Neslia paniculata* (L.) Desv. – Only old records: Shunga (Norrlin 1871; Günther 1880).  
<sup>a</sup>*Raphanus raphanistrum* L. – **Str.** (Norrlin 1871: \**Fq.*)  
*Rorippa palustris* (L.) Besser – **Fq.** (Norrlin 1871: \**Fq.*)  
<sup>a</sup>*Sinapis arvensis* L. – **Rr.**  
*Subularia aquatica* L. – **Str.** (Norrlin 1871: *Fq* in V. Guba).  
<sup>a</sup>*Thlaspi arvense* L. – **Fq.** (Norrlin 1871: \**Fqq.*)  
<sup>a</sup>*Thlaspi caerulescens* J. Presl & C. Presl – **Rr:** Volkostrov (1996 *Kuznetsov*; *Kuznetsov* 1997).  
*Turritis glabra* L. – **P.** (Norrlin 1871: *P.*)  
<sup>a</sup>*Populus balsamifera* L. – **Rr:** Rechka (2012 *Kravchenko*).  
*Populus tremula* L. – **Fq.** (Norrlin 1871: \**Fqq.*; copiose in V. Guba – Vegoruksa.)  
*Salix aurita* L. – **Stfq.** (Norrlin 1871: \**Stfq-fq.*)  
*Salix caprea* L. – **Fq.** (Norrlin 1871: \**Fq.*)  
*Salix cinerea* L. – **Fq.** (Norrlin 1871: \**Fq.*)  
*Salix lapponum* L. – **Str.** (Norrlin 1871: V. Guba – Vegoruksa.)  
*Salix myrsinifolia* Salisb. – **Fq.** (Norrlin 1871: *Fq* in V. Guba.)  
*Salix myrtilloides* L. – **R.**  
*Salix pentandra* L. – **Fq.** (Norrlin 1871: \**Fq.*)  
*Salix phylicifolia* L. – **Fq.** (Norrlin 1871: \**Fq.*)  
*Salix rosmarinifolia* L. (*S. repens* L. subsp. *rosmarinifolia* (L.) Andersson) – **R.** (Norrlin 1871: Shunga.)  
*Salix starkeana* Willd. (*S. livida* Wahlenb.) – **Str.** (Norrlin 1871: \**Fq-fqq.*)  
<sup>a</sup>*Salix viminalis* L. – **Rr.** Ernitskiy Isl. (1999 *Kashtanov*; *Kravchenko* et al. 2000 a). – RDB EF: 4  
*Andromeda polifolia* L. – **Str.** (Norrlin 1871: *Fq.*)

*Arctostaphylos uva-ursi* (L.) Spreng. – **Str.** (Norrlin 1871: \*Fq.)  
*Calluna vulgaris* (L.) Hull. – **Fq.** (Norrlin 1871: \*Fq.)  
*Chamaedaphne calyculata* (L.) Moench. – **Fq.** (Norrlin 1871: \*Fqq.)  
*Ledum palustre* L. (*Rhododendron tomentosum* Harmaja) – **Stfq.** (Norrlin 1871: Fq in V. Guba – Vegoruksa.)  
*Oxycoccus microcarpus* Turcz. ex Rupr. (*Vaccinium microcarpum* (Turcz. ex Rupr.) Schmalh.) – **Rr:** only field notes, e.g. Lake Vanchozero (2012 Kravchenko, obs.).  
*Oxycoccus palustris* Pers. (*V. oxycoccus* L.) – **Stfq.** (Norrlin 1871: \*Fq–fq.)  
*Vaccinium myrtillus* L. – **Fq.** (Norrlin 1871: Fqq.)  
*Vaccinium uliginosum* L. – **Stfq.** (Norrlin 1871: Fq in SW part.)  
*Vaccinium vitis-idaea* L. – **Fq.** (Norrlin 1871: \*Fqq.)  
*Moneses uniflora* (L.) A. Gray. – **Str.** (Norrlin 1871: Str–p.)  
*Orthilia secunda* (L.) House. – **Fq.** (Norrlin 1871: \*Fq.)  
*Pyrola chlorantha* Sw. – **R.** (Norrlin 1871: \*P.)  
*Pyrola minor* L. – **Stfq.** (Norrlin 1871: \*Fq.)  
*Pyrola media* Sw. – **R.**  
*Pyrola rotundifolia* L. – **Fq.** (Norrlin 1871: \*Fq–fq.) *P. rotundifolia* var. *chloranthoides* Norrlin (1871:160) was described from V. Guba.  
\**Hypopitys monotropa* (L.) Crantz subsp. *hypopitys* (*Monotropa hypopitys* L.) – **R**, mainly in Kizhi Skerries: Kizhi Isl. (1899 *Cajander & Lindroth*; *Cajander & Lindroth* 1900); Kosmozero, Gorskaya (1979 Ronkonen, obs.); Radkolye, Lychkov and Eglöv Isles (all 1998 *Kashtanov*); Bukolnikovskiy and Kalgov Isles (both in 1999 *Kashtanov*); B. Klim., Ernitskiy and Myal Isles (all 1999 *Kravchenko & Kashtanov*); Vertilovo (1999 *Kashtanov*; *Kravchenko et al.* 2000 a); B. Klim. (2000 *Polevoy* PTZ); Vanchozero (2004 *Talbonen* PTZ; *Kravchenko & Timofeeva* 2013); Yuzhnyi Oleniy Isl. (2004 *Kravchenko*); Lipovitsy (2013 *Polevoy* PTZ); Tipinitsy, Varnavolok (2004 *Piirainen*). – RDB EF: 3, RDB RK: 3 (LC→NT)  
*Empetrum nigrum* L. – **R.** (Norrlin 1871: \*Fq.) Perhaps only subsp. *hermaphroditum* (Hagerup) Böcher (*E. hermaphroditum* Hagerup) occurs in the area.  
<sup>a</sup>*Androsace filiformis* Retz. – **R:** few records since 2010.  
*Lysimachia vulgaris* L. – **Fq.** (Norrlin 1871: \*Stfq.)  
*Naumburgia thyrsoflora* (L.) Rchb. (*Lysimachia thyrsoflora* L.) – **Fq.** (Norrlin 1871: \*Stfq.)  
*Trientalis europaea* L. – **Fq.** (Norrlin 1871: \*Fq–fq.)  
\*\**Tilia cordata* Mill. – **R**, but **fq** in Kizhi Skerries. Sometimes forms pure secondary herb rich forests on some islands like Berezovets, Dolgiy, Gryz, Kalgov, Uimy, etc. (relevés provided by Kuznetsov 1997). According to Günther (1880: 19) occupies «...almost all islands in Lake Onega». (Norrlin 1871: Shunga.)  
<sup>a</sup>*Abutilon theophrasti* Medik. – **Rr:** V. Guba (2010 *Kravchenko*).  
<sup>a</sup>*Lavatera thuringiaca* L. – **Rr:** V. Guba (2010 *Kravchenko*); Tolvuya (2011 *Timofeeva*); Kazhma (2012 *Timofeeva*).  
<sup>a</sup>*Malva pusilla* Sm. – Only old records: mainly during World War II (*Fagerstöm & Luther* 1945; *Hultén* 1971).  
<sup>a</sup>*Euphorbia helioscopia* L. – Only old records: Tolvuya (*Günther* 1880; *Koroleva* 1927–1928).  
<sup>a</sup>*Euphorbia virgata* Waldst. & Kit. (*E. esula* L. subsp. *tommassiniana* (Bertol.) *Kuzmanov*) – **R**.  
\*\**Daphne mezereum* L. – **Fq.** (Norrlin 1871: P.)  
\*\**Chrysosplenium alternifolium* L. – **R.** (Norrlin 1871: \*P.)  
*Saxifraga hirculus* L. – **Rr:** Tambitsy–Kaskoselga (2013 *Syrjänen*). (Norrlin 1871: P.)–RDB EF: 3  
*Saxifraga nivalis* L. – **Rr:** Azhepnavolok (*Sparre* 1945; 1996 *Kashtanov*); Telpozero (1952 *Ramenskaya & Zaykova*; *Kravchenko et al.* 2000 a); Vegoruksa, Tolvuya & Fedotovo (*Hultén* 1971, but no vouchers in H). (Norrlin 1871: Azhepnavolok.) – RDB EF: 3  
<sup>a</sup>*Hylotelephium triphyllum* (Haw.) *Holub* (*Hylotelephium telephium* (L.) *H. Ohba*, coll.) – **Rr:** Kizhi Isl. (*Kravchenko* 2007).  
*Sedum acre* L. – **R.** (Norrlin 1871: Fq in Shunga.)

<sup>a</sup>*Grossularia uva-crispa* (L.) Mill. (*Ribes uva-crispa* L.) – **Rr**: V. Guba (2012 *Kravchenko*); Lambasruchei (2013 *Timofeeva*).

*Ribes nigrum* L. – **Stfq**. (Norrllin 1871: *Stfq* in V. Guba.)

\*\**Ribes spicatum* E. Robson – **Fq**. (Norrllin 1871: *Stfq*, as *R. rubrum* L.)

*Parnassia palustris* L. – **Str**. (Norrllin 1871: \**Fqq*.)

*Drosera anglica* Huds. – **Str**. (Norrllin 1871: between V. Guba and Vegoruksa.)

*Drosera rotundifolia* L. – **Stfq**. (Norrllin 1871: \**Fq*.)

<sup>a</sup>*Alchemilla acutiloba* Opiz – **Fq**. (Norrllin 1871: \**Fqq*; as *Alchemilla vulgaris* L.)

<sup>a</sup>*Alchemilla baltica* Sam. ex Juz. – **R**.

<sup>a</sup>*Alchemilla conglobata* H. Lindb. – **Rr**: Oyatevstchina (2012 *Kravchenko*).

<sup>a</sup>*Alchemilla cymatophylla* Juz. – **Rr**: Oyatevstchina (2012 *Kravchenko*).

<sup>a</sup>*Alchemilla glaucescens* Wallr. – **Stfq**.

<sup>a</sup>*Alchemilla hirsuticaulis* H. Lindb. – **R**.

<sup>a</sup>*Alchemilla micans* Buser – **Str**.

<sup>a</sup>*Alchemilla monticola* Opiz – **Fq**.

<sup>a</sup>*Alchemilla propinqua* H. Lindb. ex Juz. – **Str**.

<sup>a</sup>*Alchemilla sarmatica* Juz. – **R**.

<sup>a</sup>*Alchemilla subcrenata* Buser – **Fq**.

<sup>a</sup>*Cerasus vulgaris* Mill. (*Prunus cerasus* L.) – **Rr**: Zubovo (2012 *Kravchenko*); Kizhi Isl. (2014 *Timofeeva*).

*Comarum palustre* L. – **Fq**. (Norrllin 1871: \**Fqq*.)

*Cotoneaster antoninae* Juz. – **Str**: Kizhi Skerries (1986 *Khokhlova*; 1988 *Kuznetsov*; 1999 *Kravchenko & Kashtanov*) and Kosmozero (1999 *Timofeeva et al.*; *Kravchenko* 2010). – RDB EF: 4 *Cotoneaster laxiflorus* Jacq. ex Lindl. (*C. melanocarpus* (Bunge) Loudon; *C. vulgaris* auct. non Lindl.) – **P**. (Norrllin 1871: Azhepnavolok, Shunga; collectively as *C. vulgaris*).

<sup>a</sup>*Crataegus monogyna* Jacq. – **Rr**: Shunga (2012 *Kravchenko*).

*Filipendula ulmaria* (L.) Maxim. – **Fq**. (Norrllin 1871: \**Fqq*.)

<sup>a</sup>*Fragaria* × *ananassa* (Weston) Duchesne ex Rozier – **Rr**: B. Klim., Klimenitsy (2004 *Kravchenko*).

*Fragaria vesca* L. – **Fq**. (Norrllin 1871: \**Fqq*.)

*Geum rivale* L. – **Fq**. (Norrllin 1871: *Fqq* in Shunga and V. Guba.)

*Geum urbanum* L. – **Stfq**. (Norrllin 1871: Shunga.)

<sup>a</sup>*Malus domestica* Borkh. – **Rr**: Kizhi Isl. (2014 *Timofeeva*).

*Padus avium* Mill. (*Prunus padus* L.) – **Fq**. (Norrllin 1871: \**Fqq*.)

*Potentilla anserina* L. – **Fq**. (Norrllin 1871: *Fq*.)

*Potentilla argentea* L. – **Fq**. (Norrllin 1871: V. Guba, *fq* in Shunga.)

*Potentilla erecta* (L.) Raeusch. – **Fq**. (Norrllin 1871: \**Fqq*.)

*Potentilla goldbachii* (Rupr.) Rupr. (*P. thuringiaca* subsp. *goldbachii* (Rupr.) Th. Wolf) – **Rr**: Kizhi Isl. (1896 *Poppius*); Tolvuya (1993 *Kravchenko*).

*Potentilla heidenreichii* Zimmeter (*P. intermedia* subsp. *heidenreichii* (Zimmeter) Tzvelev) – **Rr**, only old records: Shunga (Norrllin 1871).

*Potentilla* “*impolita*” auct., non Wahlenb. – **Str**.

*Potentilla intermedia* L. – **Stfq**. (Norrllin 1871: Shunga.)

*Potentilla norvegica* L. – **Stfq**. (Norrllin 1871: V. Guba.)

\*\**Rosa acicularis* Lindl. – **Fq**. (Norrllin 1871: *Fq*.)

*Rosa majalis* Herrm. – **Fq**. (Norrllin 1871: V. Guba, Shunga.)

*Rubus arcticus* L. – **Str**. (Norrllin 1871: Shunga, V. Guba.)

*Rubus chamaemorus* L. – **Str**. (Norrllin 1871: Soslanovnavolok, V. Guba.)

\*\**Rubus humulifolius* C. A. Mey. – **Rr**: Tolvuya and Klim Nos (Hultén 1971); Unitsa (1896 *Poppius*); V. Guba (1896 *Poppius*); Kaskoselga (2013 Syrjänen, obs.); Lipovitsy (2013 *Kravchenko*); Polya (2013 Syrjänen, obs.); Tambitsy (2013 Syrjänen, obs.); Tipinitsy (2013 Syrjänen, obs.); Uzkiy Salmy (2013 Syrjänen, obs.). – RDB EF: 3

*Rubus idaeus* L. – **Fq**. (Norrllin 1871: *Fqq*.)

*Rubus saxatilis* L. – **Fq.** (Norrlin 1871: *Fqq.*)  
*Sanguisorba officinalis* L. – **Rr:** B. Klim. (1999 *Kravchenko & Kashtanov*; Kravchenko 2007); Tipinitsy (2013 *Syrjänen*).  
*Sorbus aucuparia* L. – **Fq.** (Norrlin 1871: *Fq.*)  
*Amoria hybrida* (L.) C. Presl (*Trifolium hybridum* L.) – **P.**  
*Amoria repens* (L.) C. Presl (*T. repens* L.) – **Fq.** (Norrlin 1871: *Fqq.*)  
*Chrysaspis aurea* (Pollich) Greene (*T. aureum* Pollich) – **Str.** (Norrlin 1871: V. Guba.)  
*Chrysaspis spadicea* (L.) Greene (*T. spadiceum* L.) – **R.** (Norrlin 1871: *Fq* in Shunga.)  
<sup>a</sup>*Galega orientalis* Lam. – **Rr:** V. Niva (2011 *Timofeeva*).  
*Lathyrus aleuticus* (Greene) Pobed. (*L. japonicus* Willd. var. *aleuticus* (Hartm.) Karlsson) – **Rr:** Megostrov Isl. (2004 *Kravchenko*); Rechnoi Isl. (2004 *Piirainen*).  
*Lathyrus palustris* L. – **Stfq.** (Norrlin 1871: Shunga.)  
<sup>a</sup>*Lathyrus pisiformis* L. – **Rr:** Kizhi Isl. (2007 *Znamenskiy PTZ*; Kravchenko 2007).  
*Lathyrus pratensis* L. – **Fq.** (Norrlin 1871: *\*Fq.*)  
*Lathyrus sylvestris* L. – **R:** V. Guba (1942/1943 Kujala, obs.; Hultén 1971); but **stfq** in Kizhi Skerries: Kizhi Isl. (1994 *Kuznetsov*; Kuznetsov 1997); Kalgov Isl. (1999 *Kashtanov*); Bukol'nikovskiy Isl. (1999 *Kashtanov*); etc.  
*Lathyrus vernus* (L.) Bernh. – **Fq.** (Norrlin 1871: *\*Stfq.*)  
<sup>a</sup>*Lupinus polyphyllus* Lindl. – **Rr:** Pod'elniki (2012 *Kravchenko*).  
<sup>a</sup>*Melilotus albus* Medik. – **Rr:** Kizhi Isl. (1996 *Kuznetsov*; Kuznetsov 1997).  
<sup>a</sup>*Melilotus officinalis* (L.) Lam. – **Rr:** Tolvuya (Fagerström & Luther 1945); Kazhma (2012 *Kravchenko*).  
<sup>a</sup>*Pisum sativum* L. – **Rr:** Kazhma (2012 *Kravchenko & Fadeeva*).  
*Trifolium medium* L. – **Fq.** (Norrlin 1871: V. Guba.)  
*Trifolium pratense* L. – **Fq.** (Norrlin 1871: *Fq.*)  
*Vicia cracca* L. – **Fq.** (Norrlin 1871: *Fqq.*)  
<sup>a</sup>*Vicia hirsuta* (L.) Gray – **R.** (Norrlin 1871: *Fq* in Shunga.)  
<sup>a</sup>*Vicia sativa* L. – **Rr:** Kosmozero (1999 *Timofeeva & Rudkovskaya*). (Norrlin 1871: Shunga.)  
*Vicia sepium* L. – **Fq.** (Norrlin 1871: *\*Fq.*)  
*Vicia sylvatica* L. – **Str.** (Norrlin 1871: *\*P.*)  
*Vicia tetrasperma* (L.) Schreb. – **R.**  
*Lythrum salicaria* L. – **Fq.** (Norrlin 1871: *Fq.*)  
*Peplis portula* L. **Str.** – **R:** several recent records from B. Klim. (Norrlin 1871: *Fq* in V. Guba.) Not recorded from V. Guba in 1999–2013.  
*Chamaenerion angustifolium* (L.) Scop. (*Epilobium angustifolium* L.) – **Fq.** (Norrlin 1871: *\*Fqq.*)  
**\*\*Circaea alpina** L. – **Str.** (Norrlin 1871: B. Klim.)  
<sup>a</sup>*Epilobium adenocaulon* Hausskn. – **Fq.**  
*Epilobium collinum* C. C. Gmel. – **R.**  
*Epilobium montanum* L. – **Str.** (Norrlin 1871: *\*Stfq–fq.*)  
*Epilobium palustre* L. – **Fq.** (Norrlin 1871: *Stfq.*)  
<sup>a</sup>*Epilobium pseudorubescens* A. Skvorts. (*E. ciliatum* Raf.) – **Rr:** V. Guba (2010 *Kravchenko*); Kazhma (2012 *Kravchenko*).  
*Myriophyllum alterniflorum* DC. – **Fq.** (Norrlin 1871: *R* in Shunga.)  
*Myriophyllum sibiricum* Kom. – **Str.** (Norrlin 1871: *Fq*; as *M. spicatum* L.)  
<sup>a</sup>*Myriophyllum verticillatum* L. – **R:** between Tarovskaya and Bogomolovskaya and Tolvuya (Fagerström & Luther 1945); Zharnikovo (1986 *Stoikina PTZ*); V. Guba (1999 *Butskih, Kryshen & Timofeeva*); Volkostrov (1986 & 1992 *Kuznetsov*); B. Klim., Garnitskaya Bay (1999 *Kravchenko & Kashtanov*); Orozh Isl. (1999 *Kravchenko & Kashtanov*); Vozhmariha River (1999 *Kravchenko & Kashtanov*; Kravchenko et al. 2000 a). – RDB RK: 3 (DD)  
<sup>a</sup>*Acer platanoides* L. – **Rr:** V. Guba (2010 *Kravchenko*).  
*Linum catharticum* L. – **Str.** (Norrlin 1871: Shunga – Padmozero; V. Guba.)  
*Oxalis acetosella* L. – **Fq.** (Norrlin 1871: *\*Fqq.*)



<sup>a</sup>*Erodium cicutarium* (L.) L'Her. – **R**. (Norrlin 1871: V. Guba.)

<sup>a</sup>*Geranium palustre* L. – **Rr**: B. Klim. area (Hultén 1971); Rechka (2012 *Kravchenko*).

<sup>a</sup>*Geranium pratense* L. – Only old records: Shunga (Norrlin 1871).  
*Geranium sylvaticum* L. – **Fq**. (Norrlin 1871: *Fqq*.)

<sup>a</sup>*Impatiens glandulifera* Royle – **R**: few records since 2010.  
*Impatiens noli-tangere* L. – **Rr**: Putkozerka River (1999 *Butskih, Kryshen & Timofeeva*); Unitsa (2012 *Rudkovskaya*).

*Polygala amarella* Crantz – **R**.  
<sup>a</sup>*Polygala comosa* Schkuhr. – **Rr**. Tolvuya (1993 *Kauhanen PTZ*; Ivanter & Kuznetsov 1995). – RDB EF: 1, RDB RK: 3 (VU)

*Chamaeperichlymenum suecicum* (L.) Asch. & Graebn. (*Cornus suecica* L.) – **Rr**: Lelikozero (1995 *Kuznetsov*).

*Aegopodium podagraria* L. – **Fq**. (Norrlin 1871: *Fq* in Shunga.)

<sup>a</sup>*Anethum graveolens* L. – **Rr**: V. Guba (2010 *Kravchenko*); Tolvuya (2011 *Timofeeva*); Polya (2013 *Kravchenko*).

*Angelica sylvestris* L. – **Fq**. (Norrlin 1871: *Fq*.)

*Anthriscus sylvestris* (L.) Hoffm. – **Fq**. (Norrlin 1871: *Fq* in V. Guba.)

<sup>a</sup>*Carum carvi* L. – **Fq**. (Norrlin 1871: *Fqq*.)

<sup>a</sup>*Chaerophyllum aromaticum* L. – **Fq** and abundant in Kizhi Skerries (often dominates in abandoned fields): V. Niva – Chelozero (1999 *Butskih, Kryshen & Timofeeva*); Tolvuya (Hultén 1971); Kuzaranda (1988 *Kravchenko*; *Kravchenko et al.* 2000 a); V. Guba (2010 *Kravchenko*). – RDB EF: 3

<sup>a</sup>*Chaerophyllum prescottii* DC. – Only old records: Kizhi Isl. (Hultén 1971).

*Cicuta virosa* L. – **Fq**. (Norrlin 1871: *Fq*.)

*Conioselinum tataricum* Hoffm. – **Rr**, only old records: Unitsa (Norrlin 1871: *Rr* Simming); Shunga (1952 *Ramenskaya & Zaikova*).

<sup>a</sup>*Conium maculatum* L. – **Rr**: Tolvuya (2011 *Timofeeva*); Shunga and Lakhново (both 2012 *Kravchenko*).

<sup>a</sup>*Eryngium planum* L. – Only old records: Tolvuya (Fagerström & Luther 1946).

*Heracleum sibiricum* L. – **Fq**. (Norrlin 1871: *\*Fq-fqq*.)

<sup>a</sup>*Heracleum sosnowskyi* Manden. – **Str**, mainly in northern part, also V. Guba.

<sup>a</sup>*Pastinaca sativa* L. – **Rr**: Tolvuya (Fagerström & Luther 1946); Shunga (2012 *Timofeeva*).

*Pimpinella saxifraga* L. – **Fq**. (Norrlin 1871: *\*Fq*.)

*Sium latifolium* L. – **R**: Fedotovo and Oyatovstchina (Bezais 1911); V. Guba (2010 *Kravchenko*). (Norrlin 1871: *Fq* in V. Guba.)

*Thyselium palustre* (L.) Raf. (*Peucedanum palustre* (L.) Moench). – **Fq**. (Norrlin 1871: *\*Fq*.)

<sup>a</sup>*Hippophaë rhamnoides* L. – **Rr**: Tolvuya (2011 *Timofeeva*).

*Frangula alnus* Mill. (*Rhamnus frangula* L.) – **Fq**. (Norrlin 1871: *\*Fq*.)

*Galium album* Mill. – **Fq**. (Norrlin 1871: *\*Fqq*, as *Galium mollugo* L.)

*Galium boreale* L. – **Fq**. (Norrlin 1871: *Fq* in Shunga.)

*Galium elongatum* C. Presl (*G. palustre* L. subsp. *elongatum* (C. Presl) Lange) – **Rr**: Lipovitsy and Polya (both 2013 *Kravchenko*).

**\***, **\*\*** *Galium odoratum* (L.) Scop. – **Rr**: B. Klim. (1996 *Kashtanov*; *Kravchenko et al.* 2000 a); B. Lelik. (2004 *Kravchenko, Piirainen, Uotila*; *Kravchenko* 2007); Tambitsy (2013 *Polevoy PTZ*; 2013 *Syrjänen*). Outside Zaonezhye the species is known from Karelia, west of Lake Onega, from less than ten localities. – RDB EF: 3, RDB RK: 3 (NT)

*Galium palustre* L. – **Fq**. (Norrlin 1871: *\*Fq-fqq*.)

<sup>a</sup>*Galium ruthenicum* Willd. – Only old records: Tolvuya (Fagerström & Luther 1946).

*Galium trifidum* L. – **Str**. (Norrlin 1871: *Fq* in V. Guba.) – RDB EF: 4

**\*\*** *Galium triflorum* Michaux – **Str**.

*Galium uliginosum* L. – **Fq**. (Norrlin 1871: *\*Fqq*.)

<sup>a</sup>*Galium vaillantii* DC. – **Str**. (Norrlin 1871: *\*Fq*.)

*Gentianella amarella* (L.) Börner – **Rr**: Tolvuya (1888 Kihlman); V. Guba, Tambitsy – Kaskoselga (2013 *Syrjänen*). (Norrlin 1871: see below.) – RDB EF: 4

*Gentianella lingulata* (C. Agardh) N. M. Pritch. (*G. amarella* var. *lingulata* (C. Agardh) Karlsson) – **Stfq**. [Norrlin (1871) treated *G. amarella* collectively and included f. *lingulata*; the frequency for collective *G. amarella* is *fq*]. – RDB EF: 3

*Menyanthes trifoliata* L. – **Fq**. (Norrlin 1871: *Fq*).

<sup>a</sup>*Sambucus racemosa* L. – **Rr**: Vegoruksa (2013 *Kravchenko*); Lambasruchi (2013 *Timofeeva*).

<sup>\*\*</sup>*Viburnum opulus* L. – **Fq**. (Norrlin 1871: *Fq*.)

*Linnaea borealis* L. – **Fq**.

*Lonicera pallasii* Ledeb. (*L. caerulea* L.) – **Stfq**. (Norrlin 1871: *Fq*.)

<sup>\*\*</sup>*Lonicera xylosteum* L. – **Fq**. (Norrlin 1871: Soslanovnavolok, Shunga.)

*Adoxa moschatellina* L. – **Str**.

*Knautia arvensis* (L.) Coult. – **Fq**. (Norrlin 1871: *\*Fqq*).

<sup>a</sup>*Calystegia sepium* (L.) R. Br. – **Rr**: V. Guba (2010 *Kravchenko*); Kazhma (2012 *Kravchenko*).

<sup>a</sup>*Calystegia spectabilis* (Brummitt) Tzvelev (*C. sepium* subsp. *spectabilis* Brummitt) – **Rr**: V. Guba (2010 *Kravchenko*).

<sup>a</sup>*Convolvulus arvensis* L. – **R**: Tolvuya (Fagerström & Luther 1946); Vegoruksa (1989 *Kravchenko*); B. Klim., Petry (1998 *Kashtanov*), Longasy (1999 *Kravchenko & Kashtanov*) and Vorob'i (2007 *Kravchenko*); V. Guba (2010 *Kravchenko*).

*Cuscuta europaea* L. – **Str**. (Norrlin 1871: V. Guba.)

<sup>\*</sup>*Polemonium boreale* Adams. – **Rr**: Azhepnavolok (1870 *Norrlin*; Norrlin 1871; 1888 *Kihlman*; 1888 *Günther* LE; 1896 *Poppius*; 1907 *Bezays & Verdi* LE; 1942 *Sparre* H; Sparre 1945; 1997 *Kashtanov*; 2001 *Kuznetsova* PTZ); Shunga (1979 Ronkonen, obs.; *Kravchenko* et al. 2000 a); Padmozero (1870 *Norrlin*; Norrlin 1871; 1875 *Günther* H; 1942 *Kalela* H; 1999 *Kuznetsov*; *Kravchenko* et al. 2000 a). *Polemonium onegense* Klok. was described on the basis of the material collected from Azhepnavolok by Bezays and Verdi in 1907 (Klokov 1955). – RDB EF: 3, RDB RK: 3 (VU)

*Polemonium caeruleum* L. – **Stfq**.

<sup>a</sup>*Buglossoides arvensis* (L.) I. M. Johnst. (*Lithospermum arvense* L.) – Only old records: everywhere (Koroleva 1927–1928); Tolvuya (Fagerström & Luther 1946). (Norrlin 1871: *\*Fq*).

<sup>a</sup>*Cynoglossum officinale* L. – Only old records: Tolvuya (Fagerström & Luther 1946), Shunga (Hultén 1971).

<sup>a</sup>*Echium vulgare* L. – **Rr**: Tolvuya (Fagerström & Luther 1946); B. Klim. (1999 *Kravchenko & Kashtanov*).

<sup>a</sup>*Lappula squarrosa* (Retz.) Dumort – Only old records: Tolvuya (Koroleva 1927–1928).

<sup>a</sup>*Lycopsis arvensis* L. (*Anchusa arvensis* (L.) M. Bieb.) – **Rr**: Tolvuya and Klim Nos, Shitiki (Fagerström & Luther 1946); Vegoruksa (1989 *Kravchenko*); B. Klim., Longasy and Petry (1999 *Kravchenko & Kashtanov*).

<sup>a</sup>*Myosotis arvensis* (L.) Hill – **Fq**. (Norrlin 1871: *\*Stfq-fq*.)

*Myosotis caespitosa* Schultz (*M. laxa* subsp. *caespitosa* (Schultz) Nordh.) – **Str**. (Norrlin 1871: *\*Fq*).

*Myosotis palustris* (L.) L. (*M. scorpioides* L.) – **Fq**. (Norrlin 1871: *\*Fq*.)

<sup>a</sup>*Myosotis sparsiflora* J. G. Mikan ex Pohl – **Rr**: Ladmozero (2012 *Kravchenko*).

*Myosotis stricta* Link ex Roem. & Schult. – **R**.

<sup>a</sup>*Nonea rossica* Steven (*Nonea pulla* DC.) – Only old records: Azhepnavolok (Sparre 1945).

*Pulmonaria obscura* Dumort. – **Rr**: V. Guba (1942/1943 Kujala, obs.; Hultén 1971).

<sup>a</sup>*Symphytum caucasicum* M. Bieb. – **Rr**: Kizhi Isl. (2011 *Timofeeva*); Rechka (2012 *Kravchenko*); Lambasruchi (2013 *Timofeeva*).

<sup>a</sup>*Symphytum asperum* L. – **Rr**: Foimoguba (2013 *Timofeeva*).

*Acinos arvensis* (Schur) Dandy (*Satureja acinos* (L.) Scheele) – **Str**. (Norrlin 1871: Padmozero.)

*Clinopodium vulgare* L. – **Fq**.

<sup>a</sup>*Dracocephalum ruyschiana* L. – **R**, mainly in Kizhi Skerries: Kosmozero (1896 *Poppius*); B. Klim., Sennaya Guba (1898 *Cajander & Lindroth*), Pervye Garnitsy (1998 *Kashtanov*);

1998 *Potakhin* PTZ) and Gryznavolok Cape (1999 *Kravchenko & Kashtanov*); Tolvuya and Shunga (Hultén 1971); Fomino (1988 *Kravchenko*, obs.); Radkolye and Rechnoi Isles (1988 *Kuznetsov*; *Kuznetsov* 1993); Gryz Isl. (1992 *Kuznetsov*; *Kuznetsov* 1993; 1999 *Kravchenko & Kashtanov*); Orozh and Yam Isles (1998 *Kashtanov*; *Kravchenko* et al. 2000 a); Lambaznik Isl. (1999 *Kashtanov*; *Kravchenko* et al. 2000 a); Paleostrov Isl. (1999 *Kravchenko & Kashtanov*, 2004 *Kravchenko*); B. Lelik., Radkol'e Cape (2004 *Kravchenko, Kuznetsov & Gnatyuk, Piirainen*). – RDB RK: 3 (LC→NT)

<sup>a</sup>*Dracocephalum thymiflorum* L. – **Rr**: Kizhi area (Hultén 1971); Megostrov Isl. (2004 *Kravchenko*).

*Galeopsis bifida* Boenn. – **Fq**.

<sup>a</sup>*Galeopsis ladanum* L. – **Rr**, the only recent record: Paleostrov (2001 *Kuznetsova* PTZ). (Norrlin 1871: \**Fq*.)

<sup>a</sup>*Galeopsis speciosa* Mill. – **Fq**. (Norrlin 1871: \**Fq*.)

<sup>a</sup>*Galeopsis tetrahit* L. – **Fq**. (Norrlin 1871: \**Fq*; *G. bifida* included.)

*Glechoma hederacea* L. – **Str**, mainly in Kizhi Skerries. (Norrlin 1871: Svyatoinos (Simming, Kullhem) and Kizhi “copiose” (Günther).)

<sup>a</sup>*Lamium amplexicaule* L. – Only old records: Shunga and Padmozero (Norrlin 1871).

<sup>a</sup>*Lamium confertum* Fr. – **Rr**: Kuzaranda (1888 *Kihlman*; Mennema 1989; 2004 *Kravchenko & Kuznetsov*).

<sup>a</sup>*Lamium dissectum* With. (*L. hybridum* Vill.) – **Str**.

<sup>a</sup>*Lamium purpureum* L. (*L. purpureum* var. *incisum* (Willd.) Pers.) – **Stfq**. (Norrlin 1871: *Fq*.)

<sup>a</sup>*Leonurus villosus* Desf. ex d'Urv. (*L. cardiaca* L. subsp. *villosus* (Desf. ex d'Urv.) Hyl.) – **Rr**: Tolvuya (2011 *Timofeeva*); Tipinitsy (2013 *Timofeeva*).

*Lycopus europaeus* L. – **Fq**. (Norrlin 1871: Shunga.)

*Mentha arvensis* L. – **Fq**. (Norrlin 1871: \**Fq*.)

<sup>a</sup>*Mentha × dalmatica* Tausch – **Rr**: V. Guba (2010 *Kravchenko*); Shunga (2012 *Kravchenko*).

<sup>a</sup>*Mentha longifolia* (L.) Huds. – **Rr**: V. Guba (2010 *Kravchenko*).

\**Origanum vulgare* L. – **R**, mainly in Kizhi Skerries: B. Klim., Sennaya Guba (1898 *Cajander & Lindroth*; *Cajander & Lindroth* 1900), Gryznavolok Cape, Koselga and Petry (all 1999 *Kravchenko & Kashtanov*; *Kravchenko* et al. 2000 a); Radkolye Isl. (1898 *Cajander & Lindroth*; 1988 *Kuznetsov*; *Kuznetsov* 1993; 1998 *Kashtanov*); Paleostrov Isl. (1979 *Ronkonen* PTZ; 1999 *Kravchenko & Kashtanov*); Rechnoi Isl. (1988 *Khokhlova* PTZ); Orozh Isl. (1998 *Kashtanov*; 1999 *Kravchenko & Kashtanov*); Gryz Isl. (1999 *Kravchenko & Kashtanov*); Kalgov, Konev, Lambaznik, Rogostrov and Bukolnikovskiy Isles (all in 1999 *Kashtanov*; *Kravchenko* et al. 2000 a); Yuzhnyi Oleniy Isl. (1988 *Kuznetsov*; 1999 *Kravchenko & Kashtanov*; 2004 *Gnatyuk & Kryshen*). – RDB EF: 3, RDB RK: 3 (LC→NT)

*Prunella vulgaris* L. – **Fq**. (Norrlin 1871: \**Fq*.)

*Scutellaria galericulata* L. – **Fq**. (Norrlin 1871: \**Fq*.)

*Stachys palustris* L. – **Fq**. (Norrlin 1871: *Fq*, Unitsa.)

*Stachys sylvatica* L. – **R**.

*Thymus serpyllum* L. – **Str**. (Norrlin 1871: *Fq* in Shunga.)

\**Thymus subarcticus* Klok. et Shost. – **Rr**: B. Lelik., Radkol'e Cape (1988 *Kuznetsov*; *Kuznetsov* 1993, 1997). – RDB EF: 2, RDB RK: 3 (LC→NT)

*Callitriche cophocarpa* Sendtn. – **Rr**: B. Klim., Petry (1999 *Kravchenko & Kashtanov*); Shilt-ya – Putkozerka River (1999 *Timofeeva & Rudkovskaya*); Ladmozero (2012 *Kravchenko*).

*Callitriche hermaphroditica* L. – **Rr**: Unitsa (Hultén 1971); Shunga – Putkozero (Hultén 1971; 1952 *Ramenskaya & Zaikova* PZV & PTZ; 2012 *Kravchenko*); B. Klim., Garnitskaya Guba Bay and Longasy (1999 *Kravchenko & Kashtanov*; *Kravchenko* et al. 2000 a); V. Guba (1999 *Timofeeva & Rudkovskaya*; 2010 *Kravchenko*); Kazhma (2012 *Kravchenko*). – RDB EF: 3

*Callitriche palustris* L. – **Fq**. (Norrlin 1871: \**Fq*?)

<sup>a</sup>*Hyoscyamus niger* L. – Only old records: Paleostrov (Günther 1880; Koroleva 1927–1928); Tolvuya (Fagerström & Luther 1946).

<sup>a</sup>*Lycopersicon esculentum* Mill. – **Rr**: V. Guba (2010 *Kravchenko*); Kizhi Isl. (2011 *Timofeeva*).

*Solanum dulcamara* L. – **Str**: mainly Kizhi Skerries.  
<sup>a</sup>*Solanum tuberosum* L. – **Rr**: V. Guba (2010 *Kravchenko*).  
*Euphrasia brevipila* Burn. & Gremli (*E. stricta* J. F. Lehm. var. *stricta*) – **Fq**.  
*Euphrasia hirtella* auct. (*E. rostkoviana* Hayne subsp. *fennica* (Kihlm.) Karlsson) – **Str**.  
*Euphrasia officinalis* L. s. lat. – **Rr**: V. Niva (1999 *Timofeeva & Rudkovskaya*). (Norrlin 1871: \*Fq–fqq.)  
*Euphrasia onegensis* A. Cajander – ?**Rr**: Tolvuya (syntypus in H).  
*Euphrasia parviflora* Juz. (*E. nemorosa* (Pers.) Wallr.) – **Stfq**.  
*Euphrasia vernalis* List (*E. stricta* J. P. Wolff ex J. F. Lehm. var. *tenuis* (Brenner) Jalas) – **Str**.  
*Limosella aquatica* L. – **R**: V. Niva (Hultén 1971); Kizhi area (Hultén 1971); Kazhma (2012 *Kravchenko*). (Norrlin 1871: V. Guba.) – RDB EF: 4  
*Linaria vulgaris* Mill. – **Fq**. (Norrlin 1871: *Stfq*.)  
\**Melampyrum cristatum* L. – Only old records: between Kuzaranda and Padmozero (1874 *Günther* H; Hultén 1971). – RDB EF: 3, RDB RK: 2 (EN)  
*Melampyrum nemorosum* L. – **Str**.  
*Melampyrum pratense* L. – **Fq**. (Norrlin 1871: *Fq*.)  
*Melampyrum sylvaticum* L. – **Fq**. (Norrlin 1871: \**Fqq*.)  
<sup>a</sup>*Odontites vulgaris* Moench – **Str**. (Norrlin 1871: *Fq* in Shunga.)  
*Pedicularis palustris* L. – **Fq**. (Norrlin 1871: \**Fqq*.)  
*Pseudolysimachion longifolium* (L.) Opiz (*Veronica longifolia* L.) – **Fq**. (Norrlin 1871: *Fq*.)  
*Pseudolysimachion maritimum* (L.) Á. Löve & D. Löve (*Veronica longifolia* var. *maritima* (L.) Hartm. – **Rr**: B. Klim. and Paleostrov (*Kravchenko* 2007).  
\**Pseudolysimachion spicatum* (L.) Opiz (*Veronica spicata* L.) – **R**: Kosmozero (1896 *Poppius*); B. Klim., Sennaya Guba (1898 *Cajander & Lindroth*; *Cajander & Lindroth* 1900); B. Zarevo and Poyalitsinskaya (both 1943 *Fagerström* H; *Fagerström & Luther* 1946); Telpozero (1952 *Ramenskaya & Zaykova*); Fomino (1988 *Kravchenko*, obs.); Zimnyay Mt. (1988 *Kravchenko*); Svyatuha Bay (1999 *Butskih, Kryshen & Timofeeva*; *Kravchenko et al.* 2000 a). – RDB EF: 3, RDB RK: 3 (NT)  
*Rhinanthus minor* L. – **Fq**. (Norrlin 1871: \**Fqq*.)  
*Rhinanthus serotinus* (Schönh.) Oborný – **Fq**. (Norrlin 1871: *Fqq*.)  
*Scrophularia nodosa* L. – **Str**. (Norrlin 1871: Shunga, V. Guba.)  
<sup>a</sup>*Verbascum nigrum* L. – **Str**. (Norrlin 1871: between V. Guba and Kosmozero, *fq* in V. Guba.)  
*Verbascum thapsus* L. – **Str**.  
*Veronica arvensis* L. – **Str**.  
*Veronica chamaedrys* L. – **Fq**. (Norrlin 1871: \**Fqq*.)  
*Veronica officinalis* L. – **Fq**. (Norrlin 1871: \**Fq*.)  
<sup>a</sup>*Veronica persica* Poir. – **Rr**: V. Guba (2010 *Kravchenko*).  
*Veronica scutellata* L. – **Str**. (Norrlin 1871: V. Guba; Shunga (as var. *villosa* L.)  
*Veronica serpyllifolia* L. – **Fq**. (Norrlin 1871: \**Fqq*.)  
*Veronica verna* L. – **Str**. (Norrlin 1871: *Fq*.)  
\**Littorella uniflora* (L.) Asch. – **Rr**: Vegoruksa (2013 *Kravchenko*). – RDB RF: 2, RDB EF: 2, RDB RK: 2 (EN)  
*Plantago lanceolata* L. – **Stfq**: especially in Kizhi Skerries. (Norrlin 1871: Kizhi Isl. (*Günther*.)  
*Plantago major* L. – **Fq**. (Norrlin 1871: \**Fqq*.)  
*Plantago media* L. – **Str**. (Norrlin 1871: Tolvuya.)  
*Pinguicula vulgaris* L. – **Str**. (Norrlin 1871: *Fq* in the north.)  
*Utricularia intermedia* Hayne – **Str**. (Norrlin 1871: *Fq*.)  
*Utricularia minor* L. – **R**.  
*Utricularia vulgaris* L. – **Stfq** (Norrlin 1871: *Stfq*.)  
*Hippuris vulgaris* L. – **Str**. (Norrlin 1871: Shunga.)  
*Campanula cervicaria* L. – **R**: B. Klim., Kuznetsy; Kalgostrov Isl.; Kuzaranda and Telyatnikovo (all Bezays 1911); V. Guba (1942/1943 *Kujala*, obs.); Perguba area and V. Guba (Hultén 1971); B. Klim., Medvezhia Gora (1997 *Kashanov*; *Kravchenko et al.* 2000 a); Yuzhnyi Oleniy

(2004 Piirainen, obs.); Lisitsino (2004 Piirainen, obs.). (Norrlin 1871: Dianova Gora.) – RDB EF: 3, RDB RK: 3 (LC→NT)

*Campanula glomerata* L. – **Fq.** (Norrlin 1871: *Fq.*)

**\*\*Campanula latifolia** L. – **R:** Tipinitsy, Varnavolok (2004 *Kravchenko*); Oyatevstchina (2011 escaped *Timofeeva & Nikolaeva* PTZ; Timofeeva & Nikolaeva 2012); Lipovitsy, Tambitsy and Tipinitsy (2013 Syrjänen, obs.). – RDB EF: 4, RDB RK: 3 (LC→NT)

*Campanula patula* L. – **Fq.** (Norrlin 1871: *\*Fq-fqq.*)

*Campanula persicifolia* L. – **Stfq.** (Norrlin 1871: *Fq.*)

*Campanula rapunculoides* L. – **Stfq.** (Norrlin 1871: *Fq.*)

*Campanula rotundifolia* L. – **Fq.** (Norrlin 1871: *Fq.*)

**\*Lobelia dortmanna** L. – **Stfq.**, especially in Kizhi Skerries. Species is known from ca 25 localities. (Norrlin 1871: *P.*) – RDB RF: 3, RDB RK: 3 (LC→NT)

*Achillea millefolium* L. – **Fq.** (Norrlin 1871: *\*Fqq.*)

<sup>a</sup>*Achillea nobilis* L. – **Rr:** Pryalichinskaya (Fagerström & Luther 1946); V. Guba (Ramenskaya 1983, no vouchers available)

*Antennaria dioica* (L.) Gaertn. – **Fq.** (Norrlin 1871: *\*Fqq.*)

<sup>a</sup>*Anthemis arvensis* L. – **R.** (Norrlin 1871: V. Guba.)

<sup>a</sup>*Anthemis tinctoria* L. – Only old records: V. Guba (Norrlin 1871); Oyatevstchina (Bezais 1911); Kizh Isl., Tolvuya and V. Guba (Fagerström & Luther 1946).

<sup>a</sup>*Arctium minus* (Hill) Bernh. – **Rr:** V. Guba (2010 *Kravchenko*). (Norrlin 1871: Shunga, *stfq* in V. Guba.)

<sup>a</sup>*Arctium tomentosum* Mill. – **Stfq.** (Norrlin 1871: *Stfq* in Shunga.)

<sup>a</sup>*Artemisia absinthium* L. – **Rr:** Tolvuya (Fagerström & Luther 1946); V. Guba (2010 *Kravchenko*).

<sup>a</sup>*Artemisia rupestris* L. – Only old records: Shunga (Fagerström & Luther 1946).

<sup>a</sup>*Artemisia vulgaris* L. – **Stfq.** (Norrlin 1871: V. Guba and *fq* in Tolvuya.)

<sup>a</sup>*Aster novi-belgii* L. – **Rr:** V. Guba (2010 *Kravchenko*).

<sup>a</sup>*Aster salignus* Willd. – **Rr:** V. Guba (2010 *Kravchenko*).

*Bidens cernua* L. – **Str:** mainly in Kizhi Skerries. (Norrlin 1871: *Fq* in V. Guba.)

*Bidens radiata* Thuill. – **R.**

*Bidens tripartita* L. – **Fq.** (Norrlin 1871: *Fq.*)

<sup>a</sup>*Calendula officinalis* L. – **Rr:** Kazhma (2012 *Kravchenko*).

<sup>a</sup>*Carduus crispus* L. – **Str.** (Norrlin 1871: *Fq.*)

*Centaurea jacea* L. – **Fq.** (Norrlin 1871: *Fqq* in Shunga.)

*Centaurea phrygia* L. – **Fq.** (Norrlin 1871: *Fq-fqq.*)

*Centaurea scabiosa* L. – **Stfq.** (Norrlin 1871: *Fq.*)

<sup>a</sup>*Cichorium intybus* L. – Only old records: Shunga and V. Guba (Fagerström & Luther 1946).

<sup>a</sup>*Cirsium arvense* L. (*C. arvense* var. *arvense*) – **Rr:** V. Guba (2010 *Kravchenko*).

*Cirsium heterophyllum* (L.) Hill. – **Fq.** (Norrlin 1871: *\*Fq.*)

*Cirsium oleraceum* (L.) Scop. – **Str.**

*Cirsium palustre* (L.) Scop. – **Stfq.** (Norrlin 1871: *\*Fq.*)

<sup>a</sup>*Cirsium setosum* (Willd.) Besser (*C. arvense* var. *mite* (Wimm. & Grab.) Lange) – **Fq.** (Norrlin 1871: *\*Fqq*; as *Cirsium arvense* L. s. lat.)

<sup>a</sup>*Cirsium vulgare* (Savi) Ten. – **P.** (Norrlin 1871: Shunga and *fq* in V. Guba.)

<sup>a</sup>*Conyza canadensis* (L.) Cronq. (*Erigeron canadensis* L.) – **Rr:** V. Guba (2010 *Kravchenko*); Kazhma (2012 *Kravchenko*).

*Crepis biennis* L. – **Str:** first recorded from Tolvuya (Fagerström & Luther 1946); recent records from ca. 15 places in meadows, roadsides, fields and shores. – RDB EF: 4

*Crepis paludosa* (L.) Moench – **P.** (Norrlin 1871: V. Guba.)

*Crepis tectorum* L. – **R.** (Norrlin 1871: *\*Fq.*)

<sup>a</sup>*Cyanus segetum* (L.) Hill (*Centaurea cyanus* L.) – **R.** (Norrlin 1871: *\*Fq.*)

*Erigeron acris* L. – **Fq.** (Norrlin 1871: *\*Fq.*)

*Erigeron uralensis* Less. (*E. acris* subsp. *brachycephalus* (H. Lindb.) Hiitonen) – **Str.**

\**Eupatorium cannabinum* L. – **Str.** Kizhi Isl. and Sennaya Guba (both in 1898 *Cajander & Lindroth*; *Cajander & Lindroth* 1900) and ca. 25 recent records, mainly from Kizhi Skerries. – RDB EF: 3, RDB RK: 3 (LC→NT)

*Gnaphalium uliginosum* L. – **Fq.** (Norrlin 1871: \**Fq.*)

<sup>a</sup>*Helianthus tuberosus* L. – **Rr.** V. Niva (2011 *Timofeeva*); Shunga (2012 *Kravchenko*).

*Hieracium caesiiflorum* Almq. ex Norrl. (*H. subcaesium* auct.) – Paleostrov (2004 *Uotila*); Kizhi (1898 *Liro & Cajander*).

*Hieracium chlorelliceptis* Norrl. ex Üksip – Sennaya Guba (1898 *Liro & Cajander*).

*Hieracium coronarium* Brenner (*H. adunans* Norrl.) – Kizhi (1898 *Liro & Cajander*).

*Hieracium diaphanoides* Lindeb. – B. Lelik., Radkol'e (2004 *Uotila*).

*Hieracium distendens* Brenner (*H. fenno-orbicans* Norrl.) – Sennaya Guba (1898 *Liro & Cajander*).

*Hieracium incurrens* Norrl. – B. Lelik., Radkol'e (2004 *Uotila*).

*Hieracium karelorum* (Norrl.) Norrl. (*H. multiglandulosum* Üksip; *H. prenanthoides* auct.) – **Str.** Varnavolok (2004 *Kravchenko & Piirainen*); B. Klim., Obozero (1999 *Kravchenko & Kashtanov*); probably also from Uzkaya Salma (2013 *Kravchenko*), Uimy isles (1986 *Khokhlova*), mainland by Kalgov Isl. (1986 *Kuznetsov*), Klimentitsy (2004 *Kravchenko*), Vorob'i (2007 *Kravchenko*). There are more, yet undescribed taxa of *H.* sect. *Prenanthoidea* Koch, which are found in Azhepnavolok (1870 *Norrlin*) and Shunga (Norrlin 1871, as *H. prenanthoides*) and Nizhnee Myagrozero (2002 *Kravchenko*).

*Hieracium laeticolor* (Almq.) Lönnr. (*H. prolixiforme* Norrl.) – Kizhi (1898 *Liro & Cajander*); Sennaya Guba (1898 *Liro & Cajander*); Paleostrov (2004 *Uotila*).

*Hieracium oistophyllum* Pugsl. (*H. sagittatum* (Lindeb.) Norrl.) – Lake Kosmozero (1996 *Poppius*).

*Hieracium pruiniferum* (Norrl.) Norrl. – B. Klim. (1997 *Kashtanov*).

*Hieracium ravidum* Brenner (*H. galbanum* (Dahlst.) Brenner) – Kizhi (1898 *Liro & Cajander*); Sennaya Guba (1898 *Liro & Cajander*); Paleostrov (2004 *Uotila*).

*Hieracium sagittipotens* Norrl. – Sennaya Guba (1898 *Liro & Cajander*).

*Hieracium tenuiglandulosum* Norrl. – B. Lelik. (2001 *Kuznetsova* PTZ).

*Hieracium umbellatum* L. – **Fqq.** (Norrlin 1871: \**Fqq.*)

<sup>a</sup>*Inula britannica* L. – Only old records: Pryalichinskaya (Fagerström & Luther 1946).

*Inula salicina* L. – **Rr.** Ladmozero (2012 *Kravchenko*). – RDB EF: 3

<sup>a</sup>*Lapsana communis* L. – **R.** (Norrlin 1871: \**Stfq-fq.*)

*Leontodon autumnalis* L. – **Fq.** (Norrlin 1871: \**Fq-fqq.*)

*Leontodon hispidus* L. – **Str.** (Norrlin 1871: Between Tolvuya and V. Guba.)

<sup>a</sup>*Lepidotheca suaveolens* (Pursh) Nutt. (*Matricaria discoidea* DC., *M. matricarioides* auct.) – **Fq.**

*Leucanthemum irtutianum* Turcz. ex DC. (*L. vulgare* L.) – **Fq.** (Norrlin 1871: \**Fqq.*)

*Ligularia sibirica* (L.) Cass. – **R.** (Norrlin 1871: Unitsa (*Simming*)).

<sup>a</sup>*Logfia arvensis* (L.) Holub (*Filago arvensis* L.) – **Rr.** V. Guba (2010 *Kravchenko*).

<sup>a</sup>*Matricaria recutita* L. (*M. chamomilla* L.) – **Rr.** V. Guba (2010 *Kravchenko*).

*Mulgedium sibirum* (L.) Cass. ex Less. (*Lactuca sibirica* (L.) Maxim.) – **Str.** (Norrlin 1871: *Str* in V. Guba.)

*Omalotheca sylvatica* (L.) Sch. Bip. & F. W. Schultz (*Gnaphalium sylvaticum* L.) – **Fq.** (Norrlin 1871: \**Fq-fqq.*)

\*\**Petasites frigidus* (L.) Fr. – **R.** Kuzaranda (Hultén 1971); Lake Kopanetz (1999 *Kravchenko & Kashtanov*); Ryabovo (2010 *Kravchenko*); Verkhnee Myagrozero (2012 *Kravchenko*); Lipovitsy and Uzkie Salmy (2013 *Kravchenko*); Tipinitsy (2013 Syjänen, obs.). (Norrlin 1871: Shunga – Tolvuya.)

*Picris hieracioides* L. – **Str.** (Norrlin 1871: *Str.*)

*Pilosella* × *cymiflora* (Nägeli & Peter) S.Bräut. & Greuter (*Hieracium cymiflorum* Nägeli & Peter; *H. conferciens* Norrl.; *P. officinarum* < *P. pubescens*) – Kizhi (1898 *Liro & Cajander*); Sennaya Guba (1898 *Liro & Cajander*). *Hieracium conferciens* Norrl. (1904) was described on the basis of the cited collections from Kizhi and Sennaya Guba.

*Pilosella* × *fallacina* (F.W.Schultz) F.W.Schultz (*Hieracium fallacinum* F.W.Schultz; *Pilosella officinarum* × *Pilosella praealta* × *Pilosella pubescens*) – Sennaya Guba (1898 Liro & Cajander).

*Pilosella* × *flagellaris* (Willd.) Arv.-Touv. (*Hieracium flagellare* Willd.; *Pilosella officinarum* > *Pilosella onegensis*) – Sennaya Guba (1898 Liro & Cajander); probably also Kalgov Isl. (1986 Kuznetsov).

*Pilosella floribunda* (Wimm. & Grab.) Fr. (*P. suecica* (Fr.) F. Schultz & Sch. Bip., *P. fennica* (Norrl.) Norrl., *Hieracium floribundum* Wimm. & Grab., *H. suecicum* Fr., *H. fennicum* (Norrl.) Mela) – **Stfq**: Sennaya Guba (1898 Liro & Cajander), Volkostrov Isl. (1986 Kuznetsov). (Norrlin 1871: \*Stfq–fq.)

*Pilosella* × *glomerata* (Froel.) Fr. (*Hieracium glomeratum* Froel.; *P. pubescens* × *P. onegensis*) – B. Klim. (1997 *Kashtanov*; 2004 *Piirainen*); Sennaya Guba (1898 Liro & Cajander).

*Pilosella officinarum* F. Schultz & Sch. Bip. (*Hieracium pilosella* L.) – **Stfq**: Kizhi (1898 Liro & Cajander); Sennaya Guba (1898 Liro & Cajander); Radkolye Isl. (1988 Kuznetsov); Pod’elniki (2012 *Kravchenko*). (Norrlin 1871: \*Fq–fq.)

*Pilosella onegensis* Norrl. (*Hieracium onegense* (Norrl.) Norrl.; *H. caespitosum* auct.) – **Stfq**. Not documented by specimens. This species is rather common in *Kon* (Norrlin 1871: \*Stfq; as *H. caespitosum*) in spite of the absence of preserved specimens from Zaonezhie.

*Pilosella peleteriana* (Mér.) F. Schultz & Sch. Bip. (*Hieracium peleterianum* Mér.) – **Rr**: Sennaya Guba (1898 Liro & Cajander).

*Pilosella pubescens* Norrl. (*Hieracium pubescens* Hellstr.; *H. cymosum* auct., *H. vaillantii* auct.) – **Stfq**: Sennaya Guba (1898 Liro & Cajander); Volkostrov (1986 Kuznetsov); Kizhi (1986 Kuznetsov). (Norrlin 1871: \*Fq.)

*Ptarmica cartilaginea* (Ledeb. ex Rchb.) Ledeb. (*Achillea salicifolia* Besser) – **Rr**: Shunga (Putkozzero) (Norrlin 1871, 1979 *Ronkonen*, 2012 *Kravchenko*); all records from shores of the same lake.

*Ptarmica vulgaris* Hill (*Achillea ptarmica* L.) – **Rr**: V. Niva (1999 *Timofeeva & Rudkovskaya*); V. Guba (2010 *Kravchenko*).

*Saussurea alpina* L. – **Rr**: Fedotovo (Bezais 1911); Tolvuya (Fagerström & Luther 1946); Karasozero (1999 Kuznetsov); Tipinitsy – Kaskoselga (2013 *Syrjänen*).

<sup>a</sup>*Senecio vulgaris* L. – **Str**.

*Solidago virgaurea* L. – **Fq**. (Norrlin 1871: *Fq* between V. Guba and Vegoruksa.)

<sup>a</sup>*Sonchus arvensis* L. – **Str**. (Norrlin 1871: \*Fqq.)

<sup>a</sup>*Sonchus asper* (L.) Hill – **R**. (Norrlin 1871: Shunga and V. Guba.)

<sup>a</sup>*Sonchus oleraceus* L. – **R**. (Norrlin 1871: in the whole Zaonezhye Peninsula.)

*Tanacetum vulgare* L. – **Fq**. (Norrlin 1871: *Str*, but *fq* in V. Guba; Unitsa (Kullhem).)

*Taraxacum officinale* Wigg. coll. – **Fq**. (Norrlin 1871: \*Fq.)

*Tripleurospermum inodorum* (L.) Sch. Bip. – **Fq**. (Norrlin 1871: \*Fqq.)

*Trommsdorffia maculata* (L.) Bernh. (*Hypochaeris maculata* L.) – **Stfq**. (Norrlin 1871: V. Guba.)

*Tussilago farfara* L. – **Fq**. (Norrlin 1871: \*P.)

*Paris quadrifolia* L. – **Fq**. (Norrlin 1871: *Fq* in V. Guba.)

*Convallaria majalis* L. – **Fq**. (Norrlin 1871: *Fq*.)

*Maianthemum bifolium* (L.) F. W. Schmidt – **Fq**. (Norrlin 1871: \*Fqq.)

*Polygonatum odoratum* (Mill.) Druce – **Str**. (Norrlin 1871: Azhepnavolok and near Shunga.)

*Allium oleraceum* L. – **Str**: only in Kizhi Skerries, first record at Kizhi Isl. (1995 *Heikkilä* PTZ; Kuznetsov 1997); also Orozh Isl. (1998 *Kashtanov*); Kalgov Isl. (1999 *Kashtanov*); ca. 10 localities after 1997 at B. Klim.

*Allium schoenoprasum* L. – **Rr**: Mysh’i Isles (1986 *Khokhlova* PTZ); Izbushcheyi Isl. (1988 *Kravchenko*); Severnyi Myshiy Isl. (1988 Kuznetsov); B. Klim., Ilainavolok (1997 *Kashtanov*), Pervye Garnitsy (1998 *Kashtanov*) and Lukova Bay (2004 *Kravchenko*, *Piirainen*, *Uotila*); B. Lelik. (2001 Kuznetsova).

<sup>a</sup>*Asparagus officinalis* L. – **Rr**: Rechka (2012 *Kravchenko*).

*Gagea minima* (L.) Ker Gawl. – **Rr**: Kizhi Isl. (Hultén 1971; 1986 *Drozdova*; Kuznetsov 1993; 1998 *Kravchenko*, 1999 *Znamenskiy*, 2003 *Kravchenko & Kuznetsov*); between Teliatnikov and Zharnikovo (1986 *Drozdova*; Kuznetsov 1993); Klim Nos (2001 *Shelekhov*).

*Iris pseudacorus* L. – **Stfq**. (Norrlin 1871: V. Guba.)

*Coeloglossum viride* (L.) Hartm. – **Str**: mainly in Kizhi Skerries. (Norrlin 1871: \**P-stfq*.)

*Corallorhiza trifida* Châtel. – **R**. (Norrlin 1871: \**Fq*.)

**\*\*Cypripedium calceolus** L. – **R**: Kuzaranda (Günther 1880); Yuzhnyi Oleniy Isl. (1896 *Poppius*); Lambasruchey (Hultén 1971); Zagorskoe Lake (1952 *Ramenskaya & Zaykova*). Vablok Isl. (1988 *Kuznetsov*; Kuznetsov 1993); Kainos Isl. (Kuznetsov & Khokhlova 1994); B. Klim., Ilainavolok Cape (1997 *Kashtanov*; Kravchenko et al. 2000 a) and Kurgenitsy (Markovskaya et al. 2007); Rechnoi Isl. (2004 Piirainen, obs.); Megostrov (2004 *Kravchenko* H, PTZ); Tipinitsy (2004 Piirainen & Uotila, obs., 2013 Syrjänen, obs.); Kaskoselga (2013 Tikkanen, obs.); Turastamozero (2012 *Kravchenko*; Kravchenko & Timofeeva 2013). – RDB EF 4, RDB RF 3, RDB RK 3 (LC→NT).

\**Dactylorhiza cruenta* (O. F. Muell.) Soó (*Dactylorhiza incarnata* subsp. *cruenta* (O. F. Müll.) Nyman) – **Rr**, only old records: Azhepnavolok (Sparre 1945); Tolvuya (Hultén 1971). – RDB EF 3, RDB RK 3 (NT)

*Dactylorhiza fuchsii* (Druce) Soó – **Stfq**.

*Dactylorhiza incarnata* (L.) Soó – **Str**. (Norrlin 1871: \**Stfq-fq*.)

*Dactylorhiza maculata* (L.) Soó – **Fq**. (Norrlin 1871: \**Fq*; incl. *D. fuchsii*.)

\**Dactylorhiza traunsteineri* (Saut. ex Rehb.) Soó s. lat. – **R**: V. Guba (1896 *Poppius*, 2013 *Kravchenko*); Lambasruchey (1907 *Bezays & Verdi*; Bezays 1911); Unitsa (Hultén 1971); Putkozzero (1952 *Ramenskaya*, obs.); Paltega (1999 *Butskih, Kryshen & Timofeeva*); Oyat-evstchina (Kuznetsov 1993; Kuznetsov et al. 1999; 2012 *Kravchenko*); Kuzaranda, Tipinitsy (2004 *Kravchenko*); B. Klim., Stchuchia Bay (Markovskaya et al. 2007); Turastamozero (2012 *Kravchenko*; Kravchenko & Timofeeva 2013); Polya (2013 *Kravchenko*). (Norrlin 1871: \**Stfq*, as var. *curvifolia* Nyl.) – RDB RF: 3, RDB RK: 3 (LC→NT)

*Epipactis helleborine* (L.) Crantz – **Str**. (Norrlin 1871: Unitsa.)

\**Epipactis palustris* (L.) Crantz – **R**: Azhepnavolok (Sparre 1945; 1997 *Kashtanov*); Telpozero (1952 *Ramenskaya & Zaykova*; 1979 *Ronkonen*); Lake Zagorskoe (1952 *Ramenskaya & Zaykova*); Shunga (Hultén 1971); Pigma Mire (1980 *Elina, Antipin & Kuzmina* PTZ; Kuznetsov et al. 2013); Lake Padmозero (1986 *Kuznetsov*); Lambasruchey, Kalegubskoe Mire (1991 *Dyachkova* PTZ); Lake Karasozero (1999 *Kuznetsov*; Kravchenko et al. 2000 a); Kuzaranda (2004 *Kravchenko & Kuznetsov*, 2004 *Piirainen*, 2004 *Uotila*); Gizhozero (Markovskaya et al. 2007; 2012 *Timofeeva*; Kravchenko & Timofeeva 2013). – RDB EF: 3, RDB RK: 3 (LC→NT)

*Goodyera repens* (L.) R. Br. – **R**. (Norrlin 1871: Unitsa (Kullhem).)

*Gymnadenia conopsea* (L.) R. Br. – **Stfq**. (Norrlin 1871: \**Fqq*.)

*Hammarbya paludosa* (L.) O. Kuntze – **Str**.

**\*\*Listera cordata** (L.) R. Br. – **Str**. (Norrlin 1871: \**Fq*.)

*Listera ovata* (L.) R. Br. – **Stfq**. (Norrlin 1871: \**Fq-fqq*.)

\**Malaxis monophyllos* (L.) Sw. – **Str**: between Tarovskaya and Bogomolovskaya (Fagerström & Luther 1946); Fedotovo (Hultén 1971); Telyatnikovo (1987 *Stoykina*); Lichkov Isl. (1998 *Kashtanov*); Paleostrov Isl. (1999 *Kravchenko & Kashtanov*; Kravchenko et al. 2000 a); Svyatukha Bay (1999 *Butskih, Kryshen & Timofeeva*; Kravchenko et al. 2000 a); Kuzaranda (2004 *Kravchenko & Kuznetsov, Piirainen*); Shunevskiy Isl. (Markovskaya et al. 2007); V. Guba (2010 *Kravchenko*); Turastamozero (2012 *Kravchenko*; Kravchenko & Timofeeva 2013); between Pod’elniki and Zubovo (2012 *Kravchenko*); Polya (2013 *Kravchenko*). (Norrlin 1871: \**P*.) – RDB EF: 2, RDB RK: 3 (LC→NT)

**\*\*Neottia nidus-avis** (L.) Rich. – **Str**, only in Kizhi Skerries: Boyarstchina and Zharnikovo (both 1986 *Drozdova* PZV); Telyatnikovo, Kushnavolok (Kuznetsov & Khokhlova 1994); B. Klim., Klimenitsy (1997 *Kashtanov*), Pervye Garnitsy (1998 *Kashtanov*), Gryznavolok Cape (1999 *Kravchenko & Kashtanov*), Koselga (1999 *Kravchenko & Kashtanov*) and Vorob’i



(2007 *Kravchenko*); Gryz Isl. (1999 *Kravchenko & Kashtanov*); Myal' Isl. (1999 *Kravchenko & Kashtanov*; *Kravchenko et al.* 2000 a); Yuzhnyi Oleniy Isl. (2004 *Kravchenko*); B. Lelik., Radkol'e Cape (2004 *Kravchenko & Kuznetsov*); Dolgiy Isl. (Markovskaya et al. 2007); Tambitsy (2013 *Syrjänen*); Tipinitys (2013 *Syrjänen*, obs.). – RDB EF: 3, RDB RK: 3 (LC→NT)

*Platanthera bifolia* (L.) Rich. – **Stfq.** (Norrlin 1871: \*Fq.)

*Calla palustris* L. – **Stfq.** (Norrlin 1871: Fq.)

*Lemna minor* L. – **Stfq.** (Norrlin 1871: Shunga and fq in V. Guba.)

*Lemna trisulca* L. – **Str.** (Norrlin 1871: V. Guba and fq in Shunga.)

*Spirodela polyrhiza* (L.) Schleid. – **Rr:** Meloiguba (2013 *Timofeeva*).

*Butomus umbellatus* L. – **Str.**

*Alisma plantago-aquatica* L. – **Fq.** (Norrlin 1871: Fq.)

*Sagittaria × lunata* C. D. Preston & Uotila (*S. natans × sagittifolia*) – **Rr:** B. Klim., Pervye Garnitsy (1998 *Kashtanov*) and Kumush Guba (1999 *Kravchenko & Kashtanov*).

*Sagittaria natans* Pall. – **Rr:** Shunga (1896 *Poppius*); Kosmozero, Padmozero and Putkozero (Shunga) (Klyukina 1965, no vouchers).

*Sagittaria sagittifolia* L. – **Str.** (Norrlin 1871: Fqq in V. Guba.)

*Elodea canadensis* Michx. – **Str.**

*Hydrocharis morsus-ranae* L. – **Str.** (Norrlin 1871: Dianova Gora (Simming); Unitza (Kullhem); seen in several localities in the whole Zanonezhye Peninsula.)

*Stratiotes aloides* L. – **Str.** (Norrlin 1871: Fq in the northern part; V. Guba.)

*Scheuchzeria palustris* L. – **R.** (Norrlin 1871: \*Stfq.)

*Triglochin palustris* L. – **R.** (Norrlin 1871: Fq.)

*Potamogeton alpinus* Balb. – **Fq.** (Norrlin 1871: \*Many localities.)

*Potamogeton × angustifolius* J. Presl (*P. gramineus × lucens*) – **Rr:** Regimatka (2012 *Kravchenko*).

*Potamogeton berchtoldii* Fieber – **Str.** (Norrlin 1871: \*Stfq; as *P. pusillus* L.)

*Potamogeton compressus* L. – **R.** (Norrlin 1871: Fq in Shunga.)

*Potamogeton filiformis* Pers. (*Stuckenia filiformis* (Pers.) Börner) – **Rr:** Putkozero (Klyukina 1965); B. Klim., Garnitskaya Guba Bay (1998 *Kashtanov*; *Kravchenko et al.* 2000 a). (Norrlin 1871: Shunga.) – RDB EF: 4

\**Potamogeton friesii* Rupr. – **Rr**, only old records, all from Lake Putkozero (Shunga) (1888 *Kihlman*; *Kihlman* 1888, 1890; 1896 *Poppius*; *Klyukina* 1965). – RDB EF: 4, RDB RK: 3 (NT)

*Potamogeton gramineus* L. – **Fq.** (Norrlin 1871: \*Fq.)

*Potamogeton lucens* L. – **Fq.** (Norrlin 1871: Fqq.)

*Potamogeton natans* L. – **Fq.** (Norrlin 1871: \*Fq.)

*Potamogeton obtusifolius* Mert. & W. D. J. Koch – **R.** (Norrlin 1871: Suslonov Navolok and V. Guba.)

*Potamogeton perfoliatus* L. – **Fq.** (Norrlin 1871: \*Fq.)

*Potamogeton praelongus* Wulfen – **Rr:** Valgomozero, Lakes Kosmozero and Putkozero (*Klyukina* 1965; no vouchers); Kondozero (2012 *Timofeeva*).

\**Potamogeton rutilus* Wolfg. – **Rr:** only old records, all from Lake Putkozero (Shunga) (1870 *Norrlin*; *Norrlin* 1871 (fq in Shunga); 1888 *Kihlman*; *Kihlman* 1888, 1890; 1896 *Poppius*). – RDB EF: 3, RDB RK: 3 (NT)

\**Caulinia flexilis* Willd. (*Najas flexilis* (Willd.) Rostk. & W. L. E. Schmidt) – **Rr:** V. Guba (1870 *Norrlin*; *Norrlin* 1871; *Günther* 1880; 1943 *Luther*; *Luther* 1945; *Fagerström & Luther* 1946); Kizhi Isl., drifted (*Kuznetsov* 1993). The second record of *Caulinia* from Karelia is also from *Kon*, from Lake Pyalozero (*Luther* 1945). – RDB EF: 1. RDB RF: 2, RDB RK: 1 (CR)

*Sparganium angustifolium* Michx. – **Str.** (Norrlin 1871: Shunga.)

*Sparganium emersum* Rehmman – **Str.** (Norrlin 1871: V. Guba and fq in Shunga.)

*Sparganium glomeratum* Beurl. – **Rr:** V. Guba (1942/1943 *Kujala*, obs.); *Tolvuya* and V. Niva (*Hultén* 1971); *Azhepnavolok* (1996 *Kashtanov*; *Kravchenko et al.* 2000 a). – RDB EF: 3

*Sparganium gramineum* Georgi – **Rr**, only old records: Kizhi area and B. Klim. (*Hultén* 1971).

*Sparganium microcarpum* (Neum.) Čelak. – **Rr**: V. Guba (1942/1943 Kujala, obs.); Kuzaranda (Hultén 1971); Tolvuya (1993 *Kravchenko*); Myal' Isl. (1999 *Kravchenko & Kashtanov*). (Norrlin 1871: Shunga, as *S. ramosum* Huds., nom. illeg. = *S. erectum* L., s. lat.)

*Sparganium natans* L. (*S. minimum* Wallr.) – **Stfq**. (Norrlin 1871: *Fq*.)

*Typha angustifolia* L. – **Rr**: Shunga (Günther 1880); V. Guba (Günther 1880; 1999 *Timofeeva & Rudkovskaya*; 2010 *Kravchenko*); Vegoruksa (2013 *Kravchenko*). (Norrlin 1871: Shunga.)

*Typha latifolia* L. – **Str**: first records from Gavostrov Isl. in Unitsa Bay (1988 *Kravchenko*, obs.) and Azhepnavolok (1996 *Kashtanov*).

*Juncus alpinoarticulatus* Chaix – **Fq**. (Norrlin 1871: \**Stfq-fq*, as *J. nodulosus* = *J. alpinoarticulatus* s.lat.)

*Juncus articulatus* L. – **Stfq**. (Norrlin 1871: \**Fq*.)

*Juncus bufonius* L. – **Str**. (Norrlin 1871: \**Fq*.)

*Juncus bulbosus* L. – **Rr**: Rechka (2012).

*Juncus compressus* Jacq. – **Stfq**. (Norrlin 1871: V. Guba and *fq* in Shunga.)

*Juncus conglomeratus* L. – **R**.

*Juncus effusus* L. – **Str**.

*Juncus filiformis* L. – **Fq**. (Norrlin 1871: \**Fqq*.)

*Juncus fischerianus* Turcz. ex V. I. Krecz. (*J. alpinoarticulatus* subsp. *fischerianus* Turcz. ex V. I. Krecz.) Hämet-Ahti) – **Rr**: Vorob'i (2007 *Kravchenko*).

*Juncus minutulus* (Albert & Jahand.) Prain (*J. bufonius* subsp. *minutulus* (Albert & Jahand.) Sóo, nom. illeg.) – **Rr**: Vanchozero (2012 *Kravchenko*).

*Juncus nodulosus* Wahlenb. (*J. alpinoarticulatus* subsp. *rariflorus* (Hartm.) Holub) – **Str**. (Norrlin 1871, see under *J. alpinoarticulatus*.)

*Juncus ranarius* Songeon & E. P. Perrier – **Rr**: Sennaya Guba (1898 *Liro & Cajander*).

*Juncus stygius* L. – **Rr**. (Norrlin 1871: Unitsa.)

*Luzula multiflora* (Ehrh.) Lej. – **Fq**. (Norrlin 1871: \**Fq*.)

*Luzula pallescens* Sw. – **Fq**. (Norrlin 1871: \**Fqq*.)

*Luzula pilosa* (L.) Willd. – **Fq**. (Norrlin 1871: \**Fqq*.)

*Carex acuta* L. – **Fq**. (Norrlin 1871: \**Fq*.)

*Carex appropinquata* Schumach. – **Rr**: V. Guba (1942/1943 Kujala, obs.); B. Klim., Koselga (1999 *Kravchenko & Kashtanov*); Rechnoy Isl. (2004 *Piirainen* H, PTZ); Lipovitsy, Tambitsy and Tipinitsy (2013 *Syrjänen*, obs.).

*Carex aquatilis* Wahlenb. – **R**: V. Guba and Ust'-Yandoma (1942/1943 Kujala, obs.); observations from several points, but no vouchers.

*Carex atherodes* Spreng. – **Rr**: Kosmozero (1896 *Poppius*; Hultén 1971); erroneously reported for Kizhi Isl. (Kuznetsov 1993; see *Kravchenko et al.* 2000 a). – RDB EF: 3

*Carex brunnescens* (Pers.) Poir. – **Str**.

*Carex buxbaumii* Wahlenb. – **Str**. (Norrlin 1871: Shunga.)

*Carex canescens* L. – **Fq**. (Norrlin 1871: \**Fqq*.)

*Carex capillaris* L. – **R**. (Norrlin 1871: B. Klim. (Simming).)

*Carex cespitosa* L. – **Fq**. (Norrlin 1871: \**Fqq*.)

*Carex chordorrhiza* L. f. – **Stfq**. (Norrlin 1871: \**Fqq*.)

*Carex diandra* Schrank – **Stfq**. (Norrlin 1871: \**Fqq*.)

*Carex digitata* L. – **Stfq**. (Norrlin 1871: V. Guba.)

*Carex dioica* L. – **Stfq**. (Norrlin 1871: *Fqq*.)

\*\**Carex disperma* Dewey – **Str**. (Norrlin 1871: \**P*.)

*Carex echinata* Murray – **Str**. (Norrlin 1871: \**Fq*.)

*Carex elongata* L. – **Fq**. (Norrlin 1871: \**Fq*.)

*Carex ericetorum* Pollich – **Rr**, only old records: Shunga and Vegoruksa (Hultén 1971).

*Carex flava* L. – **Fq**. (Norrlin 1871: *Fqq*.)

*Carex globularis* L. – **Str**. (Norrlin 1871: *Fq*.)

*Carex heleonastes* L. f. – **Rr**: Karasozero (1995 *Kuznetsov*); between Zharnikovo and Pod'elniki (1996 *Kuznetsov*; *Kuznetsov* 1997; *Kuznetsov et al.* 1999); B. Klim., Koselga (1999

*Kravchenko & Kashtanov*; Kravchenko et al. 2000 a); Turastamozero (2012 *Kravchenko*). – RDB EF: 4

*Carex juncella* (Fr.) Th. Fr. (*C. nigra* subsp. *juncella* Fr.) – **Stfq.** (Norrlin 1871: \*Fq.)

*Carex lasiocarpa* Ehrh. – **Fq.** (Norrlin 1871: \*Fq.)

*Carex leporina* L. – **Fq.** (Norrlin 1871: \*Fq.)

*Carex limosa* L. – **Stfq.** (Norrlin 1871: \*Fqq.)

*Carex livida* (Wahlenb.) Willd. – **Rr:** Unitsa (1870 *Norrlin*: Norrlin 1871); Boyarstchina (1986 *Stoykina*; Kuznetsov 1993; Kuznetsov et al. 1999); Uzkie (2005 *Antipin*); Oyatevstchina and Turastamozero (both 2012 *Kravchenko*).

\*\**Carex loliacea* L. – **Str.** (Norrlin 1871: \*P–stfq.)

\**Carex muricata* L. – **Str:** V. Guba, Ustjannoje (1943 Kujala, obs.; Hultén 1971; 2012 *Kravchenko*); numerous recent records from Kizhi Skerries (Kuznetsov 1997; Yudina 1999; Kravchenko et al. 2000 a; Morozova et al. 2010), also Tipinitsy (2004 *Kravchenko & Piirainen* H, PTZ). – RDB EF: 3, RDB RK: 3 (LC→NT)

*Carex nigra* (L.) Reichard. – **Fq.** (Norrlin 1871: \*Fqq.)

*Carex omskiana* Meinsh. (*C. elata* All. subsp. *omskiana* (Meinsh.) Jalas) – **Str.** (Norrlin 1871: V. Guba and *fq* in Shunga.)

*Carex pallescens* L. – **Fq.** (Norrlin 1871: \*Fq.)

*Carex panicea* L. – **Str.** (Norrlin 1871: \*Fq.)

*Carex pauciflora* Lightf. – **Str.** (Norrlin 1871: \*Fq.)

*Carex paupercula* Michx. (*C. magellanica* Lam. subsp. *irrigua* (Wahlenb.) Hiitonen) – **Fq.** (Norrlin 1871: \*Fqq.)

*Carex pseudocyperus* L. – **Rr:** Shunevskiy Isl. (2010 Dementieva, obs.; Morozova et al. 2010). – RDB RK: 3 (LC→NT)

*Carex rhynchophysa* Fisch., C. A. Mey. & Avé-Lall. – **Str.** (Norrlin 1871: \*P.)

\**Carex riparia* Curtis – **Rr:** Tambitsy (2013 Syrjänen, obs.); very rare species in Karelia, where known only in 3 other localities. – RDB EF: 2, RDB RK: 3 (VU)

*Carex rostrata* Stokes – **Fq.** (Norrlin 1871: \*Fqq.)

*Carex scandinavica* E. W. Davies (*C. viridula* Michx. var. *pulchella* (Lönnr.) B. Schmid) – **Str.** – RDB EF: 3

*Carex serotina* Mérat (*C. viridula* var. *viridula*) – **P.** (Norrlin 1871: *Fq* in Shunga; incl. *C. scandinavica*.)

\*\**Carex tenuiflora* Wahlenb. – **Rr:** Vekhkozero (2012 *Kravchenko*). – RDB EF: 3

*Carex vaginata* Tausch – **Stfq.** (Norrlin 1871: *Stfq–fq.*)

*Carex vesicaria* L. – **Fq.** (Norrlin 1871: \*Fq.)

*Eleocharis acicularis* (L.) Roem. & Schult. – **P.** (Norrlin 1871: \*Fq.)

*Eleocharis mamillata* (H. Lindb.) H. Lindb. – **Rr:** Tolvuya and Klim Nos – Okhisevskaya (Fagerström & Luther 1946); Vorob’i (2007 *Kravchenko*).

*Eleocharis palustris* (L.) R. Br. – **Stfq.** (Norrlin 1871: \*Fq.)

*Eleocharis quinqueflora* (Hartmann) O. Schwarz – **Str.** (Norrlin 1871: *Fq* in Shunga.)

*Eleocharis uniglumis* (Link.) Schult. – **Rr:** Shunga (Hultén 1971). This is the only record from Lake Onega, but the species is known from Lake Vodlozero, east of Lake Onega.

*Eriophorum angustifolium* Honck. (*E. polystachyon* L. nom. rej.) – **Stfq.** (Norrlin 1871: \*Fqq.)

*Eriophorum gracile* W. D. J. Koch ex Roth – **Str.** (Norrlin 1871: Shunga.)

*Eriophorum latifolium* Hoppe – **Str.** (Norrlin 1871: Shunga, *fq* between Tolvuya and V. Guba.)

*Eriophorum vaginatum* L. – **Stfq.** (Norrlin 1871: \*Fqq.)

*Rhynchospora alba* (L.) Vahl – **Str.** (Norrlin 1871: between Kosmozero and V. Guba.)

*Schoenoplectus lacustris* (L.) Palla (*Scirpus lacustris* L.) – **Fq.** (Norrlin 1871: *Fqq.*)

*Scirpus sylvaticus* L. – **Fq.** (Norrlin 1871: \*Stfq–fq.)

*Trichophorum alpinum* (L.) Pers. – **Str.** (Norrlin 1871: \*Fqq.)

*Trichophorum cespitosum* (L.) Hartm. – **R.**

*Agrostis canina* L. – **Fq.** (Norrlin 1871: \*Fqq.)

*Agrostis capillaris* L. (*A. tenuis* Sibth.) – **Fq.** (Norrlin 1871: \*Fqq.)

*Agrostis gigantea* Roth – **Rr**: according to Kuznetsov (1993) everywhere in Kizhi Skerries, the frequency obviously overestimated; V. Guba (2012 *Kravchenko*).

*Agrostis stolonifera* L. – **P**. (Norrlin 1871: shores of Lake Onega.)

*Alopecurus aequalis* Sobol. – **Fq**. (Norrlin 1871: \**Fq*.)

*Alopecurus geniculatus* L. – **Fq**. (Norrlin 1871: \**Stfq*.)

<sup>a</sup>*Alopecurus pratensis* L. – **Fq**.

*Anthoxanthum odoratum* L. – **Fq**. (Norrlin 1871: \**Fqq*.)

<sup>a</sup>*Apera spica-venti* (L.) P. Beauv. – Only old records: \**fqq* by Norrlin (1871), *fq* by Koroleva (1927–1928), *fqq* by Kujala (1942/1943, ms.), *stfq–fq* by Fagerström & Luther (1946).

<sup>a</sup>*Avena fatua* L. – **Rr**: V. Guba (1999 *Timofeeva & Rudkovskaya*).

*Avenella flexuosa* (L.) Drejer (*Deschampsia flexuosa* (L.) Trin., *Lerchenfeldia flexuosa* (L.) Schur, nom. illeg.) – **Fq**. (Norrlin 1871: \**Fqq*.)

<sup>a</sup>*Briza media* L. – **Str**.

<sup>a</sup>*Bromopsis inermis* (Leyss.) Holub (*Bromus inermis* Leyss.) – **Str**.

<sup>a</sup>*Bromus arvensis* L. – Only old records: Lammaspuro (1943 Kujala, obs.); Tolvuya (Fagerström & Luther 1946).

<sup>a</sup>*Bromus secalinus* L. – Only old records: Sennaya Guba (Bezais 1911); Tolvuya and Klim Nos (Fagerström & Luther 1946).

*Calamagrostis arundinacea* (L.) Roth – **Fq**. (Norrlin 1871: V. Guba.)

*Calamagrostis canescens* (Weber) Roth – **Fq**. (Norrlin 1871: \**Fq–fqq*.)

*Calamagrostis epigeios* (L.) Roth – **Fq**. (Norrlin 1871: *Fqq*.)

*Calamagrostis meinshausenii* (Tzvelev) Viljasoo (*C. epigeios* subsp. *meinshausenii* Tzvelev) – **Rr**: Megostrov (2004 *Kravchenko*); V. Guba (2010 *Kravchenko*).

*Calamagrostis neglecta* (Ehrh.) G. Gaertn., B. Mey. & Scherb. – **Fq**. (Norrlin 1871: *Fqq*.)

*Calamagrostis phragmitoides* Hartm. (*C. purpurea* (Trin.) Trin. subsp. *phragmitoides* (C. Hartm.) Tzvel.) – **Fq**. (Norrlin 1871: V. Guba.)

<sup>a</sup>*Dactylis glomerata* L. – **Fq**. (Norrlin 1871: *Fq* in Shunga and V. Guba.)

*Deschampsia cespitosa* (L.) P. Beauv. – **Fq**. (Norrlin 1871: *Fqq*.)

*Elymus caninus* (L.) L. (*Agropyron caninum* (L.) P. Beauv.) – **Fq**. (Norrlin 1871: *Fq* in Shunga and V. Guba.)

*Elytrigia repens* (L.) Nevski (*Agropyron repens* (L.) P. Beauv.) – **Fq**. (Norrlin 1871: \**Fq*.)

*Festuca arenaria* Osbeck – **Rr**: Megostrov (2004 *Kravchenko*).

*Festuca ovina* L. – **Fq**. (Norrlin 1871: \**Fq*.)

*Festuca rubra* L. – **Fq**. (Norrlin 1871: \**Fqq*.)

*Glyceria fluitans* (L.) R. Br. – **P**. (Norrlin 1871: \**Fq*.)

\*\**Glyceria lithuanica* (Górski) Górski – **R**: V. Guba (1943 Kujala, obs.); Turastamozero (1989 *Kravchenko*); Shiltya (1999 *Timofeeva & Rudkovskaya*); Lipovitsy and Uzkaya Salma (2013 *Kravchenko*); Oyatevitsa, Polya, Tambitsy, Tipinitsy – Kaskoselga and Uzkiy Salmi (all 2013 Syrjänen, obs.).

*Glyceria maxima* (C. Hartm.) Holmb. – **Rr**: Ust'-Yandoma (1943 Kujala, obs.); Shunga (Hultén 1971); Kuzaranda (Hultén 1971); Orozh Isl. (1999 *Kravchenko & Kashtanov*); V. Guba (2012 *Kravchenko*). (Norrlin 1871: Unitsa.)

*Glyceria notata* Chevall. – **P**.

<sup>a</sup>*Helictotrichon pubescens* (Huds.) Pilg. (*Avenula pubescens* (Huds.) Dumort.) – **Rr**: B. Klim., Kurginitzy (2007 *Kravchenko*); Verkhnee Myagrozzero (2012 Znamenskiy, obs.).

*Hierochloë arctica* C. Presl (*H. hirta* (Schränk) Borb. subsp. *arctica* (C. Presl) G. Weim.) – **Fq**. (Norrlin 1871: \**P*; as *H. odorata* (L.) P. Beauv.)

<sup>a</sup>*Hordeum distichon* L. – **Rr**: Pod'elniki (2012 *Kravchenko*).

*Leymus arenarius* (L.) Hochst. – **Rr**: Shunga and Tolvuya (Hultén 1971). Rather common in eastern and southern part of the lake and on Hedostrov Island east of Kuzaranda, but very rare in Zaonezhnye, may be because of lack of suitable sandy shores.

<sup>a</sup>*Lolium perenne* L. – Only old records: Kuzaranda (Günther 1880); V. Guba, Lammaspuro and Ust'-Yandoma, abundant in fields, probably cultivated (1942/1943 Kujala, obs.); Tolvuya and Klim Nos (Fagerström & Luther 1946).  
*Melica nutans* L. – **Fq.** (Norrlin 1871: \*Fqq.)  
*Milium effusum* L. – **Fq.** (Norrlin 1871: V. Guba.)  
*Molinia caerulea* (L.) Moench – **P.** (Norrlin 1871: Fq in Shunga.)  
*Nardus stricta* L. – **P.** (Norrlin 1871: \*Fqq.)  
*Phalaroides arundinacea* (L.) Rauschert (*Phalaris arundinacea* L.) – **Fq.** (Norrlin 1871: \*Stfq–fq.)  
*Phleum pratense* L. – **Fq.** (Norrlin 1871: \*Fq.)  
*Phragmites australis* (Cav.) Trin. ex Steud. – **Fq.** (Norrlin 1871: Fqq.)  
*Poa alpina* L. – **R.** (Norrlin 1871: Azhepnavolok and Shunga.)  
*Poa angustifolia* L. – **Str.**  
<sup>a</sup>*Poa annua* L. – **Fq.** (Norrlin 1871: \*Fqq.)  
*Poa compressa* L. – **Str.**  
*Poa humilis* Hoffm. (*P. pratensis* subsp. *irrigata* (Lindm.) H. Lindb., *P. subcaerulea* Smith, *P. pratensis* subsp. *subcaerulea* (Sm.) Hiitonen) – **R.**  
*Poa nemoralis* L. – **P.**  
*Poa palustris* L. – **Fq.** (Norrlin 1871: \*Stfq; incl. *P. nemoralis*.)  
*Poa pratensis* L. – **Fq.** (Norrlin 1871: \*Fqq; probably incl. *P. angustifolia*.)  
<sup>\*\*</sup>*Poa remota* Forsel. – **Rr:** V. Guba (1942/1943 Kujala, obs.); Tambitsy, Varnavolok (2004 Kravchenko).  
*Poa trivialis* L. – **Stfq.** (Norrlin 1871: \*Fq.)  
<sup>a</sup>*Puccinellia distans* (Jacq.) Parl. – **Rr:** Kosmozero (1999 *Timofeeva & Rudkovskaya*); Kuzaranda (2004 *Kravchenko & Kuznetsov*, 2004 *Uotila*); Paleostrov (2004 *Uotila*); V. Guba (2010 *Kravchenko*); Kazhma (2012 *Kravchenko*); B. Klim., Konda (2004 *Uotila*).  
<sup>a</sup>*Schedonorus arundinaceus* (Schreb.) Dumort. (*Festuca arundinacea* Schreb.) – **Str.**  
<sup>a</sup>*Schedonorus pratensis* (Huds.) P. Beauv. (*Festuca pratensis* Huds.) – **Fq.** (Norrlin 1871: Shunga; as *Festuca elatior* L.)  
*Scolochloa festucacea* (Willd.) Link – **Rr:** V. Guba (Luther 1945; Fagerström & Luther 1946); B. Klim. area (Hultén 1971); Kizhi Isl. (1994 *Kuznetsov*).  
<sup>a</sup>*Secale cereale* L. – Only old records: Klim Nos (Fagerström & Luther 1946).

#### Dubious or erroneously recorded species

*Nymphaea tetragona* Georgi (Klyukina 1965)  
*Rumex confertus* Willd. (Bezais 1911)  
*Gentiana pneumonanthe* L. (Bezais 1911)  
*Carduus nutans* L. (Bezais (1911)  
*Lactuca tatarica* (L.) C. A. Mey. (Bezais 1911)  
*Phleum alpinum* L. (Bezais 1911; Kuznetsov 1993)

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Margarita Fadeeva and Alexei Kravchenko in moist herb-rich forest (spruce swamp) near Lipovitsy village (Photo Jevgeni Jakovlev).

## 3.2 Bryophyte flora of Zaonezhye Peninsula

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### Abstract

The bryophyte flora of Zaonezhye Peninsula consists of 235 species of mosses and 64 hepatics. The proportion of red listed and indicator species is very high in the area. The establishment of nature monuments and a strictly protected area on Zaonezhye Peninsula will contribute to the conservation of a number of rare Red Data Book species and valuable forest indicator species, growing on forests with pristine and old-growth characteristics, swamp forests and black alder forests, nutrient-rich mesotrophic and eutrophic mires, as well as calcicolous cliffs and rock outcrops.

### Introduction

Floristically, Zaonezhye Peninsula is of great interest. Its distinctive flora and vegetation are due to a distinctive microclimate, different bedrocks and nutrient-rich, sodden lithogenic shungite soils. Shungite (name is according to village Shunga) is black carboniferous rock type which is typical for Zaonezhye. Due to favourable growth conditions, species of southern taiga forests occur here in a middle taiga landscape. According to the biogeographic zonation of Eastern Fennoscandia (Mela & Cajander 1906), the study area is located in the eastern part of the province of *Karelia onegensis*, or the Zaonezhye floristic province (Ramenskaya 1960). The Zaonezhye floristic province is the second most diverse province in Karelia for mosses after the Priladozhye floristic province.

Despite the proximity of Zaonezhye Peninsula to Petrozavodsk and a well-developed road network, the peninsula, especially its western and northeastern parts, has been poorly studied bryofloristically until recently. For a long time the first moss samples, collected by A.K. Cajander and J.I. Lindroth in the vicinity of Sennaya Guba and on Kizhi Island in 1898, were stored in the cryptogamous plant herbarium at the

Museum of Botany, Helsinki University. These samples have been published only recently (Ahti & Boychuk 2006). In 1921, L.I. Savich-Lyubitskaya collected mosses near the village of Shunga. Between 1987 and 1996, moss samples from Kizhi Island were collected by Oleg Kuznetsov, Anatoly Maksimov, Tatyana Brazovskaya and Natalya Stoikina who studied mire flora and vegetation; by V.A. Bakalin (Bakalin et al. 1999) who undertook a special study of moss species from Kizhi Islands and a part of Bolshoi Klimentyevsky Isl.; and by Margarita Boychuk and Jevgenia Markovskaya who studied mosses on the islands of Kizhi Nature Reserve (Boychuk & Markovskaya 2005). The moss flora of Zaonezhye Peninsula (villages Shunga, Tolvuya, Lisitsino and Kosmozero) and the planned Zaonezhye Nature Reserve was studied by Anatoly Maksimov and Tatyana Maksimova in 2000 and by Anatoly Maksimov in 2001 and 2012. Moss samples, collected by Oleg Kuznetsov in 1999 and by Stanislav Kutenkov in 2012 from mires in the study area, have been used for compiling a list of moss species growing in the nature reserve. A list of moss species from Zaonezhye Nature Reserve has been published recently (Maksimov, 2013). This publication contains a list of new mosses from Zaonezhye Peninsula based for the most part on the results of our studies. By 2013, **221** moss species had been reported from Zaonezhye Peninsula (Bakalin et al. 1999; Kuznetsov et al. 2000; Boychuk & Markovskaya 2005; Ahti & Boychuk 2006; Maksimov 2013), although a consolidated list of moss species from the peninsula has not yet been published.

In 2013, the Finnish scientists Kimmo Syrjänen and Olli Manninen continued the study of bryophytes from southern and southwestern Zaonezhye Peninsula. They collected and analyzed approximately 200 bryophyte samples, which are stored in the Turku University herbarium (TUR). Anatoly Maksimov re-analyzed the moss samples from Zaonezhye Peninsula, which are stored in the Karelian Research Centre herbarium (PTZ). In 2013, observations of certain indicator species of bryophytes like *Neckera pennata* were also collected by Jyri Mikkola, Olli-Pekka Tikkanen and Timo Kuuluvainen.

As a result, **four new moss** species, namely *Eurhynchium angustirete*, *Plagiomnium affine*, *Schistidium platyphyllum* and *Tayloria lingulata*, **and one liverwort**, *Anastrophyllum michauxii*, have been reported from the Zaonezhye floristic province. *Eurhynchium angustirete*, *Plagiomnium affine* and *Tayloria lingulata* have been included in the Red Data Book of the Republic of Karelia (2007).

**Thirteen moss species** (*Dicranum fragilifolium*, *Herzogiella seligeri*, *Mnium lycopodioides*, *Myurella julacea*, *Neckera pennata*, *Plagiomnium drummondii*, *Plagiothecium latebricola*, *Polytrichastrum pallidisetum*, *Rhizomnium magnifolium*, *Schistidium platyphyllum*, *Sphagnum quinquefarium*, *S. rubellum* and *Tayloria lingulata*) **have been found for the first time** on Zaonezhye Peninsula. Thus, **235** moss species, making up 65% of the moss flora in the Zaonezhye floristic province (363 species), are now known from Zaonezhye Peninsula (see List of species). A preliminary list of hepatics includes 64 species.

**Rare and valuable species.** Interesting Bryophyte species include *Brachythecium rutabulum*, *Calypogeia suecica*, *Encalypta brevicollis*, *Eurhynchium angustirete*, *Hamatocaulis vernicosus*, *Harpanthus scutatus*, *Homomallium incurvatum*, *Hylocomiastrum pyrenaicum*, *Isothecium alopecuroides*, *Jamesomiella autumnalis*, *Leucodon sciuroides*, *Liochlaena lanceolata*, *Lophozia ascendens*, *Neckera besseri*, *N. pennata*, *Orthotrichum gymnostomum*, *Oxystegus tenuirostris*, *Plagiomnium affine*, *P. drummondii*, *Plagiothecium latebricola*, *Platygyrium repens*, *Pylaisia selwynii*, *Scapania apiculata*, *Schistidium pulchrum*, *Sphagnum auriculatum*, *S. pulchrum*, *S. lindbergii* and *Trichocolea tomentella*. **Fourteen of them**, namely *Calypogeia suecica*, *Eurhynchium angustirete*, *Harpanthus scutatus*, *Jamesomiella autumnalis*, *Lophozia ascendens*, *Neckera besseri*, *N. pennata*, *Orthotrichum gymnostomum*, *Plagiomnium affine*, *P. drummondii*, *Scapania apiculata*, *Sphagnum auriculatum*, *Tayloria*

*lingulata* and *Trichocolea tomentella*, are listed as very rare species in the Red Data Book of Karelia (2007). Some species from Zaonezhye Peninsula, e.g. *Pylaisia selwynii* and *Hamatocaulis vernicosus*, are included in the Red Data Book of European Bryophytes (Red., 1995). *Hamatocaulis vernicosus*, *Herzogiella turfacea* and *Plagiomnium drummondii* are also listed in the EU Habitats Directive.

**Indicator species.** Overall 47 bryophyte species, which according to Andersson et al. (2009) are considered indicator species of valuable forest habitats, are found from Zaonezhye Peninsula. This is a remarkably high number of indicator bryophytes. The list of indicator species includes many of the above-mentioned red-listed species: *Anastrophyllum michauxii*, *Anomodon attenuatus*, *A. longifolius*, *Barbilophozia lycopodioides*, *Calypogeia suecica*, *Crossocalyx hellerianus*, *Dicranum drummondii*, *D. flagellare*, *D. fragilifolium*, *Eurhynchium angustirete*, *Harpanthus scutatus*, *Herzogiella seligeri*, *Homalia trichomanoides*, *Hylocomiastrum pyrenaicum*, *H. umbratum*, *Jamesoniella autumnalis*, *Leucodon sciuroides*, *Liochlaena lanceolata*, *Lophozia ascendens*, *Lophozia longiflora*, *Mnium stellare*, *Neckera complanata*, *N. pennata*, *Orthocaulis attenuatus*, *Orthotrichum gymnostomum*, *O. obtusifolium*, *Oxyrrhynchium hians*, *Philonotis* spp., *Plagiochila asplenioides*, *Plagiomnium affine*, *P. drummondii*, *Plagiothecium latebricola*, *Platygyrium repens*, *Pseudobryum cinclidioides*, *Pterigynandrum filiforme*, *Pylaisia selwynii*, *Riccardia latifrons*, *R. palmata*, *Scapania apiculata*, *Schistostega pennata*, *Sphagnum quinquefarium*, *Sphagnum wulfianum*, *Sphenolobus saxicola*, *Tayloria lingulata*, *Trichocolea tomentella* and *Tritomaria quinquedentata*.

**The most valuable and interesting habitats and sites** from the perspective of bryophyte species diversity include old-growth forests, alder swamps, mesotrophic and eutrophic mires and rich-fens as well as carboniferous rock outcrops.

**Old-growth spruce and mixed forests.** Mesic, herb-rich forests with pristine and old-growth characteristics are very important for bryophyte biodiversity on Zaonezhye Peninsula. Often these forests create a long continuum of coarse woody debris and moist microclimates. Windfallen logs include mainly spruce but also aspen and sometimes pine. These forests are mainly located on heatland sites, remote from old villages, although they are sometimes found also on mire margins and along brooks and rivulets. Epixylic liverworts favour logs where the bark has fallen off and the surface is slightly softened. The diversity of epixylic liverworts typical for pristine forests is high in the forests of Zaonezhye. The frequency of indicator species such as *Crossocalyx hellerianus*, *Lophozia longiflora* and *Riccardia* spp. as well as red-listed *Calypogeia suecica* varies from common to very common in these forests. For example, there are 160 observations of indicator species *Crossocalyx hellerianus* (syn. *Anastrophyllum hellerianum*) and red-listed *Calypogeia suecica* were collected from 21 sites in 2013. The early epixylic colonizer, *Lophozia ciliata* is common in Zaonezhye. More demanding epixylics such as red-listed *Lophozia ascendens* and *Jamesoniella autumnalis* are found in several stands, whereas both *Scapania apiculata* and *Anastrophyllum michauxii* seem to be rather rare. In the Zaonezhye population, female plants of *Jamesoniella autumnalis* also bear perianths, which indicates optimal conditions for growth. According to Damsholt (2002), perianths of *Jamesoniella autumnalis* are rare in Fennoscandia.



Fig. 1. Spruce logs host diverse flora of rare epixylic liverworts in Zaonetshye. Lipovitsy (Photo Kimmo Syrjänen).

**Swamp forests and other wet forests.** The red-listed *Harpanthus scutatus* and the indicator species *Liochlaena lanceolata* grow in more moist and wet forests with the presence of black alder (*Alnus glutinosa*). Also, *Plagiothecium latebricola* is found on the stumps and at the bases of old alder trees in swamp forests and moist forests along streams. *Trichocolea tomentella* occurs where the forest bottom is moist and affected by groundwater. It seems to grow occasionally in herb-rich swamp forests affected by springs. On the forest floor of moist spruce and swamp forests, *Rhytidiadelphus subpinnatus* is commonly found, sometimes together with *Hylocomiastrum umbratum* and more rarely with *Hylocomiastrum pyrenaicum*. The last two species are considered indicator species of valuable forest habitats.



Fig. 2. Herb-rich swamp forest near Polya (Photo Kimmo Syrjänen).

**Forests with large aspen trees.** In addition to old-growth mixed forests, large aspen individuals are also present in the late successional stages of secondary deciduous forests. These forests are common on rich soils close to abandoned villages of southern Zaanonezhye Peninsula. Indicator species *Neckera pennata* is relatively common and a typical epiphyte of large aspens. In sheltered conditions it forms large mats along trunks. In 2013, *Neckera pennata* was observed in 120 locations. Also *Orthotrichum obtusifolium* is a common indicator species, growing on Zaanonezhye aspens. *Orthotrichum gymnostomum* is mainly found on aspen trunks in old-growth forests, although it also grows in secondary forests. It is easily overlooked as it typically grows relatively high up on the trunk and is therefore mainly found on recently fallen trees (either by wind or beavers). The same is true of *Pylaisia selwynii*, which is more rare than the closely related *Pylaisia polyantha* that is common on aspen trunks.



Fig. 3. Base of aspen with *Neckera pennata*, etc. (Photo Kimmo Syrjänen).

Deciduous and mixed herb-rich forests have a diverse bryophyte flora at the bases of aspens and on the forest floor. Both *Eurhynchium angustirete* and *Plagiomnium drummondii* grow in these habitats. Also indicator species *Homalia trichomanoides* and *Isoetecium alopecuroides* can be found at the base of aspen trunks. *Plagiomnium medium* and *Sciuro-hypnum curtum* are very common on the forest floor. In addition to many rare liverworts, mosses *Herzogiella seligeri* and *Herzogiella turfacea* grow on decaying aspen trunks. The latter is common also in swamp forests. Rare *Plagiomnium affine* has been found at the base of old *Ulmus glabra* trunk in one deciduous stand.

**Bedrock exposures with carbonate rich rocks** occur in various places in the area. These outcrops host a rich flora of bryophytes that prefer calcareous substrata. Species include *Tortella tortuosa*, *Distichium capillaceum* and *Ditrichum flexicaule*, which are typical indicators of limestone rocks. Especially worth mentioning are the southern and southeastern slopes of Mount Sypun, where there are rare species such as *Encalypta brevicollis*, *Leucodon sciuroides*, *Neckera besseri*, *N. complanata* and *Oxystegus tenuirostris*. Also the bedrock exposures on the south- and southwest-facing slopes of the southern end of Svyatukha Bay are important. The Red Data Book species *Orthotrichum gymnostomum* and rare nemoral species, including *Anomodon attenuatus*, *Brachythecium rutabulum*, *Homalia trichomanoides*, *Isoetecium alopecuroides*, *I. myosuroides*, *Platygyrium repens* and *Pseudoleskeella papillosa* have been encountered here.



Fig. 4. Spring rich fen close to Kaskoselga with *Carex appropinquata*, *Saxifraga hirculus* and *Hamatocaulis vernicosus* etc. (Photo Kimmo Syrjänen).

**Valuable mires and fens.** Certain mires near the lakes Karasozero and Koibozero, as well as Kalegubskoe Mire in the vicinity of Lambasruchej, are of great scientific interest. The mosses *Sphagnum pulchrum*, *S. aongstroemii* and *S. lindbergii*, which are uncommon to Zaonezhye, have been found here. These mires also host a number of calciphilous mosses that rely on diverse ground nutrients (Dyachkova et al. 1993; Kuznetsov et al. 2000). In the southern part of the peninsula, there are also several fens that are valuable for conservation, including the fens southwest and northwest of the village of Tambitsy. These fens have a rich flora of bryophytes and vascular plants, including *Hamatocaulis vernicosus*.

## Conclusions

The moss flora of the Zaonezhye Peninsula generally comprises the basic species that grow in Zaonezhye, where impoverished south-taiga forests occur in mid-taiga landscapes. The moss flora consists of 235 species that account for about 65% of the flora in the Zaonezhye floristic province. Altogether 14 bryophyte species of Karelian Red List have been found, but the amount of indicator species of valuable forest habitat is much higher: 47 mosses and liverworts. The establishment of a strictly protected area on the Zaonezhye Peninsula will contribute to the conservation of the rare Red Data Book species, such as *Calypogeia suecica*, *Eurhynchium angustirete*, *Harpanthus scutatus*, *Jamesomiella autumnalis*, *Lophozia ascendens*, *Neckera besseri*, *N. pennata*, *Orthotrichum gymnostomum*, *Plagiomnium affine*, *P. drummondii*, *Scapania apiculata*, *Sphagnum auriculatum*, *Tayloria lingulata* and *Trichocolea tomentella*, and the nemoral moss species *Anomodon attenuatus*, *Brachythecium rutabulum*, *Leucodon sciuroides*, *Neckera complanata*, *Platygyrium repense* and *Pylaisia setwynii*, most bryophytes, which grow on nutrient-rich eutrophic mires, and bryophyte indicators of old-growth forests.



Zaonezhye has long history of traditional land use and selective cutting of forests, and also recently some forests are used in intensive forestry. However, large pristine-like stands with continuity of dead wood (both windfalls and standing trees) and large deciduous trees e.g. aspen are available in many places. Diverse bryoflora of natural forests and mires is present in the peninsula. In addition to coniferous forests Zaonezhye has also many other valuable forest habitat types and mires with intact hydrology those support diverse bryophyte species composition. For example, swamp forests with black alder are such sites as well as deciduous late successional herb-rich stands. Larger pristine-like coniferous and herb rich mixed forest stands can be connected to each other by careful planning of conservation areas. Forests can also be connected to villages with shoreline forests, mires, swamp forests and waterways. Zaonezhye provides unique possibility to make connected network of conservation areas. This green infrastructure that connects conservation areas and ancient villages would also support cultural and nature tourism around Kizhi island as well as multiple forest use by local inhabitants.

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## Appendix

### List of mosses from Zaonezhye Peninsula

Nomenclature according to Ignatov et al. (2006), with some changes.

#### **Fam. Sphagnaceae**

- Sphagnum angustifolium* (C. E. O. Jensen ex Russow) C. E. O. Jensen
- S. aongstroemii* C. Hartm.
- S. auriculatum* Schimp.
- S. balticum* (Russow) C. E. O. Jensen
- S. capillifolium* (Ehrh.) Hedw.
- S. centrale* C. E. O. Jensen
- S. compactum* Lam. & DC.
- S. contortum* Schultz
- S. cuspidatum* Ehrh. ex Hoffm.
- S. fallax* (H. Klinggr.) H. Klinggr.
- S. fimbriatum* Wilson
- S. flexuosum* Dozy & Molk.
- S. fuscum* (Schimp.) H. Klinggr.
- S. girgensohnii* Russow
- S. inundatum* Russow
- S. jensenii* H. Lindb.
- S. lindbergii* Schimp.
- S. magellanicum* Brid.
- S. majus* (Russow) C. E. O. Jensen
- S. obtusum* Warnst.
- S. papillosum* Lindb.
- S. platyphyllum* (Lindb. ex Braithw.) Warnst.
- S. pulchrum* (Lindb. ex Braithw.) Warnst.
- S. quinquefarium* (Lindb. ex Braithw.) Warnst.
- S. riparium* Ångstr.
- S. rubellum* Wilson
- S. russowii* Warnst.
- S. squarrosum* Crome
- S. subfulvum* Sjörs
- S. subsecundum* Nees
- S. teres* (Schimp.) Ångstr.
- S. warnstorffii* Russow
- S. wulfianum* Girg.

#### **Fam. Andreaeaceae**

- Andreaea rupestris* Hedw.

#### **Fam. Polytrichaceae**

- Atrichum tenellum* (Röhl.) Bruch et al.
- A. undulatum* (Hedw.) P. Beauv.
- Pogonatum urnigerum* (Hedw.) P. Beauv.
- Polytrichastrum longisetum* (Sw. ex Brid.) G. L. Smith
- P. pallidisetum* (Funck) G. L. Smith
- Polytrichum commune* Hedw.
- P. juniperinum* Hedw.
- P. piliferum* Hedw.

*P. strictum* Brid.

**Fam. Tetraphidaceae**

*Tetraphis pellucida* Hedw.

**Fam. Funariaceae**

*Funaria hygrometrica* Hedw.

**Fam. Encalyptaceae**

*Encalypta brevicolla* (Bruch et al.) Ångstr.

*E. ciliata* Hedw.

*E. rhaptocarpa* Schwägr.

*E. vulgaris* Hedw.

**Fam. Grimmiaceae**

*Bucklandiella microcarpa* (Hedw.) Bednarek-Ochyra & Ochyra

*Grimmia longirostris* Hook.

*G. muehlenbeckii* Schimp.

*Niphotrichum canescens* (Hedw.) Bednarek-Ochyra & Ochyra

*Schistidium apocarpum* (Hedw.) Bruch et al.

*S. dupretii* (Thér.) W. A. Weber

*S. papillosum* Culm.

*S. platyphyllum* (Mitt.) H. Perss.

*S. pulchrum* H. H. Blom

*S. rivulare* (Brid.) Podp.

**Fam. Dicranaceae**

*Dicranella cerviculata* (Hedw.) Schimp.

*D. heteromalla* (Hedw.) Schimp.

*D. schreberiana* (Hedw.) Dixon

*Dicranum bonjeanii* De Not.

*D. brevipodium* (Lindb.) Lindb.

*D. drummondii* Müll. Hal.

*D. flagellare* Hedw.

*D. flexicaule* Brid.

*D. fragilifolium* Lindb.

*D. fuscescens* Turner

*D. majus* Turner

*D. montanum* Hedw.

*D. polysetum* Sw.

*D. scoparium* Hedw.

*D. undulatum* Schrad. ex Brid.

*Paraleucobryum longifolium* (Hedw.) Loeske

**Fam. Rhabdoweisiaceae**

*Amphidium lapponicum* (Hedw.) Schimp.

*Cnestrum schisti* (F. Weber & D. Mohr) I. Hagen

*Cynodontium strumiferum* (Hedw.) Lindb.

*C. tenellum* (Schimp.) Limpr.

*Hymenoloma crispulum* (Hedw.) Ochyra

**Fam. Ditrichaceae**

*Ceratodon purpureus* (Hedw.) Brid.

*Distichium capillaceum* (Hedw.) Bruch et al.

*Ditrichum flexicaule* (Schwägr.) Hampe

*Saelania glaucescens* (Hedw.) Broth.

**Fam. Pottiaceae**

*Barbula convoluta* Hedw.

*Bryoerythrophyllum recurvirostrum* (Hedw.) P.C. Chen

*Didymodon ferrugineus* (Schimp. ex Besch.) M.O. Hill  
*D. rigidulus* Hedw.

*Oxystegus tenuirostris* (Hook. & Tayl.) A. J. E. Smith

*Syntrichia ruralis* (Hedw.) F. Weber & D. Mohr

*Tortella fragilis* (Hook. & Wilson) Limpr.

*T. tortuosa* (Hedw.) Schimp.

**Fam. Fissidentaceae**

*Fissidens adianthoides* Hedw.

*F. osmundoides* Hedw.

**Fam. Schistostegaceae**

*Schistostega pennata* (Hedw.) F. Weber & D. Mohr

**Fam. Meesiaceae**

*Leptobryum pyriforme* (Hedw.) Wilson

*Meesia triquetra* (Jolycl.) Ångstr.

*Paludella squarrosa* (Hedw.) Brid.

**Fam. Splachnaceae**

*Splachnum luteum* Hedw.

*S. rubrum* Hedw.

*Tayloria lingulata* (Dicks.) Lindb.

*Tetraplodon angustatus* (Hedw.) Bruch et al.

**Fam. Orthotrichaceae**

*Orthotrichum gymnostomum* Bruch ex Brid.

*O. obtusifolium* Brid.

*O. rupestre* Schleich. ex Schwägr.

*O. speciosum* Nees

**Fam. Hedwigiaceae**

*Hedwigia ciliata* (Hedw.) P. Beauv.

**Fam. Bryaceae**

*Bryum argenteum* Hedw.

*B. bimum* (Schreb.) Turner

*B. caespiticium* Hedw.

*B. capillare* Hedw.

*B. creberrimum* Tayl.

*B. lonchocaulon* Müll. Hal.

*B. moravicum* Podp.

*B. pallescens* Schleich. ex Schwägr.

*B. pseudotriquetrum* (Hedw.) P. Gaertn., B. Mey. & Schreb.

*B. weigelii* Spreng.

*Rhodobryum roseum* (Hedw.) Limpr.

**Fam. Mielichhoferiaceae**

*Pohlia bulbifera* (Warnst.) Warnst.

*P. cruda* (Hedw.) Lindb.

*P. nutans* (Hedw.) Lindb.

**Fam. Mniaceae**

*Cinclidium stygium* Sw.

*Mnium lycopodioides* Schwägr.

*M. stellare* Hedw.

*Plagiomnium affine* (Bland.) T. J. Kop.

*P. cuspidatum* (Hedw.) T. J. Kop.

*P. drummondii* (Bruch & Schimp.) T.J. Kop.

*Plagiomnium elatum* (B.S.G.) T.J. Kop.

*P. ellipticum* (Brid.) T. J. Kop.

*P. medium* (Bruch et al.) T. J. Kop.  
*Pseudobryum cinclidioides* (Huebener) T. J. Kop.  
*Rhizomnium magnifolium* (Horik.) T.J.Kop.  
*R. pseudopunctatum* (Bruch & Schimp.) T. J. Kop.  
*R. punctatum* (Hedw.) T. J. Kop.  
*Rhodobryum roseum* (Hedw.) Limpr.  
**Fam. Bartramiaceae**  
*Bartramia pomiformis* Hedw.  
*Philonotis fontana* (Hedw.) Brid.  
**Fam. Aulacomniaceae**  
*Aulacomnium palustre* (Hedw.) Schwägr.  
**Fam. Fontinalaceae**  
*Dichelyma falcatum* (Hedw.) Myrin  
*Fontinalis antipyretica* Hedw.  
**Fam. Plagiotheciaceae**  
*Herzogiella seligeri* (Brid.) Z. Iwats.  
*Herzogiella turfacea* (Lindb.) Z. Iwats.  
*Isopterygiopsis pulchella* (Hedw.) Z. Iwats.  
*Myurella julacea* (Schwägr.) Schimp.  
*Plagiothecium cavifolium* (Brid.) Z. Iwats.  
*P. denticulatum* (Hedw.) Bruch et al.  
*P. laetum* Bruch et al.  
*P. latebricola* Bruch et al.  
*P. piliferum* (Sw.) Bruch et al.  
**Fam. Pterigynandraceae**  
*Pterigynandrum filiforme* Hedw.  
**Fam. Leucodontaceae**  
*Leucodon sciuroides* (Hedw.) Schwägr.  
**Fam. Hypnaceae**  
*Hypnum cupressiforme* Hedw.  
**Fam. Pylaisiadelphaceae**  
*Platygyrium repens* (Brid.) Bruch et al.  
**Fam. Pseudoleskeaceae**  
*Lescuraea incurvata* (Hedw.) Lawt.  
**Fam. Anomodontaceae**  
*Anomodon attenuatus* (Hedw.) Huebener  
*A. longifolius* (Brid.) Hartm.  
**Fam. Heterocladiaceae**  
*Heterocladium dimorphum* (Brid.) Bruch et al.  
**Fam. Neckeraceae**  
*Homalia trichomanoides* (Hedw.) Bruch et al.  
*Neckera besseri* (Lobarz.) Jur.  
*N. complanata* (Hedw.) Huebener  
*N. oligocarpa* Bruch  
*N. pennata* Hedw.  
**Fam. Climaciaceae**  
*Climacium dendroides* (Hedw.) F. Weber & D. Mohr  
**Fam. Hylocomiaceae**  
*Hylocomiastrum pyrenaicum* (Spruce) M. Fleisch.  
*H. umbratum* (Hedw.) M. Fleisch.  
*Hylocomium splendens* (Hedw.) Bruch et al.  
*Pleurozium schreberi* (Brid.) Mitt.

*Rhytidiadelphus squarrosus* (Hedw.) Warnst.

*R. subpinnatus* (Lindb.) T. J. Kop.

*R. triquetrus* (Hedw.) Warnst.

**Fam. Lembophyllaceae**

*Isothecium alopecuroides* (Lam. ex Dubois) Isov.

*I. myosuroides* Brid.

**Fam. Brachytheciaceae**

*Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen

*Brachythecium albicans* (Hedw.) Bruch et al.

*B. erythrorrhizon* Bruch et al.

*B. mildeanum* (Schimp.) Schimp.

*B. rivulare* Bruch et al.

*B. rutabulum* (Hedw.) Bruch et al.

*B. salebrosum* (F. Weber & D. Mohr) Bruch et al.

*Cirriphyllum piliferum* (Hedw.) Grout

*Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen

*Eurhynchium angustirete* (Broth.) T.J. Kop.

*Oxyrrhynchium hians* (Hedw.) Loeske

*Sciuro-hypnum curtum* (Lindb.) Ignatov

*S. populeum* (Hedw.) Ignatov & Huttunen

*S. reflexum* (Starke) Ignatov & Huttunen

*S. starkei* (Brid.) Ignatov & Huttunen

**Fam. Calliergonaceae**

*Calliergon cordifolium* (Hedw.) Kindb.

*C. giganteum* (Schimp.) Kindb.

*C. megalophyllum* Mikut.

*C. richardsonii* (Mitt.) Kindb.

*Loeskypnum badium* (Hartm.) H. K. G. Paul

*Straminergon stramineum* (Dicks. ex Brid.) Hedenäs

*Warnstorfia exannulata* (Bruch et al.) Loeske

*W. fluitans* (Hedw.) Loeske

*W. procera* (Renauld & Arnell) Tuom.

*W. tundrae* (Arnell) Loeske

**Fam. Scorpidiaceae**

*Hamatocaulis vernicosus* (Mitt.) Hedenäs

*Hygrohypnella ochracea* (Turner ex Wilson) Ignatov & Ignatova

*Sanionia uncinata* (Hedw.) Loeske

*Scorpidium cossonii* (Schimp.) Hedenäs

*S. revolvens* (Sw. ex anon.) Rubers

*S. scorpioides* (Hedw.) Limpr.

**Fam. Pylaisiaceae**

*Breidleria pratensis* (W. D. J. Koch ex Spruce) Loeske

*Calliergonella cuspidata* (Hedw.) Loeske

*C. lindbergii* (Mitt.) Hedenäs

*Homomallium incurvatum* (Schrad. ex Brid.) Loeske

*Ptilium crista-castrensis* (Hedw.) De Not.

*Pylaisia polyantha* (Hedw.) Bruch et al.

*P. selwynii* Kindb.

*Stereodon pallescens* (Hedw.) Mitt.

**Fam. Rhytidiaceae**

*Rhytidium rugosum* (Hedw.) Kindb.

**Fam. Pseudoleskeellaceae**

*Pseudoleskeella nervosa* (Brid.) Nyh.

*P. papillosa* (Lindb.) Kindb.

*P. tectorum* (Funck ex Brid.) Kindb.

**Fam. Thuidiaceae**

*Abietinella abietina* (Hedw.) M. Fleisch.

*Helodium blandowii* (F. Weber & D. Mohr) Warnst.

*Thuidium assimile* (Mitt.) A. Jaeger

*T. recognitum* (Hedw.) Lindb.

**Fam. Amblystegiaceae**

*Amblystegium serpens* (Hedw.) Bruch et al.

*Campyliadelphus chrysophyllus* (Brid.) Kanda

*C. elodes* (Lindb.) Kanda

*Campylidium sommerfeltii* (Myrin) Ochyra

*Campylium protensum* (Brid.) Kindb.

*Campylium stellatum* (Hedw.) C. E. O. Jensen

*Cratoneuron filicinum* (Hedw.) Spruce

*Drepanocladus aduncus* (Hedw.) Warnst.

*D. polygamus* (Bruch et al.) Hedenäs

*Drepanocladus sendtneri* (Schimp. ex H. Müll.) Warnst.

*Hygroamblystegium fluviatile* (Hedw.) Loeske

*Leptodictyum riparium* (Hedw.) Warnst.

*Palustriella falcata* (Brid.) Hedenäs

*Pseudocalliergon trifarium* (F. Weber & D. Mohr) Loeske

*Serpoleskea subtilis* (Hedw.) Loeske

*Tomentypnum nitens* (Hedw.) Loeske



Fig. 5. *Neckera pennata* (Photo: Kimmo Syrjänen).



Fig. 6. *Rhytidiadelphus subpinnatus* (Photo: Kimmo Syrjänen).



Fig. 7. *Trichocolea tomentella* (Photo: Kimmo Syrjänen).



### 3.3 List of lichens and allied fungi collected on Zaonezhye Peninsula

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#### History of the studies of lichens in Zaonezhye Peninsula and adjacent islands

The pioneer study of the lichen flora on Zaonezhye Peninsula was undertaken in 1863 by two Finnish naturalists: student Th. Simming and lecturer A. Kullhem. They collected a large number of lichen specimens, which are now in the herbarium of the Botanical Museum of the Finnish Museum of Natural History, University of Helsinki (H). The collection was analyzed and partly published by W. Nylander (1866 a, c), the greatest lichen classifier at that time.

In the same time (1863) Alexander K. Günther was travelling, presumably together with Th. Simming and A. Kullhem, on Zaonezhye Peninsula. A. K. Günther, an Alexander Plant staff healer in the Olonets Province, who later collected lichens actively near Petrozavodsk, visited the northeastern part of the territory and Kizhi Island. The results of his trip are reported in his work "On flora of the Obonega Region Province" (Günther 1880), where lichens are not mentioned.

In 1870, Finnish botanist and phytogeographer J.P. Norrlin visited the biogeographic province *Karelia onegensis* (*Kon*) (it is Norrlin was the first scientist who recognized *Kon* province he interpreted it in a broader sense than modern authors do). Norrlin described many of the samples he collected near the villages of Velikaya Guba, Tolvuja and Shunga, together with the samples collected by Th. Simming and A. Kullhem, in the second part of his classical work «Flora Kareliae Onegensis. II. Lichenes» (Norrlin 1876). The collections of Th. Simming, A. Kullhem and J. P. Norrlin are referred to by E. A. Vainio in his fundamental work «Lichenographia Fennica. I–IV» (Vainio 1921, 1922, 1927, 1934). Norrlin's collections are stored in H.

In 1898 and 1899, Finnish botanists A.K. Cajander and J. I. Lindroth (subsequently Liro) toured Russian Karelia and the Onega River area. They visited many places such as Kizhi Island, Bolshoi Klimentyevsky Island, Bolshoi Lelikovskiy Island (Point Radkolye), Yuzhny Oleny Island and other smaller islands. Their routes have been described and lists of the moss species, liverworts and lichens collected by Cajander and Lindroth have been published by T. Ahti and M. Boychuk (Ahti & Boychuk 2006). The list of lichens, which consists of 68 species, does not comprise samples from the Zaonezhye Peninsula.

In 1907, Russian agronomist and botanist E.K. Bezais took a 2-month field trip to Karelia. His goal was to study and describe the coastal and insular vegetation of Lake Onega. While travelling, he collected and described both plants and lichens. He submitted a detailed report on his trip (Bezais 1911), in which he mentioned *Cladonia rangiferina* (L.) F. H. Wigg. found on Paleostrov Island. The herbarium of Botanical Institute (LE) comprises at least two lichen samples collected by E.K. Bezais and A. Verdi «on north shore of Lake Onega»: *Rhizocarpon badioatrum* (Flörke ex Spreng.) Th. Fr. and *Rhizocarpon distinctum* Th. Fr. (Fadeyeva et al. 1997).

In 1920–1924, V.P. Savich joined the Olonets Scientific Expedition led by G.U. Vereshchagin and organized by the State Hydrological Institute together with the Main Botanical Gardens (now the Botanical Institute, RAS) and other scientific institutions, and collected lichen samples on shores of lakes Sandal, Segozero and Vygzero and near Povenets (west and north shores of Lake Onega). It is well-known that he also visited the Shunga area, because LE has a sample of *Ophioparma ventosa* (L.) Norman collected by V.P. Savich and L.I. Savich-Lyubitskaya on Gorodok Hill, 9 km southeast of Shunga. Unfortunately, many samples from a huge collection of lichens (several thousand samples) brought by V.P. Savich from Karelia and kept in LE (Vereshchagin 1921, 1924) have not yet been analyzed.

In the 1970s, T.P. Sizova and T. Yu. Tolpysheva of Moscow State University studied the species composition of lichens on famous wooden Church of Transfiguration on Kizhi Island (Tolpysheva et al. 2001).

In 1999–2001 and 2007, M.A. Fadeyeva visited Kizhi Island, Bolshoi Klimentyevsky Island, Bolshoi Lelikovskiy Island, Severny and Yuzhny Oleny Island, Volkostrov, Krestovy and Belaya Selga village in Zaonezhye. Only a small portion of more than one thousand samples collected chiefly in 1999 has been published (Fadeyeva 2000, 2001, 2003, Fadeyeva et al. 2007).

In 2004, M.A. Fadeyeva joined a Russian-Finnish expedition to the Zaonezhye Peninsula and Lake Onega islands (3.–8 July, 2004). Russia was represented by E. Gnatjuk, A. Kravchenko, A. Kryshen' & O. Kuznetsov and Finland by M. Piirainen, T. Lindholm, R. Ruuhijärvi & P. Uotila. She visited Bolshoi Klimentyevsky Island (Klimentyevskiy Nos Peninsula and Point Lukovo), Bolshoi Lelikovskiy Island (Point Radkolye), Megostrov, Paleostrov, Rechnoi, Shushenevskiy and Yuzhny Oleny islands and the continental shore near Kuzaranda and Tipinitskiy villages (Point Varnavolok).

In 2010, M.A. Fadeyeva, together with A. V. Kravchenko, V.I. Krutov, O.O. Predtechenskaya and A.V. Ruokolainen (Forest Research Institute, KarRC, RAS), studied the area north and south of Velikaya Guba (the environs of the former villages Komlevo, Ryabovo, Lipovitskiy and Lakes Palozero and Khmelezero).

In 2012, M.A. Fadeyeva was involved in the integrated study of planned Zaonezhskiy Landscape Reserve. The study was conducted by the Forest Research Institute, KarRC, RAS (Fadeyeva 2013). In 2012, A. V. Kravchenko and M.A. Fadeyeva studied the vascular plant and lichen flora of the mainland shores near the Kizhi Skerries from the village of Oyatevshchina to Lake Vekhozero at the request of Kizhi Museum-Reserve (Fadeyeva & Kravchenko 2013). A list of 137 lichens and related fungi was made up, but it was not presented in the above publication. The lichen samples

collected by A. V. Kravchenko and M. A. Fadeyeva are in the Karelian Research Centre herbarium (PTZ).

Finally, in 2013, Olli Manninen, Kimmo Syrjänen and Margarita Fadeeva joined a Finnish-Russian Zaonezhye expedition in the framework of the BPAN project and collected lichen samples on southeastern part of Zaonezhye Peninsula (see Syrjänen et al. 2014, p. 212).

## Acknowledgements

The author Margarita Fadeeva is thankful for professor Soili Stenroos (Head Curator of Fungi at Botanical Museum/Finnish Museum of Natural History University of Helsinki) for the help during her visits in Helsinki University Herbarium in 2011 and 2012, and for professor Teuvo Ahti for the permanent help in her work.

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### List of lichens and allied fungi of Zaonezhye Peninsula

The list is compiled on basis of published data and from recent collections, as well as from specimens in the herbaria of Karelian Scientific Center of Russian Academy of Sciences, Petrozavodsk (PTZ), Institute of Botany of Russian Academy of Sciences, St. Petersburg PAH (LE), Botanical Museum of the Finnish Museum of Natural History, University of Helsinki (H), and University of Turku (TUR).

Bol. Klim.Isl. – Bolshoi Klimenetsky Island

\* - lichenicolous fungus, + - saprophytic fungus

The nomenclature follows Nordin et al. (2011).

The list incorporates 298 species and infraspecific taxa of lichens, 3 species of lichenicolous fungi, and 3 species of saprotrophic fungi

1. *Acarospora fuscata* (Schrad.) Th. Fr. – Norrlin 1876; Fadeeva 2013; Podyelniki, on stones in the wall around old chapel, 08.07.2012, M.A. Fadeeva, PTZ.
2. *Acarospora glaucocarpa* (Ach.) Körb. – Norrlin 1876.
3. *Adelolecia kolaënsis* (Nyl.) Hertel & Rambold – Norrlin 1876; Vainio 1934.
4. *Alectoria sarmentosa* (Ach.) Ach. – Polyá village -S, herb-rich spruce mire, on twigs of spruce, 25.08.2013, K. Syrjänen, TUR; Velikaya Guba -SW, Zubovo -N, NE of the Lake Pužej, siliceous east facing cliff, on rock wall, 24.08.2013, K.Syrjänen, TUR.
5. *Alyxoria varia* (Pers.) Ertz & Tehler – Shunga, 1870, J. P. Norrlin, H.
6. *Amandinea coniops* (Wahlenb.) M.Choisy ex Scheid. & H. Mayrhofer – Norrlin 1876.
7. *Amandinea punctata* (Hoffm.) Coppins & Scheid. – Fadeeva 2000.

8. *Arctoparmelia centrifuga* (L.) Hale – Fadeeva 2013; NW shore of Lake Vekhkzero, on blocks of seismo-colluvial scree, 11.07.2012, M.A. Fadeeva, PTZ.
9. *Arctoparmelia incurva* (Pers.) Hale – Fadeeva 2013.
10. *Arthonia cinereopruinosa* Schaer. – Nylander 1866 a; Norrlin 1876.
11. *Arthonia mediella* Nyl.– Norrlin 1876.
12. *Arthonia radiata* (Pers.) Ach. – Norrlin 1876.
13. *Arthonia spadicea* Leight. – Norrlin 1876.
14. *Aspicilia cinerea* (L.) Körb. – Norrlin 1876.
15. *Aspicilia verrucigera* Hue – Bol. Klim.Isl., 1863, A. Kullhem, H: Magnusson 1939.
16. *Bacidia bagliettoana* (A. Massal. & De Not.) Jatta – Norrlin 1876; Vainio 1922; Fadeeva 2013; Kizhi Island, on *Ulmus laevis*, 27.05.1999, M.A. Fadeeva, PTZ.
17. *Bacidia rubella* (Hoffm.) A. Massal. – Norrlin 1876; Vainio 1922.
18. *Bacidia subincompta* (Nyl.) Arnold – Norrlin 1876; Vainio 1922.
19. *Baeomyces carneus* Flörke – Fadeeva 2013.
20. *Bellemerea cinereorufescens* (Ach.) Clauzade & Cl. Roux – Norrlin 1876.
21. *Bellemerea diamarta* (Ach.) Hafellner & Cl. – Norrlin 1876.
22. *Biatora pallens* (Kullh.) Printzen – Zubovo village, on *Sorbus aucuparia*, 03.07.2012, M.A. Fadeeva, PTZ.
23. *Biatora vernalis* (L.) Fr. – Tolpysheva et al. 2001.
24. *Blastenia crenularia* (With.) Arup et al. – Norrlin 1876.
25. *Botryolepraria lesdainii* (Hue) Canals & al. – Fadeeva 2013.
26. *Bryoria capillaris* (Ach.) Brodo & D. Hawksw. – Fadeeva 2013; NW shore of Lake Vekhkzero, on twigs of spruce 11.07.2012, M.A. Fadeeva, PTZ.
27. *Bryoria fremontii* (Tuck.) Brodo & D. Hawksw. – Vegoruksy Village, ca. 1.5 km SE, forest-side edge of dry grassland on sandy ground, A.V. Kravchenko, 19.08.2010, PTZ.
28. *Bryoria furcellata* (Fr.) Brodo & D. Hawksw. – Fadeeva 2000; Tolpysheva et al. 2001; Zubovo village, on trunk and twigs of pine, 03.07.2012, M.A. Fadeeva, PTZ; Podyelniki, on trunk and twigs of pine, 10.07.2012, M.A. Fadeeva, PTZ.
29. *Bryoria fuscescens* (Gyeln.) Brodo & D. Hawksw. – Surroundings of Zubovo village, on trunks and twigs of pine, 03.07.2012, M.A. Fadeeva, PTZ; Podyelniki, on pine, 10.07.2012, M.A. Fadeeva, PTZ; Zubovo –N, on twigs of spruce, 24.08.2013, K. Syrjänen, TUR.
30. *Bryoria implexa* (Hoffm.) Brodo & D.Hawksw. – Fadeeva 2013.
31. *Bryoria nadvornikiana* (Gyeln.) Brodo & D. Hawksw. – Tolpysheva et al. 2001; Fadeeva 2013; North to Zubovo village, on dry *Juniperus communis*, 04.07.2012, M.A. Fadeeva, PTZ: Fadeeva & Kravchenko 2013, Podyelniki, on dry *Juniperus communis*, 10.07.2012, M.A. Fadeeva, PTZ: Fadeeva & Kravchenko 2013; Rybya Bay of Lake Onega, on twigs of spruce, 11.07.2012, M.A. Fadeeva, PTZ: Fadeeva & Kravchenko 2013; Polyva village, on *Betula*, 26.06.2013, M.A. Fadeeva, PTZ; Tambitsy village NW, Kaskoselga E, spruce bog at border of a fen, on birch and spruce, 28.08.2014 K. Syrjänen, TUR.
32. *Bryoria simplicior* (Vain.) Brodo & D. Hawksw. – Tolpysheva et al. 2001.
33. *Buellia disciformis* (Fr.) Mudd – Fadeeva, 2000; Zubovo village, on bark of *Sorbus aucuparia*, 03.07.2012, M.A. Fadeeva, PTZ.
34. *Calicium salicinum* Pers. – Norrlin 1876; Zubovo village, on stump of *Salix caprea*, 04.07.2012, M.A. Fadeeva, PTZ.
35. *Calicium trabinellum* (Ach.) Ach. – Podyelniki, on wood of pine, 10.07.2012, M.A. Fadeeva, PTZ.
36. *Calicium viride* Pers. – On bark of spruce, Podyelniki, 07.07.2012, western shore of Lake Vekhkzero, 11.07.2012, M.A. Fadeeva, PTZ.

37. *Caloplaca cerina* (Hedw.) Th.Fr. – Tolpysheva et al. 2001; Zubovo village, on *Prunus padus*, 03.07.2012, M.A. Fadeeva, PTZ.
38. *Caloplaca saxicola* (Hoffm.) Nordin – Norrlin 1876; Nordin 1972.
39. *Candelaria concolor* (Dicks.) Stein – Tolpysheva et al. 2001; probably this is *Candelaria pacifica* M. Westb. & Arup, see: Westberg & Arup 2010.
40. *Candelariella aurella* (Hoffm.) Zahlbr. – Tolpysheva et al. 2001; Kizhi Island, on *Ulmus laevis*, 28.05.1999, M.A. Fadeeva, PTZ.
41. *Candelariella coralliza* (Nyl.) H. Magn. – Ersenevo village, abandoned field, on stones, 05.07.2012, M.A. Fadeeva, PTZ.
42. *Candelariella vitellina* (Hoffm.) Müll. Arg. – Tolpysheva et al., 2001; Fadeeva 2013;
43. *Candelariella xanthostigma* (Ach.) Lettau – Fadeeva, 2000, Pustoy Bereg, abandoned village, on *Ulmus laevis*, 04.07.2012, M.A. Fadeeva, PTZ.
44. *Catillaria erysiboides* (Nyl.) Th. Fr. – Nylander 1866 a; Norrlin 1876; Vainio 1934;
45. *Cetraria aculeata* (Schreb.) Fr. – Bol. Klim. Isl., Lukovo Bay, on rock, 05.07.2004, M.A. Fadeeva PTZ.
46. *Cetraria ericetorum* Opiz – Fadeeva 2000.
47. *Cetraria islandica* (L.) Ach. subsp. *islandica* – Fadeeva 2000, 2013; Podyelniki, on ground, 10.07.2012, M.A. Fadeeva, PTZ.
48. *Cetraria odontella* (Ach.) Ach. – Norrlin 1876; Fadeeva 2013.
49. *Cetraria sepincola* (Ehrh.) Ach. – Tolpysheva et al. 2001; Fadeeva 2000; Podyelniki, on stones in the wall around old chapel, 08.07.2012, M.A. Fadeeva, PTZ.
50. *Cetrelia cetrarioides* (Delise & Duby) W. L. Culb. & C. F. Culb. – on rocks, Paleostrov Island, 03.07.2004, M.A. Fadeeva, PTZ; Bolshoi Lelikovsky Island, Radkolye Cape, 06.07.2004, M.A. Fadeeva, PTZ.
51. *Chaenotheca brachypoda* (Ach.) Tibell – Fadeeva 2013; Fadeeva & Kravchenko 2013; Zubovo village, stump of *Salix caprea*, 04.07.2012, M.A. Fadeeva, PTZ; Poly village, stump of *Salix caprea*, 26.06.2013, M.A. Fadeeva, PTZ; surroundings of Lake Rugozero, stump of birch, 27.06.2013, M.A. Fadeeva, PTZ.
52. *Chaenotheca brunneola* (Ach.) Müll. Arg. – Western shore of Lake Vekhozero, on bark of spruce, 11.07.2012, M.A. Fadeeva, PTZ.
53. *Chaenotheca chlorella* (Ach.) Müll. Arg. – Tambitsy-NW towards Kaskoselga, herb-rich - grassy swamp forest, on birch snag, 28.08. 2013, K. Syrjänen, TUR; Tambitsy-SW, mires NW of Kurnejnavolok cape, on old *Salix pentandra*, 27.08. 2013, K. Syrjänen, TUR; Poly village – S, on old birch, 25.08.2013, K. Syrjänen, TUR.
54. *Chaenotheca chrysocephala* (Turner ex Ach.) Th. Fr. – Vainio 1927; Fadeeva 2013; Podyelniki, on spruce, 07.07.2012, M.A. Fadeeva, PTZ.
55. *Chaenotheca ferruginea* (Turner ex Sm.) Mig. – Norrlin 1876; Vainio 1927; Fadeeva 2013; western shore of Lake Vekhozero, on bark of spruce, 11.07.2012, M.A. Fadeeva, PTZ.
56. *Chaenotheca furfuracea* (L.) Tibell – Vainio 1927; Fadeeva 2000; Fadeeva & Kravchenko 2013; south-eastern shore of Lake Vekhozero, on spruce along brook, 11.07.2012, M.A. Fadeeva, PTZ.
57. *Chaenotheca gracilentia* (Ach.) Mattsson & Middelb. – Poly village, on roots of fallen spruce, 26.06.2013, M.A. Fadeeva, PTZ; Poly village -S, decaying stump, 25.08. 2013, K. Syrjänen, TUR.
58. *Chaenotheca laevigata* Nád. – Surroundings of Zubovo village, on stump of *Salix caprea*, 04.07.2012, M.A. Fadeeva, PTZ: Fadeeva & Kravchenko 2013.
59. *Chaenotheca subroscida* (Eitner) Zahlbr. – Lipovitsy, along a brook, on stump of birch, 25.06.2013, M.A. Fadeeva, PTZ.
60. *Chaenotheca trichialis* (Ach.) Th. Fr. – Vainio 1927; surroundings of Zubovo village, on stump of pine, 04.07.2012, M.A. Fadeeva, PTZ.

61. *Chaenotheca xyloxena* Nád. – Surroundings of Zubovo village, on stump of *Salix caprea*, 04.07.2012, M.A. Fadeeva, PTZ.
62. \**Chaenothecopsis hospitans* (Th. Fr.) Tibell – “Ad Dianova-gora, saxicola, Simming, 1863”: Norrlin 1876; Vainio 1927; Zhurbenko & Ahti 2005.
63. *Chrysothrix chlorina* (Ach.) J. R. Laundon – Fadeeva 2013; Podyelniki, on stones in the wall around old chapel, 10.07.2012, M.A. Fadeeva, PTZ.
64. *Circinaria caesiocinerea* (Nyl. ex Malbr.) A. Nordin et al. – Fadeeva 2000.
65. *Cladonia amaurocraea* (Flörke) Schaer. – Fadeeva 2013; Podyelniki, abandoned field, on moss-covered stones, 10.07.2012, M.A. Fadeeva, PTZ; northern shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11.07.2012, M.A. Fadeeva, PTZ.
66. *Cladonia arbuscula* (Wallr.) Flot. – Fadeeva 2000; Tolpysheva et al. 2001; Podyelniki, abandoned field, on moss-covered stones, 10.07.2012, M.A. Fadeeva, PTZ; northern shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11.07.2012, M.A. Fadeeva, PTZ.
67. *Cladonia mitis* Sandst. – Fadeeva 2013; Podyelniki, abandoned field, on moss-covered stones, 10.07.2012, northern shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11.07.2012, M.A. Fadeeva, PTZ.
68. *Cladonia bacilliformis* (Nyl.) Glück – Podyelniki, on dry *Juniperus communis*, 10.07.2012, M.A. Fadeeva, PTZ.
69. *Cladonia botrytes* (K. G. Hagen) Willd. – Tolpysheva et al. 2001; Podyelniki, on roots of fallen spruce, 07.07.2012, M.A. Fadeeva, PTZ.
70. *Cladonia cenotea* (Ach.) Schaer. – Podyelniki, abandoned field, on moss-covered stones, 10.07.2012, M.A. Fadeeva, PTZ.
71. *Cladonia chlorophaea* (Flörke ex Sommerf.) Spreng. – Fadeeva 2013; Northern end of Kizhi Island, abandoned field, on stones, 28.05.1999, M.A. Fadeeva, PTZ; Rechka abandoned village, on ground, 04.07.2012, M.A. Fadeeva, PTZ.
72. *Cladonia coccifera* (L.) Willd. – Fadeeva 2013; northern shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11.07.2012, M.A. Fadeeva, PTZ.
73. *Cladonia coniocraea* (Flörke) Spreng. – Fadeeva 2013; surroundings of Zubovo village, on bark of pine, 03.07.2012, M.A. Fadeeva, PTZ.
74. *Cladonia cornuta* (L.) Hoffm. s.l. – Fadeeva 2013; Podyelniki, abandoned field, on moss-covered stones, 10.07.2012, northern shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11.07.2012, M.A. Fadeeva, PTZ.
75. *Cladonia crispata* (Ach.) Flot. var. *crispata* – Podyelniki, abandoned field, on moss-covered stones, 10.07.2012, M.A. Fadeeva, PTZ.
76. *Cladonia deformis* (L.) Hoffm. – Podyelniki, abandoned field, on moss-covered stones, 10.07.2012, M.A. Fadeeva, PTZ.
77. *Cladonia decorticata* (Flörke) Spreng. – Fadeeva 2013.
78. *Cladonia fimbriata* (L.) Fr. – Tolpysheva et al. 2001; Fadeeva 2013; Zubovo village, on *Salix caprea*, 03.10.2012, M.A. Fadeeva, PTZ; Podyelniki, on roots of fallen spruce, 07.07.2012, M.A. Fadeeva, PTZ.
79. *Cladonia furcata* (Huds.) Schrad. – Fadeeva 2000, 2013; NW shore of Lake Vekhkozero, on moss-covered stones in the rock wall (seismic dislocation), 11. 07.2012, M.A. Fadeeva, PTZ
80. *Cladonia gracilis* (L.) Willd. ssp. *turbinata* (Ach.) Ahti – Fadeeva 2013; Podyelniki, abandoned field, on moss-covered stones, 08.07.2012, NW shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11. 07.2012, M.A. Fadeeva, PTZ.
81. *Cladonia macilenta* Hoffm. – Fadeeva 2013.
82. *Cladonia phyllophora* Hoffm. – Volkostrov Island, on soil, 31.05.1999, M.A. Fadeeva, PTZ; Podyelniki, abandoned field, on moss-covered stones, 08.07.2012, M.A. Fadeeva, PTZ.

83. *Cladonia pleurota* (Flörke) Schaer. – Fadeeva 2013; Podyelniki, abandoned field, on moss-covered stones, 08.07.2012, M.A. Fadeeva, PTZ; NW shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11. 07.2012, M.A. Fadeeva, PTZ.
84. *Cladonia pocillum* (Ach.) Grognot – Fadeeva 2013.
85. *Cladonia pyxidata* (L.) Hoffm. – Tolpysheva et al. 2001; Northern end of Ersenevo village, stone shore of Lake Onega, on ground, 05.07.2012, M.A. Fadeeva, PTZ.
86. *Cladonia rangiferina* (L.) F. H. Wigg. – Tolpysheva et al. 2001; Fadeeva 2000, 2013; Podyelniki, abandoned field, on moss-covered stones, 08.07.2012, M.A. Fadeeva, PTZ; NW shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11. 07.2012, M.A. Fadeeva, PTZ.
87. *Cladonia squamosa* Hoffm. – Fadeeva 2013; NW shore of Lake Vekhkozero, on moss-covered stones in the rock wall (seismic dislocation), 11.07.2012, M.A. Fadeeva, PTZ.
88. *Cladonia stellaris* (Opiz) Pouzar & Vězda – Fadeeva 2000, 2013; Podyelniki, abandoned field, on moss-covered stones, 08.07.2012, M.A. Fadeeva, PTZ; NW shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11. 07.2012, M.A. Fadeeva, PTZ.
89. *Cladonia stygia* (Fr.) Ruoss – Fadeeva 2013.
90. *Cladonia subulata* (L.) F. H. Wigg. – Fadeeva 2013; Zubovo village, on stones in abandoned field, 03.10.2012, M.A. Fadeeva, PTZ.
91. *Cladonia sulphurina* (Michx.) Fr. – Zubovo village, on stones in abandoned field, 03.10.2012, M.A. Fadeeva, PTZ.
92. *Cladonia symphyocarpa* (Flörke) Fr. – Yuzhny Oleny Island, on dolomites, 20.07.2000, M.A. Fadeeva, PTZ.
93. *Cladonia turgida* Hoffm. – Fadeeva 2013; NW shore of Lake Vekhkozero on moss-covered stones in the rock wall (seismic dislocation), 11. 07.2012, M.A. Fadeeva, PTZ.
94. *Cladonia uncialis* (L.) F. H. Wigg. ssp. *uncialis* – Fadeeva 2000, 2013; NW shore of Lake Vekhkozero, on moss-covered stones in the rock wall (seismic dislocation), 11. 07.2012, M.A. Fadeeva, PTZ.
95. *Cladonia verticillata* (Hoffm.) Schaer. – Podyelniki, abandoned field, on moss-covered stones, 10.07.2012, M.A. Fadeeva, 2012 PTZ.
96. *Collema flaccidum* (Ach.) Ach. – Kuzaranda village, on marble, 04.07.2004, M.A. Fadeeva, PTZ.
97. *Collema furfuraceum* (Arnold) Du Rietz – Fadeeva 2013.
98. *Coenogonium luteum* (Dicks.) Kalb & Lücking – Nylander 1866 a; Norrlin 1876.
99. *Coenogonium pineti* (Ach.) Lücking & Lumbsch – Nylander 1866 a; Norrlin 1876; Tambitsy-NW towards Kaskoselga, swamp forest close to the bog, on birch snag, 28.08.2013, K. Syrjänen, TUR.
100. *Cyphelium karelicum* (Vain.) Räsänen – Nylander 1866a; Norrlin 1876; Vainio, 1922.
101. *Dendriscoaulon umhausense* (Auersw.) Degel. – Norrlin 1876.
102. *Dermatocarpon luridum* (With.) J.R. Laundon – Norrlin 1876.
103. *Dermatocarpon miniatum* (L.) W. s.l. – Ashepnavolok Cape, 08.1870, J.P. Norrlin, H.
104. *Diploschistes scruposus* (Schreb.) Norman – Fadeeva 2013; Podyelniki, abandoned field, on moss-covered stones, 10.07.2012, M.A. Fadeeva, PTZ.
105. *Enchylium polycarpon* (Hoffm.) Otálora et al. – Fadeeva 2013.
106. *Epilichen scabrosus* (Ach.) Clem. – Dianova Gora, on *Baeomyces rufus*, A. Kullhem, H: Norrlin 1876; Zhurbenko & Ahti 2005.
107. *Evernia divaricata* (L.) Ach. – western shore of Bol. Klim. Isl., [Kishi (Vatnavolok)], on spruce twigs, 1863, A. Kullhem, H: Norrlin 1876; Lipovitsy, along the brook, on spruce twigs, 25.06.2013, M.A. Fadeeva, PTZ; Polya village, on spruce twigs, 26.06.2013, M.A. Fadeeva, PTZ; Uzkaya Salma, on spruce twigs, 28.06.2013, M.A. Fadeeva, PTZ; Tambitsy-SW, mires to the NW of the cape Kurnejnavolok,



- herb-rich – grassy swamp forests at border of a pine bog, on twigs of spruces, 27.08.2013, K. Syrjänen, TUR; Polyva village –S, herb-rich swamp forest, on old birch, 25.08. 2013, K. Syrjänen, TUR; Velikaya Guba -SW, Zubovo –N, North east from Lake Pužej, open mire below an east facing cliff, on birch, 24.08.2014, K. Syrjänen, TUR; Tambitsy -N. W-NW from the small cape Tolstyj Navolok, swamp forest, on trunk of *Alnus glutinosa*, 26.8.2013, K. Syrjänen, TUR.
108. *Evernia mesomorpha* Nyl. – Fadeeva 2013; Fadeeva & Kravchenko 2013; surroundings of Zubovo village, on bark of pine, *Salix caprea*, *Juniperus*, birch, 03.07.2013, M.A. Fadeeva, PTZ; on bark of pine, surroundings of Lake Rugozero Lake, 27.06.2013, M.A. Fadeeva, PTZ; Uzkaya Salma, on bark of pine, *Juniperus comminis*, 28.06.2013, M.A. Fadeeva, PTZ; Velikaya Guba -SW, Zubovo –N, northeast from Lake Pužej, open oligotropic mire, on trunk of birch, 24.08.2013, K. Syrjänen, TUR.
109. *Evernia prunastri* (L.) Ach. – Tolpysheva et al. 2001; west of Zubovo village, on *Sorbus aucuparia*, 03.07.2012, M.A. Fadeeva, PTZ.
110. *Fuscidea pusilla* Tønsberg – Fadeeva 2013.
111. *Fuscopannaria praetermissa* (Nyl.) P. M. Jørg. – Fadeeva 2013; NW shore of Lake Vekkozero, on moss-covered stones in the rock wall (seismic dislocation), 11.07.2012, M.A. Fadeeva, PTZ.
112. *Graphis scripta* (L.) Ach. – Bol. Klim. Isl., on bark of *Salix*, 12.06.1863, Th. Simming, H: Nylander 1866 a; Norrlin 1876; NE end of Bol. Klim. Isl., on dry *Sorbus aucuparia*, 27.05.1999, M.A. Fadeeva, PTZ.
113. *Gyalecta fagicola* (Hepp ex Arnold) Kremp. – Fadeeva 2001, 2003, s.n. *Gyalecta truncigena* (Ach.) Hepp; Fadeeva 2013; eastern shore Kizhi Island, north of Yamka village, on old trees of *Ulmus laevis*, 27.05.1999, M.A. Fadeeva, PTZ; North to Zubovo village, on aspen, 04.07.2012, M.A. Fadeeva, PTZ: Fadeeva & Kravchenko 2013.
114. *Gyalecta truncigena* (Ach.) Hepp – 4 km N to Velikaya Guba village, on trunk of old aspen, 26.06.2013, M.A. Fadeeva, PTZ.
115. *Gyalecta ulmi* (Sw.) Zahlbr. – Dianova Gora, 1863, Th. Simming, H; Lipovitsy village –SW, to the west of Lake Bezdonoie, brook-side herb-rich deciduous forest, on old *Ulmus*, 23.08. 2013, K. Syrjänen, TUR.
116. *Gyalolechia flavorubescens* (Huds.) Søchting et al. – Tolpysheva et al. 2001.
117. *\*Homostegia piggotii* (Berk. et Broome) P. Karst. – Dianova Gora, on *Parmelia saxatilis*, 1870, J.P. Norrlin, H: Zhurbenko & Ahti 2005.
118. *Hypocenomyce scalaris* (Ach.) M.Choisy – Fadeeva 2013; NW shore of Lake Vekkozero, on bark of pine, M.A. Fadeeva, 11.07.2012, PTZ.
119. *Hypogymnia physodes* (L.) Nyl. – Tolpysheva et al. 2001; Fadeeva 2000, 2013; Zubovo village, on spruce, pine, 03.07.2012, M.A. Fadeeva, PTZ; Zubovo village, on trunk of *Alnus glutinosa*, 03.07.2012, M.A. Fadeeva, PTZ.
120. *Hypogymnia tubulosa* (Schaer.) Hav. – Tolpysheva et al. 2001; Fadeeva 2000, 2013; Pustoy Bereg abandoned village, on birch, 04.07.2012, M.A. Fadeeva, PTZ.
121. *Hypogymnia vittata* (Ach.) Parrique – Norrlin 1876; Komlevo abandoned village, on moss-covered basement rocks, 17.08.2010, M.A. Fadeeva, PTZ.
122. *Icmadophila ericetorum* (L.) Zahlbr. – Norrlin 1876.
123. *Immersaria cupreoatra* (Nyl.) Calat. & Rambold – Norrlin 1876.
124. *Imshaugia aleurites* (Ach.) S. L. F. Mey. – Podyelniki, on bark of pine, 10.07.2012, M.A. Fadeeva, PTZ.
125. *Lathagrium fuscovirens* (With.) Otálora et al. – Fadeeva 2013.
126. *Lasallia pustulata* (L.) Mérat – Fadeeva 2013.
127. *Lecania cyrtella* (Ach.) Th.Fr. – Tolpysheva et al. 2001.
128. *Lecanora allophana* Nyl. – Fadeeva 2013; surroundings of Zubovo village, on old aspens, 04.07.2012, M.A. Fadeeva, PTZ.

129. *Lecanora argopholis* (Ach.) Ach. – Norrlin 1876.
130. *Lecanora dispersa* (Pers.) Sommerf. s.l. – Norrlin 1876.
131. *Lecanora fuscescens* (Sommerf.) Nyl. – Norrlin 1876.
132. *Lecanora hagenii* (Ach.) Ach. – Tolpysheva et al. 2001.
133. *Lecanora intricata* (Ach.) Ach. – Podyelniki, on stones, 08.07.2012, M.A. Fadeeva, PTZ.
134. *Lecanora leptyroides* (Nyl.) G.B.F. Nilsson – Fadeeva 2000; North to Oyatevshina village, on aspen, 05.07.2012, M.A. Fadeeva, PTZ.
135. *Lecanora muralis* (Schreb.) Rabenh. – Fadeeva 2013; North to Ersenevo village, on stones in the abandoned field, 05.07.2012, M.A. Fadeeva, PTZ.
136. *Lecanora pulicaris* (Pers.) Ach. – Tolpysheva et al. 2001.
137. *Lecanora rupicola* (L.) Zahlbr. – Fadeeva 2001; Zhurbenko & Ahti 2005.
138. *Lecanora saligna* (Schröd.) Zahlbr. – Tolpysheva et al. 2001.
139. *Lecanora symmicta* (Ach.) Ach. s.l. – Severnye Oleny Island, on birch, 29.05.1999, M.A. Fadeeva, PTZ; Podyelniki, on dry *Juniperus communis*, 08.07.2012, M.A. Fadeeva, PTZ.
140. *Lecanora varia* (Hoffm.) Ach. – Tolpysheva et al. 2001.
141. *Lecidea confluens* (Weber) Ach. – Vainio 1934.
142. *Lecidea erythrophaea* Flörke ex Sommerf. – Norrlin 1876; Tolpysheva et al. 2001; Fadeeva 2013; Severnye Oleny Island, on aspen, 29.05.1999, M.A. Fadeeva, PTZ.
143. *Lecidea leprarioides* Tønsberg – Lipovitsy, along the brook, on bark of spruce, 25.06.2013, M.A. Fadeeva, PTZ.
144. *Lecidea lapicida* (Ach.) Ach. var. *pantherina* Ach. – Norrlin 1876; Vainio 1934.
145. *Lecidea tessellata* Flörke – Norrlin 1876.
146. *Leparia membranacea* (Dicks.) Vain. – Fadeeva 2013.
147. *Leproplaca obliterans* (Nyl.) Arup et al. – Norrlin 1876.
148. *Leptogium saturninum* (Dicks.) Nyl. – Fadeeva 2000, 2013; Fadeeva & Kravchenko 2013; surroundings of Zubovo village, on bark of aspen, 03.07.2012, M.A. Fadeeva, PTZ; Polyva village, on bark of aspen, 26.06.2013, M.A. Fadeeva, PTZ;
149. *Lichenomphalia umbellifera* (L. : Fr.) Redhead & al. – Fadeeva 2013.
150. *Lobaria pulmonaria* (L.) Hoffm. – Fadeeva 2000, 2013; surroundings of Zubovo village, on *Populus tremula*, *Sorbus aucuparia* and *Juniperus communis*, 03.07.2012, M.A. Fadeeva, PTZ; Fadeeva & Kravchenko 2013; surroundings of Zubovo village, on *Salix caprea*, 04.07.2012, M.A. Fadeeva, PTZ; Fadeeva & Kravchenko 2013; Podyelniki, on old aspens, 10.07.2012, M.A. Fadeeva, PTZ; Fadeeva & Kravchenko 2013; Rybya Bay of Lake Onega, on aspen, 11.07.2012, M.A. Fadeeva, PTZ; Fadeeva & Kravchenko 2013; NW shore of Lake Vekhkzero, on *Salix caprea*, 11.07.2012, M.A. Fadeeva, PTZ; Fadeeva & Kravchenko, 2013; Lipovitsy, along the brook, on drying *Sorbus aucuparia*, 25.06.2013, M.A. Fadeeva, PTZ; Polyva village, stump of *Salix caprea*, 26.06.2013, M.A. Fadeeva, PTZ; Tambitsy N, W-NW from the small cape Tolstyj Navolok, mixed herb-rich forest, fallen on ground from a large aspen, with sporophytes, 26.08. 2013, K. Syrjänen, TUR.
151. *Lobaria scrobiculata* (Scop.) DC. – Fadeeva 2013; Lipovitsy, along the brook, on drying *Sorbus aucuparia*, 25.06.2013, M.A. Fadeeva, PTZ.
152. *Lobothallia melanaspis* (Ach.) Hafellner – Bolshoi Lelikovsky Island, Radkolye Cape, on shore rocks, 06.07.2004, M.A. Fadeeva, PTZ.
153. *Lopadium coralloideum* (Nyl.) Lynge – Norrlin 1876; Vainio 1922.
154. *Lopadium disciforme* (Flot.) Kullh. – Lipovitsy, along the brook, on bark of spruce, 25.06.2013, M.A. Fadeeva, PTZ.
155. *Loxospora elatina* (Ach.) A. Massal. – Podyelniki, on bark of *Juniperus communis*, 10.07.2012, M.A. Fadeeva, PTZ.

156. *Megaspora verrucosa* (Ach.) Hafellner & V. Wirth – surroundings of Zubovo village, on old aspens, 03.07.2012, M.A. Fadeeva, PTZ: Fadeev & Kravchenko 2013;
157. *Melanelia hepatizon* (Ach.) A. Thell. – Fadeeva 2013; Shunga, 1870, J.P. Norrlin, H; Podyelniki, abandoned fields, on stones, 10.07.2012, M.A. Fadeeva, PTZ.
158. *Melanelia stygia* (L.) Essl. – Fadeeva 2013.
159. *Melanelixia fuliginosa* (Fr. ex Duby) O. Blanco et al. – Fadeeva 2013.
160. *Melanelixia subaurifera* (Nyl.) O. Blanco & al. – Dianova Gora, 1863, A. Kullhem, H; between Tipinitsy village and Varnavolok Cape, on aspen, 04.07.2004, M.A. Fadeeva, PTZ; North to Zubovo village, on *Sorbus aucuparia*, 03.07.2012, M.A. Fadeeva, PTZ: Fadeeva & Kravchenko 2013.
161. *Melanohalea exasperata* (De Not.) O. Blanco & al. – Fadeeva 2000; Tolpysheva et al. 2001; Fadeeva & Kravchenko 2013; Paleostrov Island, on *Tilia cordata*, 03.07.2004, M.A. Fadeeva, PTZ; North to Zubovo village, on *Sorbus aucuparia*, *Prunus padus*, *Salix caprea*, 03.07.2012, M.A. Fadeeva, PTZ.
162. *Melanohalea exasperatula* (Nyl.) O. Blanco & al. – The northern end of Kizhi Island, on *Ulmus laevis*, 30.05.1999, M.A. Fadeeva, PTZ.
163. *Melanohalea olivacea* (L.) O. Blanco & al. – Fadeeva 2000; Tolpysheva et al. 2000; surroundings of Zubovo village, on *Salix caprea*, on birch, 03.07.2012, M.A. Fadeeva, PTZ.
164. *Melanohalea septentrionalis* (Lynge) O. Blanco & al. – Tolpysheva et al. 2001.
165. *Micarea denigrata* (Fr.) Hedl. – North to Zubovo village, on stump of pine, 03.07.2012, M.A. Fadeeva, PTZ.
166. +*Microcalicium arenarium* (Hampe ex A. Massal.) Tibell – Lipovitsy, along the brook, on roots of fallen spruce, 25.06.2013, M.A. Fadeeva, PTZ.
167. \**Microcalicium disseminatum* (Ach.) Vain. – Rybya Bay of Lake Onega, on bark of spruce, 11.07.2012, M.A. Fadeeva, PTZ: Fadeeva & Kravchenko 2013; Lipovitsy, along the brook, on bark of spruce, on *Chaenotheca* sp., 25.06.2013, M.A. Fadeeva, PTZ; Polyva village, stump of birch, 26.06. 2013, M.A. Fadeeva, PTZ.
168. *Montanelia disjuncta* (Erichsen) Divakar et al. – Fadeeva 2013; Podyelniki, on stones, 08.07.2012, M.A. Fadeeva, PTZ.
169. *Montanelia panniformis* (Nyl.) Divakar et al. – Fadeeva 2013.
170. *Montanelia soredata* (Ach.) Divakar et al. – Kizhi Island, on Kizhi church wall, 31.05.1999, M.A. Fadeeva, PTZ.
171. *Mycobilimbia carnealbida* (Müll. Arg.) S. Ekman & Printzen – Fadeeva 2000, 2013; Rybya Bay of Lake Onega, on bark of aspen, 11.07.2012, M.A. Fadeeva, PTZ.
172. *Mycobilimbia epixanthoides* (Nyl.) Vitik. et al. ex Hafellner et Türk – Nylander 1866 a, b; Norrlin 1876; Vainio 1922; Fadeeva 2000, 2003, 2013; Zhurbenko & Ahti 2005; North to Zubovo village, on stump of aspen, 03.07.2012, M.A. Fadeeva, PTZ.
173. *Mycobilimbia tetramera* (De Not.) Vitik. et al. ex Hafellner & Türk – Vainio 1922.
174. *Mycoblastus sanguinarius* (L.) Norman – Fadeeva 2000, 2013.
175. +*Mycocalicium subtile* (Pers.) Szatala – Bol. Klim. Isl., 1863, Th. Simming, H.
176. *Myriospora heppii* (Nägeli ex Körb.) Hue – Norrlin 1876.
177. *Myriospora smaragdula* (Wahlenb. ex Ach.) Nägeli ex Uloth – Norrlin 1876.
178. *Naetrocymbe punctiformis* (Pers.) R. C. Harris – Norrlin 1876.
179. *Nephroma bellum* (Spreng.) Tuck. – North to Zubovo village, on aspen, *Salix caprea*, 03.07.2012, M.A. Fadeeva, PTZ: Fadeeva & Kravchenko 2013; Rybya Bay of Lake Onega, on bark of aspen, 11.07.2012, M.A. Fadeeva, PTZ: Fadeeva & Kravchenko 2013; Lipovitsy, along the brook, on drying *Sorbus*, 25.06.2013, M.A. Fadeeva, PTZ; Polyva village -S, herb-rich swamp forest, on large *Salix pentandra*, 25.08. 2013, K. Syrjänen, TUR.

180. *Nephroma parile* (Ach.) Ach. – Fadeeva 2000, 2013; Fadeeva & Kravchenko 2013; North to Zubovo village, on aspen, 03.07.2012, M.A. Fadeeva, PTZ; Rybya Bay of Lake Onega, on bark of aspen, 11.07.2012, M.A. Fadeeva, PTZ.
181. *Nephroma resupinatum* (L.) Ach. – Fadeeva 2013; Fadeeva & Kravchenko 2013; Dianova Gora, 1863, Th. Simming, H; Rybya Bay of Lake Onega, on bark of aspen, 11.07.2012, M.A. Fadeeva, PTZ; Lipovitsy, along the brook, on drying *Sorbus aucuparia*, 25.06.2013, M.A. Fadeeva, PTZ.
182. *Ochrolechia androgyna* (Hoffm.) Arnold – Dianova Gora, 26.08.1863, Th. Simming, H.
183. *Ophioparma ventosa* (L.) Norman – Norrlin 1876; Fadeeva 2013; Gorodok Hill, on diabase, 27.06.1924, V. P. Savich & L. I. Savich-Lyubitskaya, LE.
184. *Parmelia fraudans* (Nyl.) Nyl. – Norrlin 1876; Fadeeva 2000, 2013; Podyelniki, on stones, 08.07.2012, M.A. Fadeeva, PTZ.
185. *Parmelia saxatilis* (L.) Ach. – Fadeeva 2000, 2013; Podyelniki, abandoned fiels, on stones, 10.07.2012, M.A. Fadeeva, PTZ, NW shore of Lake Vekhkozero, on blocks of seismo-colluvial scree, 11.07.2012, M.A. Fadeeva, PTZ.
186. *Parmelia sulcata* Taylor – Tolpysheva et al. 2001; Fadeeva 2000, 2013; North to Zubovo village, on *Sorbus aucuparia*, *Prunus padus*, 03.07.2012, M.A. Fadeeva, PTZ.
187. *Parmeliella triptophylla* (Ach.) Müll. Arg – Norrlin 1876; Fadeeva 2013; Ashepnavolok Cape, 1870, J.P. Norrlin, H.
188. *Parmelina tiliacea* (Hoffm.) Hale – Fadeeva et al. 2007; Paleostrov Island, on *Tilia cordata*, 03.07.2004, M.A. Fadeeva, PTZ.
189. *Parmeliopsis ambigua* (Wulfen) Nyl. – Tolpysheva et al. 2001; Fadeeva 2013; North to Zubovo village, on *Salix caprea*, 03.07.2012, M.A. Fadeeva, PTZ.
190. *Parmeliopsis hyperopta* (Ach.) Arnold – Tolpysheva et al. 2001; Podyelniki, on bark of pine, 10.07.2012, M.A. Fadeeva, PTZ.
191. *Peltigera aphthosa* (L.) Willd. – Fadeeva 2000, 2013; Fadeeva & Kravchenko 2013; Rybya Bay of Lake Onega, on moss-covered basement rocks, 11.07.2012, M.A. Fadeeva, PTZ; NW shore of Lake Vekhkozero, on moss-covered basement rocks, 11.07.2012, M.A. Fadeeva, PTZ.
192. *Peltigera canina* (L.) Willd. – Fadeeva 2000, 2013; Fadeeva & Kravchenko 2013; Rybya Bay of Lake Onega, on base of old aspen, 11.07.2012, M.A. Fadeeva, PTZ; Lipovitsy, on aspen, 27.06.2013, M.A. Fadeeva, PTZ.
193. *Peltigera collina* (Ach.) Schrad. – Bol. Klim. Isl., on stony shore among mosses, 25.06.2007, M.A. Fadeeva, PTZ.
194. *Peltigera didactyla* (With.) J. R. Laundon – Fadeeva 2013.
195. *Peltigera latiloba* Holt.-Hartw. – Fadeeva 2013.
196. *Peltigera lepidophora* (Nyl. ex Vain.) Bitter – Fadeeva 2000, 2013.
197. *Peltigera leucophlebia* (Nyl.) Gyeln. – Fadeeva 2000, 2013; Fadeeva & Kravchenko 2013; Rybya Bay of Lake Onega, on moss-covered basement rocks, 11.07.2012, M.A. Fadeeva, PTZ; NW shore of Lake Vekhkozero, on moss-covered stones in the rock wall (seismic dislocation), 11. 07.2012, M.A. Fadeeva, PTZ.
198. *Peltigera malacea* (Ach.) Funck – Fadeeva 2013.
199. *Peltigera membranacea* (Ach.) Nyl. – NE end of Bol. Klim. Isl., on moss-covered stones, 27.05.1999, M.A. Fadeeva, PTZ.
200. *Peltigera neckeri* Hepp ex Müll. Arg. – Fadeeva 2000; Kizhi Island, Yamka village, the shore of Lake Onega, on soil, 27.05.1999, M.A. Fadeeva, PTZ; Bol. Klim. Isl., on base of aspen trunk, 27.05.1999, M.A. Fadeeva, PTZ.
201. *Peltigera neopolydactyla* (Gyeln.) Gyeln. – Bol. Klim. Isl., on dead wood, 29.05.1999, M.A. Fadeeva, PTZ, Rybya Bay of Lake Onega, on moss-covered basement rocks, 11.07.2012, M.A. Fadeeva, PTZ.

202. *Peltigera occidentalis* (Å. E. Dahl) Kristinsson – Bol. Klim. Isl., Lukovo Bay, 05.07.2004, P. Uotila, H; Bolshoi Lelikovsky Island, Radkolye Cape, on moss-covered basement rocks, 06.07.2004, M.A. Fadeeva, PTZ.
203. *Peltigera polydactylon* (Neck.) Hoffm. – Fadeeva 2000, 2013; south-eastern shore Lake Vekhkzero, on moss-covered basement rocks, 11.07.2012, M.A. Fadeeva, PTZ.
204. *Peltigera praetextata* (Flörke ex Sommerf.) Zopf – Fadeeva 2000, Fadeeva & Kravchenko 2013; surroundings of Zubovo village, on base of aspen, 03.07.2012, M.A. Fadeeva, PTZ; North to Oyatevshina village, on aspen, 05.07.2012, M.A. Fadeeva, PTZ; Lipovitsy, on aspen, 25.06.2013, M.A. Fadeeva, PTZ; Polyva village, on stump of *Salix caprea*, 26.06.2013, M.A. Fadeeva, PTZ.
205. *Peltigera rufescens* (Weiss) Humb. – Fadeeva 2000, 2013; Bol. Klim. Isl., dry meadow, abandoned field, on stones, 27.05.1999, M.A. Fadeeva, PTZ, Bol. Klim. Isl., Konda, 06.07.2004, P. Uotila, H; North to Ersenevo village, stony shore of Lake Onega, 05.07.2012, M.A. Fadeeva, PTZ.
206. *Peltigera scabrosa* Th. Fr. – Fadeeva 2013.
207. *Peltigera venosa* (L.) Hoffm. – Fadeeva 2013.
208. *Pertusaria albescens* (Huds.) M. Choisy & Werner – Podyelniki, 10.07.2012, M.A. Fadeeva, 2012, PTZ.
209. *Pertusaria amara* (Ach.) Nyl. – Tolpysheva et al. 2001; Fadeeva 2013; North to Zubovo village, on aspen, 04.07.2012, M.A. Fadeeva, PTZ.
210. *Pertusaria chiodectonoides* Bagl. ex A. Massal. – Norrlin 1876.
211. *Phaeophyscia ciliata* (Hoffm.) Moberg – Kainos Island (NE from Tolvuya), on aspen, 03.07.2004, P. Uotila, H; North to Oyatevshina village, clear-cut for new road, on aspen, 05.07.2012, M.A. Fadeeva, PTZ.
212. *Phaeophyscia orbicularis* (Neck.) Moberg – Fadeeva 2000; Shunga, on rock, 1870, J.P. Norrlin, H, Kizhi Island, 2 km to the North from the church, on trunk of *Ulmus laevis*, 26.05.1999, M.A. Fadeeva, PTZ.
213. *Phaeophyscia sciastra* (Ach.) Moberg – Bolshoi Lelikovsky Isl., on stony shore of Lake Onega, 06.07.2004, M.A. Fadeeva, PTZ.
214. *Phlyctis argena* (Spreng.) Flot. – Fadeeva 2000, 2013; North to Zubovo village, on aspen, 03.07.2012, M.A. Fadeeva, PTZ.
215. *Phylliscum demangeonii* (Moug. & Mont.) Nyl. – Norrlin 1876.
216. *Physcia adscendens* (Fr.) H. Olivier – Fadeeva 2000; Shunga, 1870, J.P. Norrlin, H; Kainos Island (NE from Tolvuya), on aspen, 03.07.2004, P. Uotila, H; Pustoy Bereg abandoned village, on *Ulmus laevis*, 04.07.2012, M.A. Fadeeva, PTZ.
217. *Physcia aipolia* (Ehrh. ex Humb.) Fűrnr. – Fadeeva 2000, 2013; Pustoy Bereg abandoned village, on *Ulmus laevis*, 04.07.2012, M.A. Fadeeva, PTZ.
218. *Physcia alnophila* (Vain.) Loht., Moberg, Myllys & Tehler – Fadeeva 2013; West to Zubovo village, 03.07.2012, M.A. Fadeeva, PTZ.
219. *Physcia caesia* (Hoffm.) Fűrnr. – Tolpysheva et al. 2001; Fadeeva 2000; Podyelniki, on stone wall of the chapel, 08.07.2012, M.A. Fadeeva, PTZ.
220. *Physcia dubia* (Hoffm.) Lettau – Pustoy Bereg abandoned village, on *Ulmus laevis*, 04.07.2012, M.A. Fadeeva, PTZ.
221. *Physcia phaea* (Tuck.) J. W. Thomson – Norrlin 1876.
222. *Physcia stellaris* (L.) Nyl. – Fadeeva 2000.
223. *Physcia subalbinea* Nyl. – Fadeeva 2013.
224. *Physcia tenella* (Scop.) DC. – Norrlin 1876; Fadeeva 2000; Pustoy Bereg abandoned village, on *Ulmus laevis*, 04.07.2012, M.A. Fadeeva, PTZ.
225. *Physconia detersa* (Nyl.) Poelt – Shunga, on rock, 1870, J.P. Norrlin, H; Podyelniki, on old aspens, 10.07.2012, M.A. Fadeeva, PTZ.

226. *Physconia distorta* (With.) J. R. Laundon – Eastern shore Kizhi Island, on old *Ulmus*, 27.05.1999, M.A. Fadeeva, PTZ.
227. *Physconia enteroxantha* (Nyl.) Poelt – Eastern shore Kizhi Island, on old *Ulmus*, 27.05.1999, M.A. Fadeeva, PTZ.
228. *Physconia perisidiosa* (Erichsen) Moberg – Fadeeva 2013; eastern shore Kizhi Island, on old *Ulmus*, 27.05.1999, M.A. Fadeeva, PTZ.
229. *Pilophorus cereolus* (Ach.) Th. Fr – Nylander 1866 a; Norrlin 1876.
230. *Placynthiella icmalea* (Ach.) Coppins & P. James – Norrlin 1876; Fadeeva 2013; Podyelniki, on roots of fallen spruce, 06.07.2012, M.A. Fadeeva, PTZ; same place, on fallen pine, 10.07.2012, M.A. Fadeeva, PTZ.
231. *Placynthium nigrum* (Huds.) Gray – Norrlin 1876.
232. *Platismatia glauca* (L.) W. L. Culb. & C. F. Culb. – Tolpysheva et al. 2001; Fadeeva 2013; Zubovo village, on spruce, 03.07.2012, M.A. Fadeeva, PTZ.
233. *Polycauliona candelaria* (L.) Frödén et al. – Tolpysheva et al. 2001; Fadeeva 2000; Pustoy Bereg abandoned village, on birch, 04.07.2012, M.A. Fadeeva, PTZ.
234. *Polycauliona polycarpa* (Hoffm.) Frödén et al. – Fadeeva 2000.
235. *Polychidium muscicola* (Sw.) Gray – Fadeeva 2013.
236. *Porpidia tuberculosa* (Sm.) Hertel & Knoph – Shunga, 1870, J.P. Norrlin, H.
237. *Protoblastenia rupestris* (Scop.) J. Steiner – Norrlin 1876.
238. *Protoparmelia badia* (Hoffm.) Hafellner – NW shore of Lake Vekhkzero, on blocks of seismo-colluvial scree, 11.07.2012, M.A. Fadeeva, PTZ.
239. *Pseudevernia furfuracea* (L.) Zopf – Tolpysheva et al. 2001; Fadeeva 2013; Podyelniki, on pine, 10.07.2012, M.A. Fadeeva, PTZ.
240. *Psilolechia clavulifera* (Nyl.) Coppins – Lipovitsy, along the brook, on roots of fallen spruce, 25.06.2013, M.A. Fadeeva, PTZ.
241. *Psilolechia lucida* (Ach.) M. Choisy – Klimentitsky Monastery, 12.06.1863, Th. Simming, H; Podyelniki, on stones, 08.07.2012, M.A. Fadeeva, PTZ.
242. *Pyrenopsis pleiobola* Nyl. – Norrlin 1876.
243. *Ramalina baltica* Lettau – Velikaya Guba, 1870, J.P. Norrlin, H; Norrlin 1876; Paleostrov Island, on old *Tilia cordata*, 03.07.2004, M.A. Fadeeva, PTZ; Lipovitsy, on old aspen, 25.06.2013, M.A. Fadeeva, PTZ.
244. *Ramalina dilacerata* (Hoffm.) Hoffm. – Fadeeva 2013; North to Zubovo village, on *Salix caprea*, 03.07.2012, M.A. Fadeeva, PTZ; Fadeeva & Kravchenko 2013; Oyatevshina village, on *Salix caprea*, 05.07.2012, M.A. Fadeeva, PTZ; Fadeeva & Kravchenko 2013; Lipovitsy, along the brook, on drying *Sorbus aucuparia*, 25.06.2013, M.A. Fadeeva, PTZ.
245. *Ramalina farinacea* (L.) Ach. – Fadeeva 2013; surroundings of Zubovo village, on aspen, 03.07.2012, M.A. Fadeeva, PTZ; Podyelniki, on stone in the wall around old chapel, 10.07.2012, M.A. Fadeeva, PTZ.
246. *Ramalina pollinaria* (Westr.) Ach. – Fadeeva 2000; Podyelniki, on stone in the wall around old chapel, 10.07.2012, M.A. Fadeeva, PTZ; NW shore of Lake Vekhkzero, on stone wall, 11.07.2012, M.A. Fadeeva, PTZ.
247. *Ramalina sinensis* Jatta – Fadeeva 2013; Bol. Klim. Isl., on trunk of *Sorbus aucuparia*, 19.07.2000, M.A. Fadeeva, PTZ.
248. *Ramalina thrausta* (Ach.) Nyl. – Norrlin 1876.
249. *Ramboldia elabens* (Fr.) Kantvilas & Elix – Vainio 1934.
250. *Rhizocarpon geographicum* (L.) DC. s.l. – Fadeeva 2013; Bolshoi Lelikovskiy Island, Radkolye Cape, on shore rocks, 06.07.2004, M.A. Fadeeva, PTZ;
251. *Rhizocarpon polycarpum* (Hepp) Th. Fr. – Norrlin 1876.
252. *Rimularia insularis* (Nyl.) Rambold & Hertel (obligate lichenicolous lichen) – Nylander 1866 a; Norrlin 1876; Vainio 1934; Hertel 1970; Fadeeva 2001 a; Zhurbenko & Ahti 2005.

253. *Rinodina archaea* (Ach.) Arnold – Norrlin 1876.
254. *Rinodina confragosa* (Ach.) Körb. – Shunga, on diorites in pock's crashes, in shadow, 1876, J.P. Norrlin, H: Norrlin 1876.
255. *Rinodina pyrina* (Ach.) Arnold – Fadeeva 2000.
256. *Sclerophora pallida* (Pers.) Y. J. Jao & Spooner – Lipovitsy village SW, W of Lake Bezdonnoe, brook-side herb-rich deciduous forest, on old *Ulmus*, 24.8.2013, K. Syrjänen, TUR.
257. *Sclerophora coniophaea* (Norman) J. Mattsson & Middelb. – Velikaya Guba – SW, Zubovo –N, NE of Lake Pužej, spruce swamp – mixed herb-rich forest at E-base of siliceous cliff, on birch snag, abundant, 24.8.2013, K. Syrjänen, TUR; Tambitsy NW towards Kaskoselga, herb-rich – grassy swamp forest, on birch snag, 28.08.2013, K. Syrjänen, TUR.
258. *Scoliosporum chlorococcum* (Graewe ex Stenh.) Vězda – Eastern shore Kizhi Island, Yamka village, about 0,5 km to the North, on pine, abundant, 28.05.1999, M.A. Fadeeva, PTZ.
259. *Scytinium fragrans* (Sm.) Otálora et al. – Fadeeva 2013.
260. *Scytinium gelatinosum* (With.) Otálora et al. – Norrlin 1876; Yuzhny Oleny Island, on dolomites, M.A. Fadeeva, 05.07.2004, PTZ.
261. *Scytinium lichenoides* (L.) Otálora et al. – Fadeeva 2013.
262. *Scytinium plicatile* (Ach.) Otálora et al. – Fadeeva 2013.
263. *Scytinium teretiusculum* (Wallr.) Otálora et al. – Fadeeva 2013; Lipovitsy, along the brook, on bark of aspen, 25.06.2013, M.A. Fadeeva, PTZ.
264. *Spilonema paradoxum* Bornet – Norrlin 1876.
265. *Spilonema revertens* Nyl. – Norrlin 1876.
266. *Staurothele frustulenta* Vain. – Vainio 1921.
267. +*Stenocybe pullatula* (Ach.) Stein – Fadeeva 2013.
268. *Stereocaulon evolutum* Graewe – Norrlin 1876.
269. *Stereocaulon grande* (H. Magn.) H. Magn. – Fadeeva 2013.
270. *Stereocaulon saxatile* H. Magn. – Fadeeva 2013; Ersenevo village, stony shore of Lake Onega, M.A. Fadeeva, 05.07.2012, PTZ.
271. *Stereocaulon subcoralloides* (Nyl.) Nyl. – Fadeeva 2013; on stone basement of old main church of Kizhi, 31.05.1999, M.A. Fadeeva, PTZ.
272. *Stereocaulon tomentosum* Fr. – Fadeeva 2013.
273. *Strangospora moriformis* (Ach.) Stein – Tolpysheva et al. 2001.
274. *Strigula stigmatella* (Ach.) R. C. Harris – Nylander 1866 a, Norrlin 1876; Vainio 1921.
275. *Tephromela atra* (Huds.) Hafellner M.A. – Podyelniki, on stones, 10.07.2012, M.A. Fadeeva, PTZ.
276. *Tetramelas insignis* (Nägeli ex Hepp) Kalb. – Norrlin 1876.
277. *Thamnotia vermicularis* (Sw.) Schaer. – Velikaya Guba -SW, Zubovo -N, NE of Lake Pužej. East facing siliceous cliff-wall and boulder scree above an open mire, on many boulders – Locally rather common, 24.08.2013, K. Syrjänen, TUR.
278. *Thermutis velutina* (Ach.) Flot. – Norrlin 1876.
279. *Toninia squalida* (Ach.) A. Massal. – Azhepnavolok Cape, on mosses, 1870, J.P. Norrlin, H: Norrlin 1876; Vainio 1922.
280. *Trapelia glebulosa* (Sm.) J. R. Laundon – Velikaya Guba, on schist, 1870, J.P. Norrlin, H: Norrlin 1876, s.n. *Lecidea coarctata* Ach.; Vainio 1934.
281. *Trapeliopsis granulosa* (Hoffm.) Lumbsch – Norrlin 1876; Podyelniki, on roots of fallen spruce, 06.07.2012, M.A. Fadeeva, PTZ.
282. *Tuckermanopsis chlorophylla* (Willd.) Hale – Fadeeva 2000; Tolpysheva et al. 2001; Podyelniki, on stones, 10.07. 2012, M.A. Fadeeva, PTZ.

283. *Umbilicaria deusta* (L.) Baumg. – Fadeeva 2000; 2013; Ersenevo village, stony shore of Lake Onega, 05.07.2012, M.A. Fadeeva, PTZ.
284. *Umbilicaria hirsuta* (Sw. ex Westr.) Hoffm. – Fadeeva 2013.
285. *Umbilicaria hyperborea* (Ach.) Hoffm. – Fadeeva 2013; Podyelniki, shore Lake Onega, on stones, 10.07.2012, M.A. Fadeeva, PTZ.
286. *Umbilicaria torrefacta* (Lightf.) Schrad. – Fadeeva 2013.
287. *Umbilicaria vellea* (L.) Hoffm. – Fadeeva 2013.
288. *Usnea barbata* (L.) Weber ex F.H.Wigg. – Lipovitsy, along the brook, on spruce, 25.06.2013, M.A. Fadeeva, PTZ.
289. *Usnea dasypoga* (Ach.) Röhl. – Tolpysheva et al. 2001; south-western shore of Lake Vekhkozero, on spruce, 11.07.2012, M.A. Fadeeva, PTZ.
290. *Usnea glabrescens* (Nyl. ex Vain.) Vain. – Tolpysheva et al. 2001.
291. *Usnea hirta* (L.) F. H. Wigg. – Tolpysheva et al. 2001; Fadeeva 2000, Podyelniki, on bark of pine, 10.07.2012, M.A. Fadeeva, PTZ.
292. *Usnea lapponica* Vain. – Tolpysheva et al. 2001.
293. *Usnea subfloridana* Stirt. – Fadeeva 2013; Podyelniki, on bark of pine, 10.07.2012, M.A. Fadeeva, PTZ.
294. *Vahliella leucophaea* (Vahl) P. M. Jørg. – Fadeeva 2013; Ashepnavolok Cape, 1870, J.P. Norrlin, H; Bolshoi Lelikovsky Island, on rock outcrops, 06.07.2004, M.A. Fadeeva, PTZ; Rybya Bay of Lake Onega, eastern slope, on rock outcrops, 11.07.2012, M.A. Fadeeva, PTZ.
295. *Vulpicida pinastri* (Scop.) J.-E. Mattsson & M. J. Lai – Norrlin 1876; Tolpysheva et al. 2001; Fadeeva 2000, 2013; North to Zubovo village, on *Salix caprea*, 03.07.2012, M.A. Fadeeva, PTZ.
296. *Xanthoparmelia conspersa* (Ehrh. ex Ach.) Hale – Krestovy Isl., abandoned field, on boulders, 29.05.1999, M.A. Fadeeva, PTZ; Ersenevo village, abandoned field, on stones, 05.07.2012, M.A. Fadeeva, PTZ; Podyelniki, abandoned field, on stones and mossy rocks, 10.07.2012, M.A. Fadeeva, PTZ.
297. *Xanthoparmelia pulla* (Ach.) O. Blanco et al. – Norrlin 1876; Fadeeva 2013.
298. *Xanthoparmelia stenophylla* (Ach.) Ahti & D. Hawksw. – Fadeeva 2013; Ersenevo village, abandoned field, on stones, 05.07.2012, M.A. Fadeeva, PTZ; Podyelniki, abandoned field, on stones and mossy rocks, 10.07.2012, M.A. Fadeeva, PTZ.
299. *Xanthoparmelia verruculifera* (Nyl.) O. Blanco et al. – Fadeeva 2013.
300. *Xylopsora friesii* (Ach.) Bendiksby & Timdal – Nylander 1866 a; Norrlin 1876; Fadeeva 2013; NW shore of Lake Vekhkozero, on bark of pine, 11.07.2012, M.A. Fadeeva, PTZ.
301. *Xanthoria parietina* (L.) Th. Fr. – Norrlin 1876; Fadeeva 2000; North to Zubovo village, on *Salix caprea*, 03.07.2012, M.A. Fadeeva, PTZ.
302. *Xanthoria sorediata* (Vain.) Poelt – Fadeeva 2013.
303. *Xylographa parallela* (Ach.) Fr. – Tolpysheva et al. 2001.
304. *Xylographa vitiligo* (Ach.) J. R. Laundon – Norrlin 1876; Fadeeva 2013; Podyelniki, on wood of pine, 10.07.2012, M.A. Fadeeva, PTZ.



### 3.4 Red-listed and indicator lichens of Zaonezhye Peninsula

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#### Introduction

Some of the lichen collections from Zaonezhye Peninsula date back more than a hundred years, when lichenologists and other botanists of the Imperial Alexander University of Finland made field excursions to Karelia. Also Zaonezhye Peninsula (Äänisniemi) was visited at that time. The first lichen flora of *Karelia Onegensis* (Kon) was published by Johan Petter Norrlin already in 1876 (Norrin 1876, see also Ahti & Boychuk 2006). At the time, for example, *Ramalina obtusata* was collected from Zaonezhye near Velikaya Guba and another threatened species of the genus *Ramalina*, *R. thrausta*, from Dianova Gora. However, most of the collections and observations of lichens from this area were made in the early 2000's (2000–2013), mainly by researchers from the Karelian Research Center of the Russian Academy of Sciences (Fadeeva 2013, Fadeeva & Kravchenko 2013). Altogether 1276 species of lichens are found in Karelia (Fadeeva et al. 2007) and about half of them (52 %) are present in *Karelia onegensis*. Margarita A. Fadeeva has listed 129 lichen species from Zaonezhye Peninsula in 2013. Her article (Fadeeva 2013) includes mainly sites in northern and central parts of the peninsula. Studies by Tolpysheva et al. (2001) and Fadeeva & Kravchenko (2013) have main focus on lichen flora of Kizhi archipelago. All these works include observations of many red-listed and indicator lichen species of pristine forests and other habitat hotspots.

In the summers 2012 and 2013, Fadeeva continued inventories of lichens in many parts of Zaonezhye (for example, around the villages of Lipovitsy, Podyelniki, Zubovo and Polya). List of collections is presented in chapter 3.3. Kimmo Syrjänen and Olli Manninen observed lichens in many parts of southern and southwestern Zaonezhye Peninsula during two weeks in late August 2013. As a result of the inventories of the most recent years the number of known lichen species has more than doubled in Za-

onezhye, being now over 304. Lichens specimens collected by Syrjänen and Manninen in 2013 are mainly deposited in the Turku University herbarium (TUR) and materials collected by Fadeeva are available in the Karelian Research Centre herbarium (PTZ) in Petrozavodsk. In chapter 3.3 there is a list of lichen specimens which have been collected from Zaonezhye to different scientific herbaria in Russia and Finland. All Finnish collections of the year 2013 have not yet been entirely included in the list.

## Material and methods

During the inventory in 2013 by the Finnish group most attention was paid to localities that were selected in earlier inventories (by the non-governmental nature conservation organization SPOK or Karelian Research Centre) or that looked promising in remote sensing images (TM/SPOT satellite imagery). We tried to visit as many forest compartments (*kvartal*) with pristine-like forests as possible within the study area. However, some of the forest compartments (*kvartal*), or parts of them, had been recently clear-cut. Nevertheless, we spent most of the time in old-growth forests, swamp forests and brook-side forests. Data were collected especially on indicator lichens, based on Andersson et al. (2009), and red-listed species of Karelia, based on Ivanter & Kuznetsov (2007). Special attention was paid to Calicioid lichens, many of which are used as indicator species of forest habitat quality (Tibell 1999, Andersson et al 2009).

Many of the lichen indicator species suggest a continuity of forest habitats, a stable microclimate and an intact hydrology as well as the presence of very old living and dead trees. Although the inventories concentrated on forest habitats, the authors visited also several bogs and mires as well as some rock outcrops with both basic and siliceous bedrock. During the field trip, we collected data on other species groups as well (vascular plants, fungi, bryophytes). Therefore, the results on lichens are far from complete, although they give a general insight into the importance of Zaonezhye for indicator and red-listed species. Because observation of crustaceous lichens is time consuming, more attention was paid to particularly easily observable species, especially *Lobaria pulmonaria*.

Also other members of the inventory group, especially Jyri Mikkola, Olli-Pekka Tikkanen and Timo Kuuluvainen, informed us about the occurrence of *Lobaria pulmonaria* and other easily identifiable lichen species.

## Results

The list of observed red-listed and indicator species and frequency of observations are shown in Table 1. Chapter 3.3. contains a more detailed list of lichens specimens collected on Zaonezhye. So far it includes 304 lichen species.

### Epiphytes of deciduous trees

Large aspen trees (*Populus tremula*) are present throughout the Zaonezhye landscape, both in remote herb-rich old-growth forests and in late-successional deciduous stands close to abandoned old villages. These aspen trees host a rich epiphyte flora. The large, leafy lichen *Lobaria pulmonaria* is very common in Zaonezhye. Individuals of *Lobaria pulmonaria* were often healthy, and we observed apothecia in many places. Also, we found the parasite fungus of *Lobaria pulmonaria*, *Plectocarpon lichenum* a couple of times in Zaonezhye. In 2013 we recorded *Lobaria pulmonaria* from 493 sites throughout the southern half of Zaonezhye Peninsula. Another typical epiphyte of aspens in the area is the indicator lichen *Leptogium saturninum*. Aspen trees also host other foliose lichens that

live in symbiosis with cyanobacteria. These include species from the genera *Nephroma* spp. and *Peltigera* spp. For example, *Peltigera praetextata* and *P. canina* are occasionally found at the base of large aspens throughout Zaonezhye. *Nephroma parile* and *Nephroma bellum* are relatively common epiphyte species, whereas *Nephroma resupinatum* is more rare. The latter indicator species was found only in a half a dozen locations during the 2013 survey.

These folious indicator species are also growing on certain other deciduous trees, mainly on Rowan (*Sorbus aucuparia*), Goat willow (*Salix caprea*) and Bay willow (*Salix pentandra*) and sometimes also on old birches. Old individuals of these tree species are common at the mire margins as well as in swamp forests and herb-rich forests. Other indicator epiphytes of deciduous trees in Zaonezhye include *Parmeliella triptophylla*, *Pannaria pezizoides* and *Leptogium teretiusculum*, which were occasionally found from old herb-rich mixed forests. The presence of these lichens on aspen and other deciduous trees indicates that there is continuity of old deciduous trees and a suitable microclimate and the landscape is connected so that most epiphyte lichen species can disperse and colonize new trees.

*Peltigera collina* was the most rare epiphyte in its genus of folious lichens and was found only twice. Also epiphyte species of the genus *Collema* seem to be rare in Zaonezhye: *Collema subnigrescens/nigrescens* was found a few times, *Collema fragrans* only once.

Bay willow (*Salix pentandra*) is a relatively common tree species in Zaonezhye. It grows regularly at the margins of mires and swamp forests as well as by the side of brooks and rivulets. Trunks of big trees seem to be good substrata for lichen epiphytes. In addition to *Loparia pulmonaria* and *Nephroma* spp. they are often colonized by several other species, including *Ramalina* spp. and *Calicioid* lichens such as *Chaenotheca chlorella* and *Calicium lichenoides*. The commonness of Bay willow is probably due to the fact that most mires have not been drained by ditching. Also beaver activity increases flooding dynamics in mire ecosystems and riparian environments. This contributes to the establishment and growth of *Salix pentandra*.



Fig. 1. *Salix pentandra* swamp forest (Photo: Kimmo Syrjänen).

Also some broadleaf hardwood trees such as *Tilia cordata* grow in the herb-rich forests of Zaonezhye. *Tilia cordata* is found occasionally on rich soils. *Ulmus laevis* grows in many sites at Zaonezhye, especially in Kizhi archipelago. One place worth mentioning is an *Ulmus glabra* stand southwest of the village of Lipovitsy (whose Russian name refers to a lime tree). In the upper course of a small brook that runs out of Lake Bedzdonnaye, a herb-rich deciduous forest grows about a dozen big elm trees with an interesting lichen epiphyte flora. *Bacidia rubella*, *Gyalecta ulmi* and *Sclerophora pallida* (syn. *S. nivea*) grow on the elm trunks. The presence of elm trees and these temperate lichen species are a consequence of the favourable climatic conditions and rich soils of Zaonezhye Peninsula.

Small swamps forests with *Alnus glutinosa* occur in many brook valleys and swampy depressions. In one location, we found the crustaceous *Arthonia spadicea* growing on black alder trunks. It is a red-listed indicator species of black alder swamp-forests. We also found *Coenogium pineti* growing on trunks of black alder trees in swamp forests. It is a typical species of this habitat. In addition, *Arthonia leucopellea* has been found as epiphyte of *Alnus glutinosa* in Zaonezhye. However, most occurrences of this red-listed indicator species in Zaonezhye are on spruce trunks. It typically grows on the bark of old, living spruces in swamp forests and at mire margins.

Large old birches (both *Betula pendula* and *B. pubescens*) grow in several forest habitats in Zaonezhye, including herb-rich and pristine forests as well as swamp forests and late-successional stands of deciduous forests. Even though *Lobaria pulmonaria* can occasionally be found also on the trunks of birches, these are not that important for folious species in Zaonezhye. However, birch trees host a wide range of crustaceous lichen species. Especially *Chaenotheca brachypoda* is a common indicator species on old, partly rotten birches. In swamp forests and old-growth forests, *Sclerophora conioptera* is often found by the sides of brooks, on the trunks of very old living birches or dead birch snags.

## Usnea lichens and other fruticose epiphytes

Many hanging fruticose lichens are considered to be indicators of good air quality, moist microclimate and forest continuity. Especially *Usnea* spp., *Bryoria* spp., *Alectoria sarmentosa*, *Ramalina thrausta* and *Evernia divaricata* are such species. In Zaonezhye Peninsula, *Usnea* lichens are most frequently found along bog and mire margins as well as in swamp forests and pristine old-growth forests. These species hang from twigs and trunks of both coniferous and deciduous trees. In the genus *Usnea*, common species *Usnea dasypoga* and *Usnea subfloridana* seem to prevail, although this genus was not studied in detail during the field trip. However, both more rare and threatened species *Usnea barbata*, *U. chaetophora*, *U. glabrescens* and *U. lapponica* have been collected from few places in Zaonetshye. In the genus *Bryoria*, widely distributed species like *Bryoria capillaris* and *B. fuscescens* (sensu lato) are common and can sometimes completely cover small spruces at the margins of mires. Also *Bryoria furcellata*, which demands a more natural environment, is generally found at these sites. The large, hanging *Bryoria fremontii* is not abundant on Zaonezhye Peninsula, although it has been found at a couple of sites. *Bryoria nadvoornikiana* seems to be rare, with only a few individuals found at seven sites. Surprisingly, also *Alectoria sarmentosa* seems to be a relatively rare or occasional species. Especially larger healthy populations are scarce in Zaonezhye. However, *Evernia divaricata* was found at 58 sites, typically in transition zones between mires and forests. It can grow on the trunks and twigs of almost all tree species of the region. The size and health of individual lichens varies a lot, but most of the individuals are small and the populations scarce. There are also populations with a large amount of individuals where the length of healthy individuals of hanging

lichens can reach approximately 20–30 cm. In our inventories there were no sightings of *Ramalina thrausta*, which has not been found from Zaonezhye for over 100 years.



Fig. 2. Healthy hanging *Evernia divaricata* with *Usnea* sp. and *Bryoria* spp. (Photo: Kimmo Syrjänen).

### Epiphytes of spruce

In addition to fruticous species on the branches and trunks of spruces, many crustaceous lichens grow on the bark of old living trees or on the bare wood of dead standing spruces. These include several indicator species of pristine forests, moist microclimate and very old trees. We found *Lecanactis abietina* in a few places. It is a crustaceous lichen, typically growing on the bark of old spruces. We also found *Arthonia leucopellea*, which prefers spruces in swamp forests, from a couple of places in the

area. This species was also recorded from *Alnus glutinosa*. In addition, we observed *Chaenotheca subroscida*, which is a Calicioid lichen, typically growing on spruce bark in moist pristine forests. We also found *Lobadium disciforme* from both spruce bark and deciduous trees in Zaonezhye.

### Lichens on dead wood

Tall stumps and snags of spruces and deciduous trees are extremely important for many crustaceous lichens in old-growth pristine forests. Some species, like *Chaenotheca chlorella*, prefer growing on deciduous trees but are also found from dead wood of spruce and deciduous trees. Others, like *Chaenotheca laevigata* and *Chaenotheca gracillima*, grow mainly on bare wood and dead trees but can also grow on the bark of living trees. In Zaonezhye, *Sclerophora coniophaea* seems to often grow on snags of old birches, but it occasionally grows also on other substrate, including dead wood and bark. It was found at 25 sites in old-growth swamp forests, old herb-rich forests and forests along brooks. However, *Chaenotheca gracilentata* (syn. *Cybebe gracilentata*) grows almost exclusively on decaying stumps in the moist conditions of swamp forests and moist old-growth forests. It was observed at more than ten sites in Zaonezhye. Only a few indicator lichens species are typical for downed logs. *Cladonia norvegica* is common on soft, wind fallen spruce logs in forests with pristine characteristics throughout the peninsula. In places, *Icmadophila ericetorum* grows on the sides of large, relatively soft spruce and pine logs. *Multiclavula mucida* is an easy species to identify. It has a permanent green thallus that normally covers several decimeters of large, fallen and decaying aspen trunks. Unlike many other lichens, it belongs to basidiomycota and its fruiting bodies are short-lived, whitish clubs arising from the thallus. *Multiclavula mucida* grows in various places in Zaonezhye, mainly in herb-rich mixed forests with large aspen trees.



Fig. 3. *Multiclavula mucida* (Photo: Kimmo Syrjänen).

*Cladonia parasitica* prefers more sun-exposed conditions than the above species. It is mainly found from downed pine logs and stumps in dry heath pine forests or rocky forests. The ecology of *Lecidea botryosa* is similar, although it grows also on dry wood of spruce. In suitable habitats, both of these species seem to be relatively common in Zaonezhye. *Pyrrhospora elabens* is a more rare lichen indicator in Zaonezhye. It prefers snags of large old pines in sun-exposed environments. The species has been found from old, dry pine forests in western parts of Zaonezhye.

In Zaonezhye, dead, standing pine trees and snags are common at bogs and mire margins. Shiny black spikes of *Calicium denigratum* are typically found on dry pine-wood in these habitats. In Zaonezhye it is quite often accompanied by *Chaenothecopsis fennica*, which has a similar ecology to *Calicium denigratum* but grows also on spruce wood in the same habitats. Both of these indicator species are relatively frequent at bog and mire margins in the area.

Bogs are also home for *Evernia mesomorpha*, which mainly grows on twigs and trunks of stunted pines, birches and spruces in open bogs, but sometimes also on the branches of dead trees. The species grows in several bogs in Zaonezhye, although it is not abundant.

### Basic and siliceous cliffs

Carboniferous rocks of Mount Sypun are important for lichens as well as for bryophytes. The site seems to have a very rich lichen flora of basic rocks, including e.g. *Collema fuscovirens*, *Collema polycarpon*, *Fuscopannaria leucophaea* (syn. *Vahliella leucophaea*), *Leptogium plicatile*, *Neofuscelia verruculifera* (syn. *Xanthoparmelia verruculifera*), *Peltigera lepidophora*, *P. leucophlebia*, *P. venosa* and *Xanthoria sorediata*. Also *Lobaria scrobiculata* grows there (Fadeeva 2013). The conservation value of this rocky area is very high.

Especially one site on a siliceous rock outcrop in Zaonezhye is worth mentioning. The site is situated east of the village of Lipovitsy, not far from the shores of Lake Onega. It is an east-facing, bare siliceous cliff wall with coarse talus scree beneath it. There is an open oligotrophic mire in front of the cliff. The cliff wall has a typical lichen flora of siliceous oligotrophic rocks, including *Chrysothrix chlorina*, *Ramalina pollinaria*, *Parmelia fraudans*, *Alectoria sarmentosa* and *Hypogymnia vittata*. However, there is a more interesting lichen flora on boulder scree, including *Cladonia amaurocraea* and a large population of *Thamnolia vermicularis*, which grows on the sides and tops of the boulders. The distribution of this lichen species is mainly Arctic-alpine, although it can be found in some remote locations on lowlands, especially in coastal areas. *Nephroma arctica* grows towards the southern end of the cliff.



Fig. 4. *Thamnolia vermicularis* (Photo: Kimmo Syrjänen).

## Discussion

Our inventories revealed several hotspots of pristine-like old-growth forests in larger or smaller patches as well as other types of environments that are important for lichens, including basic and siliceous rock outcrops. These short inventories revealed 1141 locations of red-listed and indicator lichens in Zaonezhye. It is evident that the species composition and the potential for conservation of biodiversity in Zaonezhye are much higher than have previously been thought.

The diverse species composition of lichens is probably due to various reasons. There are still quite large old-growth forests, with a continuity of dead wood, remote from old villages. The bogs and mires of Zaonezhye are mostly intact, and drained bogs and mires are an exception. There are often wide transition zones between the margins of peat-forming ecosystems and the forests on mineral soil, which have not been used in active forestry. Swamps forests are common in Zaonezhye. These areas have a large number of tree species, old and dead trees as well as a suitable, moist microclimate. Some of the old traditional landscapes and grazed forests close to the villages, which were more open in the past, now have old deciduous trees. For many epiphyte lichens and species of dead wood, the landscapes form a connected network of suitable habitats. Zaonezhye provides an opportunity to maintain this valuable flora by making forest conservation areas and developing green corridors to connect them. Also peatlands and waterways could be used when building connections between larger conservation areas.

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Table 1. Red listed and indicator lichens of Zaonezhye. Presence of species in Karelian (KAR) and Finnish (FIN) Red Data Books is shown in the first column (Ivanter & Kutznetsov 2007, Rassi et al. 2010). Their role as indicator (IND) of valuable forest habitats is shown in the second column (based on Andersson et al. 2009) and number of observations in the third column. Also some other lichen species with indicator characteristics are included in table. Table is based on observations by the authors in 2012–2013 and literature information (Fadeeva 2013, Fadeeva & Kravchenko 2013, Tolpysheva et al. 2001). Table includes only recent observations of valuable species; historical records are available in chapter 3.3.

Species name	Red Listed	Indicator species	Number of observations
<i>Alectoria sarmentosa</i>	KAR, FIN	IND	11
<i>Anaptychia ciliaris</i>	KAR		2
<i>Arthonia leucopellaea</i>	KAR, FIN	IND	6
<i>Arthonia spadicea</i>	FIN	IND	1
<i>Arthonia vinosa</i>	KAR, FIN		1
<i>Bacidia rubella</i>	FIN	IND	1
<i>Bryoria fremontii</i>	KAR, FIN	IND	4
<i>Bryoria nadvornikiana</i>	KAR, FIN		6
<i>Calicium denigratum</i>	FIN	IND	17
<i>Chaenotheca brachypoda</i>		IND	64
<i>Chaenotheca chlorella</i>	FIN	IND	8
<i>Chaenotheca gracilentia</i>	KAR, FIN	IND	14
<i>Chaenotheca gracillima</i>	KAR, FIN	IND	4
<i>Chaenotheca laevigata</i>	FIN	IND	3
<i>Chaenotheca stemonea</i>	KAR, FIN	IND	1
<i>Chaenotheca subroscida</i>	KAR, FIN	IND	4
<i>Chaenothecopsis fennica</i>	FIN	IND	8
<i>Cladonia decorticata</i>	KAR		1
<i>Cladonia norvegica</i>	FIN	IND	12
<i>Cladonia parasitica</i>	FIN	IND	53
<i>Coenogium pineti</i>			2
<i>Collema flaccidum</i>		IND	1
<i>Collema fragrans</i>	FIN		1
<i>Collema furfuracea</i>	FIN		1
<i>Collema fuscovirens</i>			1
<i>Collema polycarpon</i>	FIN		1
<i>Collema subnigrescens</i>	FIN	IND	2
<i>Evernia divaricata</i>	KAR, FIN		58
<i>Evernia mesomorpha</i>			13
<i>Fuscopannaria leucophaea</i>		IND	1
<i>Graphis scripta</i>			11
<i>Gyalecta truncigena</i>	FIN	IND	1
<i>Gyalecta ulmi</i>	KAR, FIN	IND	2
<i>Hypogymnia vittata</i>		IND	2
<i>Icmadophila ericetorum</i>		IND	11
<i>Lecanactis abietina</i>	KAR	IND	3
<i>Lecidea botryosa</i>		IND	18
<i>Leptogium lichenoides</i>		IND	2
<i>Leptogium plicatile</i>	FIN		1
<i>Leptogium saturninum</i>	FIN	IND	89
<i>Leptogium teretiusculum</i>	FIN	IND	7
<i>Lobaria pulmonaria</i>	KAR, FIN	IND	518
<i>Lobaria scrobiculata</i>	KAR, FIN	IND	3
<i>Lopadium disciforme</i>	FIN	IND	8
<i>Melanelia subaurifera</i>	KAR		1
<i>Microcalicium disseminatum</i>		IND	6
<i>Multiclavula mucida</i>	FIN		7
<i>Neofuscelia verruculifera</i>	KAR, FIN		1

<i>Nephroma arcticum</i>		IND	2
<i>Nephroma bellum</i>	KAR, FIN	IND	36
<i>Nephroma parile</i>		IND	36
<i>Nephroma resupinatum</i>	FIN	IND	6
<i>Pannaria pezizoides</i>		IND	2
<i>Parmeliella triptophylla</i>	FIN	IND	12
<i>Parmelina tiliacea</i>	KAR, FIN	IND	1
<i>Peltigera collina</i>	KAR, FIN	IND	2
<i>Peltigera scabrosa</i>		IND	1
<i>Peltigera venosa</i>	KAR, FIN		2
<i>Plectocarpon lichenum</i>	FIN		3
<i>Pyrrhospora elabens</i>	FIN	IND	3
<i>Psilolechia clavulifera</i>	KAR		1
<i>Ramalina baltica</i>	KAR, FIN	IND	2
<i>Ramalina dilacerata</i>	KAR, FIN		3
<i>Ramalina sinensis</i>	FIN		4
<i>Sclerophora coniophaea</i>	KAR, FIN	IND	25
<i>Sclerophora pallida</i>	FIN	IND	1
<i>Thamnolia vermicularis</i>	KAR		1
<i>Usnea barbata</i>	KAR, FIN		1
<i>Usnea chaetophora</i>	FIN		1
<i>Usnea glabrescens</i>	FIN		1
<i>Usnea lapponica</i>	FIN		1

## 3.5 Aphylophoroid fungi of Zaonezhye Peninsula

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### Introduction

Zaonezhye Peninsula is dominated by green-moss spruce forests. Also nemoral species grow in these forests, and thus the forests have features of southern taiga forests. In the past most of the areas on Zaonezhye Peninsula formerly covered with pristine spruce-dominated forests were cleared for slash-and-burn cultivation to give way to pastures, ploughland and meadows as well as secondary mixed forests (Kuznetsov et al. 1999).

### Mycological studies in Zaonezhye Peninsula and adjacent areas

Mycological studies in Zaonezhye were carried out between 1996 and 1998 by the Forest Research Institute of the Karelian Research Centre of the Russian Academy of Sciences, Petrozavodsk (FRI) and V.L. Komarov Botanical Institute of the Russian Academy of Sciences, St. Petersburg (BIN RAS) (Bondartseva et al. 2000). In 1996 and 1998, *Margarita Bondartseva*, *Vera Kotkova* (*Lositskaya*), *Vitaly Krutov* and *Svetlana Kiviniemi* conducted research on the Kizhi and Gogolev islands. In 1997, *Anna Ruokolainen* carried out studies on Bolshoi Klimenetsky Island. Between 2010 and 2013, *Anna Ruokolainen* continued her studies, in cooperation with the Finnish specialists *Olli-Pekka Turunen*, *Olli Manninen* and *Jyri Mikkola*, on Bolshoi Lelikovsky Island and other parts of Zaonezhye Peninsula (in the vicinity of the villages of Vegoruksa, Velikaya Guba, Velikaya Niva, Kuzaranda, Lipovitsy, Poly, Tambitsy, Tipinitsy and Shun'ga as well as lakes Vanchozero and Kosmozero). In 2012, fungi were studied on Kizhi Island and near the villages of Zharnikovo, Malkovo, Zubovo and Podyelniki with the initiative and support of the Kizhi museum-reserve. Samples from Zaonezhye Peninsula and the Kizhi archipelago are stored in the herbaria of BIN RAS (LE) and FRI (PTZ).

Data from previous decades are very sparse. The herbarium of the University of Helsinki contains two samples from Kizhi Island collected by W. Nyberg in 1863 and three samples taken by Pertti Uotila in 1991 (Bondartseva et al. 1999).

According to the geobotanical zonation of Karelia (Mela & Cajander 1906), Zaonezhye Peninsula forms a part of the province of *Karelia onegensis* (*Kon*). Administratively, it belongs to the Medvezhyegorsk municipality of the Republic of Karelia. As a result of the mycological studies, a total of 360 aphyllorphoid fungus species have been reported from the province of *Kon* (which is the greatest number of species reported in any of the provinces in the Republic of Karelia) and 264 aphyllorphoid fungus species from the Medvezhyegorsk District (Bondartseva et al. 1999, Bondartseva et al. 2000, Lositskaya et al. 2001; Ruokolainen 2013 a, b, c).

So far a relatively small number of fungus species has been recorded from the Kizhi archipelago. On one hand, this is due to intensive economic activities and the resulting changes in vegetation. On the other hand, the islands have been poorly studied in the past. There are records of 43 species from Bolshoi Klimenetsky Isl. (Bondartseva et al. 2000), 37 species from the Kizhi and Gogolev islands (Ruokolainen 2013 b) and 24 species from Bolshoi Lelikovskiy Island (Ruokolainen, unpublished).

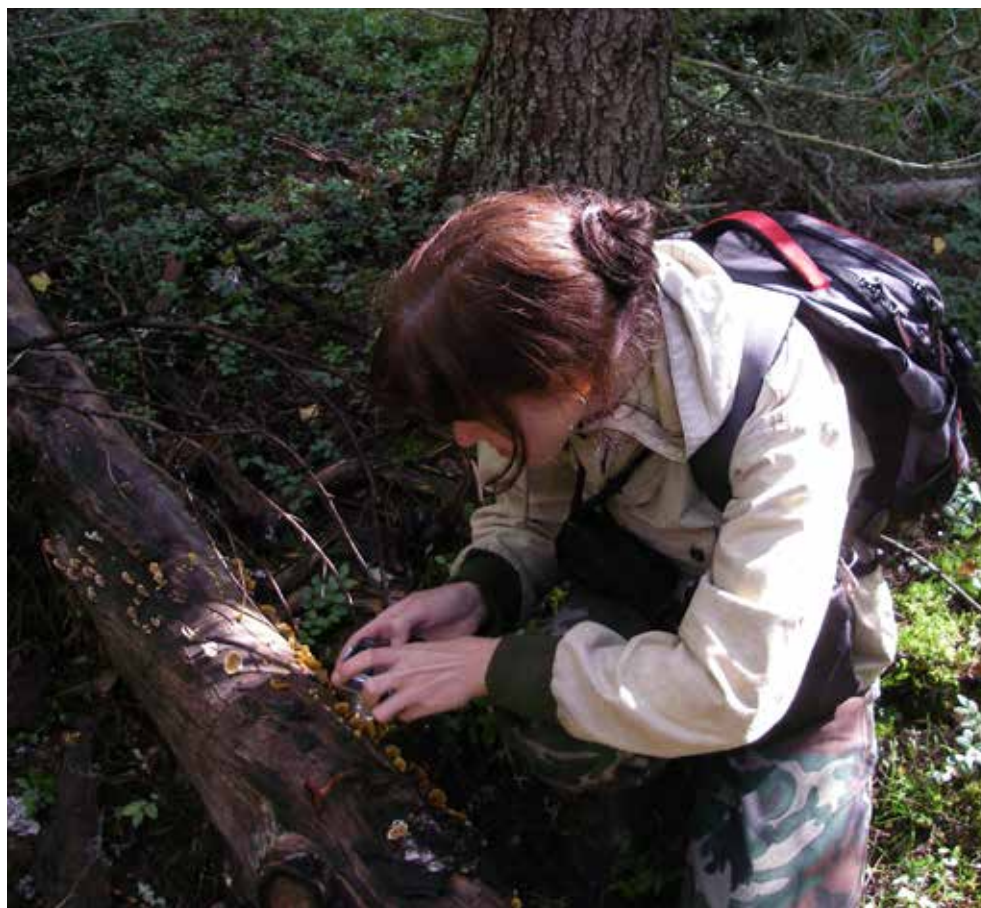


Fig. 1. Anna Ruokolainen collecting polypores on dead wood. Forest near Lipovitsy village 23.08.2013 (Photo Jevgeni Jakovlev).

## Results

To date, 233 aphyllorphoid fungus species of 113 genera, 38 families and 14 orders have been recorded from Zaonezhye Peninsula and the Kizhi archipelago. The most

numerous order *Polyporales* contains 109 species of 49 genera and 7 families. Less numerous orders include *Hymenochaetales* (41 species of 13 genera and 3 families) and *Russulales* (21, 14 and 8 species, respectively). The orders *Polyporales* and *Hymenochaetales* consist basically of 5 families: *Polyporaceae* (35 species), *Hymenochaetales* (24), *Fomitopsidaceae* (30), *Meruliaceae* (23) and *Schizoporaceae* (14 species), which in turn consist of 126 species that make up 54% of all the ascomycetous fungus species known from the peninsula. The most numerous genera are *Phellinus* (14 species), *Hyphodontia* (12 species), *Postia* (10 species), *Antrodia* (9 species), *Skeletocutis* (7 species), *Phlebia*, *Tomentella* (6 species each), *Polyporus*, *Trametes* (5 species each), *Antrodiella*, *Phanerochaete*, *Stereum*, *Trichaptum* (4 species each). Nomenclature follows Index Fungorum (2014).

Ninety-four species were found on conifers; 70 species were discovered on spruce (*Picea abies* and *P. obovata*) and 49 species on pine (*Pinus sylvestris*). A hundred species were found on deciduous tree species; 61 species were discovered on aspen (*Populus tremulae*), 40 on birches (*Betula pendula* and *B. pubescens*), 28 on alders (*Alnus incana* и *A. glutinosa*), 22 on willow (*Salix caprea*), 19 on mountain ash (*Sorbus aucuparia*) and 5 species on elms (*Ulmus laevis*, *U. glabra*).

Growing on soil and litter, there were 25 species of the genera *Albatrellus*, *Bankera*, *Boletopsis*, *Cantharellus*, *Clavariadelphus*, *Clavulina*, *Coltricia*, *Craterellus*, *Hydnellum*, *Phaeolus*, *Phellodon*, *Ramaria*, *Sarcodon* and *Thelephora*.

Sixty-three species found in Zaonezhye are indicators of old-growth forests. These species are confined to the distinctive conditions of forest communities least affected by human activities (*Albatrellus confluens*, *Amylocorticium subincarnatum*, *Amylocystis lapponica*, *Anomoporia kamchatica*, *Antrodia albobrunnea*, *A. crassa*, *A. pulvinascens*, *Antrodiella citrinella*, *Asterodon ferruginosus*, *Bankera fuligineoalba*, *Boletopsis grisea*, *Chaetoderma luna*, *Clavariadelphus pistillaris*, *Climacocystis borealis*, *Crustoderma corneum*, *C. dryinum*, *Dichomitus squalens*, *Diplomitoporus crustulinus*, *Fomitopsis rosea*, *Ganoderma lucidum*, *Gloeoporus pannocinctus*, *G. taxicola*, *Gloiodon strigosus*, *Haploporus odoratus*, *Hericium coralloides*, *Junghuhnia collabens*, *J. luteoalba*, *J. pseudozilingiana*, *Kavinia alboviridis*, *Leptoporus mollis*, *Onnia leporina*, *Perenniporia subacida*, *Phaeolus schweinitzii*, *Phellinus chrysoloma*, *Ph. ferrugineofuscus*, *Ph. lundellii*, *Ph. nigrolimitatus*, *Ph. pini*, *Ph. populicola*, *Ph. viticola*, *Phellodon niger*, *Phlebia centrifuga*, *Ph. serialis*, *Piloporia sajanensis*, *Polyporus badius*, *P. pseudobetulinus*, *Postia guttulata*, *P. lateritia*, *P. undosa*, *Pseudomerulius aureus*, *Pycnoporellus alboluteus*, *P. fulgens*, species of the genus *Ramaria*, *Rhodonina placenta*, *Rigidoporus crocatus*, *Serpula himantoides*, *Sidera lenis*, *Skeletocutis odora*, *Sk. stellae*, *Tomentella crinalis*, *Trametes suaveolens*, *Tyromyces fissilis*). The above species indicate that these ecosystems are valuable and should be protected (Kotiranta & Niemelä 1996; Andersson et al. 2009).

Twenty-one species, listed in the Red Data Book of the Republic of Karelia (2007), including *Antrodia crassa*, *A. pulvinascens*, *Antrodiella citrinella*, *Aurantiporus fissilis*, *Clavariadelphus pistillaris*, *Craterellus cornucopioides*, *Dichomitus squalens*, *Elmerina caryae*, *Ganoderma lucidum*, *Gloiodon strigosus*, *Haploporus odoratus*, *Hericium coralloides*, *Junghuhnia collabens*, *J. pseudozilingiana*, *Kavinia alboviridis*, *Leptoporus mollis*, *Piloporia sajanensis*, *Polyporus pseudobetulinus*, *Radulodon erikssonii*, *Rigidoporus crocatus*, *Sidera lenis* and *Tomentella crinalis* were reported from the study area.

In addition, 40 species, classified as VU (10 species), NT (25 species) and EN (5 species), were listed in the 2010 Red list of Finnish species (Rassi et al 2010). The species *Amylocorticium subincarnatum*, *Amylocystis lapponica*, *Boletopsis grisea*, *Ceriporia excelsa*, *Crustoderma corneum*, *C. dryinum*, *Diplomitoporus crustulinus*, *D. flavescens*, *Fomitopsis rosea*, *Odontium romellii*, *Perenniporia subacida*, *Phlebia centrifuga*, *Polyporus badius*, *Postia guttulata*, *P. lateritia*, *Pycnoporellus alboluteus*, *Scytinostroma galactinum*, *Skeletocutis brevispora*, *Sk. odora*, *Sk. stellae*, *Trametes suaveolens*, *Trichaptum laricinum*

and *T. pargamenum* have not yet been granted a protected status in Russia, although they are already protected in neighboring countries.

### Species confined to pine

Pine trees provide a number of habitats for fungi that colonize both living and dead trunks, snags, fallen logs and twigs at different stages of decay. In 2013, *Phellinus pini* was the most abundant fungal species found on pine throughout the southern part of the peninsula (120 records). The second most abundant species (in terms of frequency) was *Diplomitoporus flavescens*, which was found on standing, dead pine trunks. On fallen dead pines, the most abundant fungal species were *Antrrodia albobrunnea*, *Chaetoderma luna*, *Crustoderma corneum*, *Postia lateritia*, *P. undosa* (which can colonize spruce as well) and *Pseudomerulius aureus*. On soil litter, we found *Albatrellus confluentis*, *Bankera fuligineoalba*, *Phaeolus schweinitzii*, *Phellodon niger*, and several species of the genus *Ramaria*. The species growing on soil and litter include both mycorrhizal and humus saprotrophic fungi. These species are most abundant in old-growth pine forests, whereas in secondary pine forest they are usually rare.

### Species confined to spruce

There are several indicator species of natural forests growing on spruce. Many of them are also red-listed. In 2013, the most abundant of these species were: *Fomitopsis rosea* (350 sites), *Phellinus chrysoloma* (more than 90 sites), *Pycnoporellus fulgens* (more than 80 sites), *Phlebia centrifuga* (ca. 80 sites), *Amylocystis lapponica* (more than 70 sites), and *Phellinus viticola* (more than 50 sites). Less abundant species included *Climacocystis borealis*, *Asterodon ferruginosus*, *Crustoderma corneum*, *Gloeoporus pannocinctus*, *Hericium coralloides*, *Leptoporus mollis*, *Onnia leporina*, *Phellinus nigrolimitatus*, *Rhodonina placenta*, and *Skeletocutis odora*. Finally, some indicator species and threatened species were found only on a few sites (less than 10 sites), e.g. *Anomoporia kamtschatica*, *Antrrodia infirma*, *A. pulvinascens*, *Antrrodia citrinella*, *Clavariadelphus pistillaris*, *Diplomitoporus crustulinus*, *Gloeoporus taxicola*, *Gloiodon strigosus*, *Haploporus odoratus*, *Junghuhnia collabens*, *J. luteoalba*, *Pycnoporellus albolutescens*, *Sidera lenis*, *Skeletocutis chrysellia*, *Sk. papyracea*, *Sk. stellae* and *Trametes suaveolens*.

### Species confined to aspen

Aspen trunks are usually covered with epiphytic lichens, which can in turn be succeeded by various species of fungi. Some of these fungi are parasitoids that colonize other fungal species. For instance, large fruiting bodies of *Phellinus tremulae* are often colonized by *Junghuhnia pseudozilingiana*, which is considered an indicator species of old-growth forests and is therefore included in the Red Books of Karelia (2007) and Finland (Rassi et al. 2010). In 2013, this species was recorded from 10 sites in the southern part of Zaonezhye Peninsula. In addition, *Tomentella crinalis* and *Polyporus badius* have been found in some sites on fallen aspen logs at different stages of decay. The former is included in the Red Book of Karelia (2007), while the latter has become rare in Finland and Sweden. *Phellinus populicola*, which is considered rare in Sweden (Artdatabanken 2010), was recorded in 2013 from approximately 90 sites in the southern part of Zaonezhye Peninsula.

## The most noteworthy findings of threatened and rare species of saproxylic fungi

*Antrodia crassa* (P. Karst.) Ryvar den found in the end of Syar peninsula, Compartment 187, old-growth pine-dominated forest (19.08.2013, Olli Manninen leg.). This is maybe the most exclusive species confined the best pine forests preserved in the area. This finding must also be one of the southernmost findings in Fennoscandia.

*Ceriporia excelsa* S. Lundell ex Parmasto was found on a wind-fallen deciduous tree in a small-leaved thicket on Kizhi Island. This is the first finding of this relatively rare, southern species in the Republic of Karelia. It is also encountered in the adjacent Leningrad and Arkhangelsk Regions as well as in the Komi Republic. *Ceriporia excelsa* is a common species in Europe and North America. It is classified as NT in the 2010 Red list of Finnish species (Rassi et al. 2010) and in Sweden (Artdatabanken 2010).



Fig. 2. *Ceriporia excelsa* (Photo Anna Ruokolainen).

*Ganoderma lucidum* (M. A. Curtis : Fr.) P. Karst. was found on a drying birch trunk in a mixed forest in the vicinity of the village of Tipinitsy. In the Republic of Karelia, this is the first finding of the species in the Medvezhyegorsk District as well as in the *Kon* province. There have been sparse reports of the species from the *KI* province in the Sortavala District (on a larch stump in a plantation on Valaam Island) and the *Kton* province in the Pudozh District (on a wind-fallen alder tree in the Vodlozero National Park). *Ganoderma lucidum* is common in southern Russia, but less common in middle latitudes. It occurs widely in Europe (except for northern Scandinavia and Finland), Asia, North Africa and North America. In the Red Data Book of the Republic of Karelia (2007) the species was classified as VU. It is also included in the Red Data Book of the Russian Federation (2008) as well as regional Red Data Books.



Fig. 3. *Ganoderma lucidum* (Photo Anna Ruokolainen).

*Kavinia alboviridis* (Mordan) Gilb. et Budington. One finding on old dry pieces of dead spruce (under an old living spruce) northwest of the Vatnavolok village, Syar peninsula (Compartment 134). There are sparse records of the species in the Republic of Karelia and it is only known from the Muezersky District and the environs of the Kostomuksha nature reserve. *Kavinia alboviridis* is classified as DD in the Red Data Book of the Republic of Karelia (2007).

*Junghuhnia pseudozilingiana* (Parmasto) Ryvarden was found in several parts of Zaonezhye Peninsula. It grows in mixed forests with old aspen trees, colonized and inhabited by the fungus *Phellinus tremulae*. The species is classified as DD in the Red Data Book of the Republic of Karelia (2007) and the Red Nature Data Book of the Leningrad Region (2000), and VU in the 2010 Red list of Finnish species (Rassi et al. 2010). *Junghuhnia pseudozilingiana* occurs widely in Europe.



Fig. 4. *Junghuhnia pseudozilingiana* (Photo Anna Ruokolainen).



*Piloporia sajanensis* (Parmasto) Niemelä found in the vicinity of Uzkaya Salma village, Comparment 26 of Kizhi forestry unit. Moist spruce-dominated forest, 28.06.2013 (Olli Manninen leg.). This must be one of the southernmost findings of this rare species that is dependent on *Trichaptum laricinum*.

*Pycnoporellus alboluteus* (Ellis et Everh.) Kotl. et Pouzar. Two new records South from Velikaya Guba village, at the western part of peninsula, Comparment 9 of Kizhi forestry unit in old-growth spruce forests with very much dead wood in all stages (Olli Maninen and Timo Kuuluvainen legs). This is the first finding of the species in the Republic of Karelia. The species is classified as EN in the 2010 Red list of Finnish species (Rassi et al. 2010) and CR in Sweden (2010). *Pycnoporellus alboluteus* occurs widely in Europe, Caucasus, Asia and North America.

*Rigidoporus crocatus* (Pat.) Ryvarden was found on wind-fallen trunks of birch, alder and spruce trees in birch, motley grass-spruce and mixed forests near the villages of Zharnikovo, Lipovitsy, Polya and Tambitsy as well as on Bolshoi Klimenetsky Isl.. There are also a few reports of the species from Kondopoga and Pudozh Districts in the Republic of Karelia. The species is classified as VU in the Red Data Book of the Republic of Karelia (2007). It is also listed in the Red Nature Data Book of the Leningrad Region (2000) and classified as EN in the 2010 Red list of Finnish species (Rassi et al. 2010). Although *Rigidoporus crocatus* is rare here, it is common in other parts of Europe and North America.



Fig. 5. *Rigidoporus crocatus* (Photo Anna Ruokolainen).

*Tomentella crinalis* (Fr.) M.J. Larsen was found on a wind-fallen trunk of an aspen tree in a mixed forest near the villages of Tambitsy and Tipinitsy. In the Republic of Karelia, it is also found in Muezersky and Kondopoga Districts. The species is classified as NT in the Red Data Book of Karelia (2007). *Tomentella crinalis* also occurs in the Leningrad and Arkhangelsk Regions.

The predominance of species growing on deciduous trees indicates that the ecosystems of Zaonezhye have been transformed. However, a large number of species have been found on spruce and pine, which are the main forest-forming species. Further mycological studies and monitoring should be conducted in rocky pine forests, coastal

spruce forests and spruce forest patches along streams, as well as in old aspen forests. The large amount of rare and indicator species testifies to the importance of preserving and restoring ecosystems and habitats of species that need protection.

Table 1. List of study sites, 2010–2013.

Latitude	Longitude	Place of collection, compartment, forest type	Date
61,5605	35,08295	Bolshoi Lelikovsky Isl., pine forest	09/08/2010
61,560704	35,08214	Bolshoi Lelikovsky Isl., pine forest with spruce	09/08/2010
62,03355	35,03153	Recently fallen spruce trees; Bilberry spruce forest with aspen, south of the village of Uzkaya Salma	13/08/2010
62,03322	35,03274	Thick aspen trees (50-70 cm in diameter)	13/08/2010
62,03282	35,03251	Moist spruce forest with horsetail	13/08/2010
62,0259	35,04143		13/08/2010
62,08100	35, 07234	Fallen trees (window dynamics)	11/08/2010
62,08094	35,07096	Lake shore	11/08/2010
62,07580	35,07131	Creek	11/08/2010
62,07576	35, 07101	Rock	11/08/2010
62,20098	35,08238	Rock	17/08/2010
62,23095	35,05072	Mixed forest near a ridge	17/08/2010
62,23077	35,05072	Rocky pine forest	17/08/2010
62,22324	35,05524	Lake shore	17/08/2010
62,04187	35,06582	Compartment 63, unit 20, spruce forest near a logging area	18/08/2010
62,04181	35 ,07116	Compartment 63, unit 20, spruce forest near a logging area	18/08/2010
62,04181	35 ,07116	Pine forest with aspen and spruce	18/08/2010
62,15156	35,00375	Bilberry spruce forest	19/08/2010
62,12589	34,54187	Bilberry motley-grass pine forest	19/08/2010
62,13394	34,58162	Pine forest	19/08/2010
62,17287	35,15553		05/08/2011
62,10552	35,26476	South of Tambitsy, spruce forest	04/08/2011
62,10547	35,21341	South of Tambitsy, spruce forest	04/08/2011
62, 10393	35,20512	Spruce forest with overmature birch forest nearby	04/08/2011
62,11019	35,19156	Birch forest with spruce undergrowth	04/08/2011
62,16483	35,19158	Mixed forest	05/08/2011
62,20142	35,11240	Overmature motley grass-bilberry-shamrock spruce forest	05/08/2011
62,20091	35,11 010	Overmature aspen forest with spruce and birch	05/08/2011
62,20576	35,12 281	Spruce forest near a logging area	05/08/2011
62,14408	35,33 061	Motley grass birch forest with aspen and spruce	06/08/2011
62,66532	35,34077	Overmature spruce forest with aspen and birch	06/08/2011
62,15192	35,34179	Selective cutting area in green moss spruce forest with aspen	06/08/2011
62,1772	35,34074	East shore, south of Kuzaranda, spruce forest with aspen	07/08/2011
62,17527	35.34392	Aspen forest	07/08/2011
62,17446	35,34180	Spruce forest	07/08/2011
62,1772	35.34074	Pine forest	08/08/2011
62,25191	35,08184	Rocky pine forest	08/08/2011
62,25193	35,07515	Spruce forest with fallen trees (window dynamics)	08/08/2011
62,30067	34,93836	Environs of Velikaya Niva	23/08/2012

62,11621	35,030734	A ridge between lakes	23/08/2012
62,62897	34,55234	Lake Vanchezero	22/08/2012
62,238002	34,88029	south of the village of Lambasruchei, Lake Onega shore	24/08/2012
62,497863	34,76967	south of the village of Lambasruchei, Lake Onega shore, a ridge	24/08/2012
62,53639	34,82289	Lake Kosmozero	25/08/2012
62,131327	35,093334	Lipovitsy, spruce forest with aspen and fallen spruce	21/08/2013
62,151863	34,943757	by the lake in pine forest, compartment 13	22/08/2013
62,10509	35,02556	Lipovitsy, spruce forest with aspen and fallen spruce, compartment 41-42	23/08/2013
62,290624	35,309113	trap, Polya, compartment 84, mixed forest with aspen and fallen spruce	24/08/2013
62,29052	35,57008	north of Tambitsy, environs of Tolsty Navolok, mixed and spruce forest, compartment 71	26/08/2013
62,1849	35,31122	Lake Korbozero, Tipinitsy, mixed and spruce forest	27/08/2013
62,17725	35,3571	Tipinitsy, spruce forest	27/08/2013
62,24515	35,49294	Tambitsy, motley grass spruce forest	28/08/2013
62,2418	35,49248	Tambitsy, spruce forest with aspen	28/08/2013

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Table 2. Numbers of wood-growing fungal species recorded on Zaonezhye Peninsula (nomenclature according to Index Fungorum 2014).

Order/Family	Species
<b>Agaricomycetes</b>	
<b>Incertae sedis</b>	<i>Odonticum</i> (1)
<b>Agaricales</b>	
<i>Cyphellaceae</i>	<i>Chondrostereum</i> (1)
<b>Incertae sedis</b>	<i>Plicatura</i> (1)
<b>Atheliales</b>	
<i>Atheliaceae</i>	<i>Amphynema</i> (1), <i>Piloderma</i> (1)
<b>Auriculariales</b>	
<i>Auriculariaceae</i>	<i>Elmerina</i> (1)
<b>Incertae sedis</b>	<i>Pseudohydnum</i> (1)
<b>Boletales</b>	
<i>Amylocorticiaceae</i>	<i>Amylocorticum</i> (2), <i>Ceraceomyces</i> (2)
<i>Coniophoraceae</i>	<i>Coniophora</i> (2)
<i>Serpulaceae</i>	<i>Serpula</i> (1)
<i>Tapinellaceae</i>	<i>Pseudomerulius</i> (1)
<b>Cantharellales</b>	
<i>Botryobasidiaceae</i>	<i>Botryobasidium</i> (3), <i>Botryohypochnus</i> (1)
<i>Cantharellaceae</i>	<i>Cantharellus</i> (1), <i>Clavulina</i> (1), <i>Craterellus</i> (2)
<i>Clavulinaceae</i>	<i>Multiclavula</i> (1)
<i>Hydnaceae</i>	<i>Hydnum</i> (2), <i>Sistotrema</i> (1)
<b>Corticiales</b>	
<i>Corticaceae</i>	<i>Corticium</i> (1), <i>Cytidia</i> (1)
<b>Dacrymycetales</b>	
<i>Dacrymycetaceae</i>	<i>Calocera</i> (1)
<b>Gloeophyllales</b>	
<i>Gloeophyllaceae</i>	<i>Gloeophyllum</i> (2), <i>Veluticeps</i> (1)
<b>Gomphales</b>	
<i>Clavariadelphaceae</i>	<i>Clavariadelphus</i> (2)
<i>Gomphaceae</i>	<i>Ramaria</i> (3)
<i>Lentariaceae</i>	<i>Kavinia</i> (1), <i>Lentaria</i> (1)
<b>Hymenochaetales</b>	
<i>Hymenochaetaceae</i>	<i>Asterodon</i> (1), <i>Coltricia</i> (1), <i>Hymenochaete</i> (1), <i>Inonotus</i> (3), <i>Onnia</i> (1), <i>Phellinus</i> (14), <i>Pseudochaete</i> (1), <i>Tubulicrinis</i> (2)
<i>Repetobasidiaceae</i>	<i>Sidera</i> (1), <i>Resinicium</i> (2)

Schizoporaceae	Basidioradulum (1), Hyphodontia (12), Schizopora (1)
<b>Polyporales</b>	
Fomitopsidaceae	Amylocystis (1), Anomoporia (1), Antrodia (9), Climacocystis (1), Fomitopsis (2), Ischnoderma (1), Laetiporus (1), Phaeolus (1), Piptoporus (1), Postia (10), Pycnoporellus (2)
Ganodermataceae	Ganoderma (2)
Meripilaceae	Oxyporus (2), Physisporinus (1), Rigidoporus (1)
Meruliaceae	Bjerkandera (1), Crustoderma (2), Gloeoporus (3), Hyphoderma (1), Junghuhnia (4), Merulius (1), Mycoacia (2), Phlebia (6), Radulodon (1), Steccherinum (2)
Phanerochaetaceae	Antrodiella (4), Ceriporia (2), Ceriporiopsis (2), Phanerochaete (4), Phlebiopsis (1)
Polyporaceae	Aurantiporus (1), Cerrena (1), Daedaleopsis (3), Datronia (1), Dichomitus (1), Diplomitoporus (2), Fomes (1), Hapalopilus (1), Haploporus (1), Lenzites (1), Leptoporus (1), Perenniporia (1), Piloporia (1), Polyporus (5), Pycnoporus (1), Rhodonia (1), Skeletocutis (7), Trametes (5), Trichaptum (4)
Xenasmataceae	Phlebiella (1)
<b>Russulales</b>	
Albatrellaceae	Albatrellus (2)
Amylostereaceae	Amylostereum (1)
Auriscalpiaceae	Auriscalpium (1), Clavicornia (1)
Bondarzewiaceae	Gloiodon (1), Heterobasidion (1)
Hericiaceae	Hericium (2), Laxitextum (1)
Lachnocladiaceae	Dichostereum (1), Scytinostroma (2)
Peniophoraceae	Peniophora (2)
Stereaceae	Chaetoderma (1) Gloiothele (1) Stereum (4)
<b>Thelephorales</b>	
Bankeraceae	Bankera (1), Boletopsis (1), Hydnellum (3), Phellodon (2), Sarcodon (3)
Thelephoraceae	Thelephora (1), Tomentella (6)
<b>Trechisporales</b>	
Hydnodontaceae	Trechispora (2)

## APPENDIX

### List of fungi recorded from Zaonezhye Peninsula, Syar-Peninsula and adjacent islands

NOTES: Each species is provided by an estimation of frequency in Zaonezhye according to the following scale:

*rr* (very rare), *r* (rare), *str* (fairly rare), *p* (here and there), *stfq* (fairly frequent), *fq* (frequent and very frequent).

Species status: \* - Indicator species of old-growth and deciduous forests (Kotiranta & Niemelä 1996);

\*\* - Specialist and indicator species of minimally transformed forest (Andersson et al. 2009).

Threat status: EN, NT, VU, DD – species included in the Red Data Book of Karelia, **Kar** (Ivanter & Kuznetsov 2007) and in the 2010 Red list of Finnish species, Fin (Rassi et al. 2010);

2, 3, 4 - Species included in the Red Data Book of nature of Leningrad Region, **Len** (Red Data Book...2000).

ABBREVIATIONS: Bol. Klim. Isl. – Bolshoi Klimenty Island, comp. – forest compartment (kvartal or quartal in Russian).

\*\* *Albatrellus confluens* (Alb. et Schwein. : Fr.) Kotl. et Pouzar – Syar peninsula, comp. 180, 182, north of Tambitsy, environs of Tolsty Navolok, comp. 71, pine and spruce forest, on litter, 22.08.2013, 26.08.2013, A.V. Ruokolainen; 18–19.08.2013, O. Manninen; *str*. *A. ovinus* (Schaeff.) Kotl. et Pouzar – Ruokolainen 2013 c; Lipovitsy, comp. 41, Lake Korbozero, Tipinitsy, spruce-dominated and mixed forest, on litter, 23.08.2013, 27.08.2013, A.V. Ruokolainen; *str*.

*Amphynema byssoides* (Pers. : Fr.) J. Erikss. – Ruokolainen 2013 c; pine forest, comp. 13, on fallen spruce, 22.08.2013; *p*.

*Amylocorticium suaveolens* Parmasto – Ruokolainen 2013 a, c; Velikaya Niva, motley grass spruce forest, on fallen spruce, 23.08.2012, A.V. Ruokolainen, PTZ; Tambitsy, *Myrtilus* spruce forest, on fallen spruce, 28.08.2013, A.V. Ruokolainen, PTZ; *str*.

*A. subincarnatum* (Peck) Pouzar – Ruokolainen 2013 c; spruce forest, on fallen spruce. Threat status: Fin – VU; *str*.

\*, \*\* *Amylocystis lapponica* (Romell) Singer – Ruokolainen 2013 a, c; Lipovitsy; Lake Korbozero, Tipinitsy, north of Tambitsy, environs of Tolsty Navolok, comp. 71, *Myrtilus* spruce forest, on fallen spruce, 21.08.2013, 26.08.2013, 27.08.2013, A.V. Ruokolainen; Syar peninsula, comp. 152–153, 174–176, 180–181, 16–17.08.2013, 19.08.2013, O. Manninen; *str*. Threat status: Fin – NT.

*Amylostereum chailletii* (Pers.) Boidin – Ruokolainen 2013 a; Lipovitsy, comp. 41, *Myrtilus* spruce forest, on fallen spruce, 23.08.2013, A.V. Ruokolainen, PTZ; *str*.

\*, \*\* *Anomoporia kamtschatica* (Parmasto) Bondartseva – old-growth pine-dominated forest, on dead pine, 27.06.2013 and 22.08.2013, O. Manninen; *rr*.

\*, \*\* *Antrodia albobrunnea* (Romell) Ryvarden – Syar peninsula, comp. 153, 182, 183, old-growth pine-dominated forest, on dead pine, 17.08.2013 and 18.08.2013, O. Manninen; *stp*. Threat status: Fin – NT.

\* *A. crassa* (P. Karst.) Ryvarden – Documentation ... 2013; Syar peninsula, comp. 187, old-growth pine-dominated forest, 19.08.2013, O. Manninen; *r*. Threat status: Kar – 2 (EN), Len – 2, Fin – EN.

*A. heteromorpha* (Fr. : Fr.) Donk – Syar peninsula, comp. 180, on aspen, 19.08.2013, O. Manninen; *r*.

\* *A. infirma* Rennvall et Niemelä – Syar peninsula, comp. 180, 183, 18–19.08.2013; 24.08.2013, O. Manninen; *r*. Threat status: Fin – VU.

\*, \*\* *A. pulvinascens* (Pilát) Niemelä – Documentation ... 2013; Syar peninsula, comp. 181, 19.08.2013, 24.08.2013, O. Manninen; r. Threat status: Kar – 3 (VU), Fin – VU.

*A. serialis* (Fr.) Donk – Bondartseva et al. 1999; Ruokolainen 2013 c; southern part on Bol. Klim. Isl., spruce forest, on fallen spruce, 03.07.1997, A.V. Ruokolainen, PTZ; fq.

*A. sinuosa* (Fr.) P. Karst. – Bondartseva et al. 1999; Ruokolainen 2013 c; southern part on Bol. Klim. Isl., spruce forest on fallen pine, 06.07.1997, A.V. Ruokolainen, PTZ; fq.

*A. sitchensis* (D.V. Baxter) Gilb. et Ryvarden – 24.08.2013, O. Manninen; r. Threat status: Fin – EN.

*A. xantha* (Fr. : Fr.) Ryvarden – Bondartseva et al. 1999; Ruokolainen 2013 c; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest, on fallen spruce, 06.07.1997, A.V. Ruokolainen, PTZ; fq.

\*, \*\* *Antrodiella citrinella* Niemelä et Ryvarden – Documentation ... 2013; rr. Threat status: Kar – 3 (VU), Fin – NT.

*A. hoehnelii* (Bres.) Niemelä – mixed forest on deadwood of deciduous trees, 23.08.2013, O. Manninen; rr. Threat status: Len – 3.

*A. pallasii* Renvall, Johann. et Stenlid – Tambitsy, *Myrtillus* spruce forest, on fallen spruce, 27.08.2013, A.V. Ruokolainen, PTZ; r.

*A. pallescens* (Pilát) Niemelä et Miettinen – Ruokolainen 2013 c; Zharnikovo, mixed forest on fallen *Sorbus aucuparia*, 01.08.2012, A.V. Ruokolainen, PTZ; p.

\*, \*\* *Asterodon ferruginosus* Pat. – Ruokolainen 2013 c; Syar peninsula, comp. 178, 186, 18- 19.08.2013, O. Manninen; Lipovitsy, comp. 41, north of Tambitsy, environs of Tolsty Navolok, comp. 71, 23.08.2013, 26.08.2013, 28.08.2013, spruce forest on fallen aspen, pine and spruce, A.V. Ruokolainen; pine forest, comp. 13, on fallen pine, 22.08.2013, A.V. Ruokolainen, PTZ; stp.

\*\* *Aurantiporus fissilis* (Berk et M.A. Curtis) H. Jahn [= *Tyromyces fissilis* (Berk et M.A. Curtis) Donk] – Documentation ... 2013; on deciduous trees, 24.08.2013, O. Manninen; rr. Threat status: Kar – 3 (VU), Len – 3, Fin – NT.

*Auriscalpium vulgare* Gray – near the road, 28.06.2013, O. Manninen; r.

\*\* *Bankera fuligineoalba* (J.C. Schmidt) Coker et Beers ex Pouzar – Syar peninsula, comp. 185, pine forest, on litter, 19.08.2013, O. Manninen; r.

*Basidioradulum radula* (Fr.) Nobles – Ruokolainen 2013 c; Zharnikovo, mixed forest on deadwood of *Sorbus aucuparia*, 01.08.2012, A.V. Ruokolainen; Palozero, mixed forest, on deadwood of deciduous trees, 23.08.2012, A.V. Ruokolainen; p.

*Bjerkandera adusta* (Willd.: Fr.) P. Karst. – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Kizhi Isl., H; Kizhi Isl., on deadwood of *Sorbus aucuparia*, 16.07.1998, V.I. Krutov, PTZ; Tipinitsy, spruce forest, on aspen, 27.08.2013; Tambitsy, spruce forest, on aspen, 28.08.2013, A.V. Ruokolainen; stfq.

\*\* *Boletopsis grisea* (Peck) Bondartsev et Singer – Ruokolainen 2013 a; south of the village of Lambasruchei, pine forest, on litter, 23.08.2012, A.V. Ruokolainen; r. Threat status: Fin – NT.

*Botryobasidium laeve* (J. Erikss.) Parmasto – Ruokolainen 2013 c; north of Podyelniki, spruce forest, on fallen spruce; p.

*B. subcoronatum* (Höhn. et Litsch.) Donk – Ruokolainen 2013 c; north of Podyelniki, spruce forest, on fallen spruce; stp.

*B. vagum* (Berk. et M.A. Curtis) D.P. Rogers – Bondartseva et al. 1999; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., on fallen spruce, 05.07.1997, A.V. Ruokolainen, PTZ; p.

*Botryohypochnus isabellinus* (Fr.) J. Erikss. – Ruokolainen 2013 c; Zharnikovo, mixed forest, on dead *Alnus incana*, 01.08.2012, A.V. Ruokolainen; p.

*Calocera viscosa* (Pers. : Fr.) Fr. – Ruokolainen 2013 c; environs of Velikaya Niva, mixed spruce-dominated forest, on litter, 23.08.2012, A.V. Ruokolainen; p.

*Cantharellus cibarius* Fr. – Ruokolainen 2013 c; south of the village of Lambasruchei, pine forest, on litter, 23.08.2012, A.V. Ruokolainen; common species, stfq.

*Ceraceomyces microsporus* K.H. Larss. – Ruokolainen 2013 c; pine forest, near the lake, comp. 13, on fallen pine, 22.08.2013, A.V. Ruokolainen, PTZ; p.

*C. serpens* (Tode : Fr.) Ginns – Ruokolainen 2013 c; Paltega, motley grass birch forest, on fallen birch, 06.08.2011, A.V. Ruokolainen, PTZ; p.

*Ceriporia excelsa* S. Lundell ex Parmasto – Ruokolainen 2013 a, b, c; Kizhi Isl., on fallen *Sorbus aucuparia*, 04.08.2012, A.V. Ruokolainen, PTZ; rr. Threat status: Fin – NT.

*C. viridans* (Berk. et Broome) Donk – Ruokolainen 2013 a; northeast of Velikaya Guba, on fallen *Alnus incana*, 17.08.2010, A.V. Ruokolainen, PTZ; rr.

*Ceriporiopsis aneirina* (Sommerf. : Fr.) Domański – on dead aspen, 26.06.2013, O. Manninen; rr. Threat status: Len – 3.

*C. resinascens* (Romell) Domański – Ruokolainen 2013 c; Polyá, mixed forest, on fallen aspen, 25.08.2013, A.V. Ruokolainen, PTZ; 27–28.08.2013, O. Manninen; r. Threat status: Len – 3.

*Cerrena unicolor* (Bull.) Murrill – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest, on fallen birch, 06.07.1997, A.V. Ruokolainen; Zharnikovo, mixed forest, on deadwood of *Salix caprea*, 01.08.2012, A.V. Ruokolainen, stfq.

\*, \*\* *Chaetoderma luna* (Romell ex Rogers et H.S. Jacks.) Parmasto – Ruokolainen 2013 c; environs of Velikaya Niva, pine forest, on dead pine, 17.08.2010; A.V. Ruokolainen; Syar peninsula, comp. 180, 183, pine forest, on dead pine, 18–19.08.2013, O. Manninen; r.

*Chondrostereum purpureum* (Pers. : Fr.) Pouzar – Bondartseva et al. 1999; Kizhi Isl., on deadwood of alder, 16.07.1998, V.I. Krutov, PTZ; north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest, on fallen birch, 26.08.2013, A.V. Ruokolainen; p.

*Clavariadelphus ligula* (Schaeff. : Fr.) Donk – Ruokolainen 2013 c; south of the village of Lambas Ruchei, pine forest, on litter, 23.08.2012, A.V. Ruokolainen; r.

\*\* *C. pistillaris* (L. : Fr.) Donk – Documentation ... 2013; on litter, 23.08.2013 and 26.08.2013, O. Manninen; r. Threat status: Kar – 3 (VU), Len – 3.

*Clavicornia pyxidata* (Pers.) Doty – Bondartseva et al. 1999; Ruokolainen 2013 c; Korbozero, Tipinitsy, Lipovitsy, comp. 41, north of Tambitsy, environs of Tolsty Navolok, comp. 71, mixed spruce-dominated forest, on fallen aspen, 23.08.2013, 26–27.08.2013, A.V. Ruokolainen; Syar peninsula, comp. 178, 186, 16.08.2013, 18–19.08.2013, O. Manninen; p.

*Clavulina cinerea* (Bull. : Fr.) J. Schröt. – Ruokolainen 2013 a; Podyelniki, ecological trail, on litter, 03.08.2012, A.V. Ruokolainen, PTZ; Kizhi Isl., on litter, 04.08.2012, A.V. Ruokolainen, PTZ; r.

\*\* *Climacocystis borealis* (Fr.) Kotl. et Pouzar – Ruokolainen 2013 a, c; Lipovitsy, comp. 41, north of Tambitsy, environs of Tolsty Navolok, comp. 71, Tipinitsy, mixed herb-rich and spruce forest, on dead spruce, 23.08.2013, 26–27.08.2013, A.V. Ruokolainen; Syar peninsula, comp. 153, 178, 181, 16.08.2013, 17–19.08.2013, O. Manninen; stfq.

*Coltricia perennis* (L. : Fr.) Murrill – Ruokolainen 2013 c; near Lake Nizhnee Pigmosero, on dead *Salix*, 22.08.2012, A.V. Ruokolainen; pine forest, comp. 13, on litter, 22.08.2013, A.V. Ruokolainen; p.

*Coniophora arida* (Fr.) P. Karst. – Bondartseva et al. 1999; Ruokolainen 2013 c; fq.

*C. olivacea* (Pers. : Fr.) P. Karst. – Ruokolainen 2013 c; Ruokolainen 2013 c; fq.

*Corticium roseum* Pers. : Fr. – Ruokolainen 2013 c; north of Tambitsy, environs of Tolsty Navolok, comp. 71, Korbozero, Tipinitsy, spruce and mixed forest, on fallen aspen, A.V. Ruokolainen; p.

*Craterellus cornucopioides* (L. : Fr.) Pers. – Ruokolainen 2013 c; environs of Velikaya Niva, spruce forest, on deadwood of *Salix*, 23.08.2012, A.V. Ruokolainen; Lipovitsy, comp. 41, Tambitsy, spruce forest on litter, 23.08.2013, 28.08.2013, A.V. Ruokolainen; stp. Threat status: Kar – 3 (NT).

*C. tubaeformis* (Fr.) Quél. – Lipovitsy, spruce forest, on litter, stp.



\*, \*\* *Crustoderma corneum* (Bourdot et Galzin) Nakasone – Syar peninsula, comp. 180, 182–183, on fallen pine, 18–19.08.2013; 22.08.2013, O. Manninen; r. Threat status: Fin – NT.

\*, \*\* *C. dryinum* (Berk. et M.A. Curtis) Parmasto – Ruokolainen 2013 c; north of Podyelniki, spruce forest, on fallen spruce, 10.08.2010, A.V. Ruokolainen; Lipovitsy, *Myrtillus* spruce forest, on fallen spruce, 21.08.2013, A.V. Ruokolainen, PTZ; north of Tambitsy, environs of Tolsty Navolok, comp. 71, 26.08.2013, A.V. Ruokolainen; Syar peninsula, comp. 154, 17.08.2013, O. Manninen; stp. Threat status: Fin – NT.

*Cytidia salicina* (Fr.) Burt – Ruokolainen 2013 c; near Lake Nizhnee Pigmosero, on deadwood of *Salix*, 22.08.2012, A.V. Ruokolainen; stp.

*Daedaleopsis confragosa* (Bolton) Schröt. – Bondartseva et al. 1999; Ruokolainen 2013 c; Kizhi Isl., on deadwood of *Sorbus aucuparia*, 16.07.1998, V.I. Krutov, PTZ; Bol. Klim. Isl., LE; like Kopanez, on birch, 15.07.1999, A.V. Polevoi, PTZ; Zharnikovo, mixed and birch forest on fallen *Alnus incana* and *Salix*, A.V. Ruokolainen; p.

*D. septentrionalis* (P. Karst.) Niemelä – Ruokolainen 2013 c; environs of Velikaya Niva, pine forest, on dead birch, 23.08.2012; stp.

*D. tricolor* (Bull. : Fr.) Bondartsev et Singer – Bondartseva et al. 1999; Kizhi Isl., LE; like Kopanez, on dead birch, 15.07.1999, A.V. Polevoi, PTZ; stp.

*Datronia mollis* (Sommerf.) Donk – Bondartseva et al. 1999; Ruokolainen 2013 c; north of Tambitsy, environs of Tolsty Navolok, comp. 71, Tambitsy, Kaskoselga, south of Uzkaya Salma, mixed forest, on birch and aspen, 11.08.2010, 13.08.2010, 26.08.2013, 28.08.2013, A.V. Ruokolainen; p.

\* *Dichomitus squalens* (P. Karst.) D.A. Reid – Ruokolainen 2013 c; pine-dominated forest, on fallen spruce, 17.08.2010, A.V. Ruokolainen; r. Threat status: Kar – 3 (NT), Fin – VU.

*Dichostereum boreale* (Pouzar) Ginns et M.N.L. Lefebvre – Ruokolainen 2013 c; north of Podyelniki, spruce forest, on fallen spruce, 10.08.2010, A.V. Ruokolainen; stp.

\*, \*\* *Diplomitoporus crustulinus* (Bres.) Domański – Ruokolainen 2013 a, c; south of the village of Uzkaya Salma, moist spruce forest, on fallen spruce, 13.08.2010, A.V. Ruokolainen, PTZ; rr. Threat status: Fin – VU.

*D. flavescens* (Bres.) Ryvarden – Ruokolainen 2013 a; Velikaya Guba, pine forest, on pine, 17.08.2010, A.V. Ruokolainen, PTZ; Ladmozero, old-growth pine forest, on dead pine, 24.08.2012, A.V. Ruokolainen; Syar peninsula, comp. 174, 177, 180, old-growth pine forest, on dead pine, 17–19.08.2013, O. Manninen; stp. Threat status: Fin – NT.

*Elmerina caryae* (Schwein) D.A. Rein [= *Protomerulius caryae* (Schwein) Ryvarden] – Bondartseva et al. 2000; Documentation ... 2013; Syar peninsula, comp. 180, 19.08.2013, O. Manninen; rr. Threat status: Kar – 3 (VU), Len – 3, Fin – NT.

*Fomes fomentarius* (L.) Fr. – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Bol. Klim. Isl., LE; mixed spruce-dominated forest, on dead birch, fq.

*Fomitopsis pinicola* (Sw. : Fr.) P. Karst. – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Bol. Klim. Isl., LE; mixed spruce-dominated forest on deadwood of birch, fq.

\*, \*\* *F. rosea* (Alb. et Schwein. : Fr.) P. Karst. – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Bol. Klim. Isl., LE; Lipovitsy, comp. 41, Podyelniki, north of Tambitsy, environs of Tolsty Navolok, comp. 71, Tipinitsy, south of the village of Uzkaya Salma et al., spruce forest on deadwood of spruce, A.V. Ruokolainen; Syar peninsula, comp. 133, 151–154, 174–177, 180–183, 186, 17–19.08.2013, O. Manninen; p. Threat status: Fin – NT.

*Ganoderma applanatum* (Pers.) Pat. – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Kizhi Isl., H; Bol. Klim. Isl., LE; Zharnikovo, mixed forest, on deadwood of *Sorbus aucuparia* and *Salix caprea*, 01.08.2012, A.V. Ruokolainen; Lipovitsy, comp. 41, spruce forest on fallen aspen, 23.08.2013, A.V. Ruokolainen; p.

\*\* *G. lucidum* (M. A. Curtis : Fr.) P. Karst. – Documentation ... 2013; Lake Korbozero, Tipinitsy, mixed forest on old birch, 27.08.2013, A.V. Ruokolainen, PTZ; rr. Threat status: RF – 3, Len – 3, Kar – 3 (VU).

*Gloeophyllum odoratum* (Wulfen : Fr.) Imazeki – Bondartseva et al. 1999; Ruokolainen 2013 c; Kizhi Isl., H; near Lake Nizhnee Pigmosero, on deadwood of pine, 22.08.2012, A.V. Ruokolainen; Tipinitsy, spruce forest, on deadwood of spruce, 27.08.2013, A.V. Ruokolainen; r.

*G. sepiarium* (Wulfen : Fr.) P. Karst. – Bondartseva et al. 1999; Bol. Klim. Isl., LE; near Lake Nizhnee Pigmosero, on deadwood of spruce, 22.08.2012, A.V. Ruokolainen; p.

*Gloeoporus dichrous* (Fr. : Fr.) Bres. – Bondartseva et al. 1999; Ruokolainen 2013 c; Kizhi Isl., LE; Zharnikovo, Tipinitsy, spruce and mixed forest, on birch, aspen and *Sorbus aucuparia*; p.

\*\* *G. pannocinctus* (Romell) J. Erikss. – Bondartseva et al. 1999; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest on fallen aspen, 06.07.1997, A.V. Ruokolainen, PTZ; north of Podyelniki, spruce forest on fallen aspen, 11.08.2010, A.V. Ruokolainen, PTZ; stp. Threat status: Len – 3.

\*, \*\* *G. taxicola* (Pers. : Fr.) Gilb. et Ryvarden – Ruokolainen 2013 b, c; Lipovitsy, comp. 43, south of Lipovitsy, comp. 63, *Myrtillus* spruce forest, on fallen spruce, 18.08.2010, A.V. Ruokolainen, PTZ; Zharnikovo, pine forest on fallen pine, 02.08.2012, A.V. Ruokolainen, PTZ; Podyelniki, pine forest on fallen pine, 03.08.2012, A.V. Ruokolainen; 22–24.08.2013, O. Manninen; stp. Threat status: Len – 3.

\*, \*\* *Gloiodon strigosus* (Schwein. : Fr.) P. Karst. – Documentation ... 2013; mixed forest, on deadwood of deciduous trees (aspen, *Salix caprea*), 23–24.08.2013, 28.08.2013, O. Manninen; r. Threat status: Kar – 3 (VU), Fin – NT.

*Gloeothele citrina* (Pers.) Ginns et G.W. Freeman – Ruokolainen 2013 c; Podyelniki, Zubovo, on fallen pine, 03.08.2012, A.V. Ruokolainen, PTZ; stp.

*Hapalopilus rutilans* (Pers.) P. Karst. – Ruokolainen 2013 c; like Kopanez, on dead birch, 15.07.1999, A.V. Polevoi, PTZ; Zharnikovo, mixed forest, on deadwood of birch, 01.08.2012, A.V. Ruokolainen; near Lake Nizhnee Pigmosero, on deadwood of birch, 22.08.2012, A.V. Ruokolainen; p.

\*\* *Haploporus odoratus* (Sommerf. : Fr.) Bondartsev et Singer – Documentation ... 2013; comp. 183, on old *Salix caprea*, 18.08.2013, O. Manninen; rr. Threat status: Kar – 3 (VU), Len – 3, Fin – NT.

*Hericium cirrhatum* (Pers.) Nikol. – Ruokolainen 2013 c; Zharnikovo, environs of Velikaya Niva, mixed and spruce-dominated forest, on *Salix caprea* and aspen, 05.08.2012, 23.08.2012, A.V. Ruokolainen; r. Threat status: Len – 3.

\*\* *H. coralloides* (Scop.) Pers. – Ruokolainen 2013 c; Bol. Klim. Isl., on deadwood of deciduous trees, 09.08.2010; north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest on birch and aspen, 26.08.2013, A.V. Ruokolainen; Syar peninsula, comp. 132, 180, 185, 16.08.2013, 19.08.2013, O. Manninen; stp. Threat status: Kar – 3 (NT).

*Heterobasidion parviporum* Niemelä et Korhonen – Bondartseva et al. 1999; Ruokolainen 2013 b; Bol. Klim. Isl., LE; Bol. Klim. Isl., spruce forest, on fallen spruce, 03.07.1997, A.V. Ruokolainen, PTZ; stp.

*Hydnellum aurantiacum* (Batsch) P. Karst. – Ruokolainen 2013 a, c; Ladmozero, south of the village of Lambasruchei, Vanchozero, pine forest on litter, 24–25.08.2012, A.V. Ruokolainen; stp.

*H. caeruleum* (Hornem.) P. Karst. – Ruokolainen 2013 c; Vanchozero, pine forest, on litter, 25.08.2012, A.V. Ruokolainen; Syar peninsula, comp. 185, 19.08.2013, O. Manninen; stp.

*H. ferrugineum* (Fr.) P. Karst. – Ruokolainen 2013 c; north of Podyelniki, south of the village of Lambasruchei, Vanchozero, pine forest on litter, 11.08.2010, 24–25.08.2012, A.V. Ruokolainen; Syar peninsula, comp. 154, 177, 180, 182, 185, 17–19.08.2013, O. Manninen; stp.

*Hydnum repandum* L. : Fr. – Ruokolainen 2013 c; environs of Velikaya Niva, spruce forest, on litter, 23.08.2012, A.V. Ruokolainen; stp.

*H. rufescens* Schaeff. : Fr. – Ruokolainen 2013 c; environs of Velikaya Niva, spruce forest, on litter, 23.08.2012, A.V. Ruokolainen; stp.

*Hymenochaete rubiginosa* (Fr.) Lév. – Bondartseva et al. 1999; Klimenetsky Isl., LE; southern part of Bol. Klim. Isl., 07.07.1997, A.V. Ruokolainen, PTZ; r.

*Hyphoderma setigerum* (Fr.) Donk – Bondartseva et al. 1999; Kizhi Isl., LE; Kizhi Isl., on *Sorbus aucuparia* and *Alnus incana*, 16.07.1998, V.I. Krutov, PTZ; r.

*Hyphodontia abieticola* (Bourdot et Galzin) J. Erikss. – Lake Korbozero, Tipinitsy, mixed forest on fallen pine, 27.08.2013, A.V. Ruokolainen, PTZ; stp.

*H. alienata* (S. Lundell) J. Erikss. – Ruokolainen 2013 c; Lipovitsy, spruce forest, on fallen spruce, 21.08.2013, A.V. Ruokolainen, PTZ; stp.

*H. alutacea* (Fr.) J. Erikss. – Ruokolainen 2013 c; north of Podyelniki, on fallen spruce, 11.08.2010, A.V. Ruokolainen; stp.

*H. alutaria* (Burt) J. Erikss. – Ruokolainen 2013 c; 1,5 km southwestern of Velikaya Guba, *Myrtillus* pine forest on fallen pine, 19.08.2010, A.V. Ruokolainen, PTZ; north of Podyelniki, on fallen spruce, 10.08.2010, A.V. Ruokolainen; stp.

*H. arguta* (Fr.) J. Erikss. – Ruokolainen 2013 c; Zharnikovo, mixed forest, on deadwood of *Salix caprea* and *Sorbus aucuparia*, 05.08.2012, A.V. Ruokolainen; stp.

*H. aspera* (Fr.) J. Erikss. – Ruokolainen 2013 c; north of Podyelniki, on fallen pine and spruce, 10–11.08.2010, A.V. Ruokolainen; p.

*H. barba-jovis* (Bull. : Fr.) J. Erikss. – Ruokolainen 2013 c; south of Tambitsy, birch forest with spruce on fallen birch, 04.08.2011, A.V. Ruokolainen, PTZ; p.

*H. breviseta* (P. Karst.) J. Erikss. – Ruokolainen 2013 c; Zharnikovo, pine forest, on fallen pine; p.

*H. crustosa* (Pers. : Fr.) J. Erikss. – Bondartseva et al. 1999; Kizhi Isl., on *Alnus incana*, LE; r.

*H. detritica* (Bourdot et Galzin) J. Erikss. – Polya, mixed forest on fallen aspen, 25.08.2013, A.V. Ruokolainen, PTZ; r.

*H. pruni* (Lasch) Svrček – Bondartseva et al. 1999; Kizhi Isl., on deadwood of *Ulmus*, LE; r.

*H. subalutacea* (P. Karst.) J. Erikss. – Bondartseva et al. 1999; Bol. Klim. Isl., LE; by the lake in pine forest, comp. 13, on fallen pine, 22.08.2013, A.V. Ruokolainen, PTZ; stp.

*Inonotus obliquus* (Pers. : Fr.) Pilát – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Kizhi Isl., on *Alnus incana*, 16.07.1998, S.N. Kiviniemi, V.I. Krutov, PTZ; stfq.

*I. radiatus* (Sowerby : Fr.) P. Karst. – Ruokolainen 2013 c; Lipovitsy, comp. 41, environs of Tolsty Navolok, comp. 71, on deadwood of *Alnus incana*, 23.08.2013, 26.08.2013, A.V. Ruokolainen; stp.

*I. rhaedes* (Pers.) Bondartsev et Singer – Bondartseva et al. 1999; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest, on fallen aspen, 06.07.1997, A.V. Ruokolainen, PTZ; north of Podyelniki, mixed forest on deadwood of aspen, 03.08.2012, A.V. Ruokolainen; Syar peninsula, comp. 174, 176, 17.08.2013, O. Manninen; stp.

*Ischnoderma bensoinum* (Wahlenb. : Fr.) P. Karst. – Ruokolainen 2013 c; north of Podyelniki, environs of Tolsty Navolok, comp. 71, Lake Korbozero, Tipinitsy, Polya, comp. 82–83, spruce forest, on deadwood of spruce, 11.08.2010, 05.08.2011, 26–27.08.2013, A.V. Ruokolainen; stp.

\*, \*\* *Junghuhnia collabens* (Fr.) Ryvarde – Bondartseva et al. 1999; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest, on fallen spruce, 05.07.1997, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 180, 183, 18–19.08.2013, O. Manninen; r. Threat status: Kar – 3 (VU), Len – 3, Fin – NT.

\* *J. luteoalba* (P. Karst.) Ryvarde – Ruokolainen 2013 c; Velikaya Guba, *Myrtillus* pine forest on fallen pine, 08.08.2011, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 154, 17.08.2013, O. Manninen; r.

*J. nitida* (Pers. : Fr.) Ryvarden – on deadwood of deciduous trees, 24.08.2013, O. Manninen; rr.

\*\* *J. pseudozilingiana* (Parmasto) Ryvarden – Ruokolainen 2013 c; Bolshoi Lelikovskiy Isl., pine forest with spruce on old birch, 09.08.2010, A.V. Ruokolainen, PTZ; Lipovitsy, spruce forest on deadwood of aspen, 21.08.2013, A.V. Ruokolainen, PTZ; Tambitsy, spruce forest with aspen, on fallen aspen, 28.08.2013, A.V. Ruokolainen, PTZ; stp. Threat status: Kar – 4 (DD), Len – 4, Fin – VU.

\*\* *Kavinia alboviridis* (Mordan) Gilb. et Budington – Documentation ... 2013; Syar peninsula, comp. 134, south of Tambitsy, spruce forest on deadwood, 28.08.2013, O. Manninen; rr. Threat status: Kar – 4 (DD).

*Laetiporus sulphureus* (Bull. : Fr.) Murrill - Lipovitsy, comp. 41, spruce forest on deadwood of aspen, 23.08.2013, A.V. Ruokolainen; rr.

*Laxitextum bicolor* (Pers.) Lentz – Ruokolainen 2013 c; near Lake Nizhnee Pigmosero, on *Alnus incana*, 22.08.2012, A.V. Ruokolainen; stp.

*Lentaria byssiseda* (Pers. : Fr.) Corner – Polya, mixed forest on *Salix*, 25.08.2013, A.V. Ruokolainen, PTZ; rr.

*Lenzites betulina* (L.) Fr. – Bondartseva et al. 1999; Ruokolainen 2013 c; Kizhi Isl., on deadwood of *Sorbus aucuparia*, LE; stp.

\*, \*\* *Leptoporus mollis* (Pers.) Quél. – Ruokolainen 2013 c; south of Tambitsy, birch forest with spruce on fallen spruce, 04.08.2011, A.V. Ruokolainen, PTZ; Lipovitsy, comp. 41, spruce forest on on deadwood of spruce, 23.08.2013, A.V. Ruokolainen; Syar peninsula, comp. 133, 178, on deadwood of spruce. 16.08.2013, 18.08.2013, O. Manninen; stp. Threat status: Kar – 3 (NT), Len – 3.

*Merulius tremellosus* Schrad. : Fr. – Ruokolainen 2013 c; Zharnikovo, mixed forest, on deadwood of aspen, 05.08.2012, A.V. Ruokolainen; Lipovitsy, spruce forest on fallen aspen, 21.08.2013, A.V. Ruokolainen; Lake Korbozero, Tipinitsy, spruce forest, on deadwood of aspen, 27.08.2013, A.V. Ruokolainen; p.

\*\* *Multiclavula mucida* (Pers. : Fr.) R.H. Petersen – northwest of the Vatnavolok village, Syar peninsula, comp. 174, on deadwood of aspen, 17.08.2013, O. Manninen; 24.08.2013, O. Manninen; north of Tambitsy, environs of Tolsty Navolok, comp. 71, mixed forest, on deadwood of aspen, 26.08.2013, A.V. Ruokolainen; stp.

*Mycoacia fuscoatra* (Fr. : Fr.) Donk – Lipovitsy, comp. 41, spruce forest on deadwood of aspen, 23.08.2013; stp. Threat status: Len – 3.

*M. uda* (Fr.) Donk – Ruokolainen 2013 c; south of the village of Lambasruchei, Lake Onega shore, pine forest on fallen aspen, 24.08.2012, A.V. Ruokolainen, PTZ; stp.

*Odonticium romellii* (S. Lundell) Parmasto – northwest of the Vatnavolok village, Syar peninsula, comp. 154, 180, 185, on deadwood of pine, 17.08.2013, 19.08.2013; 22.08.2013, 27.08.2013, O. Manninen; r. Threat status: Fin – NT.

\*, \*\* *Onnia leporina* (Fr.) H. Jahn – Ruokolainen 2013 c; Syar peninsula, comp. 154, 176, on deadwood of spruce, 17.08.2013, O. Manninen; north of Tambitsy, environs of Tolsty Navolok, Tambitsy, Lake Korbozero, Tipinitsy, comp. 71, 132, 177, 193, mixed herb-rich and spruce forest on old deadwood spruce, 26–28.08.2013, A.V. Ruokolainen; stp.

*Oxyporus corticola* (Fr.) Ryvarden – Bondartseva et al. 1999; southern part on Bol. Klim. Isl., spruce forest on fallen aspen, 04.07.1997, A.V. Ruokolainen, PTZ; Zharnikovo, mixed forest on fallen of *Sorbus aucuparia*, A.V. Ruokolainen; Syar peninsula, comp. 153, 180, 17.08.2013, 19.08.2013, O. Manninen; p.

*O. populinus* (Schumach. : Fr.) Donk – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Kizhi Isl., H; Zharnikovo, mixed forest on *Salix*, A.V. Ruokolainen; Tambitsy, spruce forest on deadwood of aspen, 28.08.2013, A.V. Ruokolainen; p.

*Peniophora incarnata* (Pers.) P. Karst. – Ruokolainen 2013 c; south of the village of Uz-kaya Salma, moist spruce forest on fallen aspen, 13.08.2010, A.V. Ruokolainen, PTZ; p.

*P. rufa* (Pers. : Fr.) M.P. Christ. – Bondartseva et al. 1999; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest on fallen aspen, 06.07.1997, A.V. Ruokolainen, PTZ; r.  
 \*, \*\* *Perenniporia subacida* (Peck) Donk – Bondartseva et al. 1999; Ruokolainen 2013 c; Bol. Klim. Isl., LE; Polya, *Myrtillus* spruce forest, on fallen spruce, 25.08.2013, A.V. Ruokolainen, PTZ; r. Threat status: Fin – NT.  
 \*, \*\* *Phaeolus schweinitzii* (Fr.) Pat. – northwest of the Vatnavolok village, Syar peninsula, comp. 154, 184, in old-growth forest on the roors of pine, 17.08.2013, 19.08.2013, O. Manninen; r.  
*Phanerochaete laevis* (Fr.) J. Erikss. et Ryvarden – Ruokolainen 2013 c; environs of Velikaya Niva, spruce forest on deadwood of aspen, 23.08.2012, A.V. Ruokolainen; p.  
*Ph. sanguinea* (Fr.) Pouzar – Ruokolainen 2013 c; south of the village of Uzkaya Salma, north of Podyelniki, spruce forest on fallen pine and spruce, 11.08.2010, 13.08.2010, A.V. Ruokolainen; Tambitsy, spruce forest on deadwood of birch, 28.08.2013, A.V. Ruokolainen; p.  
*Ph. sordida* (P. Karst.) J. Erikss. et Ryvarden – Ruokolainen 2013 c; Zharnikovo, mixed forest, on *Alnus incana*, 05.08.2012; p.  
*Ph. velutina* (DC. : Fr.) P. Karst. – Tambitsy, *Myrtillus* spruce forest, on fallen spruce, 28.08.2013, A.V. Ruokolainen, PTZ; stp.  
*Phellinus alni* (Bondartsev) Parmasto – Bondartseva et al. 1999; Ruokolainen 2013 c; Kizhi Isl., Zharnikovo, pine and mixed forest, on *Alnus incana*, A.V. Ruokolainen; p.  
 \*, \*\* *Ph. chrysoloma* (Fr.) Donk – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest, on fallen spruce, 03.07.1997, A.V. Ruokolainen, PTZ; north of Podyelniki, 03.08.2012, A.V. Ruokolainen; Lipovitsy, Polya, north of Tambitsy, environs of Tolsty Navolok, Tambitsy, Lake Korbozero, Tipinitsy, comp. 41, 71, 84, 177, 193 et al., spruce forest on old deadwood spruce, 23–24.08.2013, 26–27.08.2013, A.V. Ruokolainen; Syar peninsula, comp. 151–154, 177–178, 180–181, 183, 16–19.08.2013, O. Manninen; p.  
*Ph. conchatus* (Pers. : Fr.) Quél. – Ruokolainen 2013 b, c; like Kopanez, on deadwood of deciduous trees, 13.07.1999, A.V. Polevoi, PTZ; Lake Korbozero, Tipinitsy, environs of Velikaya Niva, Zharnikovo, north of Podyelniki, Polya, spruce and mixed forest on deadwood of *Salix caprea*, 23.08.2012, A.V. Ruokolainen; p.  
 \*, \*\* *Ph. ferrugineofuscus* (P. Karst.) Bourdot – Bondartseva et al. 1999; Ruokolainen 2013 a, c; Bol. Klim. Isl., LE; environs of Velikaya Niva, spruce forest on deadwood of spruce, 23.08.2012, A.V. Ruokolainen; Syar peninsula, comp. 153–154, 174–178, 180, 181, 183, 186, 17–19.08.2013, O. Manninen; Lipovitsy, Polya, Lake Korbozero, north of Podyelniki, Tambitsy, Tipinitsy, comp. 41, 84, 177, 132, et al., A.V. Ruokolainen; p.  
*Ph. igniarius* (L. : Fr.) Quél. – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Kizhi Isl., on deadwood of *Salix caprea*, 16.07.1998, V.I. Krutov, PTZ; Kizhi Isl., LE; southern part on Bol. Klim. Isl., LE; Zharnikovo, A.V. Ruokolainen; p.  
*Ph. laevigatus* (P. Karst.) Bourdot et Galzin – Ruokolainen 2013 c; Bolshoi Lelikovskiy Isl., pine forest with spruce on old deadwood birch, 09.08.2010, north of Podyelniki, south of the village of Uzkaya Salma, 10–11.08.2010, 13.08.2010, A.V. Ruokolainen; Syar peninsula, comp. 153, 17.08.2013, O. Manninen; stp.  
 \* *Ph. lundelii* Niemelä – Bondartseva et al. 1999; Ruokolainen 2013 c; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest on deadwood of birch, 07.07.1997, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 132, 176, 16–17.08.2013, O. Manninen; Lipovitsy, north of Tambitsy, environs of Tolsty Navolok, Tambitsy, A.V. Ruokolainen; stp.  
*Ph. nigricans* (Fr.) P. Karst. – Bondartseva et al. 1999 (*Ph. igniarius*); Ruokolainen 2013 b, c; Bolshoi Lelikovskiy Isl., southern part on Bol. Klim. Isl., Zharnikovo, Polya, Tambitsy, mixed spruce-dominated forest on dead birch; fq.  
 \*, \*\* *Ph. nigrolimitatus* (Romell) Bourdot et Galzin – Ruokolainen 2013 a, c; north of Podyelniki, Lipovitsy, spruce forest on dead spruce, 11.08.2010, 05–06.08.2011, 23.08.2013,

A.V. Ruokolainen; Syar peninsula, comp. 174, 176, 186, 17.08.2013, 19.08.2013, O. Manninen; stp.

\*, \*\* *Ph. pini* (Brot. : Fr.) A. Ames – Ruokolainen 2013 a, c; south of the village of Lambasruchi, old-growth pine forest, on old pine, 24.08.2012, 22.08.2013, 27.08.2013, A.V. Ruokolainen; Syar peninsula, comp. 134, 152–154, 174–178, 180–184, 186, 16–19.08.2013, O. Manninen; p.

\*\* *Ph. populicola* Niemelä – Ruokolainen 2013 a, c; south of the village of Lambasruchi, Lake Onega shore, Lipovitsy, Tipinitsy, mixed forest on dead of aspen, 24.08.2012, 23–25.08.2013, A.V. Ruokolainen; Syar peninsula, comp. 133–134, 153–154, 174–175, 177, 180, 182–183, 17–19.08.2013, O. Manninen; stp.

*Ph. punctatus* (P. Karst.) Pilát – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Kizhi Isl., on deadwood of *Salix caprea*, 16.07.1998, V.I. Krutov, PTZ; Zharnikovo, Poly, on *Alnus incana* and *Sorbus aucuparia*, 01.08.2012, 24.08.2013, A.V. Ruokolainen; p.

*Ph. tremulae* (Bondartsev) Bondartsev et P.N. Borisov – Bondartseva et al. 1999, Ruokolainen 2013 a, b, c; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest on dead aspen, 09.07.1997, A.V. Ruokolainen, PTZ; Poly, Zharnikovo, spruce-dominated forest on dead aspen, A.V. Ruokolainen, fq.

\*, \*\* *Ph. viticola* (Schwein. ex Fr.) Donk – Ruokolainen 2013 a, c; Syar peninsula, on deadwood of conifers, comp. 153–154, 176–178, 183, 17–18.08.2013, O. Manninen; environs of Velikaya Niva, spruce forest on dead spruce, 23.08.2012, A.V. Ruokolainen; Lipovitsy, Poly, north of Tambitsy, environs of Tolsty Navolok, Tambitsy, Tipinitsy, comp. 41, 71, 84 et al., A.V. Ruokolainen; stp.

\*\* *Phellodon niger* (Fr. : Fr.) P. Karst. – Syar peninsula, on litter, 18.08.2013, O. Manninen; pine forest, comp. 13, on litter, 22.08.2013, A.V. Ruokolainen, PTZ; r.

*Ph. tomentosus* (L.) Banker – Ruokolainen 2013 c; Syar peninsula, on litter, 19.08.2013, O. Manninen; Ladmozero, Vanchozero, pine forest, on litter, 24–25.08.2012, A.V. Ruokolainen; pine forest, comp. 13, on litter, 22.08.2013, A.V. Ruokolainen; stp.

\*, \*\* *Phlebia centrifuga* P. Karst. – Bondartseva et al. 1999; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest on fallen pine, 07.07.1997, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 177–178, 180, 183, 186, on spruce, 19.08.2013, O. Manninen; Tambitsy, *Myrtilus* spruce forest, on fallen spruce, 28.08.2013, A.V. Ruokolainen, PTZ; stp. Threat status: Fin – NT.

*Ph. livida* (Pers. : Fr.) Bres. – Ruokolainen 2013 c; north of Podyelniki, pine forest, on fallen pine, 10.08.2010, A.V. Ruokolainen, PTZ; r.

*Ph. radiata* Fr. – Ruokolainen 2013 c; Zharnikovo, mixed forest, on fallen *Salix*, A.V. Ruokolainen; stp.

*Ph. rufa* (Pers. : Fr.) M.P. Christ. – Ruokolainen 2013 c; Kizhi Isl., LE; Kizhi Isl., on deadwood of *Sorbus aucuparia*, 16.07.1998, V.I. Krutov, PTZ; stp.

*Ph. segregata* (Bourdot et Galzin) Parmasto – north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest, on old fallen spruce, 26.08.2013, A.V. Ruokolainen, PTZ; r.

\* *Ph. serialis* (Fr. : Fr.) Donk – northwest of the Vatnavolok village, Syar peninsula, comp. 183, on deadwood of conifers 18.08.2013; 27.06.2013, 23.08.2013, O. Manninen; r.

*Phlebiella sulphurea* (Pers.) Ginns et M.N.L. Lefebvre – Ruokolainen 2013 c; spruce, pine and mixed forest on deadwood of coniferous and deciduous trees; p.

*Phlebiopsis gigantea* (Fr.) Jülich – Ruokolainen 2013 c; north of Podyelniki, south of Uzskaya Salma, Tambitsy, spruce forest on dead of spruce, 10.08.2010, 13.08.2010, 28.08.2013, A.V. Ruokolainen; stp.

*Physisporinus vitreus* (Pers. : Fr.) P. Karst. – Lipovitsy, comp. 41–42, spruce forest, on deadwood of coniferous and deciduous trees, 23.08.2013, 24.08.2013, O. Manninen; r. Threat status: Len – 3.

*Piloderma bicolor* (Peck) Jülich – Ruokolainen 2013 c; north of Podyelniki, spruce forest, on deadwood of coniferous and deciduous trees, A.V. Ruokolainen; p.

\*\* *Piloporia sajanensis* (Parmasto) Niemelä – Documentation ... 2013; Uzkaya Salma village, comp. 26, moist spruce forest, on fallen spruce on fruitbody of *Trichaptum laricinum*, 28.06.2013, O. Manninen, A.V. Kravchenko, PTZ; rr. Threat status: Kar – 3 (VU), Fin – EN.

*Piptoporus betulinus* (Bull. : Fr.) P. Karst. – Ruokolainen 2013 b, c; Bol. Klim. Isl., environs of Lipovitsy, Podyelniki, Polyta, Tambitsy, Tipinitsy, Uzkaya Salma, Velikaya Guba, Zharnikovo, pine, spruce and mixed forest, on dead birch, A.V. Ruokolainen; fq.

*Plicatura nivea* (Sommerf. : Fr.) P. Karst. – Bondartseva et al. 1999; Ruokolainen 2013 c; southern part on Bol. Klim. Isl., spruce forest, on fallen *Alnus incana*, LE; stp.

\*\* *Polyporus badius* (Pers.) Schwein. – Ruokolainen 2013 c; Bolshoi Lelikovskiy Isl., mixed forest, on fallen aspen, 09.08.2010, A.V. Markovsky, O. Turunen, PTZ; Zharnikovo, mixed forest, on fallen aspen, 05.08.2012, A.V. Ruokolainen, PTZ; Tipinitsy, spruce forest on fallen aspen, 27.08.2013, A.V. Ruokolainen, PTZ; stp. Threat status: Fin – VU. *P. leptcephalus* (Jacq.) Fr. [= *P. varius* (Pers.) Fr.] – Bondartseva et al. 1999; Ruokolainen 2013 c; Bolshoi Lelikovskiy Isl., mixed forest, on fallen aspen, 09.08.2010, A.V. Ruokolainen; Zharnikovo, mixed forest, on fallen aspen, 05.08.2012, A.V. Ruokolainen; p. *P. melanopus* (Pers.) Fr. – Ruokolainen 2013 c; Podyelniki, Zubovo, mixed forest, on old deadwood of birch, 03.08.2012, A.V. Ruokolainen, PTZ; stp.

\*\* *P. pseudobetulinus* (Pilát) Thorn. Kotir. et Niemelä – Documentation ... 2013; on old aspen, rr. Threat status: Kar – 2 (EN), Fin – VU.

*P. squamosus* (Huds.) Fr. – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Kizhi and Bolshoi Lelikovskiy Isl.s, north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest mixed forest, on deadwood of *Salix caprea* and aspen, 09.08.2010, 04.08.2012, 26.08.2013, A.V. Ruokolainen; stp.

*Postia alni* Niemelä et Vampola – Ruokolainen 2013 b, c; Zharnikovo, Lipovitsy, comp. 41, spruce and mixed forest, on deadwood of *Salix caprea*, *Sorbus aucuparia* and alder, A.V. Ruokolainen; stp.

*P. caesia* (Schrad. : Fr.) P. Karst. – Bondartseva et al. 2000; Ruokolainen 2013 c; north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest on deadwood of spruce, 26.08.2013, A.V. Ruokolainen; stp.

*P. fragilis* (Fr.) Jülich – Ruokolainen 2013 c; spruce forest on fallen pine, 05.08.2011, A.V. Ruokolainen, PTZ; Zharnikovo, pine forest, on dead pine, 02.08.2012, A.V. Ruokolainen; Syar peninsula, comp. 186, 19.08.2013, O. Manninen; north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest on fallen pine and spruce, 26.08.2013, A.V. Ruokolainen; Tambitsy, motley grass spruce forest, on fallen spruce, 28.08.2013, A.V. Ruokolainen; p.

\*, \*\* *P. guttulata* (Peck) Jülich – Ruokolainen 2013 b, c; south of the village of Uzkaya Salma, spruce forest, on dead spruce, 13.08.2010, A.V. Ruokolainen; Podyelniki, mixed forest, on the roots of dry spruce, 03.08.2012, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 181, 186, on deadwood of spruce, 19.08.2013, O. Manninen; stp. Threat status: Fin – NT.

\*, \*\* *P. lateritia* Rennvall – Ruokolainen 2013 a; Syar peninsula, comp. 175, 180, 183, 186, on deadwood of conifers, 17–19.08.2013; 22.08.2013, O. Manninen; stp. Threat status: Fin – NT.

\*\* *P. leucomallella* (Murrill) Jülich – Zharnikovo, pine forest, on dead pine, 02.08.2012, A.V. Ruokolainen; Syar peninsula, comp. 174, 182, 186, on dead of pine, 17–19.08.2013; 28.08.2013, O. Manninen; stp. Threat status: Len – 3.

*P. sericeomollis* (Romell) Jülich – Syar peninsula, comp. 152, 183, spruce forest, on deadwood of conifers, 16.08.2013, 18.08.2013; 25.06.2013, 27.06.2013, 22.08.2013, O. Manninen; stp.

*P. stiptica* (Pers. : Fr.) Jülich – Ruokolainen 2013 c; Lake Korbozero, Tipinitsy, mixed forest on deadwood of spruce, 27.08.2013, A.V. Ruokolainen; Tambitsy, motley grass spruce forest on deadwood of spruce, 28.08.2013, A.V. Ruokolainen; stp.

*P. tephroleuca* (Fr.) Jülich – Ruokolainen 2013 c; Bolshoi Lelikovskiy Isl., mixed forest on fallen aspen, 09.08.2010, A.V. Ruokolainen, PTZ; north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest, on fallen birch and spruce, 26.08.2013, A.V. Ruokolainen; stp.

\*\* *P. undosa* (Peck) Jülich [= *Spongiporus undosus* (Peck) A. David] – north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest on fallen pine and spruce, 26.08.2013, A.V. Ruokolainen, PTZ; r. Threat status: Len – 3.

*Pseudochaete tabacina* (Sowerby) T. Wagner et M. Fisch. [= *Hymenochaete tabacina* (Sowerby) Lév.] – Ruokolainen 2013 c; Kizhi Isl., mixed forest on fallen aspen, 04.08.2012, A.V. Ruokolainen; Zharnikovo, mixed forest on fallen *Sorbus aucuparia*, 01.08.2012, A.V. Ruokolainen; stp.

*Pseudohydnum gelatinosum* (Scop. : Fr.) P. Karst. – spruce forest, on fallen spruce, 27.08.2013, O. Manninen; r.

\* *Pseudomerulius aureus* (Fr.) Jülich – Syar peninsula, comp. 133, 180, 183, 16.08.2013, 18–19.08.2013, O. Manninen; r.

\*\* *Pycnoporellus alboluteus* (Ellis et Everh.) Kotl. et Pouzar – south from Velikaya Guba village, at the western part of peninsula, comp. 9 of Kizhi forestry unit in old-growth spruce forests on fallen 24.08.2013, O. Manninen, T. Kuuluvainen; rr. Threat status: Fin – EN.

\*, \*\* *P. fulgens* (Fr.) Donk – Bondartseva et al. 1999; Ruokolainen 2013 c; Bol. Klim. Isl., LE; Bol. Klim. Isl., spruce forest, on fallen spruce, 07.07.1997, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 153–154, 174, 176, 178, 180, 185–186, 17–19.08.2013, O. Manninen; Lipovitsy, north of Tambitsy, environs of Tolsty Navolok, Tambitsy, Kaskoselga, Lake Korbozero, Tipinitsy, comp. 41, 71, 132, 177 et al., spruce forest on old deadwood spruce, 21–23.08.2013, 26–28.08.2013, A.V. Ruokolainen; p. Threat status: Len – 3.

*Pycnoporus cinnabarinus* (Jacq.) P. Karst. – Ruokolainen 2013 c; Zharnikovo, mixed forest, on deadwood of birch, 01.08.2012, A.V. Ruokolainen; stp.

*Radulodon erikssonii* Ryvarden – Ruokolainen 2013 c; spruce forest on old deadwood aspen; rr. Threat status: Kar – 3 (VU), Fin – VU.

\*\* *Ramaria aurea* (Schaeff.) Quél. – Ruokolainen 2013 c; pine forest, 22.08.2013; rr.

\*\* *R. eumorpha* (P. Karst.) Corner [= *R. invalii* (Cotton et Wakef.) – Bondartseva et al. 1999; Kizhi Isl., LE; Podyelniki, spruce forest on litter, 03.08.2012, A.V. Ruokolainen, PTZ; r. *R. suecica* (Fr. : Fr.) Donk – Kizhi Isl., on litter, 04.08.2012, A.V. Ruokolainen, PTZ; r.

*Resinicium bicolor* (Alb. et Schwein.) Parmasto – Ruokolainen 2013 c; Podyelniki, Zharnikovo, spruce and pine forest on fallen spruce; stp.

*R. furfuraceum* (Bres.) Parmasto – Bondartseva et al. 1999; Bol. Klim. Isl., LE; Bol. Klim. Isl., spruce forest, on fallen spruce, 04.07.1997, A.V. Ruokolainen, PTZ; stp.

\*, \*\* *Rhodonía placenta* (Fr.) Niemelä, K.H. Larss. et Schigel – Ruokolainen 2013 a, c; south of the village of Uzkaya Salma, moist spruce forest, on fallen spruce, 13.08.2010, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 178, 180, 183, 186, 18–19.08.2013, O. Manninen; Lipovitsy, comp. 41, spruce forest on deadwood of spruce, 23.08.2013, A.V. Ruokolainen; stp.

\*\* *Rigidoporus crocatus* (Pat.) Ryvarden – Bondartseva et al. 1999; Ruokolainen 2013 b, c; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest, on fallen spruce, 03.07.1997, A.V. Ruokolainen, PTZ; Bol. Klim. Isl., spruce forest on fallen aspen, 06.07.1997, A.V. Ruokolainen, PTZ; Zharnikovo, birch forest on deadwood of deciduous trees, 05.08.2012, A.V. Ruokolainen, PTZ; Tambitsy, motley grass spruce forest, on fallen birch, 28.08.2013, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 180–181, 19.08.2013, O. Manninen; r. Threat status: Kar – 3 (VU), Len – 3, Fin – EN.

*Sarcodon fennicus* (P. Karst.) P. Karst. – Ruokolainen 2013 c; south of the village of Lambasrucheï, Lake Onega shore, pine forest, on litter, 24.08.2012, A.V. Ruokolainen; by the lake in pine forest, comp. 13, on litter, 22.08.2013, A.V. Ruokolainen; r.



*S. glaucopus* Maas Geest. et Nannf. – Syar peninsula, comp. 177, 180, 182, 185–186, pine forest on litter, 18–19.08.2013; 27.08.2013, O. Manninen; r.

*S. imbricatus* (L. : Fr.) P. Karst. – north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest on litter, 26.08.2013, A.V. Ruokolainen; r.

*Schizopora paradoxa* (Schrad. : Fr.) Donk – Ruokolainen 2013 c; on deadwood of aspen and birch; r.

*Scytinostroma galactinum* (Fr.) Donk – Ruokolainen 2013 c; Zharnikovo, pine forest, on fallen birch, 02.08.2012, A.V. Ruokolainen, PTZ; r. Threat status: Fin – NT.

*S. odoratum* (Fr.) Donk – Tambitsy, *Myrtillus* spruce forest, on fallen spruce, 28.08.2013, A.V. Ruokolainen, PTZ; r.

\*\* *Serpula himantioides* (Fr. : Fr.) P. Karst. – 27.06.2013, O. Manninen; r.

\*, \*\*, *Sidera lenis* (P. Karst.) Miettinen [= *Skeletocutis lenis* (P. Karst.) Niemelä] – Documentation ... 2013; Syar peninsula, comp. 153, 176–177, on fallen pine, 17–18.08.2013, O. Manninen; 22.08.2013 and 25.08.2013, O. Manninen; r. Threat status: Kar – 3 (VU), Len – 3, Fin – NT.

*Sistotrema raduloides* (P. Karst.) Donk – Velikaya Niva, mixed forest, on fallen aspen, 23.08.2012, A.V. Ruokolainen, PTZ; r.

*Skeletocutis amorpha* (Fr.) Kotl. et Pouzar – Ruokolainen 2013 b, c; Kizhi Isl., on pine wood, 04.08.2012, A.V. Ruokolainen; r.

*Sk. biguttulata* (Romell) Niemelä – Ruokolainen 2013 c; north of Podyelniki, pine forest, on fallen pine, 11.08.2010, A.V. Ruokolainen, PTZ; r.

*Sk. brevispora* Niemelä – Ruokolainen 2013 c; north of Podyelniki, spruce forest, on fallen spruce, 10.08.2010, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 153, 17.08.2013, O. Manninen; r. Threat status: Fin – NT.

*Sk. chrysella* Niemelä – spruce forest, on fallen spruce, 23.08.2013, O. Manninen; rr. Threat status: Fin – NT.

\*, \*\* *Sk. odora* (Sacc.) Ginns – Ruokolainen 2013 a, c; south of the village of Uzkaya Salma, moist spruce forest, on fallen spruce, 13.08.2010, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 180–183, 18–19.08.2013, O. Manninen; r. Threat status: Fin – NT.

*Sk. papyracea* A. David – Ruokolainen 2013 c; Zharnikovo, pine forest, on fallen pine, 02.08.2012, A.V. Ruokolainen, PTZ; Syar peninsula, comp. 177, 182, 18.08.2013; 25.06.2013, 24.08.2013, O. Manninen; r.

\*, \*\* *Sk. stellae* (Pilát) J. Keller – Syar peninsula, comp. 182–183, 18.08.2013; 27.06.2013, 23.08.2013, 26.08.2013, O. Manninen; r. Threat status: Fin – VU.

*Steccherinum fimbriatum* (Pers. : Fr.) J. Erikss. – Ruokolainen 2013 c; Tambitsy, spruce forest, on fallen aspen, 28.08.2013, A.V. Ruokolainen; stp.

*St. ochraceum* (Pers.) Gray – Bondartseva et al. 1999; Bol. Klim. Isl., LE; Bol. Klim. Isl., on fallen deadwood of deciduous trees, 06.07.1997, A.V. Ruokolainen, PTZ; stp.

*Stereum hirsutum* (Willd.) Pers. – Bondartseva et al. 1999; Ruokolainen 2013 c; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., spruce forest, on fallen birch, 06.07.1997, A.V. Ruokolainen, PTZ; Kizhi Isl., on deadwood of *Sorbus aucuparia* and alder, 16.07.1998, V.I. Krutov, PTZ; p.

*S. rugosum* Pers. – Bondartseva et al. 1999; Ruokolainen 2013 c; Kizhi Isl., on deadwood of alder, 16.07.1998, V.I. Krutov, PTZ; p.

*S. sanguinolentum* (Alb. et Schwein.) Fr. – Bondartseva et al. 1999; Ruokolainen 2013 c; Bol. Klim. Isl., LE; southern part on Bol. Klim. Isl., on fallen spruce, 06.07.1997, A.V. Ruokolainen, PTZ; stp.

*S. subtomentosum* Pouzar – Bondartseva et al. 1999; Bol. Klim. Isl., LE; Bol. Klim. Isl., on fallen aspen, 06.07.1997, A.V. Ruokolainen, PTZ; stp.

*Thelephora terrestris* Ehrh. – Ruokolainen 2013 c; Lipovitsy, comp. 41, spruce forest, on litter, A.V. Ruokolainen; stp.

*Tomentella bryophila* (Peck) M.J. Larsen – Lipovitsy, spruce forest, on fallen aspen, 21.08.2013, A.V. Ruokolainen, PTZ; stp.

\*\* *T. crinalis* (Fr.) M.J. Larsen – Ruokolainen 2013 a, c; south of Uzkaya Salma, spruce forest with aspen, on old fallen aspen, 13.08.2010, A.V. Ruokolainen, PTZ; north of Tambitsy, environs of Tolsty Navolok, comp. 71, spruce forest, on old fallen aspen, 26.08.2013, A.V. Ruokolainen, PTZ; Lake Korbozero, Tipinitsy, mixed forest, on old fallen aspen, 27.08.2013, A.V. Ruokolainen, PTZ; Threat status: Kar – 3 (NT); r.

*T. lateritia* Pat. – Ruokolainen 2013 a, c; mixed forest, on fallen aspen; stp.

*T. stuposa* (Link) Stalpers – Ruokolainen 2013 c; Velikaya Niva, motley grass birch forest, 23.08.2012, A.V. Ruokolainen, PTZ; r.

*T. sublilacina* (Ellis et Holw.) Wakef. – Ruokolainen 2013 c; Zharnikovo, mixed forest on deadwood of deciduous trees, 02.08.2012, A.V. Ruokolainen, PTZ; r.

*T. terrestris* (Berk. et Broome) M.J. Larsen – Ruokolainen 2013 c; north of Podyelniki, spruce forest, near fallen aspen, 11.08.2010, A.V. Ruokolainen, PTZ; r.

*Trametes hirsuta* (Wulfen) Lloyd – Bondartseva et al. 1999; Ruokolainen 2013 c; Kizhi Isl., on deadwood of *Sorbus aucuparia*, 07.08.1998, V.I. Krutov, PTZ; Bol. Klim. Isl., Zharnikovo, mixed forest, on fallen *Sorbus aucuparia* and birch, 01.08.2012, A.V. Ruokolainen; p.

*T. ochracea* (Pers.) Gilb. et Ryvarden – Bondartseva et al. 1999; Ruokolainen 2013 c; Bol. Klim. Isl., LE; Bol. Klim. Isl., spruce forest, on fallen aspen, 06.07.1997, A.V. Ruokolainen, PTZ; Zharnikovo, mixed forest on fallen aspen and birch, 01.08.2012, A.V. Ruokolainen; fq.

*T. pubescens* (Schumach.) Pilát – Ruokolainen 2013 c; Zharnikovo, mixed forest, on fallen birch and alder, 01.08.2012, A.V. Ruokolainen; p.

\*\* *T. suaveolens* (L. : Fr.) Fr. – the river Padma, on deadwood of *Salix caprea*, 04.09.2005, A.V. Ruokolainen, PTZ; 26.06.2013, 27.08.2013, 28.08.2013, O. Manninen; r. Threat status: Len – 3, Fin – NT.

*T. trogii* Berk – Syar peninsula, comp. 153, 17.08.2013; 27-28.08.2013, O. Manninen; r. Threat status: Fin – VU.

*Trecispora hymenocystis* (Berk. et Broome) K.H. Larss. – 27.08.2013, O. Manninen; r.

*T. mollusca* (Pers. : Fr.) Liberta – 25.08.2013 and 27.08.2013, O. Manninen; r.

*Trichaptum abietinum* (Dicks.) Ryvarden – Bondartseva et al. 1999; in the southern part on Bol. Klim. Isl., spruce forest, on fallen spruce, 05.07.1997, A.V. Ruokolainen, PTZ; fq.

*T. fuscoviolaceum* (Ehrenb.) Ryvarden – Ruokolainen 2013 c; the river Padma, on fallen pine, 04.09.2005, A.V. Ruokolainen, PTZ; stp.

*T. laricinum* (P. Karst.) Ryvarden – Ruokolainen 2013 c; Syar peninsula, comp. 181, 19.08.2013, O. Manninen; rr. Threat status: Fin – NT.

*T. pargamenum* (Fr.) G. Cunn. – Bondartseva et al. 1999; Syar peninsula, comp. 186, 19.08.2013; Polyá, mixed, pine and spruce forest, on fallen birch, 22.08.2013, 24.08.2013, A.V. Ruokolainen; 27.08.2013, O. Manninen; stp. Threat status: Fin – NT.

*Tubulicrinis calothrix* (Pat.) Donk – Bondartseva et al. 1999; Bol. Klim. Isl., LE; Bol. Klim. Isl., spruce forest on fallen pine, 06.07.1997, A.V. Ruokolainen, PTZ; pine forest, comp. 13, on fallen pine, 22.08.2013, A.V. Ruokolainen, PTZ; stp.

*T. effugiens* (Bourdot et Galzin) Liberta – Bondartseva et al. 1999; Bol. Klim. Isl., LE; r.

*Veluticeps abietina* (Pers. : Fr.) Hjortstam et Tellería – Ruokolainen 2013 a, c; near Lake Nizhnee Pigmosero, 22.08.2012; Polyá, spruce forest, on dead spruce, 25.08.2012, A.V. Ruokolainen; stp.

## 3.6 Insect fauna of Zaonezhye Peninsula and adjacent islands

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### Introduction

Zaonezhye Peninsula is situated on the northwestern coast of Lake Onega, in the eastern part of the biogeographical province of *Karelia onegensis*. In the east its shores are washed by Zaonezhye Gulf, while in the west the peninsula is bordered by Lizhma Bay and Bolshoye Onego Gulf of Lake Onega. Zaonezhye Peninsula lies on the basement rocks of Fennoscandia and characterized by underlying basic limestone and carbonate rocks. This, together with highly fertile soils, has contributed to the diversity of habitats and plant species on Zaonezhye Peninsula. For this reason, it is considered a separate vegetation region (Ramenskaya 1983). The same is true of the insect fauna, which has interested entomologists for a long time.

### History of entomological studies on Zaonezhye Peninsula

Entomological studies on Zaonezhye Peninsula began in the second half of the 19<sup>th</sup> century. At that time it was one of the most developed agricultural areas in Karelia with good connection to Petrozavodsk by water transport. The earliest records from this area date back to 1859–1899 when the apothecary of Alexandrovsky plant (Petrozavodsk), Alexander Günther, collected insects mainly around Petrozavodsk, covering eastern parts of the provinces *Kon* and *Kol* (Pekkarinen & Huldén 1995). The collections of Alexander Günther are not available in Russia. However, he maintained contact with Finnish entomologists and published species lists of Lepidoptera (Günther 1868, 1896 a) and Coleoptera (Günther 1896 b). A large part of his collections have been identified by Finnish entomologists and subsequently published, e.g. Kaisila (1947) for Lepidoptera, and Poppius (1899) for Coleoptera. Most of the samples are stored in the Zoological Museum of Helsinki.

The first detailed study of beetles (Coleoptera) around Lake Onega was conducted by the famous Finnish entomologist Bertil Robert Poppius (Poppius 1899). Between June and August 1896, he visited several places on the shores of the lake, including Zaonezhye Peninsula inland areas (locations Dianova Gora, Kosmozero, Unitsa), villages on its eastern and southern shores, Kuzaranda, Shun'ga (Schungu in Poppius' transcription), Tolvyua (Tolvoja), Velikaya Guba (Velikaja-guba), and the Kizhi archipelago, islands Bolshoi Klimenetsky, Kizhi (Kischi), and Southern Oleny (Yu. Oleny in the species list). Several species are recorded as 'Saoneshje-halfön' without indication of certain locality. As a result, more than 400 of presently recognized beetle species were reported for the first time from Zaonezhye area.

The next records of insect from Zaonezhye Peninsula were by Finnish entomologists during the Second World War (Kaisila 1947, Valle 1952, Kontuniemi 1965, etc.). After the war, the insect fauna of the area was not studied until the middle of the 1990s when entomologists from the Forest research institute of the Karelian Research Center of the Russian Academy of Sciences started inventories of the Kizhi archipelago, including the islands of Kizhi, Bolshoi Klimenetsky, Volkostrov and Yuzhnyi Oleniy (Jakovlev et al. 1999). Later, faunistic studies have been continued in the same areas as well as on the southern end of the peninsula, adjacent to the Kizhi archipelago, (e.g. Podyelniki and Oyatevshina). Additional materials of Lepidoptera have been collected by Dr. Vyacheslav Gorbach (Petrozavodsk State University) and Finnish entomologists around the village of Sennaya Guba (Gorbach & Saarinen 2002; Gorbach & Kabanen 2010). All these areas are a part of the Kizhi nature reserve (*zakaznik*). As a result, nearly 2 000 insect species have been recorded from the entire Kizhi archipelago (Humala & Polevoi 2012).

Areas north of the Kizhi Nature Reserve remained unstudied from the time of Poppius until 2012 when approximately 1 000 insect species were recorded in the northern part of the peninsula, including the villages of Kosmozero, Myagrozero, Shun'ga and Turastamozero (Polevoi & Humala 2013). These areas are proposed to be included in the planned Zaonezhye landscape reserve (*zakaznik*). The latest samples were collected outside of the planned landscape reserve in 2013 during the joint Finnish-Russian expedition to the southern lowlands of Zaonezhye Peninsula (Kizhi forestry unit, or *lesnichestvo*, and a part of the Velikaya Niva forestry unit, compartments (quartals) 46-47, 69-71, 79-83, 97-100, 102-104, 114-117, 123-124, 140-143, 158-162). Also, Karelian entomologists collected samples during a short visit to the coastal areas of Zaonezhye Peninsula and adjacent islands in 2004, and northern part of the Kizhi Nature Reserve in 2014 (Eglov Island and its vicinities).

## Study area and methods

Materials were collected between 1994 and 2013 in the Medvezhiegorsk and Kondopoga municipalities of the Republic of Karelia, within the biogeographical province of *Karelia onegensis*. Our samples originated from approximately 74 sites (Fig. 1), which have been grouped into 40 generalised locations in the species list.

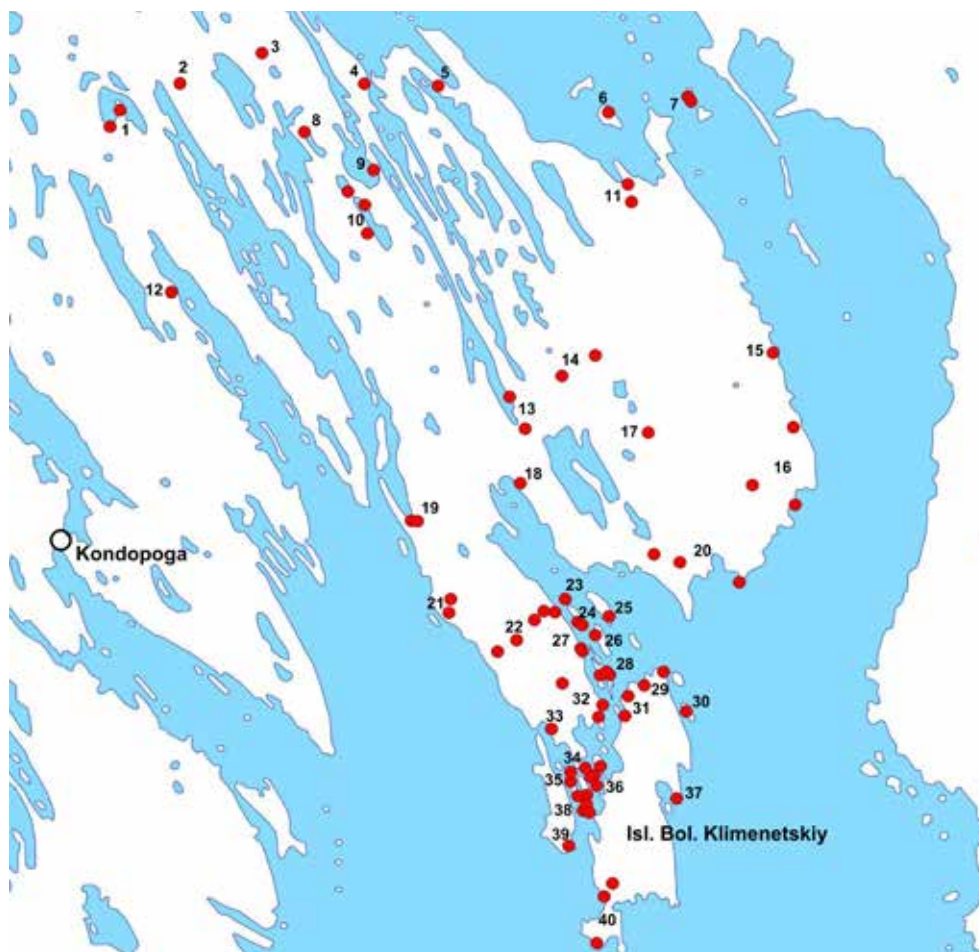


Fig. 1. Study sites in Zaonezhye Peninsula: 1–Vikshezero, 2–Unitsa, 3–Dianova Gora, 4–Nikonova Guba, 5–Shun'ga, 6–Paleostrov Isl., 7–Isl. Kainos and Vavlok, 8–Turastamozero, 9–Kazhma, 10–Verkhnee and Nizhnee Myagrozero, 11–Tolvuya, 12–Lizhma, 13–Kosmozero, 14–Velikaya Niva, 15–Kuzaranda, 16–Tambitsy, 17–Polya, 18–Velikaya Guba, 19–Vegoruksy, 20–Tipinitsy, 21–Uzkaya Salma, 22–Lipovitsy, 23–Khvost Isl., 24–Isl. Egl'ov and Rogachev, 25–Isl. Shunevskiy, 26–Volkostrov Isl., 27–Pod'elniki, 28–Kizhi Isl., 29–Kurgeniitsy, 30–Yuzhnyi Olen Isl., 31–Vorobyi, 32–Oyatevshina, 33–Kopanets Lake, 34–Vertilovo, 35–Myal' Isl. and Lelikovo, 36–Sennaya Guba, 37–Voinalovok, 38–Isl. Ernitskiy, Lyudskoy and Kuivakhda, 39–Bolshoy Lelikovskiy Isl., 40–Klimentitsy.

We used a variety of collecting methods in order to capture different insect groups: sweep netting, portable Malaise traps (Jaschoff & Didham 2002) (Fig 2), yellow pan traps (Masner 1976), polypore traps (Kaila 1993) as well as light trapping with an ultraviolet lamp and a white sheet. In addition, we collected insects on dead wood, fungi and flowers (Fig. 3). In 2013, three Malaise traps were placed in the Kizhi forestry unit (surroundings of the villages Uzkaya Salma and Lipovitsy) and Velikaya Niva forestry unit (near the village Polya) for the period between 26<sup>th</sup> June and 25<sup>th</sup> August. Easily distinguishable species were identified by appearance, or photographed.

We concentrated on three large insect orders: Coleoptera, Hymenoptera and Diptera. In the order Lepidoptera we recorded mostly representatives of the suborder Rhopalocera. Some insect groups were excluded due to problems in identification. Other groups have limited samples due to selective methods used. Original materials are stored at the Forest research institute of Karelian Research Center of the Russian Academy of Sciences (Petrozavodsk), and in Finnish Environment Institute (Helsinki). There are also old insect collections from Zaonezhye area which are now stored in the Zoological Museum of the University of Helsinki (Finland). We could not manage checking of all these materials, but listed only published records.



Fig. 2. Malaise trap in spruce-dominated unmanaged forest with great proportion of aspen. NE of the abandoned Lipovitsy village (Photo Jevgeni Jakovlev).



Fig. 3. Handpicking from thin dead branches of windfallen aspen trees of a dark black color – typical larval microhabitat of a rare beetle species, *Leiodus punctulatus* (Photo Andrei Humala).

## Results

In total, approximately 2453 insect species were recorded from Zaonezhye Peninsula and adjacent archipelagos. Of these: Ephemeroptera–1, Odonata–27, Orthoptera–14, Blattoptera–2, Mecoptera–2, Raphidioptera–1, Neuroptera–3, Hemiptera–61, Coleoptera–583, Lepidoptera–218, Hymenoptera–428, and Diptera–1113 species.

The characteristics of insect fauna are determined not only by the diversity of natural habitats, but also by the history of landuse on Zaonezhye Peninsula. In addition

to species typical of old-growth forests, there are species associated with secondary forests with a large amount of dead wood of deciduous trees, as well as meadow insect fauna.

Originally the area was covered with high quality coniferous forests, growing in conditions close to optimal. At present, intact coniferous forests are preserved only in paludified areas and on steep, rocky slopes. The rest of the forests have been affected by selective cuttings. Especially close to the villages, forests have grown naturally on abandoned fields and hay meadows. According to forest inventory data from 1999 (Gromtsev & Krutov 2000), pine- and spruce-dominated forests occupy nearly 60 percent of the forest cover in approximately equal proportions. The remaining area is covered by forests dominated by birch (ca. 30%), aspen (5%) or grey alder (6 %).

The studied forests in the lowland parts of Zaonezhye Peninsula can be divided roughly into three classes. These are (1) high quality primeval forests with negligible human impact, (2) forest of high conservation potential, rapidly restoring natural values after earlier human use, and (3) successional forests, which are developing after the abandonment of fields and forest pastures (see Kuuluvainen and Tikkanen, Reports of the Finnish Environment Institute 40 | 2014).

Human impact on the study area has always been significant. During our sampling trips in 2012 (northern parts of Zaonezhye Peninsula) and 2013 (southern parts), we found only a few sites of high quality spruce dominated forests and mire-spruce stands that could be characterized as near primeval forest. At least, two threatened beetle species, *Pytho kolwensis* and *Monochamus urussovi* seem to be fairly well-preserved here.

Forests of the second class which has been used to some extent in the past for selective cutting, slash-and-burn cultivation, etc., and then developed naturally during dozens of years occupy large areas in Zaonezhye Peninsula and in some islands, e.g. Bolshoy Klimenetsky. Although of secondary origin, these forests are rich in coarse woody debris and, therefore, host a series of saproxylic beetle (Coleoptera) species that are typical for intact boreal forests, e.g. *Ceruchus chrysomelinus* (Lucanidae), *Phaenops cyanea*, *Chrysobothris chrysostigma* (Buprestidae), *Phryganophilus ruficollis* (Melandryidae), *Nivellia sanguinosa*, *Pedostrangalia pubescens* and *Leptura nigripes* (Cerambycidae) as well as their parasitoids, e.g. ichneumonoid wasps *Arotes albicinctus* and *Coleocentrus exareolatus* (Hymenoptera). Many of these species have declined dramatically in Western Europe, many are redlisted. Pine-dominated stands usually contain old trees bearing signs of resin extraction which was carried out some tens years ago, however, neither signs of insect epidemics, nor symptoms of forest decline due to insect pests have been observed.

The third class of forests - mixed deciduous stands with alder, birch and aspen occupy abandoned fields, slash-and-burn sites and pastures near former villages. In many sites, there is plenty of dead wood of aspen where we found several internationally rare insect species, including flies *Symmerus nobilis* and *Xylomya czekanovskii* (Diptera), beetles *Hylocharis cruentatus*, *Rhizophagus pincticollis*, and *Leiopus punctulatus* (Coleoptera). In Finland these species are highly threatened, ranging from vulnerable (VU) to regionally extinct (RE). In Karelia they have been recorded only in southern part from limited areas like Kivach Nature Reserve (Ivanter & Kuznetsov 2007). In Zaonezhye they seem to be well-preserved in secondary forests on fertile soils.

Grasslands are located mainly in the southern and eastern lowlands where they have been intensively used as hay meadows and pastures. Relatively large areas have been covered with arable land. At present, most of these areas are abandoned, gradually transforming into young secondary deciduous forest. We found and observed only a few intact grasslands on the islands of the Kizhi archipelago and in the eastern shore of Zaonezhye Peninsula. Wet grasslands can be found in the narrow bays along

the shoreline. Formerly, local population used these grasslands for haymaking, whereas presently they are occupied with a combination of mire and meadow vegetation (Kuznetsov 1993). Typical grassland species include *Psophus stridulus* (Orthoptera) and several species of butterflies, e.g. internationally rare *Parnassius mnemosyne* and *Zygaena osterodensis*, which are considered very rare and threatened both in Karelia and the entire Europe. Very interesting is a recent finding of a longhorn beetle species, *Aromia moschata* at the edge of abandoned field on Bolshoy Klimenetsky Island. This species develops primarily in willows.

## Conclusions

Zaonezhye Peninsula was one of the most highly developed rural regions in Karelia during the extended period. Long history of traditional agriculture and its general decline in the recent years led to formation of huge variety of habitats in the area including open meadows, secondary stands on abandoned fields and remnants of natural coniferous forests. Such variety together with a set of favorable abiotic conditions provide successful existence of various insect group: saproxylic species, requiring dead wood of certain tree species at different stages of decay; herbivores, trophically associated with certain plant species; aquatic species, which require special water conditions, etc. Many of such species nowadays become very rare or even extinct in other parts of Karelia as well as in whole Fennoscandia. Our findings undoubtedly indicate the uniqueness of Zaonezhye Peninsula territory and its significant value in terms of insects' biodiversity conservation. It is a strong ecological argument to establish protected areas for conservation of the habitats of saproxylic insects and insects confined to intact grasslands which were revealed during the entomological studies.

Zaonezhye Peninsula and adjacent islands is an exceptional area in Karelia for which there is a considerable amount of old records of insects made before vast-scale mechanical forest logging was started in Karelia. It allows tracing dynamics of distribution of the threatened insect species in forests and grasslands. The twenty-year studies in 1994-2014, showed that saproxylic insects associated with aspen are well preserved in many places. Also, several threatened Coleoptera species associated with spruce and birch have been rediscovered in suitable habitats. These are, for instance, *Pytho kolwensis*, *Phryganophyllis ruficollis*, *Ceruchus chrysomelinus* which are strongly declined throughout Northern Europe. All these species have a special value for nature conservation. On the other hand, we have failed to rediscover many Coleoptera species associated with pine, e.g. a bark beetle *Ips sexdentatus* which was recorded from the area by Poppius (1899) more than hundred years ago. This species is possibly extinct in Southern Karelia, and can be found only in places of stored barked pine wood (Jakovlev et al. 2000). A buprestid species, *Phaenops cyanea* which also seems to be declined in southern part of Karelia has been found in the timber store.

Among the insects dependent on traditional agriculture landscapes, several species were evidently strongly declined. For instance, we have not found a dung beetle *Onthophagus nuchicornis* recorded by Poppius (1899). At the same time, several threatened insect inhabiting dry meadows still exist, inspite of the declining of agriculture and overgrowth of their natural habitats. The most interesting finding is the rattle grasshopper, *Psophus stridulus* which was mentioned by old authors (Ozeretskovsky 1989) as a common species in Southern Karelia. At present, *P. stridulus* population in Kizhi archipelago seems to be the only one in Russian Karelia. To maintain it, the special measures aimed to restore dry meadows in Zaonezhye are in urgent need. In Finland, the rattle grasshopper is considered as rapidly-declining, endangered species inhabit primarily dry and sunny sandy areas and eskers,



and gradually moving from its natural biotopes to manmade environments, like the embankments of railroad tracks and roadside verges (Intke & Piirainen 2014).

There are ecological groups, e.g. aquatic insects, and many taxonomic groups of insects which were not studied in the area yet. Further research is needed for these groups, as well as for localities which are not covered for entomological research in Zaonezhye Peninsula and adjacent islands.

## Acknowledgements

We thank Mrs. N.N. Kutenkova (Kivach Nature Reserve) for the help in identifying Lepidoptera species, Mr. Juho Paukkunen (Helsinki Zoological Museum, Finland) for the help with identifying of some aculeates (Hymenoptera) and results of his trip in 2010 to Kizhi Nature Reserve.

The study was partly supported in 1994–2014 by the Russian Foundation for Basic Research (grant No 13-04-98821), the Presidium of the Russian Academy of Sciences (Program of Fundamental Research Living Nature: Modern State and Development Problems), Kizhi Nature Reserve (State Zakaznik Kizhsky), and the project Barents Protected Area Network (BPAN) led by the Finnish Environment Institute.

## Annotated list of the insect species included in Red Data Book of the Republic of Karelia (Ivanter & Kuznetsov 2007) and other noteworthy insect species

The threat status is given according to the following sources: Karelia (Kar) – Ivanter & Kuznetsov (2007), Leningrad Region (Len) – Noskov (2002), Finland (Fin) – Rassi et al. (2010).

Species reported for the first time in Karelia are marked with asterisks.

### ODONATA

#### Aeshnidae

##### *Aeshna viridis* Eversmann, 1836

Material. 5 km N of Nikonova Guba, 1 ♂, under an electric power line, 22/8/2012 (A.Humala).

There are old records of the species from northern Ladoga (Valle 1927; Tiensuu 1933). There are also unconfirmed findings in the Kondopoga region (S.Uzenbaev, pers. comm.). Larvae of the species develop in thickets of Water soldiers (*Stratiotes aloides* L.). Due to habitat specification, the species is scarce and under threat over much of its range (Dijkstra, Lewington, 2006). Threat status: Kar – 4 (DD); Len– 3 (VU).

#### Libellulidae

##### *Libellula fulva* Müller, 1764

Material. 5 km S of Turastamozero, 1 ♂, 1 ♀, on the shore of a small river, 21/7/2012 (A.Polevoi).

This is the first modern record of the species in Karelia. It was previously known only from northern Ladoga (Valle 1927; Tiensuu 1933). The species requires a specific combination of water quality and habitat structure and is therefore only locally common in Europe (Dijkstra, Lewington 2006). Threat status: Kar – 4 (DD).

### ORTHOPTERA

#### Acrididae

##### *Psophus stridulus* (Linnaeus, 1758) (Fig. 4)

Material. Bolshoi Klimenetsky Island, Vorob'i, numerous specimens, 18-22/8/2008 (Polevoi, Humala).

An outstanding representative of the order Orthoptera. In adults, the hind wings have a bright red colour, and the males emit a characteristic chatter during flight. The species was first recorded in Karelia, near Konchezzero, at the end of the 18th century (Ozeretskovsky 1989). Previously the species seems to have been distributed throughout the southern part of Karelia up to the border of the middle taiga (Albrecht 1979). However, it had not been observed here for over 50 years, and was considered as regionally extinct (Ivanter & Kuznetsov 1995) until it has been rediscovered in Kizhi archipelago. The cause of decline is the overgrowth of its natural habitats. Threat status: Kar – 1(CR); Len – 3 (VU); Fin – VU.



Fig. 4. *Psophus stridulus* (Photo Alexei Polevoi).

## COLEOPTERA

### Scarabaeidae

#### *Onthophagus nuchicornis* (Linnaeus, 1758)

The species was recorded from Kizhi Island by Poppius in 1896 (Poppius 1899). It has been formerly distributed in southern parts of Fennoscandia. At present, the species is probably extinct in Russian Karelia, as well as in Finland, where the most recent record are from the years 1946 and 1955, respectively (Muona et al. 1998). In Zaonezhye, well-developed traditional husbandry provided the optimal habitats for *O. nuchicornis*. However, environmental changes caused by decline of the agricultural ecosystems are suggested as a reason for the decline in the occurrence of this vulnerable species with dung-living larvae. Threat status: Kar – 0 (RE); Fin – RE.

### Lucanidae

#### *Ceruchus chrysomelinus* (Hochenwarth, 1785)

Material: larvae inside spruce logs: Bolshoi Klimenetsky Island, 18.07.2000 (Jakovlev), Polyva, 25/8/2013 (Polevoi).

This is typical inhabitant of old-growth forest with big amount of coarse woody debris. Larvae live in well-decayed wood with brown rot fungi. They can colonize different tree species. In Karelia, most records are from spruce. Considered as threatened in all countries on Northern Europe, the threat factor is reduction of the area of old-growth forests. In Karelia has been recorded only from southern part. Common

in Kivach Nature Reserve (Jakovlev et al. 1986). Threat status: Kar – 3 (Vu); Fin – EN. The risk of extinction of this species is assigned also in the global level – category NT in the global Red List (IUCN 2014).

## Pythidae

### *Pytho kolwensis* Sahlberg, 1833 (Fig. 5)

Material: larvae under bark of spruce logs: Bolshoi Klimenetsky Island, July 2000, Lipovitsy, 25/6/2013 (Jakovlev); Polya, 25/8/2013 (Humala), Tambitsy, 27/8/2013 (Polevoi). A species with a narrow ecological specialization. Larvae live under the bark of fallen, old spruce trees, usually in wet places. Sharply declined in Northern Europe due to forest management and drainage of spruce-mire moist forest. It is possible that *P. kolwensis* became extinct in large parts of southern Finland as early as the 1800s or even earlier, in regions where slash and burn cultivation was intensive at the time (Siitonen & Saaristo 2000). In Zaonezhye peninsula it survived in remains of old-growth forests. Generally, the species is widespread in Karelia, but recorded only in areas of old-grown forests with a lot of dead wood (Jakovlev et al. 2000). Threat status: Kar – 3 (NT); Len – 2 (EN); Fin – EN.



Fig. 5. Larva of *Pytho kolwensis* (Photo Andrei Humala).

## Eucnemidae

### *Hylochaes populi* Brüstle & Muona<sup>1</sup>

Material. Polya, 2 specimens under the bark of an old, dead aspen tree, 26/6/2013 (Humala); Tambitsy, cavities and holes on aspen trunks, 26/8/2013 (Polevoi).

This species develops in large, dead aspens in old-growth forests. In Karelia, there are only two known populations in the Kondopoga and Pudozh municipalities (Ivanter & Kuznetsov 2007, Jakovlev 2009). There are also old records from the Olonets municipality (Palmén 1946). Threat status: Kar – 3(VU); Fin – EN.

## Buprestidae

### *Chrysobothris chrysostigma* (Linnaeus, 1758) (Fig. 3)

Material. Nizhnee Myagrozero, 1 specimen on a spruce trunk near the road, 22/7/2012 (Polevoi); Vegoruksy, 1 specimen, 25/6/2013 (Kravchenko), 2 specimens on spruce

<sup>1</sup> According to Brüstle and Muona (2009), all Karelian specimens found on aspens should be considered *H. populi*. *H. cruentatus* (Gyllenhal) develops on willows and to date is only known from southern Finland. However, some authors question the validity status of *H. populi* (Kovalev 2014).

trunks near the road, 27/6/2013 (Polevoi, Humala); 7 km south of Kosmozero, 1 specimen on a dead spruce at the edge of a clear-cut, 26/6/2013 (Polevoi).

This species develops under the bark of dying or dead conifers. In Karelia, the species is confined to old-growth forests. However, it is probably more widely distributed than previously thought. There are a few known old and modern records from southern Karelia (Palmén 1946; Humala & Polevoi 2009). Threat status: Kar – 3 (NT).

***Phaenops cyanea* (Fabricius, 1775) (Fig. 6)**

Material. Vegoruksy, several specimens on pine trunks near the road, 27/6/2013 (Polevoi, Humala).

This species develops inside and under the bark of dead or dying pines, especially of those damaged by fire. In the past it was a common species in southern Karelia (Palmén 1946). The latest records from the vicinities of Petrozavodsk date back to 1954 (Yakovlev et al. 1986). Threat status: Kar – 3 (VU).

Nitidulidae

***Cyllodes ater* (Herbst, 1792)**

Material. Bolshoi Klimenetsky Island 7/06/1995, 17/07/2000 (Jakovlev), Zharnikovo, 12/07/1999 (Polevoi), Lipovitsy 25/6/2013 (Humala), on the fruiting bodies of wood-growing fungi *Fomes fomentarius*, *Piptoporus betulinus* and *Pleurotus pulmonarius*. This species is relatively common in Karelia. It is associated with forests with great amount of dead aspens. Threat status: Kar – 3 (LC); Fin – NT.

**Monotomidae**

***Rhizophagus puncticollis* Sahlberg, 1837**

Material. Mixed spruce dominated forest with great proportion of aspen, Kopanets Lake shore. 1 specimen (imago), under bark of dead aspen trunk, 15/07/1999 (Polevoi). This species has been drastically declining in Northern Europe due to eradication of aspen. In Karelia recorded only from southern part: Kivach Strict Nature Reserve, Kotkozero (Olonets municipality) and Gumbaritsa (SE shore of Ladoga Lake) (Siitonen et al. 1996). Threat status: Kar – 3 (NT); Fin – RE.

**Melandryidae**

***Phryganophilus ruficollis* (Fabricius, 1798)**

Material. Bolshoi Klimenetsky Island, 1 specimen have been collected by window trap, 5-10.06.1995 (Jakovlev). This species develops feeding on fungal mycelia in dead wood rotten by *Fomes fomentarius* and other white rot fungi. In Northern Europe, most records are from fungus infected trunks of spruce and birch, in Sweden – also from oak (Ehnsröm & Axelsson 2002), and it has been suggested to be favoured by forest fires (Lundberg 1993). Estimated as very rare species in all countries from where it has been recorded. There are only ca. 20 records from Northern Europe, of these three records from southern Karelia: Kivach Strict Nature Reserve, Kizhi Nature Reserve (Ivanter & Kuznetsov 2007) and vicinity of Matrossy village (Kolström & Leinonen 2000) In Karelia, Finland, Sweden and Norway, *P.ruficollis* has been assessed as threatened species based on a small area of occupancy and a small distribution area due to the reduction in the area of natural forests. Threat status: Kar 2(EN); FIN – VU.



Fig. 6. *Phaenops cyanea* (Photo Andrei Humala).

### **Cerambycidae**

#### ***Nivellia sanguinosa* (Gyllenhal, 1827)**

Material. Vikshezero, 1 ♀, on flowers at the edge of an abandoned hayfield, 28/6/2007 (Humala).

This is a rare species developing in coarse woody debris (thin trunks, stumps and branches), most often – *Alnus spp*, also birch and some other deciduous trees like *Prunus* and *Corylus* (Ehnström & Axelsson 2002). It is known from only a few records in southern Karelia (Jakovlev et al., 1986; Polevoi et al. 2005). Threat status: Kar – 4 (DD); Fin – VU.

#### ***Pedostrangalia pubescens* (Fabricius, 1787)**

Material. Turastamozero, 1 ♀, on flowers, 24/7/2012 (Polevoi).

The species develops in dead wood of pine (also on hardwoods in southern parts of its range). Its earlier records in Karelia are from northern Ladoga (Humala & Polevoi 2011). Threat status: Kar – 4 (DD); Fin – VU.

#### ***Leptura nigripes* DeGeer, 1775 (Fig. 7)**

Material. Turastamozero, 1 specimen, 20/7/2012 (Humala, Polevoi); Vegoruksy, 1 specimen, 27/6/2013 (Humala). On flowers at the edges of hayfields.

Larvae develop in dead wood of deciduous trees. The species is found in southern Karelia, although it is relatively rare across its range (Jakovlev et al. 1986). Threat status: Kar – 4 (DD); Fin – EN.



Fig. 7. *Leptura nigripes* (Photo Andrei Humala).

***Leiopus punctulatus* (Paykull, 1800)**

Material. Polya, 1 specimen, on a branch of a fallen aspen, 25/8/2013 (Jakovlev). Larvae of this species feed subcortically in relatively thin dead branches of windfallen aspen trees of a dark black color caused by a fungus *Encoelia fascicularis* (Ascomycota). This species is probably extinct in Finland, and has been viewed as extinct since 1902 also in Sweden, but had been recently rediscovered (Lundberg & Martin 1991). To date only two locations were known in Karelia: Kivach Nature Reserve (Jaakko Mattila leg., 2002, unpubl.) and Pudozh municipality (Humala & Polevoi 2009). Threat status: Fin – RE.

***Phytoecia cylindrica* (Linnaeus, 1758)**

Material. Vikshezero, 1 ♀, on flowers at the edge of an abandoned hayfield, 28/6/2007 (Polevoi); Vegoruksy, 1 ♀, 25/6/2013 (Polevoi). The species develops in the stems of Apiaceae and Asteraceae. There are only a few, mostly old, records from Karelia (Silfverberg & Biström, 1981, Polevoi et al. 2005). Threat status: Kar – 4 (DD).

**Curculionidae**

***Ips sexdentatus*** (Börner 1776), or six-toothed bark beetle. Recorded from Kosmozero by Poppius (Poppius 1899) as *Tomicus stenographus* Duffschmidt. This is the largest species of scolytids in boreal forest zone. Larvae develop under thick bark of recently fallen old pines. Generally, six-toothed bark beetle is known as forest pest which is able to attack healthy trees of Scotch pine under outbreak conditions. However, during last century it has become extremely rare in Northern Europe. In Russian Karelia it has been recorded only in fallen logs in places of long-time storage (Jakovlev et al. 2000). Threat status: Fin – VU.

## LEPIDOPTERA

### Papilionidae

#### *Parnassius mnemosyne* (Linnaeus, 1758) (Fig. 8)

Material. Velikaya Niva, numerous specimens along the road, 10/6/2000 (Humala, Polevoi).

The distribution of Clouded Apollo is limited to southern Karelia (Bolotov et al. 2012). It has first been reported from Zaonezhye (Velikaya Niva and Bolshoy Klimenetsky Island) in the middle of the 20th century (Kaisila 1947). Recently large but scattered populations have been found on the Kizhi skerries (Jakovlev et al. 1999; Gorbach & Kabanen 2010). However, its distribution on the mainland of Zaonezhye Peninsula needs to be clarified. The species is also recorded from southeastern parts of Karelia and Ladoga area (Humala 1998; Humala & Polevoi 2009; Gorbach & Reznichenko 2009). Threat status: Russia – 2; Kar – 3 (VU); Len – 2 (EN); Fin – VU.



Fig. 8. *Parnassius mnemosyne* (Photo Andrei Humala).

### Lycaenidae

#### *Thecla betulæ* (Linnaeus, 1758) (Fig. 9)

Material. 5 km N of Nikonova Guba, 1 ♀, along the road, 22/8/2012 (Humala). In Karelia the species is known only from old records (Gorbach & Reznichenko 2009). Threat status: Kar - 4 (DD).



Fig. 9. *Thecla betulae* (Photo Andrei Humala).

#### Lasiocampidae

##### *Gastropacha quercifolia* (Linnaeus, 1758)

Material. Vegoruksy, 1 ♂, light trap, 26/6/2013 (Polevoi, Humala).

A rare species; there are a few earlier records from the Kivach nature reserve (Kutenkova 2006).

#### Arctiidae

##### *Rhyparia purpurata* (Linnaeus, 1758) (Fig. 10)

Material. Vegoruksy, 2 specimens, light trap, 26/6/2013 (Polevoi, Humala); Pa-leostrov Island, 1 specimen, 3/7/2004, (Polevoi); Kuzaranda, 2 specimens, 4/7/2004 (Humala); Eglov island, 1 specimen 29/6/2014 (Polevoi).

The species inhabits meadows. The only other place in Fennoscandia where the species occurs is southern Finland (Hydén et al. 2006). Threat status: Fin – NT.



Fig. 10. *Rhyparia purpurata* (Photo Alexei Polevoi).



## Zygaenidae

### *Zygaena osterodensis* (Linnaeus, 1758) (Fig. 11)

Material. Podyelniki, numerous specimens, 20-25/7/2011 (Polevoi, Humala); Eglov and Rogachev islands, numerous specimens, 26-29/6/2014, (Polevoi, Humala).

This species is very endangered in Finland. It is also quite rare in Karelia, although locally abundant in Zaonezhye. Threat status: Kar – 3(NT); Fin – RE.



Fig. 11. *Zygaena osterodensis* (Photo Andrei Humala).

## HYMENOPTERA

### Argidae

#### *Aprosthemina hyalinopterum* Conde, 1934

Material. Bukol'nikov Island, 1 ♂, 25/6/2003 (Humala). The first record from Karelia.

### Vespidae

#### *Discoelius dufourii* Lepeletier, 1841

Material. Bolshoi Klimenetsky Isl., 2 km NE of Kurgenitsy, 1 ♀, 19/7/2000 (Humala). A rare species; there are only a few records from Karelia (Polevoi et al. 2005, Polevoi & Humala 2013, Kutenkova 2006). Threat status: Kar - 3(VU); Finland – VU.

### Pompilidae

#### *Dipogon vechti* Day, 1979

Material. Nizhnee Myagrozero, meadow, 1 ♀, 20/7/2012 (Humala); Myagrozero, meadow, 1 ♀, 22/7/2012 (Humala).

In Karelia, the species has only been recorded from samples from Velikaya Guba (Wolf 1967). Threat status: Fin – VU.

### Crabronidae

#### \**Ectemnius spinipes* (A. Morawitz, 1866)

Material. Turastamozero, meadow, 1 ♀, 20/7/2012 (Humala).

This forest-dwelling digger wasp species has not been reported previously from Karelia. Even though the species occurs in many Central European countries, it is not known from Finland and Scandinavia, west of Zaonezhye (Lomholdt 1984).

## Ichneumonidae

### **\*\**Apechthis capulifera* (Kriechbaumer, 1887)**

Material. Turastamozero, 1 ♀, 24/7/2012, (Humala). This is the first record of the species in Karelia.

### **\**Perithous albicinctus* (Gravenhorst, 1829)**

Material. Turastamozero, meadow, 1 ♂, 21/7/2012, (Humala). This is the first record of the species in Karelia.

### ***Zatypota albicoxa* (Walker, 1874)**

Material. Tambitsy, 1 ♂, 26/8/2013 (Humala).

In Karelia, cocoons of this parasitoid spider have only been found from the Lake Ladoga area. Threat status: Kar – 3 (LC).

### ***Rossemia longithorax* Humala 1997**

Material. Polya, 1 ♀, Malaise trap, 26/6-25/8/2013 (Humala, Polevoi).

The species is described from the Kivach nature reserve (Humala 1997 a). It has also been recorded from the Pudozh district (Humala & Polevoi 2009).

### ***Coleocentrus exareolatus* Kriechbaumer, 1894**

Material. 3 km NE of Lipovitsy, 1 ♀, Malaise trap, 25/6-21/8/2013 (Humala, Polevoi).

The species is a parasite of larvae of longhorn beetles and horntails from the genus *Urocerus*, inhabiting coniferous tree trunks. In Karelia, it has previously been known only from the Kivach nature reserve (Humala 1997 b). Threat status: Fin – RE.

### ***Arotes albicinctus* (Gravenhorst, 1829)**

Material. Verkhnee Myagrozero, 1 ♀, mixed forest, 27/7/2012 (Polevoi).

This ichneumon wasp species is associated with longhorn beetles. This is second record of the species in Karelia. It was first recorded by Walter Hellén in the surroundings of the Maselgskaya station in 1943. Threat status: Fin – EN; recommended to be included in the Red Data Book of Karelia as “requiring monitoring”.

### **\**Lycorina triangulifera* Holmgren, 1859**

Material. Radkolye Island, 1 ♂, meadow, 25/6/2003 (Humala).

The species has not been found in Karelia before. Threat status: Fin – VU.

### **\**Tranosemella coxalis* (Brischke, 1880)**

Material. Bolshoi Klimenetsky Isl., 2 km NE of Kurgenitsy, 1 ♀, 19/7/2000 (Humala).

This is the first record of the species in Karelia.

### **\**Heteropelma amictum* Fabricius, 1775 (= *capitatum* Desvignes, 1856)**

Material. Tipinitsy, 1 ♂, 27/8/2013 (Humala).

This is the first record of the species in Karelia.

## DIPTERA

### Limoniidae

#### ***Limonia badia* (Walker, 1848)**

Material. Tipinitsy, 5 ♂♂, 1 ♀, 27/8/2013 (Polevoi).

This poorly known species has been described from North America and it has only recently been discovered in Fennoscandia (Starý & Salmela 2004). There are few records from Karelia to date (Polevoi & Salmela, 2014). The species is probably an old-growth forest specialist. It is understood that its larvae develop in dead aspens (Starý & Salmela, 2004; Halme et al. 2013). Threat status: Fin – NT.

## Ditomyiidae

### *Symmerus nobilis* Lackschewitz, 1937

Material. 7 km S of Kosmozero, 1 ♂, 26/6/2013 (Polevoi).

*Symmerus nobilis* has been found in several Central European countries but is considered a rare species everywhere (Jakovlev et al. 2014). All the records of adults are from broadleaved forests, with the exception of Russian Karelia that lies entirely within the boreal forest zone. In Karelia, there are only two earlier records of female specimens from the Kivach nature reserve (Polevoi 2000). In Finland it has been recorded only once from Ruissalo Strict Nature Reserve, from an herb-rich spruce-dominated forest with aspen, birch, lime and oak (*Quercus robur*). Both the Finnish and the Karelian sites are old-growth forests, growing on fertile soils. There is a high amount of dead aspen wood, in which larvae of the species most probably develop. Threat status: Fin – VU.

## Mycetophilidae

### *Boletina kivachiana* Polevoi & Hedmark, 2004

Material. Turastamozero, 21 ♂♂, 21-24/7/2012 (Polevoi).

In Fennoscandia, this is a characteristic species of old-growth boreal forests. However, its distribution in Karelia is still poorly known. Threat status: Fin – VU.

## Asilidae

### *Choerades tenebraus* Esipenko, 1974

Material. Verkhnee Myagrozero, 1 ♂, edge of a clear-cut, 22/7/2012 (Polevoi).

This is the first record in the European part of Russia. The species has previously been known from Primorye, Sakhalin and Krasnoyarsk Krai in the East (Lehr, 1999). The biology of the species is not known but its larvae probably inhabit dead wood, like other species of the genus *Choerades*. Two females from the Kivach nature reserve have previously been misidentified as *Choerades marginata* (Jakovlev & Polevoi 1991, Polevoi, 1997). However, after finding the male of *Ch. tenebraus* and re-examining old samples, it has become clear that the specimens belong to the same species.

## Rhagionidae

### *Rhagio annulatus* DeGeer, 1776

Material. Kainos Island, 1 ♀, 3/7/2004 (Polevoi)

In Karelia, this species has previously been known only from the Kivach nature reserve (Polevoi 1997). Threat status: Fin – NT.

## Syrphidae

### *Ceriana conopsoidea* (Linnaeus, 1758) (Fig. 12)

Material. Turastamozero, 2 ♂♂, abandoned hay meadows 20-21/7/2012 (Polevoi)

Larvae of the species develop in wet, decaying wood of deciduous trees. In Karelia, the species has been recorded previously from Petrozavodsk (Polevoi et al. 2009). There are also old and new unpublished findings from different parts of southern Karelia. Threat status: Kar – 4 (DD); Fin – NT.

## Strongylophthalmyidae

### *Strongylophthalmyia pictipes* Frey, 1935

Material. Vavlok Island, 7 ♂♂, 2 ♀♀, 3/7/2004 (Polevoi).

Larvae of the species develop under the bark of dead aspens. In southern Karelia, the species is relatively common in forests with a large proportion of aspen (Polevoi 1997, Humala & Polevoi 1999; Jakovlev et al. 2001, Polevoi et al. 2005). Threat status: Fin – VU.

**Tachnidae**

***Tachina grossa* Linnaeus, 1758 (Fig. 13)**

Material. Turastamozero, 1 ♀, 21/7/2012 (Polevoi)

A large and distinctive species. Larvae are parasites in caterpillars of moths of the family Lasiocampidae. It is a relatively rare species, although it may be more abundant in southern areas. In 2013 it was encountered in large numbers in southern Olonets region. Threat status: Len – 3 (NT).



Fig. 12. *Ceriana conopsoides* (Photo Andrei Humala).



Fig. 13. *Tachina grossa* (Photo Andrei Humala).

## List of insect species recorded in Zaonezhye and adjacent islands

\* – species not present in the collections, is known for the studied territory from literature only

? – doubtful identification

Abbreviations: Bol. Klim. Isl. – Bolshoi Klimenetsky Island

### EPHEMEROPTERA

#### Ephemeroidea

*Ephemera vulgata* L. – Vorobyi, Eglov Isl., Khvost Isl., Rogachev Isl.

### ODONATA

#### Calopterygidae

*Calopteryx splendens* Harr. – Turastamozero, Oyatevshina, Velikaya Niva (Valle 1952)

*Calopteryx virgo* L. – Kosmozero, Oyatevshina

#### Coenagrionidae

*Coenagrion armatum* Charp. – Kizhi Isl.

*Coenagrion hastulatum* Charp. – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Kizhi Isl., Kosmozero, Podyelniki, Polya, Vegoruksy, Velikaya Niva (Valle 1952)

*Ischnura elegans* V.d.Lind. – Eglov Isl., Verkhnee Myagrozero

*Erythromma najas* Hans. – Eglov Isl., Kizhi Isl., Podyelniki

*Enallagma cyathigerum* Charp. – Eglov Isl., Khvost Isl., Kizhi Isl., Podyelniki, Rogachev Isl., Turastamozero, Vikshezero, Vorobyi

#### Lestidae

*Lestes sponsa* Hans. – Bol. Klim. Isl., Oyatevshina, Turastamozero

*Lestes dryas* Kirby – Kazhma, Kosmozero, Oyatevshina, Shun'ga, Podyelniki, Turastamozero,

#### Cordulegasteridae

*Cordulegaster boltoni* (Donovan) – Turastamozero, Vikshezero.

#### Gomphidae

*Gomphus vulgatissimus* L. – Bol. Klim. Isl., Myagrozero, Verkhnee Myagrozero

*Onychogomphus forcipatus* L. – Vikshezero

#### Corduliidae

*Cordulia aenea* L. – Bol. Klim. Isl., Eglov Isl., Kazhma, Turastamozero

*Somatochlora flavomaculata* V.d.Lind. – Kizhi Isl., Oyatevshina

*Somatochlora metallica* V.d.Lind. – Bol. Klim. Isl., Eglov Isl., Rogachev Isl., Velikaya Niva (Valle 1952)

#### Libellulidae

*Sympetrum danae* Sulzer – Kazhma, Shun'ga, Turastamozero, Vorobyi,

*Sympetrum flaveolum* L. – Bol. Klim. Isl., Kazhma, Kizhi Isl., Kosmozero, Nizhnee Myagrozero, Oyatevshina, Podyelniki, Shun'ga, Turastamozero, Vegoruksy, Vorobyi, o. Yu. Oleniy.

*Leucorrhinia albifrons* Burm. – Podyelniki

*Leucorrhinia caudalis* Charp. – Podyelniki

*Leucorrhinia dubia* V.d.Lind. – Bol. Klim. Isl.

*Leucorrhinia rubicunda* L. – Bol. Klim. Isl., Kizhi Isl., Polya

*Libellula fulva* Müller – Turastamozero

*Libellula quadrimaculata* L. – Bol. Klim. Isl., Eglov Isl., Kizhi Isl., Nizhnee Myagrozero, Polya, Vegoruksy, Velikaya Guba (Valle 1952), Volkostrov Isl.

#### Aeshniidae

*Aeshna cyanea* Müll. – Tambitsy, Uzkaya Salma, Uzkaya Salma l., Tipinitsy.

*Aeshna grandis* L. – Bol. Klim. Isl., Eglov Isl., Kosmozero, Myagrozero, Podyelniki, Polya, Shun'ga, Tambitsy, Turastamozero, Vegoruksy, Vorobyi

*Aeshna juncea* L. – Kazhma, Nizhneje Myagrozero, Shun'ga, Turastamozero, Vegoruksy, Vorobyi  
*Aeshna viridis* Eversmann – Nikonova Guba

## **ORTHOPTERA**

### **Tettigoniidae**

*Decticus verrucivorus* L. – Bol. Klim. Isl., Kosmozero, Podyelniki, Rogachev Isl., Turastamozero, Vegoruksy  
*Metrioptera brachyptera* L. – Bol. Klim. Isl., Podyelniki  
*Metrioptera roeseli* Hagenbach – Turastamozero, Vegoruksy  
*Tettigonia cantans* Fuessly – Podyelniki

### **Tetrigidae**

*Tetrix bipunctata* (L.) – Zaonezhye (Albrecht 1979), Nizhnee Myagrozero, Bol. Klim. Isl.  
\**Tetrix subulata* (L.) – Zaonezhye (Albrecht 1979)  
\**Tetrix tenuicornis* (Sahlberg) – Zaonezhye (Albrecht 1979)

### **Acrididae**

*Podisma pedestris* (L.) – Zaonezhye (Albrecht 1979), Bol. Klim. Isl., Podyelniki, Turastamozero, Vegoruksy, Kosmozero  
*Omocestus viridulus* L. – Khvost Isl., Kosmozero, Nizhneje Myagrozero, Podyelniki, Rogachev Isl., Turastamozero  
? *Chorthippus biguttulus* L. – Bol. Klim. Isl.  
*Chorthippus brunneus* (Thunb.) – Bol. Klim. Isl., Turastamozero  
*Pseudochorthippus montanus* (Charp.) – Zaonezhye (Albrecht 1979), Turastamozero  
*Pseudochorthippus parallelus* (Zett.) – Turastamozero  
*Psophus stridulus* L. – Vorobyi

## **BLATTOPTERA**

### **Blattellidae**

*Ectobius lapponicus* L. – Nizhneje Myagrozero  
*E. sylvestris* Poda – Eglov Isl., Nizhneje Myagrozero, Vegoruksy

## **MECOPTERA**

### **Panorpidae**

*Panorpa alpina* Ramb. – Bol. Klim. Isl.  
*P. communis* L. – Kizhi Isl., Velikaya Niva, Eglov Isl., Kazhma, Khvost Isl., Kosmozero, Rogachev Isl., Shun'ga, Vegoruksy, Velikaya Niva.

## **RAPHIDIOPTERA**

*Raphidia xanthostigma* Schumm. – Zaonezhye

## **NEUROPTERA**

### **Chrysopidae**

*Chrysopa perla* L. – Kizhi Isl., Eglov Isl., Khvost Isl., Rogachev Isl.  
*Anisochrysa prasina* (Burm.) – Kosmozero, Bol. Klim. Isl.

### **Hemerobiidae**

*Drepanopteryx phalaenoides* L. – Podyelniki

## **HEMIPTERA**

### **Cixiidae**

*Cixius cunicularius* L. – Eglov Isl.  
? *Cixius distinguendus* Kirschbaum – Podyelniki

### **Membracidae**

*Centrotus cornutus* L. – Eglov Isl.

### **Cicadellidae**

*Cicadella viridis* L. – Podyelniki

*Evacanthus interruptus* (L.) – Turastamozero

### **Aphrophoridae**

*Aphrophora alni* (Fall.) – Velikaya Niva, Nikonova Guba, Podyelniki, Turastamozero

*Aphrophora pectoralis* (Mats.) – Velikaya Niva, Shun'ga, Turastamozero, Velikaya Niva

*Lepyronia coleoptrata* L. – Eglov Isl., Rogachev Isl.

### **Berytidae**

*Berytinus clavipes* F. – Vegoruksy

*Neides tipularius* L. – Eglov Isl.

### **Notonectidae**

*Notonecta lutea* Mull. – Vorobyi

### **Microphysidae**

*Myrmedobia coleoptrata* Fallen – Shun'ga

### **Miridae**

? *Adelphocoris lineolatus* Goeze – Podyelniki

*Adelphocoris* cf. *seticornis* F. – Podyelniki

*Adelphocoris quadripunctatus* F. – Nizhneje Myagrozero, Podyelniki

*Adelphocoris seticornis* F. – Nizhneje Myagrozero, Podyelniki

*Atractotomus parvulus* Reuter – Uzkaya Salma

*Capsus ater* L. – Vegoruksy

*Capsus wagneri* Rem. – Podyelniki, Rogachev Isl.

*Closterotomus biclavatus* (H-Sch.) – Uzkaya Salma.

*Closterotomus fulvumaculatus* DeGeer – Polya

? *Dicyphus constrictus* Boheman – Tambitsy

*Globiceps flavomaculatus* Deg. – Podyelniki

? *Globiceps juniperi* Reuter – Podyelniki

*Halticus apterus* L. – Podyelniki

*Labops sahlbergii* Fallen – Eglov Isl.

*Leptopterna dolabrata* L. – Eglov Isl., Nizhneje Myagrozero, Rogachev Isl., Turastamozero, Vegoruksy

*Megaloceroea recticornis* Geoffr. – Nizhneje Myagrozero

? *Monalocoris filicis* L. – Tipinitsy

? *Orthops kalmii* L. – Nizhneje Myagrozero, Vegoruksy

? *Plagiognathus arbustorum* F. – Podyelniki

*Polymerus palustris* Reut. – Oyatevshina, Podyelniki

*Polymerus unifasciatus* Fabricius – Rogachev Isl.

*Stenodema holsata* F. – Tambitsy, Tipinitsy

*Stenotus binotatus* F. – Oyatevshina, Podyelniki

### **Nabiidae**

*Dolichonabis limbatus* Dhlb. – Podyelniki, Tambitsy, Turastamozero

*Nabis flavomarginatus* Scholtz – Nikonova Guba, Nizhneje Myagrozero, Podyelniki,

Shun'ga, Turastamozero

### **Anthocoridae**

*Anthocoris nemorum* (L.) – Podyelniki, Turastamozero

### **Coreidae**

*Coreus marginatus* L. – Eglov Isl., Podyelniki, Turastamozero

### **Rhopalidae**

*Corizus hyoscyami* L. – Eglov Isl., Oyatevshina, Podyelniki, Turastamozero

*Myrmus miriformis* Fallen – Vegoruksy

*Stictopleurus punctatonervosus* (Goeze) – Oyatevshina, Podyelniki, Tipinitsy

#### **Acanthosomatidae**

*Acanthosoma haemorrhoidale* L. – Vegoruksy

*Elasmotethus interstinctus* L. – Tipinitsy

*Elasmucha betulae* Deg. – Podyelniki, Velikaya Niva

*Elasmucha ferrugata* F. – Tambitsy

*Elasmucha grisea* L. – Velikaya Niva

#### **Aradidae**

*Aradus betulae* F. – Lipovitsy

*Aradus depressus* F. – Nizhneje Myagrozzero

*Aradus pictus* Baerensprung – Lipovitsy, Vegoruksy

#### **Lygaeidae**

*Drymus brunneus* R.F. Sahlberg – Uzkaya Salma

? *Nysius thymi* Wolff – Oyatevshina

#### **Pentatomidae**

*Neottiglossa pusilla* Gmel. – Eglov Isl., Podyelniki, Tipinitsy

? *Carpocoris pudicus* Poda – Oyatevshina

*Carpocoris purpureipennis* Deg. – Eglov Isl., Lipovitsy, Nizhneje Myagrozzero, Podyelniki, Turastamozero

*Dolycoris baccarum* L. – Eglov Isl., Nikonova Guba, Nizhneje Myagrozzero, Oyatevshina, Podyelniki, Rogachev Isl., Shun'ga, Turastamozero, Vegoruksy.

*Aelia acuminata* (L.) – Podyelniki, Tipinitsy, Vegoruksy

*Chlorochroa pinicola* Mulsant & Rey – Kazhma, Nizhneje Myagrozzero

*Eurydema oleracea* L. – Nizhneje Myagrozzero

*Picromerus bidens* L. – Velikaya Niva, Nikonova Guba, Podyelniki, Shun'ga, Turastamozero, Vegoruksy.

*Troilus luridus* Fabricius – Nikonova Guba, Shun'ga

**COLEOPTERA** (Nomenclature follows Silfverberg 2010. Species' names within families appear in the alphabetic order)

### **ADEPHAGA**

#### **Gyrinidae**

\**Gyrinus marinus* Gyllenhal – Tolvuya, Shun'ga (Poppius 1899)

#### **Haliplidae**

\**Haliplus fluviatilis* Aubé – Tolvuya (Poppius 1899)

\* *Haliplus fulvus* (Fabricius) – Shun'ga (Poppius 1899)

\**Haliplus furcatus* Seidlitz – Tolvuya (Poppius 1899)

\**Haliplus lineolatus* Mannerheim – Shun'ga (Poppius 1899)

\**Haliplus ruficollis* DeGeer – Tolvuya, Kosmozzero (Poppius 1899)

#### **Dytiscidae**

\**Acathodes fuscipennis* Paykull var. *obscurior* J.Sahlb. – Tolvuya (Poppius 1899)

*Acilius canaliculatus* Nicolai – Podyelniki

\* *Agabus biguttulus* Thomson – Zaonezhye (Poppius 1899)

\* *Agabus congener* (Thunberg) – Zaonezhye (Poppius 1899)

\* *Agabus setulosus* J.Sahlb. – Tolvuya (Poppius 1899)

\* *Agabus uliginosus* L. – Tolvuya (Poppius 1899)

\**Agabus sturmii* (Gyllenhal) – Tolvuya (Poppius 1899)

\**Bidessus unistriatus* (Goeze) – Kizhi Isl., Tolvuya, Velikaya Guba (Poppius 1899)

\**Coelambus impressopunctatus* (Schaller) – Tolvuya, Velikaya Guba (Poppius 1899)

*Colymbetes paykulli* Er. – Velikaya Guba (Poppius 1899), Oyatevshina, Podyelniki

\**Colymbetes striatus* L. – Tolvuya (Poppius 1899)



- \**Dytiscus marginalis* L. – Tolvuya (Poppius 1899)
- \* *Graptodytes granularus* (L.) – Tolvuya (Poppius 1899)
- \* *Graptodytes pictus* (Fabricius.) – Tolvuya (Poppius 1899)
- \**Heterocerus fuculus* Kiesenwetter – Oleny Island (Poppius 1899)
- \**Hydroporus rufifrons* (Müller) – Kosmozero, Tolvuya (Poppius 1899)
- ? \**Hydroporus fennicus* Seidlitz – Kosmozero, Velikaya Guba (Poppius 1899)
- \**Hydroporus erythrocephalus* (L.) – Kosmozero, Tolvuya (Poppius 1899)
- \**Hydroporus pubescens* (Gyllenhal) – Tolvuya (Poppius 1899)
- \**Hydroporus melanarius* Sturm – Velikaya Guba (Poppius 1899)
- \**Hydroporus obscurus* Sturm – Kizhi Isl., Tolvuya (Poppius 1899)
- \**Hydroporus tristis* Paykull – Velikaya Guba (Poppius 1899)
- \**Hydroporus striola* (Gyllenhal) – Kosmozero, Tolvuya (Poppius 1899)
- \**Hydrotus inaequalis* (Fabricius) – Tolvuya (Poppius 1899)
- \**Ilybius obscurus* Marshall – Tolvuya (Poppius 1899)
- \**Ilybius wasastjerna*e Sahlberg – Velikaya Guba (Poppius 1899)
- \**Nebriporus depressus* (Fabricius) – Kizhi Isl., Tolvuya (Poppius 1899)
- \**Noterus crassicornis* Fabricius – Kizhi Isl., Oleny Island (Poppius 1899)
- \**Parnus prolifericornis* Fabricius – Kosmozero, Tolvuya, Shun'ga (Poppius 1899)
- \**Rantus bistratus* (Bergsträsser) – Tolvuya (Poppius 1899)

#### **Carabidae**

- \**Agonum afrum* (Duftschmid) – Velikaya Guba, Shun'ga (Poppius 1899)
- Agonum ericeti* (Panzer) – Velikaya Guba (Poppius 1899), Kizhi Isl., B. Klim. Isl.
- Agonum fuliginosum* (Panzer) – Kizhi Isl., B. Klim. Isl.
- \**Agonum gracile* Sturm – Shun'ga (Poppius 1899)
- \**Agonum viduum* (Panzer) – Shun'ga (Poppius 1899)
- \**Amara apricaria* Paykull – Shun'ga (Poppius 1899)
- \**Amara aulica* Panz. – Unitsa (Poppius 1899)
- Amara brunnea* (Gyllenhal) – Unitsa (Poppius 1899), Kizhi Isl., Bol. Klim. Isl., Yu. Oleny Isl.
- \**Amara communis* Panzer – Tolvuya, Kosmozero (Poppius 1899)
- \**Amara familiaris* (Duftschmid) – Tolvuya (Poppius 1899)
- \**Amara plebeja* (Gyllenhal) – Tolvuya, Velikaya Guba (Poppius 1899)
- \**Anchomenus sexpunctatus* L. – Velikaya Guba, Kosmozero (Poppius 1899)
- \**Badister peltatus* (Panzer) – Kosmozero (Poppius 1899)
- \**Bembidion doris* (Panzer) – Tolvuya, Lihmajärvi (Poppius 1899)
- \**Bembidion lampros* (Herbst) – Kizhi Isl., Velikaya Guba, Kosmozero, Tolvuya, Shun'ga (Poppius 1899), Vegoruksy
- \**Bembidion obliquum* Sturm – Velikaya Guba (Poppius 1899)
- Bembidion quadrimaculatum* L. – Velikaya Guba, Tolvuya, Shun'ga (Poppius 1899), Vegoruksy
- \**Blethisa multipunctata* L. – Tolvuya (Poppius 1899)
- \**Calathus erratus* Sahlberg – Tolvuya, Kosmozero (Poppius 1899)
- Calathus micropterus* (Duftschmid) – B. Klim. Isl., Yu. Oleny Isl., Lipovitsy
- Carabus glabratus* L. Tolvuya (Poppius 1899), Kosmozero, B. Klim. Island, Vegoruksy, Lipovitsy
- Carabus violaceus* L. – B. Klim. Isl.
- \**Cicindela campestris* L. – Kizhi Isl. (Poppius 1899)
- \**Cicindela hybrida* L. – Kosmozero (Poppius 1899)
- \**Clivina fossor* L. – Shun'ga (Poppius 1899)
- Cychnus caraboides* L. – B. Klim. Isl. (Poppius 1899), Kosmozero
- Dromius agilis* L. – Unitsa (Poppius 1899), B. Klim. Island, Lipovitsy

- \**Dromius sigma* Rossi – Unitsa (Poppius 1899)  
 \**Dyschirius aeneus* (Dejean) – Tolvuya (Poppius 1899)  
 \**Dyschirius globosus* (Herbst) – Zaonezhye (Poppius 1899)  
*Elaphrus cupreus* Duftschmid – Vikshezero  
 ?\**Feronia vitrea* Dejean – Unitsa (Poppius 1899)  
*Harpalus affinis* (Schränk.) – Kosmozero, Tolvuya, Shun'ga (Poppius 1899), B. Klim. Isl.  
*Harpalus latus* (L.) – Kosmozero (Poppius 1899), Lipovitsy  
*Lebia chlorocephala* L. – Kizhi Isl. (Poppius 1899), B. Klim. Isl.  
 \* *Lebia cruxminor* L. – Kizhi Isl. (Poppius 1899)  
 \**Nebria gyllenhalii* Schönh. – Tolvuya (Poppius 1899)  
 \**Oodes helopioides* (Fabricius) – Velikaya Guba (Poppius 1899)  
 \**Patrobis excavatus* Paykull var. *assimilis* Chaud. – Tolvuya (Poppius 1899)  
 \* *Poecilus versicolor* Sturm – Velikaya Guba (Poppius 1899)  
*Pterostichus diligens* (Sturm.) – Bol. Klim. Isl.  
*Pterostichus melanarius* (Illiger) – Bol. Klim. Isl.  
*Pterostichus minor* (Gyllenhal, 1827) – Shun'ga (Poppius 1899)  
*Pterostichus niger* (Schall.) – Bol. Klim. Isl.  
*Pterostichus nigrita* (Paykull) – Bol. Klim. Isl.  
*Pterostichus oblongopunctatus* (Fabricius) – Bol. Klim. Isl., Yu. Oleny Isl.  
 \**Tachys nanus* Gyllenhal – Kizhi Isl., Velikaya Guba (Poppius 1899)  
 \**Taphria nivalis* (Panzer) – Tolvuya, Shun'ga (Poppius 1899)  
 \**Trechys rivularis* Gyllenhal – Velikaya Guba (Poppius 1899)  
 \**Trechys secalis* Paykull – Tolvuya (Poppius 1899)

## POLYPHAGA

### HYDROPHILOIDEA

#### Hydrophilidae

- \**Berosus luridus* L. – Velikaya Guba (Poppius 1899)  
 \**Laccobius minutus* L. – Kosmozero, Tolvuya, Shun'ga (Poppius 1899)  
 \**Philydrus frontalis* Er. – Velikaya Guba, Tolvuya (Poppius 1899)  
 \**Choetarthria seminulum* Paykull – Shun'ga (Poppius 1899)  
 \* *Coelostoma orbiculare* Fabricius – Velikaya Guba (Poppius 1899)  
 \**Cercyon haemorrhoidalis* (Fabricius) – Velikaya Guba, Shun'ga (Poppius 1899)  
 \**Cercyon unipunctatus* (L.) – Velikaya Guba (Poppius 1899)  
 ?\**Cryptopleurum atomarium* (Fabricius) – Velikaya Guba, Tolvuya (Poppius 1899)  
 \**Helophorus aquaticus* (L.) – Tolvuya, Shun'ga (Poppius 1899)  
 \**Hydrochus elongatus* (Schaller) – Kosmozero (Poppius 1899)  
 \**Hydrochus brevis* (Herbst) – Kizhi Isl. (Poppius 1899)

### HISTEROIDEA

#### Sphaeritidae

*Sphaerites glabratus* (Fabricius) – Bol. Klim. Isl.

#### Histeridae

- \**Platysoma minus* (Rossi) – Kizhi Isl. (Poppius 1899)  
 \**Platysoma deplanatum* (Gyllenhal) – Kizhi Isl. (Poppius 1899)  
 \**Margarinotus ventralis* (Marseul) – Kizhi Isl. (Poppius 1899)  
*Plegaderus vulneratus* (Panzer) – Kizhi Isl. (Poppius 1899), Bol. Klim. Isl.

## STAPHYLINOIDEA

### Hydraenidae

\**Limnebius truncatellus* (Thunberg) – Kizhi Isl., Kosmozero, Tolvuya, Shun'ga (Poppius 1899)

### Ptiliidae

\**Acrotrichis grandicollis* Mannerheim – Kosmozero (Poppius 1899)

\**Acrotrichis thoracica* (Waltl) – Shun'ga (Poppius 1899)

\**Acrotrichis montandonii* (Allibert) – Unitsa (Poppius 1899)

\**Pteryx suturalis* (Heer) – Unitsa (Poppius 1899)

\**Ptiliolium caledonicum* (Sharp) – Unitsa (Poppius 1899)

### Leiodidae

\**Leiodes gyllenhalii* Stephens – Kizhi Isl., Tolvuya (Poppius 1899)

\**Leiodes polita* (Marsham) – Unitsa (Poppius 1899)

*Anisotoma axillaris* (Gyll.) – Bol. Klim.Isl., Volkostrov Isl.

*Anisotoma castanea* (Hbst.) – Bol. Klim.Isl.

*Anisotoma glabra* (Kug.) – Bol. Klim.Isl., Yu. Oleny Isl.

*Anisotoma humeralis* (Fabricius) – Bol. Klim.Isl., Oyatevschina, Yu. Oleny Isl., Volkostrov Isl.

*Anisotoma orbicularis* (Hbst.) – Bol. Klim.Isl.

*Amphicyllus globus* Fabricius – Bol. Klim.Isl., Oyatevschina, Volkostrov Isl.

*Agathidium badium* Erich. – Bol. Klim.Isl., Yu. Oleny Isl.

*Agathidium confusum* Bris. de Barn. – Bol. Klim. Isl.

*Agathidium discoideum* Erich. – Bol. Klim. Isl., Yu. Oleny Isl.

*Agathidium pisanum* Bris. de Barn. – Bol. Klim.Isl.

*Agathidium seminulum* (L.) – Bol. Klim.Isl., Volkostrov Isl.

*Sciodrepoides watsoni* (Spence) – Velikaya Guba (Poppius 1899), Bol. Klim. Isl., Volkostrov Isl.

\**Stenichnus bicolor* (Denny) – Kizhi Isl. (Poppius 1899)

### Silphidae

*Necrodes littoralis* (L.) – Unitsa (Poppius 1899), Podyelniki

*Nicrophorus vespillo* (L.) – Bol. Klim.Isl.

*Nicrophorus vespilloides* Herbst – Bol. Klim.Isl.

*Oiceoptoma thoracica* (L.) – Velikaya Guba (Poppius 1899), Lipovitsy, Bol. Klim. Isl.

*Phosphuga atrata* (L.) – Vorobyi

### Staphylinidae

\**Acrotoma aterrima* Gravenhorst – Shun'ga, Tolvuya (Poppius 1899)

\**Acryria inflata* Gyllenhal – Kizhi Isl. (Poppius 1899)

\**Amisha analis* Gravenhorst – Shun'ga (Poppius 1899)

\**Anthobium longipanne* Er. – Kosmozero (Poppius 1899)

\**Anthobium ophthalmicum* Paykull – Kizhi Isl., Kosmozero (Poppius 1899)

\**Atheta celata* Er. – Unitsa (Poppius 1899)

\**Baptolinus alternans* Gravenhorst – Velikaya Guba (Poppius 1899)

\**Baryodma lanuginosa* Gravenhorst – Unitsa (Poppius 1899)

\**Baryodma lugubris* Aubé – Tolvuya (Poppius 1899)

\**Baryodma morion* Gravenhorst – Shun'ga (Poppius 1899)

\**Baryodma nitida* Gravenhorst – Kizhi Isl. (Poppius 1899)

\**Bledius fracticornis* Paykull – Shun'ga (Poppius 1899)

\**Bolitochara pulchra* (Gravenhorst) – Kosmozero (Poppius 1899)

\**Bryaxis bulbifer* Reich. – Shun'ga (Poppius 1899)

\**Creophilus maxillosus* L. – Shun'ga (Poppius 1899)

\**Cryptobium fracticorne* Paykull – Shun'ga (Poppius 1899)

\**Dinarcaea aequata* Er. – Kizhi Isl., Velikaya Guba (Poppius 1899)

- \**Etheothassa concinna* Marsh. – Kizhi Isl. (Poppius 1899)  
 \**Euplectus karsteni* Reichenbach, – Kizhi Isl. (Poppius 1899)  
 \**Gabrius splendidulus* Gravenhorst – Kizhi Isl., Kosmozero (Poppius 1899)  
 \**Gabrius trossulus* Nordmann – Unitsa (Poppius 1899)  
 \**Geodromicus plagiatus* Fabricius, var. *nigrita* Mull. – Tolvuya (Poppius 1899)  
 \**Gyrophaena laevipennis* Kr. – Kosmozero, Unitsa (Poppius 1899)  
 \**Gyrophaena manca* Er. – Kosmozero (Poppius 1899)  
 \**Haploderus caelatus* Gravenhorst – Shun’ga (Poppius 1899)  
 \**Ischnosoma splendida* Gravenhorst – Kosmozero, Velikaya Guba (Poppius 1899)  
 \**Leptusa analis* Gyllenhal – Kizhi Isl. (Poppius 1899)  
*Lordithon lunulatus* L. – Kurgenitsy  
 \**Micrisaurus xantopus* Er. – Unitsa (Poppius 1899)  
 \**Omaliium caesum* Gravenhorst – Shun’ga (Poppius 1899)  
 \**Omaliium excavatum* Steph. – Shun’ga (Poppius 1899)  
 \**Othius lapidicola* Kiesw. – Unitsa (Poppius 1899)  
*Oxyporus maxillosus* Fabricius – Kurgenitsy  
*Oxyporus rufus* (L.) – Kurgenitsy  
 \**Oxytelus fulvipes* Er. – Shun’ga (Poppius 1899)  
 \**Oxytelus rugosus* Sahlb. – Shun’ga (Poppius 1899)  
 \**Philonthus agilis* Gravenhorst – Shun’ga (Poppius 1899)  
 \**Philonthus cephalotes* Gravenhorst – Kizhi Isl., Shun’ga (Poppius 1899)  
 \**Philonthus fulvipes* Fabricius – Shun’ga (Poppius 1899)  
 \**Philonthus micans* Gravenhorst – Tolvuya (Poppius 1899)  
 \**Philonthus opacus* Gyllenhal – Kizhi Isl., Shun’ga, Tolvuya (Poppius 1899)  
 \**Philonthus sordidus* Gravenhors – Kizhi Isl. (Poppius 1899)  
 \**Philonthus splendens* Fabricius – Kizhi Isl. (Poppius 1899)  
 \**Philonthus umbratilis* Gravenhorst – Shun’ga (Poppius 1899)  
 \**Phyllodrepa rufipes* Geoffroy – Shun’ga (Poppius 1899)  
 \**Placusa infima* Er. – Unitsa (Poppius 1899)  
 \**Placusa pumilio* Er. – Unitsa (Poppius 1899)  
 \**Platystethus nodufrons* Sahlb. – Shun’ga, Tolvuya (Poppius 1899)  
 \**Raphirus attenuatus* Gyllenhal – Tolvuya, Unitsa (Poppius 1899)  
 \**Raphirus umbrinus* Er. – Unitsa (Poppius 1899)  
*Scaphidium quadrimaculatum* Olivier – Bol. Klim. Isl.  
*Scaphisoma agaricinum* (L.) Kizhi Isl., Tolvuya (Poppius 1899), Bol. Klim. Isl., Volkostrov Isl.  
*Scaphisoma boleti* (L.) – Bol. Klim. Isl., Yu. Oleny Isl.  
*Scaphisoma boreale* (Lundbl.) – Bol. Klim. Isl., Volkostrov Isl.  
 \**Scaphisoma subalpinum* Reitter – Kizhi Isl., Kosmozero (Poppius 1899)  
 \**Stenus bifoveolatus* Gyllenhal – Unitsa (Poppius 1899)  
 \**Stenus biguttatus* L. – Tolvuya (Poppius 1899)  
 \**Stenus canaliculatus* Gyllenhal – Tolvuya (Poppius 1899)  
 \**Stenus carbonarius* Gyllenhal – Kizhi Isl., Shun’ga, Unitsa (Poppius 1899)  
 \**Stenus fornicatus* Steph. – Kizhi Isl. (Poppius 1899)  
 \**Stenus fuscicornis* Steph. – Shun’ga (Poppius 1899)  
 \**Stenus fuscipes* Gravenhorst – Unitsa (Poppius 1899)  
 \**Stenus melanarius* Steph. – Kizhi Isl., Oleny Island (Poppius 1899)  
 \**Stenus nanus* Steph. – Unitsa (Poppius 1899)  
 \**Stenus nitens* Steph. – Shun’ga (Poppius 1899)  
 \**Stenus oculatus* Gravenhorst – Unitsa (Poppius 1899)  
 \**Stenus opticus* Gravenhorst – Kizhi Isl. (Poppius 1899)  
 \**Stenus palposus* Zetterstedt – Shun’ga (Poppius 1899)  
 \**Stenus proditor* Er. – Velikaya Guba (Poppius 1899)

- \**Stenus pussilus* Steph. – Kizhi Isl. (Poppius 1899)
- \**Stenus scabriculus* J.Sahlb. – Unitsa (Poppius 1899)
- \**Stenus speculator* (Lac.) – Kuzaranda, Shun'ga (Poppius 1899)
- \**Stenus tarsatus* Ljung. – Kizhi Isl., Kosmozero, Shun'ga, Tolvuya, Velikaya Guba (Poppius 1899)
- \**Stenus vafellus* Er. – Velikaya Guba (Poppius 1899)
- \**Tachinus collaris* Gravenhorst – Shun'ga (Poppius 1899)
- \**Tachinus fimetarius* Gravenhorst – Kizhi Isl. (Poppius 1899)
- \**Tachinus laticollis* Gravenhorst – Velikaya Guba (Poppius 1899)
- \**Tachinus marginatus* Gyllenhal – Tolvuya (Poppius 1899)
- Tachyporus obtusus* L. – Tipinitsy
- \**Tachyporus scitulus* Er. – Unitsa (Poppius 1899)
- \**Tanykraerus laqueatus* Marsh. – Kizhi Isl. (Poppius 1899)
- \**Trichoderma pubescens* DeGeer. – Bol. Klim. Isl. (Poppius 1899)
- \**Xantholinus distans* Muls. & Rey. – Unitsa (Poppius 1899)

## SCARABAEOIDEA

### Lucanidae

- Ceruchus chrysomelinus* (Hochenwarth) – Lipovitsy
- Platycerus caprea* (DeGeer) – Bol. Klim. Isl., Volkostrov Isl.

### Geotrupidae

- Geotrupes stercorosus* (Scriba) – Zaonezhye (Poppius 1899), Lipovitsy, Kosmozero, Eglov Isl. Kizhi Isl., Bol. Klim. Isl.

### Scarabaeidae

- \**Aphodius merdarius* Fabricius – Velikaya Guba (Poppius 1899)
- \**Aphodius niger* (Panzer, 1797) – Tolvuya (Poppius 1899)
- \**Aphodius plagiatus* (L.) – Tolvuya (Poppius 1899)
- \**Aphodius prodromus* (Brahm) – Velikaya Guba (Poppius 1899)
- \**Aphodius punctatosulcatus* Sturm) – Velikaya Guba (Poppius 1899)
- Aphodius rufipes* (L.) – Kizhi Isl. (Poppius 1899), Bol. Klim. Isl., KlzhIsl., Volkostrov Isl.
- \**Aphodius sordidus* (Fabricius) – Tolvuya (Poppius 1899)
- Cetonia aurata* (L.) – Bol. Klim. Isl.
- \**Onthophagus nuchicornis* (L.) – Kizhi Isl. (Poppius 1899)
- Phyllopertha horticola* (L.) – Bol. Klim. Isl., Volkostrov Isl.
- Protaetia cuprea* (Fabricius, 1775) ssp. *metallica* Herbst – Kurgenitsy, Yu. Oleny Isl., Nizhneje Myagrozero, Eglov Isl., Khvost Isl., Rogachev Isl.
- Trichius fasciatus* (L.) – Kizhi Isl., Kosmozero, Kuzaranda, Velikaya Guba (Poppius 1899), Bol. Klim. Isl., Eglov Isl., Khvost Isl., Nizhneje Myagrozero, Podyelniki, Uzkaya Salma, Vegoruksy, Lipovitsy.

## SCIRTOIDEA

### Scritidae

- Microcara testacea* (L.) – Tolvuya (Poppius 1899), Khvost Isl.
- \**Cyphon variabilis* (Thunberg) – Kosmozero (Poppius 1899)

### Melyridae

- Dasytes niger* (L.) – Kosmozero, Shun'ga, Tolvuya (Poppius 1899)

## DASCILLOIDEA

### Dascilidae

- Dascillus cervinus* (L.) – Kizhi Isl., Kosmozero (Poppius 1899), Bol. Klim. Isl.

## BUPRESTOIDEA

### Buprestidae

*Anthaxia quadripunctata* (L.) – Tolvuya (Poppius 1899), Oyatevshina, Vegoruksy, Uzskaya Salma

*Chrysobothris chrysostigma* (L.) – Nizhnee Myagzero, Kosmozero, Vegoruksy

\**Habroloma nanum* (Paykull) – Kizhi Isl. (Poppius 1899)

*Phaenops cyanea* (Fabricius) – Vegoruksy

*Trachys minutus* L. – Khvost Isl.

## BYRRHOIDEA

### Byrrhidae

\**Byrrhus pilula* (L.) – Kizhi Isl. (Poppius 1899)

\**Byrrhus pustulatus* (Forster) – Kizhi Isl. (Poppius 1899)

\**Cytilus auricomus* (Duftschmid) – Kosmozero (Poppius 1899)

## DRYOPOIDEA

### Elmidae

\* *Normandia nitens* (Müller) – Shun'ga (Poppius 1899)

## ELATEROIDEA

### Eucnemidae

*Hylochaeres populi* Muona & Brustle – Polyta, Tambitsy

*Microrrhagus pygmaeus* (Fabricius) – Bol. Klim. Isl.

### Elateridae

*Ampedus balteatus* (L.) – Bol. Klim. Isl., Eglov Isl.

\**Ampedus cinnabarinus* (Eschscholtz) – Kizhi Isl. (Poppius 1899)

*Ampedus erythrogonus* (Müller) – Bol. Klim. Isl., Volkostrov Isl.

*Ampedus nigrinus* (Herbst) – Unitsa (Poppius 1899) – Bol. Klim. Isl., Volkostrov Isl.

\**Ampedus pomorum* (Herbst) – Kosmozero (Poppius 1899)

*Ampedus sanguineus* (L.) – Oyatevshina

*Ampedus tristis* (L.) – Bol. Klim. Isl., Kizhi Isl.

*Athous subfuscus* (Müller) – Velikaya Guba (Poppius 1899), Bol. Klim. Isl., Eglov Isl., Volkostrov Isl.

\* *Cidnopus aeruginosus* (Olivier) – Kizhi Isl. (Poppius 1899)

*Ctenicera pectinicornis* (L.) – Kizhi Isl. (Poppius 1899), Bol. Klim. Isl., Volkostrov Isl.

*Ctenicera cuprea* (Fabricius) – Eglov Isl., Khvost Isl., Rogachev Isl.

\**Dalopius marginatus* (L.) – Shun'ga (Poppius 1899), Bol. Klim. Isl.

\**Denticollis borealis* (Paykull) – Kizhi Isl. (Poppius 1899)

*Denticollis linearis* L. – Kizhi Isl., Lipovitsy, Kosmozero (Poppius 1899), Bol. Klim. Isl.

*Eanus costalis* (Paykull) – Bol. Klim. Isl., Kizhi Isl., Volkostrov Isl.

\**Ectinus aterrimus* (L.) – Kizhi Isl. (Poppius 1899)

*Harminius undulatus* (Deg.) – Bol. Klim. Isl., Kosmozero, Yu. Oleny Isl.

\**Lacon fasciatus* (L.) – Tolvuya, Velikaya Guba (Poppius 1899)

\**Liotrichus affinis* (Paykull) – Bol. Klim. Isl. (Poppius 1899)

*Melanotus castanipes* (Paykull) – Bol. Klim. Isl.

\**Oedostethus quadripustulatus* (Fabricius) – Tolvuya, Kosmozero (Poppius 1899)

*Prosternon tessellatum* (L.) – Kizhi Isl., Velikaya Guba (Poppius 1899), Eglov Isl., Rogachev Isl.

*Sericus brunneus* (L.) – Bol. Klim. Isl.

*Selatosomus aeneus* (L.) – Eglov Isl., Rogachev Isl.

*Selatosomus cruciatus* (L.) – Bol. Klim. Isl., Volkostrov Isl.

*Selatosomus melancholicus* (Fabricius) – Bol. Klim. Isl.

## CANTHAROIDEA

### Lycidae

*Dictyoptera aurora* (Herbst) – Velikaya Guba (Poppius 1899), Kurgenitsy

*Lopheros rubens* (Gyllenhal) – Vikshezero

*Lygistopterus sanguineus* L. – Velikaya Guba (Poppius 1899), Bol. Klim.Isl., Nizhneje Myagrozero, Vikshezero

*Platycis minutus* Fabricius – Turastamozero

### Lampyriae

*Lampyrus noctiluca* L. – Kizhi Isl., Kosmozero, Uzkaya Salma, Velikaya Guba (Poppius 1899), Bol. Klim.Isl., Kizhi

### Cantharidae

*Abdisia schoenherri* (Dejean) – Dianova Gora, Kosmozero (Poppius 1899), Bol. Klim. Isl. Poly, Uzkaya Salma, Volkostrov Isl.

*Cantharis figurata* Mannerheim – Kizhi Isl., Kosmozero, Velikaya Guba (Poppius 1899), Eglov Isl., Khvost Isl.

\**Cantharis flavilabris* Fallén – Kosmozero, Shun'ga, Tolvuya (Poppius 1899)

*Cantharis nigricans* (Müller) – Eglov Isl., Rogachev Isl.

*Cantharis pellucida* Fabricius – Lipovitsy, Rogachev Isl.

*Malthinus biguttatus* (L.) – Kuzaranda, Tolvuya (Poppius 1899), Bol. Klim.Isl. Eglov Isl.

*Malthinus punctatus* (Geoffroy) – Kosmozero (Poppius 1899) Eglov Isl., Khvost Isl., Uzkaya Salma

*Malthodes brevicollis* (Paykull) – Kizhi Isl. (Poppius 1899), Eglov Isl.

\**Malthodes flavoguttatus* Kiesenwetter – Tolvuya (Poppius 1899)

*Malthodes fuscus* Waltl – Uzkaya Salma

\**Malthodes mysticus* Kiesenwetter – Chunga (Poppius 1899)

\**Malthodes maurus* (Laporte de Castelnau) – Kizhi Isl. (Poppius 1899)

*Podabrus lapponicus* (Gyllenhal) – Velikaya Guba (Poppius 1899)

*Rhagonycha atra* (L.) – Kizhi Isl., Kosmozero (Poppius 1899), Bol. Klim.Isl. Lipovitsy

*Rhagonycha elongata* (Fallen) – Bol. Klim.Isl.

*Rhagonycha lignosa* (Müller) – Eglov Isl., Lipovitsy, Poly

*Rhagonycha nigriventris* Motschulsky – Khvost Isl., Poly

*Rhagonycha testacea* (L.) – Kizhi Isl. (Poppius 1899)

## BOSTRICHODEA

### Dermestidae

*Dermestes lardarius* L. – Kizhi Isl.

*Trogoderma glabrum* (Herbst) – Kizhi Isl.

*Anthrenus museorum* (L.) – Schun'ga (Poppius 1899), Kizhi Isl., Oyatevshchina

### Anobiidae

*Anobium rufipes* Fabricius – Kizhi Isl., Oyatevshchina, Bol. Klim. Isl.

*Anobium thomsoni* (Kraatz.) – Bol. Klim. Isl.

*Caenocara bovistae* (Hoffmann.) – Kizhi Isl. (Poppius 1899)

*Dorcatoma dresdensis* (Herbst). – Kosmozero (Poppius 1899), Bol. Klim.Isl., Volkostrov Isl.

*Dorcatoma robusta* Strand. – Bol. Klim.Isl., Volkostrov Isl.

*Hadrobregmus pertinax* (L.) – Kizhi Isl., Bol. Klim. Isl.

*Hadrobregmus confusus* (Kraatz) – Kizhi Isl.

*Priobium carpini* (Herbst) – Kizhi Isl., Kosmozero, Schun'ga (Poppius 1899), Kizhi Isl.

*Ptilinus fuscus* Geoffroy – Bol. Klim. Isl., Lipovitsy, Poly, Vegoruksy, Turastamozero, Volkostrov Isl., Yu. Oleny

*Ptinus raptor* Sturm – Kizhi Isl.

*Ptinus villiger* Reitter – Kizhi Isl.

## LYMEXYLOIDEA

### Lymexylonidae

*Hylecoetus dermestoides* (L.) – Bol. Klim.Isl., Kosmozero, Volkostrov Isl.

## CLEROIDEA

### Trogossitidae

*Grynocharis oblonga* (L.) – Kizhi Isl.

*Ostoma ferruginea* (L.) – Uzkaya Salma, Bol. Klim.Isl., Kosmozero, Lipovitsy

*Peltis grossa* (L.) – Dianova Gora (Poppius 1899), Lipovitsy, Kurgenitsy

### Cleridae

*Thanasimus formicarius* L. – Vikshezero

### Dasytidae

*Dasytes niger* (L.) – Rogachev Isl.

*Dolichosoma lineare* (Rossi) – Eglov Isl., Rogachev Isl.

### Malachidae

*Malachius bipustulatus* (L.) – Velikaya Guba (Poppius 1899), Eglov Isl., Kizhi Isl., Vikshezero

## CUCUJOIDEA

### Kateretidae

\**Brachypterolus pulicarius* (L.) – Kizhi Isl. (Poppius 1899)

\**Brachypterus urticae* (Fabricius) – Shun'ga (Poppius 1899)

\**Kateretes pusillus* (Thunberg) – Kosmozero (Poppius 1899)

### Nitidulidae

*Cydramus luteus* (Fabricius) – Kosmozero, Unitsa (Poppius 1899), Velikaya Niva, Bol. Klim.Isl., Volkostrov Isl.

*Cydramus variegatus* (Herbst) – Bol. Klim.Isl., Tambitsy, Tipinitsy, Uzkaya Salma, Volkostrov Isl.

*Cyllodes ater* Hbst. – Kurgenitsy, Oyatevshchina, Lipovitsy, Uzkaya Salma, Volkostrov Isl.

\**Epuraea lapponica* (J.Sahlberg) – Shun'ga, Tolvuya (Poppius 1899)

\**Epuraea longula* Erichson – Velikaya Guba (Poppius 1899)

\**Epuraea marseuli* Reitter – Velikaya Guba (Poppius 1899)

\**Epuraea pallescens* (Stephens) – Kizhi Isl., Tolvuya (Poppius 1899)

\**Epuraea terminalis* (Mannerheim) – Unitsa (Poppius 1899)

*Glischrochilus hortensis* (Geoffroy) – Bol. Klim. Isl.

*Glischrochilus quadripunctatus* (L.) – Bol. Klim. Isl., Tipinitsy, Vikshezero

*Ipidia binotata* Reitter – Volkostrov Isl.

\**Meligethes aeneus* (Fabricius) – Kosmozero, Tolvuya (Poppius 1899)

\**Meligethes flavimanus* Stephens, 1830 – Unitsa (Poppius 1899)

\**Meligethes subrugosus* (Gyllenhal, 1808) – Kizhi Isl., Tolvuya (Poppius 1899)

\**Meligethes viduatus* Sturm – Shun'ga, Kosmozero (Poppius 1899)

*Pityophagus ferrugineus* L. – Volkostrov Isl.

*Pocadius ferrugineus* (Fabricius) – Velikaya Guba (Poppius 1899), Bol. Klim. Isl.

*Soronia punctatissima* (Ill.) – Bol. Klim. Isl.

### Monotomidae

\**Rhizophagus bipustulatus* (Fabricius) – Shun'ga, Kosmozero (Poppius 1899)

*Rhizophagus cribratus* (Gyllenhal) – Bol. Klim. Isl.

*Rhizophagus depressus* (Fabricius) – Bol. Klim. Isl.

*Rhizophagus dispar* (Paykull) – Kizhi Isl., Kosmozero (Poppius 1899), Bol. Klim. Isl., Volkostrov Isl.



*Rhizophagus puncticollis* Sahlberg – Kopanets Lake, Kurgenitsy

#### **Silvanidae**

\* *Silvanus unidentatus* (Olivier) – Dianova Gora, Velikaya Guba (Poppius 1899)

#### **Phalacridae**

\* *Phalacrius substriatus* Gyllenhal – Kizhi Isl., Kosmozero, Shun'ga, Tolvuya, Velikaya Guba (Poppius 1899)

#### **Cryptophagidae**

\* *Antherophagus pallens* (L.) – Kizhi Isl. (Poppius 1899)

\* *Atomaria fuscata* (Schönherr) – Unitsa, Velikaya Guba (Poppius 1899)

\* *Atomaria peltata* Kraatz – Unitsa (Poppius 1899)

*Micrambe abietis* (Paykull) – Bol. Klim. Isl.

#### **Erotylidae**

*Dacne bipustulata* (Thunberg) – Bol. Klim. Isl.

*Triplax aenea* Schall. – Bol. Klim. Isl., Lipovitsy, Kosmozero

*Triplax rufipes* Fabricius – Vikshezero

*Triplax russica* L. – Zaonezhye (Poppius 1899), Bol. Klim. Isl., Volkostrov Isl., Yu. Oleny, Turastamozero, Uzkaya Salma

*Triplax scutellaris* (Charp.) – Kurgenitsy

#### **Byturidae**

*Byturus tomentosus* (Deg.) – Bol. Klim. Isl., Volkostrov Isl.

#### **Cerylonidae**

*Cerylon fagi* Brisout de Barneville – Bol. Klim. Isl., Volkostrov Isl.

*Cerylon ferrugineum* Stephens – Volkostrov Isl.

*Cerylon histeroides* (Fabricius) – Kosmozero, Unitsa (Poppius 1899), Bol. Klim. Isl.

#### **Endomychidae**

*Endomychus coccineus* (L.) – Volkostrov Isl.

#### **Coccinellidae**

*Anatis ocellata* L. – Turastamozero

*Anisosticta novemdecimpunctata* L. – Vorobyi

*Calvia quatuordecimguttata* L. – Oyatevshchina, Podyelniki, Rogachev Isl., Turastamozero

*Chilocorus renipustulatus* Scriba – Turastamozero

*Coccinella hieroglyphica* L. – Eglov Isl., Podyelniki, Turastamozero, Verkhnee Myagrozero

\* *Coccinella magnifica* Redtenbacher – Unitsa (Poppius 1899)

*Coccinella septempunctata* L. – Kizhi Isl., Kosmozero, Vikshezero, Bol. Klim. Isl., Tolvuya (Poppius 1899)

*Coccinula quatuordecimpustulata* L. – Vorobyi, Eglov Isl., Oyatevshchina, Podyelniki, Verkhnee Myagrozero, Vikshezero

*Hippodamia notata* L. – B. Klim. Isl., Oyatevshchina, Podyelniki, Uzkaya Salma, Vegoruksy, Vorobyi

*Hippodamia septemmaculata* DeGeer – Vorobyi

*Myrrha octodecimguttata* L. – Kizhi Isl. (Poppius 1899), Eglov Isl., Turastamozero

*Myzia oblongoguttata* (L.) – Vegoruksy, Eglov Isl.

\* *Oenopia conglobata* L. – Kosmozero (Poppius 1899)

*Propylea quatuordecimpunctata* L. – Vorobyi, Eglov Isl., Podyelniki, Rogachev Isl., Tipinitsy, Turastamozero, Vikshezero

*Psyllobora vigintiduopunctata* (L.) – Vorobyi, Eglov Isl., Tambitsy, Vegoruksy, Vikshezero

#### **Latridiidae**

*Corticarina fuscata* (Gyllenhal) – Kizhi Isl., Kosmozero, Shun'ga, Velikaya Guba (Poppius 1899)

\* *Corticaria ferruginea* Marsham – Tolvuya (Poppius 1899)

*Corticaria lapponica* Zett. – Bol. Klim. Isl.

\**Corticaria lateritia* Mannerheim – Oleny Isl. (Poppius 1899)

\**Corticaria pubescens* (Gyllenhal) – Shun'ga (Poppius 1899)

*Enicmus rugosus* (Herbst) – Bol. Klim. Isl., Volkostrov Isl.

*Latridius hirtus* (Gyllenhal) – Bol. Klim. Isl.

\**Latridius minutus* (L.) – Shun'ga (Poppius 1899)

\**Stephostethus lardarius* (DeGeer) – Oleny Isl. (Poppius 1899)

#### Mordellidae

\**Mordellochroa abdominalis* (Fabricius, 1775)– Kuzaranda (Poppius 1899)

*Mordella aculeata* L. – Bol. Klim. Isl.

*Mordella holomelaena* Apfelbeck – Shunevskiy Isl.

*Mordellistena humeralis* (L.) – Shun'ga (Poppius 1899), Shunevskiy Isl.

*Mordellistena parvula* (Gyllenhal) – Kizhi Isl. (Poppius 1899), Bol. Klim. Isl.

*Mordellistena pumila* (Gyllenhal, 1810)– Vorobyi

*Tomoxia bucephala* Costa – Bol. Klim. Isl., Podyelniki

#### Zopheridae

*Bitoma crenata* (Fabricius) – Dianova Gora, Unitsa (Poppius 1899)

### TENEBRIONOIDEA

#### Mycetophagidae

*Litargus connexus* (Geoffroy) – Bol. Klim. Isl.

\**Mycetophagus decempunctatus* Fabricius – Kizhi Isl. (Poppius 1899)

*Mycetophagus fulvicollis* Fabricius – Bol. Klim. Isl.

*Mycetophagus multipunctatus* Fabricius – Kosmozero, Unitsa (Poppius 1899), Bol. Klim. Isl.

*Mycetophagus piceus* (Fabricius) – Velikaya Guba (Poppius 1899), Bol. Klim. Isl.

*Mycetophagus populi* Fabricius – Bol. Klim. Isl.

*Mycetophagus quadripustulatus* (L.) – Velikaya Guba (Poppius 1899), Kurgenitsy, Volkostrov Isl.

#### Ciidae

\**Cis comptus* (Gyllenhal) – Dianova Gora, Schun'ga, Unitsa (Poppius 1899)

\**Cis bidentatus* (Olivier) – Kosmozero (Poppius 1899)

*Cis jacquemartii* Mellié – Bol. Klim. Isl.

*Cis micans* (Fabricius) – Dianova Gora, Unitsa (Poppius 1899), B. Klim. Isl.

\**Cis rugulosus* Mellié – Schun'ga (Poppius 1899)

\**Dolichocis laricinus* (Mellié, 1848) – Kosmozero (Poppius 1899)

\**Octotemnus glabriculus* (Gyllenhal) – Dianova Gora (Poppius 1899)

*Orthocis alni* (Gyllenhal) – Bol. Klim. Isl., Volkostrov Isl.

\**Sulcacis fronticornis* (Panzer, 1805) – Dianova Gora (Poppius 1899)

#### Tenebrionidae

*Bolitophagus reticulatus* (L.) – Bol. Klim. Isl., Uzkaya Salma, Poly, Volkostrov Isl.

*Diaperis boleti* (L.) – Bol. Klim. Isl.

*Lagria hirta* (L.) – Zaonezhye (Poppius 1899), Vorobyi, Eglov Isl., Khvost Isl., Nizhneje

Myagrozero, Podyelniki, Rogachev Isl.

*Mycetochara flavipes* (Fabricius) – Kizhi Isl., Rogachev Isl.

\**Tenebrio molitor* L. – Unitsa (Poppius 1899)

\**Uloma culinaris* (L.) – Unitsa (Poppius 1899)

#### Oedemeridae

*Chrysanthia geniculata* Heyden – Nizhneje Myagrozero, Verkhnee Myagrozero

*Chrysanthia viridissima* (L.) – Kosmozero, Tolvuya (Poppius 1899), Bol. Klim. Isl.

*Oedemera virescens* L. – Rogachev Isl.

#### Tetratomidae

*Tetratoma ancora* (Fabricius) – Bol. Klim. Isl.

*Hallomenus binotatus* (Quensel) – Bol. Klim. Isl.

## Melandryidae

- Melandrya dubia* Schall. – Bol. Klim. Isl.  
*Orchesia fasciata* (Illiger) – Bol. Klim. Isl., Podyelniki  
*Orchesia micans* (Panzer) – Bol. Klim. Isl., Volkostrov Isl.  
*Phryganophilus ruficollis* (Fabricius) – Bol. Klim. Isl.  
*Xylita laevigata* (Hellenius) – Bol. Klim. Isl.

## Pythidae

- Pytho depressus* (L.) – Bol. Klim. Isl., Velikaya Guba (Poppius 1899), Kosmozero, Uzkaya Salma  
*Pytho kolwensis* Sahlberg – Lipovitsy, Poly, Tambitsy

## Pyrochroidae

- Schizotus pectinicornis* (L.) – Zaonezhye (Poppius 1899), Bol. Klim. Isl.  
Anthicidae Latreille, 1819  
\**Notoxus monoceros* (L.) – Tolvuya (Poppius 1899)

## Scaptiidae

- Anaspis arctica* Zetterstedt – Dianova Gora, Kosmozero, Unitsa (Poppius 1899), Bol. Klim. Isl., Volkostrov Isl.  
\**Anaspis frontalis* (L.) – Kizhi Isl., Kosmozero, Oleny Isl., Shun'ga, Velikaya Guba (Poppius 1899)  
*Anaspis marginicollis* Lindberg – Bol. Klim. Isl.

## Salpingidae

- \**Salpingus planirostris* (Fabricius) – Shun'ga (Poppius 1899), Kizhi Isl.  
*Salpingus ruficollis* L. – Zaonezhye  
\**Sphaeriestes stockmanni* (Biström) – Kizhi Isl. (Poppius 1899)

## CHRYSOMELOIDEA

### Cerambycidae

- \**Acmaeops pratensis* (Laicharting) – Kizhi Isl. (Poppius 1899)  
*Aegomorphus clavipes* (Schrank) – Kosmozero (Poppius 1899), Bol. Klim. Isl., Verkhnee Myagrozero  
*Agapanthia villosoviridescens* DeGeer – Rogachev Isl.  
*Alosterna tabacicolor* DeGeer – Kosmozero (Poppius 1899), Bol. Klim. Isl., Kizhi Isl., Eglov Isl., Klimenicy, Lipovitsy, Rogachev Isl., Uzkaya Salma, Vikshezero  
*Anoplodera livida* (Fabricius) – Podyelniki, Vorobyi  
*Anoplodera maculicornis* (L.) – Vorobyi, Podyelniki, Vegoruksy, Poly, Eglov Isl., Kizhi Isl., Nizhneje Myagrozero, Rogachev Isl., Shunevskiy Isl.  
*Anoplodera reyi* (Heyden) – Podyelniki, Kuzaranda, Eglov Isl., Kainos Isl., Nizhneje Myagrozero, Poly, Turastamozero, Uzkaya Salma, Vegoruksy, Verkhnee Myagrozero  
*Anoplodera sanguinolenta* L. – Podyelniki, Nizhneje Myagrozero, Oyatevschina, Vikshezero  
*Anoplodera virens* L. – Kuzaranda (Poppius 1899), Kosmozero, Bol. Klim. Isl., Kizhi Isl., Podyelniki, Nizhneje Myagrozero, Volkostrov Isl.  
\**Arhopalus rusticus* (L.) – Kizhi Isl., Velikaya Guba (Poppius 1899)  
*Aromia moschata* (L.) – Bol. Klim. Isl.  
*Brachyta interrogationis* (L.) – Kizhi Isl., Velikaya Guba (Poppius 1899), Tipinitsy, Bol. Klim. Isl.  
*Callidium coriaceum* Paykull – Velikaya Guba (Poppius 1899), Bol. Klim. Isl., Lipovitsy, Vikshezero  
*Callidium violaceum* (L.) – Kizhi Isl.  
*Gaurotes virginea* L. – Velikaya Guba (Poppius 1899), Lipovitsy, Vegoruksy, Uzkaya Salma, Tipinitsy, Vikshezero  
*Judolia sexmaculata* L. – Kuzaranda (Poppius 1899), Bol. Klim. Isl., Turastamozero

*Leiopus punctulatus* (Paykull) – Polyta  
*Leptura melanura* L. – Kizhi Isl., Bol. Klim. Isl., Kosmozero, Eglov Isl., Nizhneje Myagrozero, Rogachev Isl., Vorobyi  
*Leptura nigripes* (DeGeer) – Velikaya Guba (Poppius 1899), Podyelniki, Oyatevschina, Turastamozero, Vegoruksy  
*Leptura pubescens* Fabricius – Turastamozero  
*Leptura quadrifasciata* L. – Kosmozero (Poppius 1899), Kizhi Isl., Nizhneje Myagrozero, Oyatevschina, Podyelniki, Turastamozero, Vorobyi  
 \**Molorchus minor* (L.) – Kizhi Isl. (Poppius 1899)  
*Monochamus galloprovincialis* Olivier – Tolvuya (Poppius 1899), Podyelniki, Nizhneje Myagrozero  
*Monochamus sutor* L. Turastamozero, Nizhneje Myagrozero  
*Monochamus urussovi* Fischer von Waldheim – Turastamozero, Nizhneje Myagrozero, Oyatevschina  
*Necydalis major* L. – Kosmozero, Kurgenitsy  
*Nivellia sanguinosa* (Gyllenhal) – Oyatevschina, Vikshezero  
*Pachyta quadrimaculata* L. – Kosmozero, Nizhneje Myagrozero, Podyelniki  
*Pedostrangalia pubescens* (Fabricius) – Turastamozero.  
*Phytoecia cylindrica* (L.) – Vegoruksy, Bol. Klim. Isl.  
*Pogonocherus fasciculatus* (DeGeer) – Bol. Klim. Isl.  
*Rhagium inquisitor* L. – Lipovitsy  
*Rhagium mordax* Deg. – Bol. Klim. Isl., Kazhma, Volkostrov Isl.  
*Saperda carcharias* (L.) – Bol. Klim. Isl.  
*Saperda perforata* Pallas – Verkhnee Myagrozero  
 \* *Saperda scalaris* (L.) – Kizhi Isl. (Poppius 1899)  
*Tetropium castaneum* (L.) – Lipovitsy  
*Tetrops praeusta* (L.) – Tolvuya (Poppius 1899), Rogachev Isl.  
*Xylotrechus rusticus* (L.) – Bol. Klim. Isl., Turastamozero, Nizhneje Myagrozero  
**Chrysomelidae**  
 \**Altica oleracea* (L.) – Tolvuya (Poppius 1899)  
 \**Aphthona erichsoni* (Zetterstedt) – Unitsa (Poppius 1899) (Silfverberg 1987)  
*Bromius obscurus* L. – Podyelniki, Eglov Isl., Khvost Isl., Kizhi Isl., Nizhneje Myagrozero, Oyatevschina, Rogachev Isl., Tipinitsy, Vegoruksy, Vikshezero  
 \**Bruchus atomarius* L. – Bol. Klim. Isl., Kosmozero (Poppius 1899)  
 \**Cassida denticollis* Suffrian – Kizhi Isl., Oleny Isl. (Poppius 1899)  
 \**Cassida nebulosa* L. – Shun'ga (Poppius 1899)  
 \**Cassida rubiginosa* Müller – Shun'ga (Poppius 1899)  
 \**Cassida sanguinosa* Suffrian – Kosmozero, Tolvuya (Poppius 1899)  
*Cassida viridis* L. – Verkhnee Myagrozero  
 \**Chaetocnema aerosa* (Letzner) – Shun'ga (Poppius 1899)  
 \**Chaetocnema aridula* (Gyllenhal, 1827) – Kuzaranda (Poppius 1899)  
*polita* (L.) – Tolvuya (Poppius 1899), Eglov Isl.  
 \**Chrysolina hyperici* (Forster) – Kizhi Isl. (Poppius 1899)  
*Chrysolina varians* (Schaller) – Podyelniki, Nizhneje Myagrozero, Verkhnee Myagrozero, Vikshezero  
*Chrysomela collaris* L. – Kosmozero, Tolvuya (Poppius 1899), Uzkaya Salma  
*Chrysomela cuprea* Fabricius – Kizhi Isl. (Poppius 1899), Vorobyi  
*Chrysomela lapponica* L. – Oleny Isl. (Poppius 1899), Tipinitsy, Turastamozero, Uzkaya Salma, Verkhnee Myagrozero  
*Clytra quadripunctata* L. – Eglov Isl.  
*Crepidodera fulvicornis* Fabricius – Tipinitsy

*Cryptocephalus aureolus* Suffrian – Vikshezero, Vorobyi, Zaonezhye (Silfverberg 1987)  
 \**Cryptocephalus bipunctatus* (L.) – Kosmozero (Poppius 1899), Zaonezhye (Silfverberg 1987)  
 \**Cryptocephalus cordiger* (L.) – Kizhi Isl. (Poppius 1899), Zaonezhye (Silfverberg 1987)  
*Cryptocephalus coryli* L. – Rogachev Isl.  
 \**Cryptocephalus distinguendus* Schneider – Bol. Klim. Isl., Kizhi Isl. (Poppius 1899), Zaonezhye *Chrysolina*  
 \**Cryptocephalus exiguus* Schneider – Kosmozero, Shun'ga, Velikaya Guba (Poppius 1899), Zaonezhye (Silfverberg 1987)  
 \**Cryptocephalus labiatus* (L.) – Kizhi Isl., Tolvuya, Shun'ga (Poppius 1899), Zaonezhye (Silfverberg 1987)  
*Cryptocephalus moraei* (L.) – Zaonezhye (Silfverberg 1987)  
 \**Cryptocephalus nitidulus* Fabricius – Kizhi Isl. (Poppius 1899), Zaonezhye (Silfverberg 1987)  
 \**Cryptocephalus octopunctatus* (Scopoli) – Kizhi Isl. (Poppius 1899), Zaonezhye (Silfverberg 1987)  
*Cryptocephalus pini* (L.) – Zaonezhye (Silfverberg 1987)  
*Cryptocephalus sericeus* (L.) – Kizhi Isl. (Poppius 1899), Bol. Klim. Isl., Oyatevshchina, Turastamozero, Vikshezero  
 \**Cryptocephalus sexpunctatus* (L.) – Velikaya Guba (Poppius 1899), Zaonezhye (Silfverberg 1987)  
 \**Derocrepis rufipes* (L.) – Kuzaranda (Poppius 1899)  
*Donacia clavipes* Fabricius – Podyelniki, Oyatevshchina  
*Donacia crassipes* Fabricius – Kosmozero (Poppius 1899), Zaonezhye (Silfverberg 1987), Eglov Isl.  
*Donacia impressa* Paykull – Zaonezhye (Silfverberg 1987)  
*Donacia obscura* Gyllenhal – Dianova Gora (Poppius 1899), Zaonezhye (Silfverberg 1987)  
*Donacia thalassina* Germar – Zaonezhye (Silfverberg 1987)  
*Donacia vulgaris* Zschach – Velikaya Guba (Poppius 1899), Zaonezhye (Silfverberg 1987)  
*Galeruca tanacetii* L. – Eglov Isl., Podyelniki, Nizhnee Myagrozero  
*Galerucella californiensis* L. – Kizhi Isl., Uzkaya Salma  
*Galerucella grisescens* Joannis – Vorobyi  
*Galerucella lineola* Fabricius – Kizhi Isl.  
*Galerucella nymphaeae* L. – Vorobyi, Eglov Isl., Khvost Isl., Rogachev Isl., Verkhnee Myagrozero, Vorobyi  
 \**Galerucella sagittariae* (Gyllenhal) – Unitsa (Poppius 1899)  
 \**Gastrophysa polygoni* (L.) – Shun'ga (Poppius 1899)  
 \**Gonioctena flavicornis* (Suffrian) – Oleny Isl. (Poppius 1899)  
 \**Gonioctena pallida* (L.) – Bol. Klim. Isl. (Poppius 1899)  
*Gonioctena quinquepunctata* F. – Podyelniki, Verkhnee Myagrozero  
*Gonioctena viminalis* (L.) – Kizhi Isl., Shun'ga (Poppius 1899), Bol. Klim. Isl., Turastamozero  
 \**Hippuriphila modeeri* (L.) – Kuzaranda, Unitsa (Poppius 1899)  
 \**Hydrothassa hannoveriana* (Fabricius) – Velikaya Guba (Poppius 1899)  
*Hydrothassa marginella* L. – Podyelniki, Oyatevshchina  
 \**Lema cyanella* (L.) – Shun'ga (Poppius 1899), Zaonezhye (Silfverberg 1987)  
*Liliocercis merdigera* (L.) – Oyatevshchina, Tambitsy  
*Lochmaea caprea* L. – Rogachev Isl., Tipinitsy  
 \**Lochmaea suturalis* (Thomson) – Kizhi Isl. (Poppius 1899), Tipinitsy  
 \**Longitarsus holsaticus* (L.) – Kosmozero, Unitsa (Poppius 1899)

- \**Longitarsus lycopi* (Foudras) – Tolvuya (Poppius 1899)  
 \**Longitarsus pratensis* (Panzer) (as *L. pusillus* Gyllenhal) – Shun'ga, Unitsa (Poppius 1899)  
 \**Lythrararia salicariae* (Paykull) – Kizhi Isl. (Poppius 1899)  
*Neocrepidodera femorata* (Gyllenhal) – Velikaya Guba (Poppius 1899), Tambitsy  
 \**Oulema erichsonii* (Suffrian) – Kosmozero (Poppius 1899), Zaonezhye (Silfverberg 1987)  
 \**Oulema gallaeciana* (Heyden – Shun'ga, Tolvuya (Poppius 1899), Zaonezhye (Silfverberg 1987)  
 \**Phaedon cochleariae* (Fabricius) (as *Hydrothassa egena* (Gyllenhal) – Kizhi Isl., Oleny Isl. (Poppius 1899)  
*Phratora atrovirens* Cornelius – Vikshezero  
 \**Phratora vitellinae* (L.) – Zaonezhye (Poppius 1899)  
*Phyllobrotica quadrimaculata* L. – Podyelniki  
*Phyllotreta nemorum* (L.) – Tolvuya (Poppius 1899)  
 \**Plagioderia versicolora* (Laicharting) – Oleny Isl. (Poppius 1899)  
*Plagiosterna aenea* (L.) – Uzkaya Salma, Tambitsy  
*Plateumaris affinis* (Kunze) – Rogachev Isl., Zaonezhye (Silfverberg 1987)  
*Plateumaris discolor* – Zaonezhye (Silfverberg 1987)  
 \**Plateumaris rustica* (Kunze) – Velikaya Guba (Poppius 1899)  
 \**Plateumaris sericea* (L.) – Kizhi Isl., Velikaya Guba (Poppius 1899), Zaonezhye (Silfverberg 1987)  
 \**Psylliodes cucullata* (Illiger) – Shun'ga, Tolvuya, Unitsa (Poppius 1899)  
 \**Psylliodes napi* (Fabricius) – Shun'ga (Poppius 1899)  
*Pyrrhalta viburni* Paykull – Tipinitsy  
*Smaragdina affinis* (Illiger) – Zaonezhye (Silfverberg 1987)  
 \**Smaragdina aurita* (L.) – Kizhi Isl., Tolvuya (Poppius 1899)  
*Smaragdina flavicollis* Charp. – Podyelniki  
 \**Smaragdina salicina* (Scopoli) – Kosmozero (Poppius 1899)
- Anthribidae**  
*Dissoleucas niveirostris* Fabricius – Turastamozero  
*Platystomos albinus* L. – Bol. Klim. Isl., Kizhi Isl. (Poppius 1899), Verkhnee Myagrozero
- Atellabidae**  
*Apoderus coryli* (L.) – Kizhi Isl., Kuzaranda (Poppius 1899), Uzkaya Salma  
 \**Byctiscus betulae* (L.) – Kizhi (Poppius 1899)  
*Byctiscus populi* L. – Velikaya Guba (Poppius 1899), Vikshezero  
*Deporaus betulae* L. – Kosmozero (Poppius 1899), Khvost Isl.
- Curculionidae**  
 \**Amycterus marshami* (Schönherr) – Shun'ga, Tolvuya (Poppius 1899)  
 \**Apion apricans* Herbst – Kizhi Isl. (Poppius 1899)  
*Apion cerdo* Gerstaecker Bol. Klim. Isl., Kizhi Isl., Kosmozero, Shun'ga (Poppius 1899), Eglov Isl.  
 \**Apion ervi* Kirby – Unitsa (Poppius 1899)  
 \**Apion frumentarium* (L.) – Kizhi Isl. (Poppius 1899)  
 \**Apion gyllenhali* Kirby – Kizhi Isl., Shun'ga (Poppius 1899)  
 ? *Apion opeticum* Bach – Tipinitsy  
 \**Apion viciae* (Paykull) – Shun'ga (Poppius 1899)  
 \**Apion violaceum* Kirby – Kosmozero, Shun'ga, Tolvuya (Poppius 1899)  
 \**Apion virens* Herbst – Kosmozero, Shun'ga, Tolvuya, Velikaya Guba (Poppius 1899)  
*Auleutes epilobii* (Paykull) – Kuzaranda (Poppius 1899), Tipinitsy  
 \**Bagous lutulentus* (Gyllenhal) – Velikaya Guba (Poppius 1899)  
 \**Brachysomus echinatus* (Bonsdorff) – Kizhi Isl. (Poppius 1899)

\**Ceutorhynchus rugulosus* (Herbst) – Shun'ga, Unitsa (Poppius 1899)  
 \**Ceutorhynchus typhae* (Herbst – Shun'ga (Poppius 1899)  
 \**Cionus tuberculatus* (Scopoli) (as *C. verbasci* Fabricius) – Kizhi Isl. (Poppius 1899)  
*Cleopomiarus distinctus* Boheman – Rogachev Isl.  
*Cryphalus saltuarius* Weise – Bol. Klim. Isl.  
*Cryptorhynchus lapathi* L. – Khvost Isl.  
 \**Dorytomus minutus* (Gyllenhal) – Kizhi Isl. (Poppius 1899)  
*Dryocoetes alni* (Georg) – Bol. Klim. Isl., Volkostrov Isl.  
 \**Eutrichapion facetum* (Gyllenhal) (as *Apion sundevallii* Boheman) – Bol. Klim. Isl., Shun'ga, Unitsa  
 \**Grypys equiseti* (Fabricius) – Shun'ga (Poppius 1899)  
 \**Hylastes angustatus* (Herbst) – Kosmozero (Poppius 1899)  
*Hylastes cunicularius* Erichsen – Bol. Klim. Isl.  
*Hylobius abietis* (L.) Bol. Klim. Isl., Vegoruktsy, Uzkaya Salma, Eglov Isl.  
*Hylobius pinastri* Gyllenhal – Lipovitsy, Tipinitsy  
*Hylurgops palliatus* (Gyllenhal) – Kosmozero, Velikaya Guba (Poppius 1899), Bol. Klim. Isl., Uzkaya Salma, Vegoruktsy  
 \**Hypera arator* (L.) (as *H. polygoni* L.) – Oleny Isl., Shun'ga (Poppius 1899)  
 \**Hypera nigrirostris* (Fabricius) – Kosmozero, Shun'ga, Tolvuya (Poppius 1899)  
*Hypera rumicis* (L.) – Tolvuya (Poppius 1899), Verkhnee Myagrozero  
 \**Hypera suspiciosa* (Herbst) – Kizhi Isl., Oleny Isl., Shun'ga, Unitsa (Poppius 1899)  
 \**Ips sexdentatus* (Börner) – Kosmozero (Poppius 1899)  
*Ips typographus* (L.) – Kosmozero, velikaya Guba (Poppius 1899), Bol. Klim. Isl., Lipovitsy, Poly, Uzkaya Salma, Vegoruktsy  
*Limnobaris dolorosa* Goeze – Eglov Isl., Khvost Isl.  
 ?*Limobius borealis* (Paykull) – (as *Hypera dissimilis* Herbst – Oleny Isl., Shun'ga (Poppius 1899))  
 \**Magdalis carbonarius* (L.) – Kizhi Isl. (Poppius 1899)  
 \**Magdalis frontalis* (Gyllenhal) – Velikaya Guba (Poppius 1899)  
 \**Magdalis ruficornis* (L.) (as *M. pruni* L.) – Bol. Klim. Isl., Oleny Isl. (Poppius 1899)  
 \**Magdalis violacea* (L.) – Kizhi Isl. (Poppius 1899)  
 \**Miarus campanulae* (L.) – Tolvuya (Poppius 1899)  
 \**Orthotomicus laricis* (Fabricius) – Kosmozero (Poppius 1899)  
*Otiorhynchus ovatus* (L.) – Kosmozero, Shun'ga, Tolvuya (Poppius 1899), Kizhi Isl.  
*Otiorhynchus scaber* (L.) – Kizhi Isl. (Poppius 1899), Tipinitsy, Vorobyi  
 \**Pelenomus comari* (Herbst) – Zaonezhye (Poppius 1899)  
*Phloeotribus spinulosus* (Rey) – Kurgenitsy  
*Phyllobius arborator* Herbst – Kizhi Isl.  
*Phyllobius maculicornis* Germar – Kosmozero (Poppius 1899), Kizhi Isl., Rogachev Isl.  
 \**Phyllobius pomaceus* Gyllenhal – Tolvuya (Poppius 1899)  
*Pissodes pini* L. – Eglov Isl.  
*Pityogenes chalcographus* L. – Kizhi  
 \**Polydrusus cervinus* (L.) – Kizhi Isl., Oleny Isl. (Poppius 1899)  
*Polydrusus fulvicornis* (Fabricius) – Shun'ga (Poppius 1899), Eglov Isl., Podyelniki, Rogachev Isl., Turastamozero  
 \**Polydrusus micans* (Fabricius) – Kizhi Isl., Velikaya Guba (Poppius 1899)  
*Polygraphus poligraphus* (L.) – Kosmozero (Poppius 1899), Bol. Klim. Isl.  
 \**Rhinoncus castor* (Fabricius) – Kizhi Isl. (Poppius 1899)  
 \**Rhynchites cupreus* (L.) – Kosmozero (Poppius 1899)  
*Scolytus ratzeburgi* Janson – Bol. Klim. Isl., Volkostrov Isl.  
 ? \**Scolytus scolytus* (Fabricius) (as *S. destructor* Olivier) – Velikaya Guba (Poppius 1899)  
 \**Sitona lineatus* (L.) – Kizhi Isl., Shun'ga (Poppius 1899)

*Strophosoma capitatum* DeGeer – Eglov Isl., Khvost Isl., Tipinitsy  
 \**Taeniapion urticarium* (Herbst) (as *Apion vernale* Fabricius) – Shun'ga (Poppius 1899)  
 \**Tachyerges stigma* (Germar) – Kosmozero (Poppius 1899)  
 \**Tanymecus palliatus* (Fabricius) – Kosmozero, Tolvuya (Poppius 1899)  
 \**Temnocerus nanus* (Paykull) – Kizhi Isl. (Poppius 1899)  
 \**Tomicus minor* (Hartig) – Bol. Klim. Isl., Kosmozero, Vegoruksy, Uzkaya Salma  
*Tomicus piniperda* (L.) – Velikaya Guba (Poppius 1899), Kosmozero, Bol. Klim. Isl.,  
 Uzkaya Salma, Vegoruksy  
*Trypodendron lineatum* Olivier – Bol. Klim. Isl., Volkostrov Isl.  
*Trypodendron signatum* (Fabricius) – Bol. Klim. Isl., Volkostrov Isl.  
 \**Tychius quinquepunctatus* (L.) – Oleny Isl. (Poppius 1899)  
*Xyleborus cryptographus* (Ratz.) – Bol. Lelikovskiy Isl.  
*Xylechinus pilosus* (Ratz.) – Kurgenitsy

## LEPIDOPTERA

### Hepialidae

*Hepialis humuli* L. – Vegoruksy.  
*Phymatopus hecta* L. – Nizhneje Myagrozero  
*Pharmacis fusconebulosa* Deg. – Nizhneje Myagrozero

### Adelidae

*Nemophora amatella* Staudinger – Vikshezero  
*Nemophora degeerella* L. – Eglov Isl., Khvost Isl.

### Tineidae

*Scardia boletella* Fabricius – Oyatevschina

### Yponomeutidae

*Yponomeuta evonymellus* L. – Eglov Isl., Rogachev Isl.  
*Argyresthia sorbiella* (Treitschke) – Vegoruksy

### Plutellidae

*Plutella xylostella* (L.) – Vegoruksy

### Coleophoridae

*Coleophora deauratella* Lienig & Zeller – Vegoruksy

### Choreutidae

*Anthophila fabriciana* L. – Vorobyi

### Gelechiidae

*Metzneria aprilella* (Herr.-Schäff.) – Vegoruksy  
*Helcystogramma rufescens* (Haworth) – Vegoruksy  
*Acompsia cinerella* (Clerck) – Vegoruksy

### Cossidae

*Cossus cossus* L. – Bol. Klim. Isl., Kazhma, Kosmozero

### Tortricidae

*Celypha lacunana* Den. & Schiff. – Eglov Isl., Khvost Isl., Rogachev Isl., Vegoruksy  
*Olethreutes arcuella* – Eglov Isl., Khvost Isl., Rogachev Isl.  
*Epinotia trigonella* (L.) – Vegoruksy  
*Thiodia citrana* (Hbn.) – Vegoruksy  
*Eucosma cana* (Haworth) – Vegoruksy  
*Lathronympha strigana* (F.) – Eglov Isl., Vegoruksy  
*Clepsis rogana* – Khvost Isl., Rogachev Isl.  
*Phiaris umbrosana* – Rogachev Isl.  
*Eana argentana* – Rogachev Isl.  
*Aphelia unitana* Hübner – Kizhi Isl., Rogachev Isl.  
*Dichrorampha petioverella* L. – Rogachev Isl.

### Epermeniidae

*Epermenia illigerella* Hb. – Khvost Isl.



### **Pterophoridae**

*Hellinsia didactylites* (Ström) – Vegoruksy

*Hellinsia osteodactylus* (Zeller) – Vegoruksy

*Gillmeria pallidactyla* (Haworth) – Rogachev Isl.

### **Pyralidae**

*Eurrhyncha hortulata* L. – Rogachev Isl.

*Evergestis pallidata* Hufn. – Kizhi Isl.

? *Udea lutealis* Hübner – Nizhneje Myagrozero

*Udea hamalis* Thunb. – Lipovitsy

*Nymphula nitidulata* Hufnagel – Podyelniki, Verkhnee Myagrozero

### **Crambidae**

*Crambus lathoniellus* (Zincken) – Vegoruksy

*Chrysoteuchia culmella* L. – Eglov Isl., Khvost Isl.,

### **Zygaenidae**

*Adscita statices* L. – Kizhi Isl., Vikshezero, Rogachev Isl.

*Zygaena lonicera* Scheven – B. Klimenetsky Isl., Podyelniki, Rechnoi Isl.

*Zygaena osterodensis* Reiss – B. Klimenetsky Isl., Podyelniki, Eglov Isl., Khvost Isl., Rogachev Isl.

*Zygaena viciae* Scheven – Podyelniki

### **Hesperidae**

*Pyrgus alveus* Hb. – Isl. B. Klimenetsky, Eglov Isl., Kosmozero (Kaisila 1947), Sennaya Guba, Shun'ga (Kaisila 1947)

*Pyrgus malvae* L. – Bol. Klim. Isl., Sennaya Guba, Sennaya Guba

*Carterocephalus palaemon* Pallas – Bol. Klim. Isl., Eglov Isl., Velikaya Guba (Kaisila 1947).

*Carterocephalus silvicola* Mg. – Bol. Klim. Isl., Kizhi Isl. (Kaisila 1947), Sennaya Guba, Velikaya Guba (Kaisila 1947), Volkostrov Isl., Oyatevshina

*Thymelicus lineola* Ochs. – Bol. Klim. Isl., Myagrozero, Nizhneje Myagrozero, Podyelniki, Rogachev Isl., Sennaya Guba, Shun'ga, Turastamozero, Verkhnee Myagrozero, Vorobyi

*Hesperia comma* L. – Shun'ga (Kaisila 1947), Vorobyi

*Ochlodes sylvanus* Esper – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Kizhi Isl., Lelikovo, Myagrozero, Rogachev Isl., Sennaya Guba, Turastamozero, Uzkaya Salma, Vegoruksy

*Leptidea sinapis* L. – Kizhi Isl., Bol. Klim. Isl., Oyatevshina, Eglov Isl., Sennaya Guba, Kosmozero

*Aporia crataegi* L. – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Kizhi Isl., Kuzaranda, Nizhneje Myagrozero, Oyatevshina, Isl. Rechnoi, Rogachev Isl., Sennaya Guba, Vorobyi.

*Pieris brassicae* L. – Bol. Klim. Isl., Kizhi Isl.

*Pieris napi* L. – Bol. Klim. Isl., Kizhi Isl., Lelikovo, Kosmozero, Sennaya Guba, Oyatevshina

*Pieris rapae* L. – Bol. Klim. Isl., Oyatevshina, Sennaya Guba

*Pontia edusa* F. – Kizhi Isl., Kurgenitsy

*Anthocharis cardamines* L. – Bol. Klim. Isl., Eglov Isl., Kizhi Isl., Sennaya Guba, Uzkaya Salma, Oyatevshina,

*Gonepteryx rhamni* L. – Bol. Klim. Isl., B. Lelikoskiy Isl., Kizhi Isl., Kosmozero, Lelikovo, Podyelniki, Sennaya Guba, Tambitsy, Verkhnee Myagrozero, Vorobyi

*Colias palaeno* L. – Sennaya Guba, Turastamozero

### **Papilionidae**

*Papilio machaon* L. – Bol. Klim. Isl., Kizhi Isl., Oyatevshina, Podyelniki, Sennaya Guba, Turastamozero, Vorobyi

*Parnassius mnemosyne* (L.) – Kizhi Isl., Sennaya Guba, Shunevskiy Isl., Velikaya Niva, Volkostrov Isl., Vorobyi

## Lycaenidae

*Lycaena virgaureae* L. – Kizhi Isl., Bol. Klim. Isl., Kosmozero, Lelikovo, Nizhneye Myagrozero, Oyatevshina, Podyelniki, Sennaya Guba, Turastamozero, Vorobyi

*Lycaena hippothoe* L. – Bol. Klim. Isl., Eglov Isl., Rogachev Isl., Sennaya Guba, Tolvuya (Kaisila 1947)

*Lycaena dispar* Haworth – Lelikovo (Juho Paukkunen pers. comm.)

*Celastrina argiolus* L. – Bol. Klim. Isl., Eglov Isl., Nizhneye Myagrozero, Sennaya Guba

*Glaucopsyche alexis* Poda – Bol. Klim. Isl., Sennaya Guba

*Aricia artaxerxes* F. – Bol. Klim. Isl., Sennaya Guba

*Aricia eumedon* Esper – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Rogachev Isl., Sennaya Guba

\**Aricia nicias* Meigen – Kosmozero (Kaisila 1947)

*Plebeius optilete* Knoch – Podyelniki, Turastamozero

*Plebeius argus* L. – Nizhneye Myagrozero, Sennaya Guba, Turastamozero

*Polyommatus amandus* Schneider – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Kuzaranda, Nizhneye Myagrozero, Podyelniki, Rechnoi Isl., Rogachev Isl., Sennaya Guba, Turastamozero

*Polyommatus icarus* Rott. – Bol. Klim. Isl., Lelikovo, Sennaya Guba

*Polyommatus semiargus* Rott. – Bol. Klim. Isl., Kizhi Isl., Nizhneye Myagrozero, Rogachev Isl., Sennaya Guba, Turastamozero, Isl. Volkostrov

*Callophrys rubi* L. – Bol. Klim. Isl., Sennaya Guba

*Thecla betulae* (L.) – Nikonova Guba

*Satyrrium pruni* L. – Bol. Klim. Isl., Eglov Isl., Kosmozero (Kaisila 1947), Tolvuya (Kaisila 1947), Velikaya Niva (Kaisila 1947), Uzkaya Salma

## Nymphalidae

*Aglais urticae* L. – Bol. Klim. Isl., Kizhi Isl., Kosmozero, Lelikovo, Nizhneye Myagrozero, Podyelniki, Isl. Rechnoi, Sennaya Guba, Tambitsy, Turastamozero.

*Vanessa atalanta* L. – Bol. Klim. Isl., Kosmozero, Lelikovo, Polya, Sennaya Guba, Vegoruksy

*Vanessa cardui* L. – Bol. Klim. Isl., Sennaya Guba

*Nymphalis antiopa* L. – Bol. Klim. Isl., B.Lelikoskiy Isl., Kosmozero, Oyatevshina, Sennaya Guba, Turastamozero

*Polygonia c-album* L. – Bol. Klim. Isl., Kazhma, Kizhi Isl., Kosmozero, Kuzaranda, Podyelniki, Isl. Rechnoi, Sennaya Guba, Tambitsy, Turastamozero, Vorobyi

*Inachis io* L. – Bol. Klim. Isl., B.Lelikoskiy Isl., Sennaya Guba, Turastamozero

*Araschnia levana* L. – Bol. Klim. Isl., Eglov Isl., Kizhi Isl., Kosmozero, Lelikovo, Podyelniki, Sennaya Guba., Oyatevshina

*Limenitis populi* L. – Bol. Klim. Isl., Oyatevshina, Sennaya Guba, Turastamozero

*Euphydryas maturna* L. – Bol. Klim. Isl., Kizhi Isl., Sennaya Guba

*Argynnis niobe* L. – Kosmozero, Tolvuya (Kaisila 1947)

*Argynnis adippe* Den. & Schiff. – Bol. Klim. Isl., Kosmozero, Sennaya Guba, Tolvuya

*Argynnis aglaja* L. – Bol. Klim. Isl., Kizhi Isl., Nizhneye Myagrozero, Podyelniki, Sennaya Guba, Turastamozero, Verkhnee Myagrozero, Vikshezero

*Argynnis paphia* L. – Bol. Klim. Isl., Kosmozero, Myagrozero, Nizhneye Myagrozero, Podyelniki, Turastamozero, Vegoruksy, Verkhnee Myagrozero, Shun'ga

*Brenthis ino* Rott. – Bol. Klim. Isl., Eglov Isl., Kizhi Isl., Nizhneye Myagrozero, Oyatevshina, Podyelniki, Sennaya Guba, Turastamozero

*Melitaea athalia* Rott. – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Kizhi Isl., Rogachev Isl., Sennaya Guba, Turastamozero

*Boloria euphrosyne* L. – Bol. Klim. Isl.

*Boloria selene* Den. & Schiff. – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Kosmozero, Kuzaranda, Lelikovo, Podyelniki, Rogachev Isl., Sennaya Guba, Tipinitsy, Turastamozero, Volkostrov Isl., Oyatevshina.

*\*Boloria titania* Esper – Shun'ga, Vegoruksy (Kaisila 1947)  
*Boloria aquilonaris* Stich. – Tolvuya (Kaisila 1947), Uzkaya Salma  
*Pararge aegeria* L. – Bol. Klim. Isl., Boyarschina, Sennaya Guba  
*Aphantopus hyperantus* L. – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Kuzaranda, Nizhneje Myagrozzero, Podyelniki, Rogachev Isl., Sennaya Guba, Shun'ga, Turastamozero, Vegoruksy  
*Coenonympha glycerion* Borkh. – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Kuzaranda, Nizhneje Myagrozzero, Podyelniki, Rogachev Isl., Sennaya Guba, Turastamozero, Vegoruksy  
*Maniola jurtina* L. – Bol. Klim. Isl., Sennaya Guba, Turastamozero, Vegoruksy  
*\*Oenis jutta* Hübner – Kizhi Isl., Velikaya Guba (Kaisila 1947)  
*\*Hyponphele lycaon* Kühn – Shun'ga (Kaisila 1947)  
*Lasionmata maera* L. – Bol. Klim. Isl., Eglov Isl., Khvost Isl., Kuzaranda, Rogachev Isl., Sennaya Guba, Turastamozero  
*Lasionmata petropolitana* F. – Bol. Klim. Isl.  
*\*Erebia euryale* Esper. – Lizhma (Kaisila 1947)  
*Erebia ligea* L. – Bol. Klim. Isl., Kosmozero, Oyatevschina, Turastamozero  
**Geometridae**  
*\*Baptria tibiale borealis* Lankeila – Bol. Klim. Isl., Kizhi Isl. (Kaisila 1947)  
*Abraxas sylvatus* Scop. – Oyatevschina, Sennaya Guba, Volkostrov Isl.  
*Antonechloris smaragdaria* F. – Rogachev Isl.  
*Thetidia smaragdaria* (F.) – Rogachev Isl.  
*Cabera pusaria* L. – Vegoruksy  
*Macaria alternata* Den. & Schiff. – Rogachev Isl.  
*Plemyria rubiginata* (Den. & Schiff.) – Vorobyi  
*Geometra papilionaria* L. – Bol. Klim. Isl., Kosmozero.  
*Scotopteryx chenopodiata* L. – Kizhi Isl., Podyelniki, Turastamozero  
*Dysstroma citrata* (L.) – Oyatevschina, Kizhi Isl., Lelikovo, Vegoruksy  
*Eulithis populata* L. – Oyatevschina  
*\*Apeira syringaria* L. – Kosmozero (Kaisila 1947)  
*\*Arichanna melanaria* L. – Tolvuya (Kaisila 1947)  
*\*Anticollix sparsatus* Treitschke – Tolvuya (Kaisila 1947)  
*\*Catarhoe cuculata* Hufn. – Kosmozero, Velikaya Guba (Kaisila 1947)  
*\*Electrophaes corylata* Thunb. – Kizhi Isl., Velikaya Guba (Kaisila 1947)  
*\*Spargania luctuata* (Den. & Schiff.) – Bol. Klim. Isl., Kizhi Isl., Kuzaranda, Velikaya Guba (Kaisila 1947)  
*\*Antyclea derivata* (Den. & Schiff.) – Velikaya Guba (Kaisila 1947)  
*\*Colostygia aptata* Hbn. – Kizhi Isl., Kosmozero (Kaisila 1947)  
*Hydriomena furcata* Thunb. – Oyatevschina.  
*Plemyria rubiginata* Den. & Schiff. – Vorobyi  
*Perizoma alchemillatum* L. – Kizhi Isl.  
*Perizoma didymatum* L. – Oyatevschina  
*Perizoma flavofasciata* Thunb. – Khvost Isl.  
*Odezia atrata* L. – Eglov Isl., Khvost Isl., Polya, Rogachev Isl.  
*Siona lineata* Scop. – Eglov Isl., Khvost Isl., Rogachev Isl., Vegoruksy  
*Itame brunneatum* Thunb. – Oyatevschina  
*Pseudopanthera macularia* L. – Bol. Klim. Isl.  
*Epirrhoe alternata* (Müller) – Lelikovo, Sennaya Guba, Vorobyi  
*Epirrhoe tartuensis* Möls – Khvost Isl.  
*Epirrhoe tristata* L. – Rogachev Isl.  
*Xanthorhoe montanata* (Den. & Schiff.) – Rogachev Isl., Vegoruksy  
*Scopula floslactata* Haworth – Vegoruksy

*Scopula immorata* L. – Khvost Isl., Vegoruksy  
*Scopula immutata* L. – Khvost Isl.  
*Idaea aversata* L. – Vegoruksy  
*Timandra griseata* W. Petersen – Khvost Isl., Rogachev Isl., Vegoruksy  
*Angerona prunaria* (L.) – Rogachev Isl., Vegoruksy  
*Chiasmia clathrata* L. – Eglov Isl., Khvost Isl.  
*Cosmorhoe ocellata* L. – Khvost Isl.  
*Crocallis elinguaris* L. – Kizhi Isl.  
*Chloroclysta citrata* L. – Kizhi Isl.

**Sphingidae**

*Hemaris tityus* L. – Kizhi Isl. (Kaisila 1947), Vorobyi  
 \**Hemaris fuciformis* L. – Kuzaranda (Kaisila 1947)  
*Deilephila elpenor* (L.) – Turastamozero, Velikaya Niva, Vorobyi  
 \**Deilephila porcellus* L. – Kizhi Isl. (Kaisila 1947)  
 \**Smerinthus ocellatus* L. – Kizhi Isl., Kosmozero (Kaisila 1947)  
*Hyles gallii* Rtmbrg – Velikaya Niva, Kazhma, Nizhnee Myagrozero, Kazhma.

**Lasiocampidae**

*Gastropacha quercifolia* L. – Vegoruksy  
*Euthrix potatoria* L. – Eglov Isl., Kizhi Isl., Tambitsy, Vegoruksy, Shunevsky Isl.  
*Lasiocampa quercus* L. – Shunevsky Isl.

**Notodontidae**

\**Pterostoma palpinum* Clerck – Bol. Klim. Isl., Kizhi Isl., Velikaya Guba (Kaisila 1947)  
*Clostera anastomosis* (L.) – Vegoruksy  
*Ptilodon capucina* L. – Tipinitsy

**Lymantriidae**

*Orgyia antiqua* L. – Zaonezhye  
*Calliteara pudibunda* (L.) – Turastamozero, Lambasruchey, Tambitsy

**Nolidae**

*Nola aerugula* Hübner – Vegoruksy

**Arctiidae**

\**Thumatha senex* (Hb.) – Tolvuya (Kaisila 1947)  
*Eilema lurideolum* (Zinck.) – Kizhi Isl.  
 \**Eilema lutarellum* (L.) – Kosmozero (Kaisila 1947)  
 \**Eilema cereolum* (Hb.) – Velikaya Niva (Kaisila 1947)  
*Parasemia plantaginis* (L.) – Zaonezhye  
*Rhyparia purpurata* (L.) – Eglov Isl., Isl., Kuzaranda, Paleostrov Isl., Rechnoi, Vegoruksy  
*Cybosia mesomella* (L.) – Eglov Isl., Rogachev Isl., Vegoruksy  
 \**Coscinia cribraria* (L.) – Lizhma (Kaisila 1947)  
*Diacrisia sannio* (L.) – Eglov Isl., Rogachev Isl., Uzkaya Salma, Vegoruksy  
*Spilosoma luteum* (Hufnagel) – Khvost Isl., Oyatevschina

**Noctuidae**

*Hypena proboscidalis* L. – Kizhi Isl., Rogachev Isl.  
*Euclidia glyphica* L. – Eglov Isl., Oyatevschina  
*Plusia putnami* Grote – Kizhi Isl.  
*Autographa excelsa* Kretschmar – Kizhi Isl., Vorobyi  
 \**Autographa macrogamma* Ev. – Kosmozero, Tolvuya (Kaisila 1947)  
*Autographa bractea* (Den. & Schiff.) – Vorobyi  
*Acrionicta rumicis* L. – Vorobyi, Turastamozero  
*Acrionicta auricoma* (Den. & Schiff.) – Podyelniki, Vorobyi  
*Syngrapha interrogationis* L. – Kizhi Isl.  
 \**Syngrapha microgamma* Hbn. – Velikaya Guba, Velikaya Niva (Kaisila 1947)  
*Abrostola triplasia* L. – Kizhi Isl.

*Oligia strigilis* L. – Kizhi Isl.  
*Cerapteryx graminis* L. – Kizhi Isl.  
*Mythimna impura* Hbn. – Kizhi Isl.  
*Actinotia polyodon* Cl. – Kizhi Isl.  
*Phytometra viridaria* Clerck – Kizhi Isl. (Kaisila 1947)  
*Rivula sericealis* Scop. – Khvost Isl., Kosmozero (Kaisila 1947), Vegoruksy, Velikaya Guba (Kaisila 1947)  
 \**Anarta myrtilli* L. – Kizhi Isl. (Kaisila 1947)  
 \**Athetis pallustris* Hbn. – Bol. Klim. Isl. (Kaisila 1947)  
 \**Platyperigea montana* (Bremer) – Shun'ga (Kaisila 1947)  
 \**Cucullia gnaphalii* Hbn. – Kosmozero (Kaisila 1947)  
 \**Cucullia umbratica* L. – Kosmozero (Kaisila 1947)  
 \**Panemeria tenebrata* Scop. – Zaonezhye (Kaisila 1947)  
 \**Hadena bicurris* Hufnagel – Kosmozero (Kaisila 1947)  
 \**Papestra biren* Goeze – Kosmozero (Kaisila 1947)  
 \**Discestra trifolii* Hufnagel – Velikaya Guba (Kaisila 1947)  
 \**Mamestra brassicae* L. – Kuzaranda (Kaisila 1947)  
 \**Spaelotis ravida* (Den. & Schiff.) – Shun'ga (Kaisila 1947)  
*Chersotis cuprea* Den. & Schiff. – Vorobyi  
*Xestia baja* Den. & Schiff. – Nizhneje Myagrozero  
 \**Xestia c-nigrum* L. – Kosmozero (Kaisila 1947)  
 \**Xestia cincera* Herrich-Schaeffer – Velikaya Guba (Kaisila 1947)  
*Xanthia icteritia* Hufnagel – Turastamozero  
*Polymixis gemmea* Treitschke – Vegoruksy  
*Hoplodrina blanda* Den. & Schiff. – Vegoruksy  
*Rusina ferruginea* Esper – Vegoruksy  
*Amphipoea crinanensis* Burrows – Vegoruksy  
*Lasionycta imbecilla* (F.) – Nizhneje Myagrozero, Tolvuya (Kaisila 1947), Vegoruksy  
*Helotropha leucostigma* Hübner – Velikaya Niva  
*Catocala fraxini* – Lipovitsy, Poly, Vegoruksy  
*Melanchra pisi* (L.) – Vorobyi  
*Melanchra persicariae* L. – Tambitsy  
*Staurophora celsia* L. – Turastamozero, Vegoruksy  
*Polypogon tentacularia* L. – Khvost Isl., Rogachev Isl., Vegoruksy  
*Protodeltote pygarga* Hufnagel – Eglov Isl., Khvost Isl., Vegoruksy  
*Deltote uncula* Clerck – Eglov Isl.  
*Allophyes oxyacanthae* L. – Vegoruksy

## **HYMENOPTERA**

### **Argidae**

*Arge nigripes* Retz. – Kurgenitsy, Turastamozero, Eglov Isl., Rogachev Isl., Sennaya Guba

*Arge pagana* Pz. – Kurgenitsy, Podyelniki, Turastamozero, Nizhnee Myagrozero

*Arge ustulata* L. – Vorobyi, Uzkaya Salma, Turastamozero, Nizhnee Myagrozero, Eglov Isl.

*Aprosthemina hyalinopterum* Conde – Sennaya Guba

### **Pamphilidae**

*Pamphilus hortorum* Klug – Rogachev Isl.

### **Cimbicidae**

*Abia candens* Konow – Velikaya Niva, Kosmozero (Kontuniemi 1965)

*Abia (Zaraea) fasciata* L. – Kurgenitsy

*Cimbex connata* Schr. – Vorobyi  
*Cimbex femorata* L. – Vorobyi, Myagrozzero, Nizhnee Myagrozzero  
*Cimbex lutea* L. – Lyudskoi Isl.  
*Corynis obscura* (F.) – Lelikovo, Sennaya Guba  
 \**Trichiosoma aenescens* Guss. – Oyatevschina, Kizhi Isl. (Kontuniemi 1965)  
*Trichiosoma sylvaticum* Leach – Vorobyi  
**Diprionidae**  
 \**Monoctenus obscuratus* Htg. – Podyelniki, Kizhi Isl. (Kontuniemi 1965)  
 \**Macrodipton nemoralis* Ensl. – Velikaya Guba (Kontuniemi 1965)  
*Neodiprion sertifer* Geoffr. – Vorobyi  
**Tenthredinidae**  
 \**Dolerus elderi* Kincaid – Shun'ga (Kontuniemi 1965)  
 \**Brachythops flavens* (Klug) – Kizhi Isl. (Kontuniemi 1965)  
 \**Brachythops wuestneii* (Konow) – Kizhi Isl. (Kontuniemi 1965)  
 \**Heterarthrus nemoratus* (Fallen) – Kizhi Isl. (Kontuniemi 1965)  
 \**Hoplocampa alpina* Zett. – Kizhi Isl. (Kontuniemi 1965)  
 \**Nematus (Pteronidea) capreae* (L.) – Shun'ga (Kontuniemi 1965)  
 \**Athalia glabricollis* Thoms. – Tolvuya (Kontuniemi 1965)  
*Cladius pectinicornis* Geoffr. – Vorobyi  
 \**Eriocampa dorpatica* Konow – Velikaya Niva (Kontuniemi 1965)  
*Siobla ruficornis* (Cameron) – Tipinitsy  
*Fenusa pusilla* Lep. – Shun'ga (Kontuniemi 1965, Viramo, 1969)  
 \**Tenthredo rossii* (Panzer) – Shun'ga, Velikaya Niva (Kontuniemi 1965)  
**Cephusidae**  
*Cephus cultratus* Evers. – Kizhi Isl. (Kontuniemi 1965), Eglov Isl., Khvost Isl., Rogachev Isl., Lyudskoi Isl., Sennaya Guba  
*Cephus fumipennis* Evers. – Lelikovo, Ernitsky Isl.  
*Cephus nigrinus* Thoms. – Eglov Isl., Rogachev Isl., Lyudskoi Isl.  
*Calameuta filiformis* (Evers.) – Lyudskoi Isl., Sennaya Guba, Lelikovo  
**Xiphydriidae**  
*Xiphydria camelus* L. – Vorobyi, Kurgenitsy, Myagrozzero, Oyatevschina  
*Xiphydria picta* Konow – Kizhi Isl.  
**Siricidae**  
*Urocerus gigas* L. – Oyatevschina, Nizhnee Myagrozzero  
*Sirex juvencus* L. – Kizhi Isl.  
**Bethylidae**  
*Bethylus fuscicornis* (Jurine) – Eglov Isl.  
**Dryinidae**  
*Lonchodryinus ruficornis*-complex – Vorobyi, Velikaya Niva  
**Mutillidae**  
*Mutilla europaea* L. – Bol. Klim. Isl., B.Lelikoskiy Isl., Kuzaranda, Oyatevschina, Turastamozero, Nizhnee Myagrozzero  
**Chrysididae**  
*Chrysis angustula* Schenck – Oyatevschina, Kizhi Isl., Vorobyi, Turastamozero  
*Chrysis impressa* Schenck – Vorobyi, Turastamozero  
*Chrysis solida* Haupt – Kurgenitsy  
*Chrysis ruddii* Shuckard – Kizhi Isl.  
*Chrysura hirsuta* (Gerstaecker) – Vorobyi  
 \**Pseudomalus auratus* (L.) – Tolvuya (Hellén 1919)  
**Formicidae**  
*Myrmica lobicornis* Nyl. – Sennaya Guba  
*Myrmica lonae* Finzi – Sennaya Guba

*Myrmica rubra* L. – Kizhi Isl., Vorobyi, Sennaya Guba

*Myrmica ruginodis* Nyl. – Vorobyi

*Myrmica rugulosa* Nyl. – Sennaya Guba

*Myrmica scabrinodis* Nyl. – Sennaya Guba

*Lasius niger* (L.) – Sennaya Guba

*Formica fusca* L. – Sennaya Guba

*Formica rufa* coll. – Sennaya Guba

*Formica sanguinea* Latr. – Sennaya Guba

*Camponotus herculeanus* L. – Vorobyi

### **Pompilidae**

*Dipogon vechti* Day – Myagrozero, Nizhnee Myagrozero

*Dipogon bifasciatus* (Geoffr.) – Velikaya Guba (Wolf 1967), Turastamozero,

*Auplopus carbonarius* (Scop.) – Turastamozero, Nizhnee Myagrozero

*Agenioideus cinctellus* (Spin.) – Vorobyi, Podyelniki, Myagrozero, Nizhnee Myagrozero, Eglov Isl.

*Arachnospila opinata* (Tourn.) – Vorobyi, Myagrozero

*Anoplius nigerrimus* (Scop.) – Podyelniki, Myagrozero, Nizhnee Myagrozero, Lelikovo

### **Vespidae**

*Eumenes coarctatus* (L.) – Shun'ga

*Eumenes coronatus* (Panz.) – Vorobyi, Shun'ga, Turastamozero

*Eumenes pedunculatus* (Panz.) – Vorobyi, Nizhnee Myagrozero

*Discoelius dufourii* Lep. – Kurgenitsy, Turastamozero

*Ancistrocerus antilope* (Panz.) – Vorobyi, Turastamozero, Nizhnee Myagrozero

*Ancistrocerus claripennis* Thoms. – Shun'ga (Pekkarinen & Huldén 1991), Turastamozero, Nizhnee Myagrozero

*Ancistrocerus parietinus* (L.) – Rogachev Isl., Shun'ga, Podyelniki

*Ancistrocerus parietum* (L.) – Kizhi Isl., Ladmozero, Nizhnee Myagrozero

*Ancistrocerus scoticus* Curtis – Turastamozero

*Ancistrocerus trifasciatus* Mull. – Kizhi Isl., Turastamozero, Podyelniki, Kosmozero, Eglov Isl.

*Symmorphus angustatus* Zett. – Turastamozero, Ladmozero, Nizhnee Myagrozero

*Symmorphus allobrogus* (Saussure) – Tolvuya (Pekkarinen & Huldén 1991), Kizhi Isl., Turastamozero, Vikshezero

*Symmorphus bifasciatus* (L.) – Vorobyi, Kurgenitsy, Kosmozero, Turastamozero, Shun'ga, Rogachev Isl.

*Gymnomerus laevipes* (Schuck.) – Vorobyi, Lelikovo

*Stenodynerus picticus* Thoms. – Nizhnee Myagrozero

*Euodynerus quadrifasciatus* (F.) – Vorobyi

*Vespa crabro* L. – Vorobyi, Podyelniki, Turastamozero, Nizhnee Myagrozero, Myagrozero

*Vespula rufa* L. – Kizhi Isl., Turastamozero

*Vespula vulgaris* L. – Kizhi Isl., Boyarschina, Sennaya Guba, Turastamozero

*Dolichovespula media* Retz. – Bol'shoiu Lelikoskiy Isl., Eglov Isl., Polyu, Uzkaya Salma, Turastamozero

*Dolichovespula norwegica* F. – Kizhi Isl., Vorobyi, Vikshezero, Podyelniki, Polyu, Uzkaya Salma, Turastamozero, Myagrozero

*Dolichovespula saxonica* F. – Myagrozero, Turastamozero, Eglov Isl., Rogachev Isl.

*Dolichovespula sylvestris* Scop. – Podyelniki, Turastamozero

### **Sphecidae**

*Ammophila sabulosa* L. – Kurgenitsy, Vorobyi

### **Crabronidae**

*Trypoxylon attenuatum* Smith – Vegoruksy, Lyudskoi Isl., Lelikovo

*Trypoxylon figulus* (L.) – Podyelniki

*Pemphredon inornata* Say – Eglov Isl.,  
*Pemphredon lugubris* (F.) – Eglov Isl., Podyelniki  
*Pemphredon morio* v.d.Lind. – Podyelniki, Nizhnee Myagrozero  
*Pemphredon wesmaeli* A.Mor. – Rogachev Isl.  
*Mimumesa dahlbomi* (Wesm.) – Kurgenitsy  
*Crabro peltarius* (Schreber) – Rechnoi Isl.  
*Ectemnius cavifrons* Thoms. – Kizhi Isl., Volkostrov Isl.  
*Ectemnius continuus* F. – Kurgenitsy, Myagrozero, Turastamozero  
*Ectemnius dives* Lep. et Br. – Podyelniki  
*Ectemnius fossorius* L. – Vorobyi, Kurgenitsy, Volkostrov Isl., Bolshoi Lelikoskiy Isl.,  
 Turastamozero, Podyelniki, Zubovo, Eglov Isl., Ladmozero, Myagrozero, Nizhnee  
 Myagrozero  
*Ectemnius lapidarius* Panz. – Kurgenitsy  
*Ectemnius ruficornis* Zett. – Nizhnee Myagrozero, Kurgenitsy, Turastamozero  
*Ectemnius spinipes* (A. Mor.) – Nizhnee Myagrozero, Turastamozero  
*Lestica clypeata* (Schreber) – Podyelniki  
*Crossocerus assimilis* Smith – Kizhi Isl.  
*Crossocerus dimidiatus* (F.) – Kurgenitsy  
*Crossocerus heydeni* Koehl. – Vorobyi, Podyelniki  
*Crossocerus vagabundus* Pz. – Eglov Isl.  
*Spilomena enslini* Blüthgen – Podyelniki, Myagrozero  
*Mellinus arvensis* (L.) – Vorobyi  
*Oxybelus uniglumis* – Ladmozero  
*Nysson interruptus* (F.) – Vorobyi  
*Nysson niger* Chevriér – Nizhnee Myagrozero  
*Nysson spinosus* – Nizhnee Myagrozero  
 ?*Passaloecus borealis* Dahlbom – Nizhnee Myagrozero  
 ?*Passaloecus gracilis* (Curtis) – Vorobyi  
*Passaloecus insignis* v.d.Lind. – Vorobyi, Ernitsky Isl., Nizhnee Myagrozero  
*Argogorytes fargei* Shuckard – Vorobyi  
*Argogorytes mystaceus* L. – Nizhnee Myagrozero, Eglov Isl.  
*Gorytes quadrifasciatus* (F.) – Vorobyi, Kurgenitsy, Yu. Oleny Isl., Podyelniki  
*Rhopalum clavipes* L. – Turastamozero  
*Rhopalum coarctatum* Scop. – Kurgenitsy, Nizhnee Myagrozero, Eglov Isl., Rogachev Isl.  
*Tachysphex pompiliformis* (Panzer) – Volkostrov Isl.

#### **Apidae**

*Hylaeus annulatus* (L.) – Kizhi Isl., Rogachev Isl., Sennaya Guba  
*Hylaeus bisinuatus* Först. – Kizhi Isl., Kurgenitsy  
*Hylaeus communis* Nyl. – Kizhi Isl., Kurgenitsy  
 \**Hylaeus confusus* Nyl. – Sennaya Guba, Tolvuya (Söderman & Leinonen 2003)  
*Hylaeus gibbus* Saunders – Rogachev Isl.  
*Hylaeus nigritus* (F.) – Vorobyi  
*Lasioglossum albipes* (F.) – Sennaya Guba  
 \**Lasioglossum fratellum* (Perez) – Sennaya Guba (Söderman & Leinonen 2003)  
*Lasioglossum leucopus* (Kirby) – Sennaya Guba  
*Halictus rubicundus* Christ – Kizhi Isl.  
 \**Halictus tumulorum* (L.) – Sennaya Guba, Tolvuya (Söderman & Leinonen 2003)  
 \**Nomada panzeri* Lep. – Sennaya Guba (Söderman & Leinonen 2003)  
 \**Andrena cineraria* L. – Sennaya Guba (Söderman & Leinonen 2003)  
*Andrena intermedia* Thoms. – Kosmozero  
 \**Andrena haemorrhoea* F. – Sennaya Guba (Söderman & Leinonen 2003)  
 \**Andrena pilipes* F. – Sennaya Guba (Söderman & Leinonen 2003)



- \**Andrena ruficrus* Nyl. – Tolvuya (Söderman & Leinonen 2003)  
 \**Andrena semilaevis* Perez – Tolvuya (Söderman & Leinonen 2003)  
 \**Andrena subopaca* Nyl. – Sennaya Guba (Söderman & Leinonen 2003)  
 \**Andrena tarsata* Nyl. – Tolvuya (Söderman & Leinonen 2003)  
 \**Dufourea dentiventris* (Nyl.) – Tolvuya (Söderman & Leinonen 2003)  
 \**Melitta haemorrhoidalis* F. – Tolvuya (Söderman & Leinonen 2003)  
 \**Anthophora furcata* Pz. – Tolvuya (Söderman & Leinonen 2003)  
*Osmia nigriventris* Zett. – Vorobyi  
*Osmia pilicornis* F.Smith – Vorobyi  
*Megachile lagopoda* L. – Nizhnee Myagrozzero  
 \**Megachile lapponica* Thoms. – Kuzaranda (Niemelä 1936)  
 \**Megachile versicolor* F.Smith – Tolvuya (Söderman & Leinonen 2003)  
 \**Megachile willughbiella* (Kirby) – Turastamozero, Shun'ga (Niemelä 1936)  
*Macropis fulvipes* (F.) – Myagrozzero  
*Bombus consobrinus* Dahlb. – Oyatevshchina  
 \**Bombus distinguendus* F.Mor. – Kizhi Isl., Tolvuya (Söderman & Leinonen 2003)  
*Bombus hypnorum* L. – Sennaya Guba, Oyatevshchina, Lipovitsy, Poly  
*Bombus humilis* Ill. – Kizhi Isl., Sennaya Guba, Rogachev Isl.  
*Bombus jonellus* Kirby – Eglov Isl., Oyatevshchina  
*Bombus lapidarius* L. – Kizhi Isl., Vorobyi, Oyatevshchina, Podyelniki, Sennaya Guba, Rogachev Isl.  
*Bombus lucorum* L. – Kizhi Isl., Vorobyi, Sennaya Guba, Nizhnee Myagrozzero, Turastamozero, B.Lelikoskiy Isl., Lipovitsy, Poly, Uzkaya Salma, Tambitsy, Eglov Isl.  
*Bombus pascuorum* Scop. – Vorobyi, Oyatevshchina, Nizhnee Myagrozzero, Podyelniki, Turastamozero, Sennaya Guba, Lipovitsy, Eglov Isl.  
*Bombus pratorum* Scop. – Kizhi Isl., Oyatevshchina, Podyelniki, Nizhnee Myagrozzero, Turastamozero, Poly  
*Bombus ruderarius* Muller – Kizhi Isl.  
*Bombus schrencki* Morawitz, – Poly, Tambitsy, Turastamozero  
*Bombus semenoviellus* Skorikov – Lelikovo  
*Bombus solstitialis* Pz. – Vorobyi  
 \**Bombus soroensis* (F.) – Sennaya Guba, Tolvuya (Söderman & Leinonen 2003)  
*Bombus sporadicus* Nyl. – Poly, Lipovitsy, Uzkaya Salma, Turastamozero  
*Bombus veteranus* F. – Kizhi Isl., Vorobyi, Oyatevshchina, Lelikovo, Sennaya Guba, Rogachev Isl.  
*Bombus Psithyrus campestris* Pz. – Oyatevshchina  
*Bombus Psithyrus bohemicus* (Seidl.) – Sennaya Guba  
 \**Bombus Psithyrus quadricolor globosus* Ev. – Sennaya Guba, Tolvuya (Pekkarinen et al. 1981)  
*Bombus Psithyrus rupestris* F. – Kizhi Isl., Sennaya Guba  
*Bombus Psithyrus sylvestris* (Lep.) – Sennaya Guba
- Gasteruptiidae**  
*Gasteruption assectator* L. – Kizhi Isl.  
*Gasteruption jaculator* L. – Kizhi Isl.
- Evaniidae**  
*Brachygaster minuta* Ol. – Lipovitsy, Bol. Lelikoskiy Isl., Nizhnee Myagrozzero, Turastamozero, Uzkaya Salma
- Diapriidae**  
 \**Zygota nigra* (Thoms.) – Velikaya Guba (Hellén 1964)
- Heloridae  
*Helorus striolatus* Cameron – Myagrozzero
- Proctotrupidae**  
*Disogmus areolator* Hal. – Podyelniki

*Phaneroserphus calcar* (Hal.) – Eglov Isl.  
*Proctotrupes gravidator* L. – Vegoruksy  
*Exallonyx (Eocodrus)* sp. – Oyatevschina

#### **Scelionidae**

*Sparasion rufipes* Ruthe – Kizhi Isl.

#### **Aphidiidae**

*Pauesia unilachni* (Gahan) – Turastamozero  
*Aphidius cingulatus* (Ruthe) – Turastamozero  
*Aphidius urticae* Haliday – Lipovitsy  
*Aphidius* sp. – Turastamozero  
*Lipolexis gracilis* Först. – Turastamozero  
\**Trioxys (Binodoxys) centaureae* (Hal.) – Shun'ga (Mackauer 1968)

#### **Braconidae**

*Chorebus trjapitzini* Tobias – Kizhi Isl.  
*Rogas circumscriptus* Nees – Eglov Isl.  
*Rogas geniculator* Nees – Eglov Isl.  
*Rogas medianus* Thoms. – Podyelniki  
\**Proterops nigripennis* Wesm. – Tolvuya (Hellén 1958)

#### **Ichneumonidae**

*Hybrizon buccatus* Breb. – Vorobyi, Turastamozero, Nizhnee Myagrozero  
*Endromopoda arundinator* (F.) – Lelikovo, Ernitsky Isl.  
*Endromopoda detrita* (Holmgr.) – Lelikovo, Turastamozero, Eglov Isl., Rogachev Isl.  
*Endromopoda phragmitidis* (Perkins) – Ernitsky Isl.  
*Endromopoda nigricoxis* (Ulbricht) – Velikaya Niva  
*Scambus inanis* (Schrank) – Myagrozero  
*Scambus nigricans* Thoms. – Oyatevschina  
*Gregopimpla inquisitor* (Scop.) – Rogachev Isl.  
*Ephialtes manifestator* (L.) – Kizhi Isl.  
? *Dolichomitus dux* Tscheck – Lipovitsy  
*Perithous albicinctus* (Grav.) – Turastamozero  
*Apechtis capulifera* (Kriechb.) – Turastamozero  
*Apechtis compunctor* L. – Vorobyi, Turastamozero, Shun'ga, Nizhnee Myagrozero, Eglov Isl., Rogachev Isl.  
*Apechtis quadridentata* Thoms. – Vorobyi, Turastamozero, Polya, Tipinitsy, Tambitsy  
*Pimpla arctica* Zett. – Kizhi Isl., Uzkaya Salma l., Turastamozero  
*Pimpla contemplator* (Müll.) – Velikaya Niva, Shun'ga  
*Pimpla insignatoria* (Grav.) – Kizhi Isl., Vorobyi, Kosmozero, Oyatevschina, Sennaya Guba, Podyelniki, Turastamozero, Uzkaya Salma  
*Pimpla melanacrias* Perkins – Kizhi Isl., Uzkaya Salma  
*Pimpla rufipes* (Miller) – Vorobyi, Kurgenitsy, Oyatevschina, Sennaya Guba, Turastamozero, Nizhnee Myagrozero, Eglov Isl., Rogachev Isl.  
*Pimpla turionellae* L. – Velikaya Niva, Vorobyi  
*Itoplectis alternans* (Grav.) – Oyatevschina, Turastamozero  
*Acropimpla pictipes* (Grav.) – Tolvuya  
*Iseropus stercorator* F. – Kizhi Isl., Vorobyi  
*Zaglyptus multicolor* Grav. – Vorobyi, Tipinitsy  
*Zaglyptus varipes* (Grav.) – Vorobyi, Sennaya Guba, Podyelniki, Uzkaya Salma  
? *Clistopyga canadensis* Prov. – Vorobyi, Turastamozero  
*Schizopyga flavifrons* Holmgr. – Vorobyi  
*Schizopyga frigida* Cresson – Kosmozero  
*Acrodactyla degener* (Hal.) – Lipovitsy, Turastamozero  
*Acrodactyla quadrisculpta* (Grav.) – Lipovitsy, Turastamozero

*Polysphincta rufipes* Grav. – Kurgenitsy, Yu. Oleny Isl., Sennaya Guba, Oyatevshina  
*Zatypota albicoxa* Walk. – Tambitsy  
*Delomerista* sp. – Oyatevshina  
*Poemenia hectica* Grav. – Podyelniki, Kazhma  
*Megarhyssa rixator* (Shellenberg) – Kizhi Isl.  
*Rhyssella approximator* (F.) – Kizhi Isl., Myagrozero, Uzkaya Salma  
*Diplazon deletus* (Thoms.) – Podyelniki  
*Diplazon laetatorius* F., Yu. Oleny Isl., Nizhnee Myagrozero, Podyelniki, Khvost Isl., Rogachev Isl., Tipinitsy  
*Diplazon tetragonus* Thunb. – Vorobyi  
*Diplazon tibiatorius* (Thunb.) – Velikaya Niva  
*Diplazon scutatorius* Teunissen – Eglov Isl.  
*Homotropus megaspis* Thoms. – Eglov Isl.  
*Homotropus nigritarsus* (Grav.) – Eglov Isl.  
*Promethes sulcator* (Grav.) – Kurgenitsy, Eglov Isl.  
*Syrphophilus bizonarius* Grav. – Kizhi Isl., Sennaya Guba  
*Sussaba cognata* (Holmgr.) – Lelikovo, Tolvuya  
*Cylloceria caligata* (Grav.) – Oyatevshina  
*Cylloceria melancholica* (Grav.) – Bol. Lelikoskiy Isl., Myagrozero, Turastamozero, Uzkaya Salma, Polya  
*Rossemia longithorax* Humala – Polya  
*Orthocentrus patulus* Holmgr. – Turastamozero  
*Orthocentrus sannio* Holmgr. – Turastamozero  
*Orthocentrus spurius* Grav. – Podyelniki, Volkostrov Isl., Oyatevshina, Turastamozero  
*Orthocentrus winnertzii* Först. – Myal Isl., Turastamozero, Podyelniki  
*Plectiscus impurator* – Nizhnee Myagrozero, Uzkaya Salma, Turastamozero  
*Picrostigeus recticauda* (Thoms.) – Turastamozero, Bol. Lelikoskiy Isl.  
*Stenomacrus celer* (Holmgr.) – Bol. Klim. Isl., Polya  
*Nerateles compressus* – Turastamozero  
*Gnathochorisis crassulus* (Thoms.) – Oyatevshina, Podyelniki, Lipovitsy, Uzkaya Salma, Turastamozero  
*Gnathochorisis dentifer* Thoms. – Turastamozero, Kopanets lake.  
*Aperileptus albipalpus* (Grav.) – Turastamozero, Nizhnee Myagrozero  
*Aperileptus infuscatus* Först. – Turastamozero  
*Aperileptus vanus* Först. – Turastamozero  
*Aperileptus cf. vanus* Först. – Lipovitsy  
*Eusterinx argutula* Först. – Uzkaya Salma, Turastamozero, Tipinitsy  
*Eusterinx inaequalis* Först. – Nizhnee Myagrozero  
*Eusterinx tenuicineta* Först. – Vorobyi  
*Symplecis bicingulata* Grav. – Turastamozero  
*Symplecis cf. clipeator* Lundbeck – Vorobyi  
*Hemiphanes erratum* Humala – Tipinitsy  
*Megastylus cruentator* Schiødte – Podyelniki  
*Megastylus orbitator* Schiødte – Volkostrov Isl., Podyelniki, Uzkaya Salma, Turastamozero  
*Megastylus pectoralis* – Lipovitsy  
*Helictes borealis* Holmgr. – Turastamozero, Vorobyi  
*Helictes erythrostoma* Gmelin – Vorobyi  
*Proclitus ardentis* Rossem – Myagrozero, Turastamozero  
*Proclitus comes* Hal. – Lipovitsy, Turastamozero  
*Proclitus praetor* Hal. – Vorobyi, Eglov Isl. Nizhnee Myagrozero, Turastamozero  
*Dialipsis exilis* Först. – Turastamozero

*Plectiscidea aquilonia* Humala – Turastamozero  
*Plectiscidea collaris* Grav. – Lipovitsy, Turastamozero, Tipinitsy  
*Plectiscidea communis* Först. – Lipovitsy, Tipinitsy  
*Plectiscidea posticata* Först. – Myagrozero, Turastamozero, Tipinitsy  
*Plectiscidea zonata* (Grav.) – Velikaya Niva  
*Pantisarthrus lubricus* Först. – Turastamozero  
*Pantisarthrus luridus* Först. – Turastamozero  
*Lycorina triangulifera* Holmgr. – Sennaya Guba  
*Coleocentrus caligatus* Grav. – Eglov Isl.  
*Coleocentrus exareolatus* Kriechb. – Lipovitsy  
*Coleocentrus excitator* Poda – Kosmozero, Vikshezero  
*Arotes albicinctus* (Grav.) – Myagrozero  
*Ischnocerus rusticus* Geoffr. – Kizhi Isl., Vorobyi, Podyelniki  
*Odontocolon dentipes* Gmel. – Vorobyi  
 \**Gelis agilis* (F.) – Velikaya Niva (Hellén 1970)  
 \**Gelis discedens* (Först.) – Velikaya Niva (Hellén 1970)  
*Ecthrus reluctator* L. – Velikaya Niva  
*Theroscopus hemipterus* (F.) – Turastamozero  
*Mesoleptus distinctus* (Först.) – Eglov Isl.  
*Glyphicnemis profligator* (F.) – Tolvuya  
*Pleolophus basizonus* (Grav.) – Uzkaya Salma  
*Schenkia graminicola* (Grav.) – Velikaya Niva, Velikaya Niva  
*Cubocephalus femoralis* (Thoms.) – Velikaya Niva  
*Cubocephalus associator* Thunb. – Tolvuya, Velikaya Niva, Oyatevshina  
*Megaplectes monticola* (Grav.) – Unitsa  
*Sphecophaga vesparum* Curtis – Vorobyi  
*Acroricnus stylator* Thunb. – Vorobyi  
 ?*Aptesis improba* (Grav.) – Tolvuya  
*Ischnus migrator* (F.) – Vorobyi, Velikaya Niva  
*Glypta caudata* Thoms. – Kizhi Isl.  
*Glypta ceratites* Grav. – Eglov Isl., Podyelniki  
*Glypta cylindrator* F. – Vorobyi, Turastamozero, Podyelniki, Oyatevshina, Eglov Isl., Rogachev Isl.  
*Glypta extincta* Ratz. – Velikaya Niva  
*Glypta heterocera* Thoms. – Kizhi Isl.  
*Glypta mensurator* F. – Turastamozero, Nizhnee Myagrozero  
*Lissonota lineolaris* (Gmel.) – Kurgenitsy, Yu. Oleny Isl., Oyatevshina, Rogachev Isl.  
*Lissonota nitida* (Grav.) – Velikaya Niva  
*Lissonota punctiventris* Thoms. – Velikaya Niva  
*Alloplasta piceator* (Thunb.) – Kizhi Isl., Eglov Isl.  
*Cryptopimpla caligata* (Grav.) – Vorobyi, Kosmozero  
*Cryptopimpla errabunda* (Grav.) – Podyelniki, Velikaya Niva  
*Exetastes laevigator* (Villers) – Shun'ga  
*Adelognathus brevicornis* Holmgr. – Lydskoi Isl., Sennaya Guba  
 ?*Adelognathus dealbatus* Kasp. – Nizhnee Myagrozero  
*Adelognathus dorsalis* (Grav.) – Vorobyi, Eglov Isl., Podyelniki  
*Adelognathus pilosus* Thoms. – Eglov Isl.  
*Idiogramma euryops* Schmied. – Velikaya Niva  
*Phytodietus gelitorius* Thunb. – Vorobyi, Turastamozero  
*Dyspetes luteomarginatus* Hab. – Tipinitsy, Turastamozero  
*Cosmoconus ceratophorus* Thoms. – Podyelniki  
*Cosmoconus elongator* F. – Zubovo, Nizhnee Myagrozero

*Cosmoconus hinzi* Kasp. – Vorobyi, Kosmozero  
*Cosmoconus nigriventris* Kasp. – Vorobyi, Podyelniki  
*Polyblastus nanus* Kasp. – Kurgenitsy  
*Polyblastus pinguis* Grav. – Vorobyi  
*Polyblastus subalpinus* Holmgr. – Turastamozero  
*Polyblastus tener* Haberm. – Lyudskoi Isl.  
*Polyblastus varitarsus* (Grav.) – Eglov Isl., Poly, Tipinitsy, B.Lelikoskiy Isl., Myal Isl.  
*Polyblastus wahlbergi* Holmgr. – Turastamozero  
*Ctenochira gilvipes* (Holmgr.) – Eglov Isl.  
*Ctenochira marginata* Holmgr. – B.Lelikoskiy Isl., Kopanets lake  
*Ctenochira propinqua* Grav. – Vorobyi, B.Lelikoskiy Isl., Sennaya Guba  
*Ctenochira xanthopyga* (Holmgr.) – Eglov Isl.  
*Tryphon bidentatus* Stephens – Vorobyi, Kurgenitsy, Lelikovo  
*Tryphon exclamationis* Grav. – Kurgenitsy  
*Tryphon obtusator* (Thunb.) – Kizhi Isl., Eglov Isl., Ernitsky Isl., Lyudskoi Isl.  
*Tryphon thomsoni* Roman – Kurgenitsy  
*Erromenus plebejus* (Woldst.) – Lelikovo  
*Cycasis rubiginosa* Grav. – Vorobyi  
*Kristotomus laetus* Grav. – Vorobyi  
*Exyston sponsorius* (F.) – Vorobyi, Oyatevschina  
*Eridolius aurifluus* (Hal.) – Kurgenitsy  
*Eridolius rufilabris* (Holmgr.) – Oyatevschina  
*Eridolius rufonotatus* (Holmgr.) – Oyatevschina  
*Eridolius schiodtei* Holmgr. – Kosmozero  
*Smicroplectrus excisus* Kerrich – Lelikovo  
*Smicroplectrus perkinsi* Kerrich – Vorobyi  
*Exenterus amictorius* Panz. – Vorobyi  
*Excavarus apiarius* (Grav.) – Vorobyi  
*Ctenopelma lapponicum* Holmgr. – Rogachev Isl.  
*Ctenopelma nigrum* Holmgr. – Velikaya Niva (Hellén 1948)  
*Ctenopelma tomentosum* Desv. – Oyatevschina  
*Xenoschesis ustulata* (Desv.) – Podyelniki, Lipovitsy, Velikaya Niva  
*Pion fortipes* Grav. – Vorobyi, Kizhi Isl., Rogachev Isl.  
*Pion nigripes* Schiødte = *crassipes* Holmgr. – Kizhi Isl.  
*Scolobates auriculatus* F. – Lipovitsy  
*Opheltes glaucopterus* L. – Kurgenitsy, Vorobyi, Lipovitsy, Vegoruksy  
*Perilissus rufoniger* (Grav.) – Oyatevschina  
*Perilissus variator* (Müll.) – Vorobyi, Rogachev Isl.  
*\*Phobetes leptocerus* (Grav.) – Velikaya Niva (Hellén1961)  
*Hypamblys albopictus* (Grav.) – Velikaya Niva  
*Rhaestus lativentris* Holmgr. – Vorobyi  
*Rhaestus ophthalmicus* Holmgr. – Vorobyi  
*Rhaestus rufipes* Holmgr. – Vorobyi  
*?Alexeter multicolor* (Grav.) – Kosmozero  
*Sympherta jactator* (Thunb.) – Podyelniki  
*Sympherta obligator* (Thunb.) – Vorobyi, Velikaya Niva  
*Mesoleius aulicus* Grav. – Poly  
*Anisotacrus bipunctatus* (Grav.) – Oyatevschina  
*Hadrodactylus tiphæ* (Geoffr.) – Tolvuya, Kizhi Isl.  
*Oxytorus luridator* (Grav.) – Vorobyi, Turastamozero, Nizhnee Myagrozero, Myagrozero  
*Collyria trichophthalma* Thoms. – Lelikovo, Sennaya Guba, Ernitsky Isl., Eglov Isl., Rogachev Isl.

*Probles microcephalus* Grav. – Kurgenitsy  
*Tersilochus caudatus* (Holmgr.) – Vorobyi  
*Barycnemis bellator* (Müll.) – Vorobyi  
*Charops cantator* (DeGeer) – Eglov Isl.  
*Casinaria* sp. – Podyelniki  
*Tranosemella coxalis* Brischke – Kurgenitsy  
*\*Dusona stenogaster* (Först.) – Velikaya Niva (Hellén 1962)  
*\*Dusona stragifex* (Först.) – Velikaya Niva (Hellén 1937)  
*?Diadegma rectificator* Aubert – Kosmozero  
*\*Enicospilus undulatus* (Grav.) – Kizhi Isl. (Hellén 1926)  
*Cidaphus areolatus* Boie – Podyelniki  
*Therion circumflexum* L. – Turastamozero  
*Heteropelma amictum* (F.) – Tipinitsy  
*Aphanistes ruficornis* Grav. – Vorobyi, Eglov Isl.  
*Camposcopus canaliculatus* Ratz. – B.Lelikoskiy Isl.  
*Agrypon flexorium* Thunb. – Velikaya Niva, Podyelniki, Turastamozero  
*Chorinaeus brevicar* Thoms. – Podyelniki  
*Exochus prosopius* Grav. – Sennaya Guba  
*Triclistus pallipes* Holmgr. – Eglov Isl.  
*Alomya debellator* F. – Kizhi Isl., Turastamozero, Kosmozero, Podyelniki, Eglov Isl., Rogachev Isl.  
*Alomya pygmaea* Heinrich – Kurgenitsy, Vorobyi, Sennaya Guba, Radkol'e, Tolvuya (Hellén 1951), Eglov Isl., Rogachev Isl.  
*Misetus oculatus* Wesm. – Vorobyi, Turastamozero, Uzkaya Salma, Polya  
*Heterischnus debilis* Grav. – Podyelniki  
*Platylabus vibratorius* Thunb. – Vorobyi  
*Platylabus heteromallus* (Berthouemieu) – Vikshezero  
*Pseudoplatylabus violentus* (Grav.) – Kurgenitsy  
*Acolobus albimanus* (Grav.) – Megostrov Isl.  
*Protichneumon similatorius* (F.) – Kizhi Isl., Vorobyi, Oyatevschina  
*Aoplus castaneus* (Grav.) – Vorobyi  
*Cratichneumon jocularis* (Wesm.) – Ernitsky Isl.  
*Cratichneumon rufifrons* (Grav.) – Eglov Isl.  
*Cratichneumon sicarius* (Grav.) – Kizhi Isl.  
*Cratichneumon viator* (Scop.) – Kizhi Isl., Velikaya Guba, Oyatevschina, Vorobyi, Eglov Isl.  
*Ctenichneumon divisorius* (Grav.) – Vorobyi  
*Ctenichneumon inspector* (Wesm.) – Vorobyi  
*Syspasis scutellator* (Grav.) – Vikshezero, Eglov Isl.  
*\*Hoplismenus bidentatus* (Gmel.) – Kizhi Isl. (Hellén 1936)  
*Homotherus locutor* (Thunb.) – Ernitsky Isl.  
*Homotherus varipes* (Grav.) – Vorobyi  
*\*Hybophorellus injucundus* (Wesm.) – Velikaya Niva (Hellén 1951)  
*Anisopygus pseudonymus* (Wesm.) – Rogachev Isl.  
*Hepiopelmus melanogaster* (Gmelin) – Vorobyi  
*Ichneumon balteatus* Wesm. – Kurgenitsy  
*Ichneumon caedator* Grav. – Lambaznik Isl.  
*Ichneumon cessator* Müller – Velikaya Niva  
*Ichneumon gracilicornis* Grav. – Vorobyi, Myal Isl.  
*Ichneumon oblongus* Schrank – Vikshezero  
*Ichneumon primatorius* Först. – Eglov Isl.  
*\*Eurylabus tristis* (Grav.) – Shun'ga (Hellén 1951)  
*Amblyjoppa proteus* Christ – Vorobyi, Bol. Lelikoskiy Isl., Turastamozero

*Limerodops elongatus* (Brischke) – Vikshezero, Kizhi Isl.  
*Sycaonia foersteri* (Wesm.) – Ernitsky Isl.  
*Virgichneumon albosignatus* (Grav.) – Vorobyi  
\**Virgichneumon faunus* (Grav.) – Kuzaranda (Ranin 1979)  
*Vulgichneumon deceptor* (Scop.) – Ernitsky Isl.  
*Vulgichneumon suavis* (Grav.) – Ernitsky Isl., Lelikovo

## DIPTERA

### Trichoceridae

*Trichocera rufescens* Edwards – Poly, Tambitsy, Tipinitsy

### Pediciidae

*Ula bolitophila* Loew – Velikaya Niva

*Ula sylvatica* Meigen – Poly, Tipinitsy

*Pedicia rivosa* L. – Lipovitsy, Tambitsy, Tipinitsy, Turastamozero

*Tricyphona unicolor* Schummel – Ernitskiy Isl., Kizhi Isl., Lelikovo

### Limoniidae

*Elephantomyia krivosheinae* Savtshenko – Myal' Isl.

*Helius longirostris* Meigen – Ernitskiy Isl., Klimenicy, Lelikovo, Poly, Sennaya Guba, Shunevskiy Isl., Uzkaya Salma, Vikshezero

*Austrolimnophila unica* Osten-Sacken – Paleostrov Isl., Tolvuya

*Idioptera linnei* Oosterbroek – Kizhi Isl., Vikshezero

*Idioptera pulchella* Meigen – Vikshezero, Volkostrov Isl.

*Limnophila pictipennis* Meigen – Lelikovo

*Neolimnomyia nemoralis* Meigen – Lipovitsy, Lyudskoi Isl., Paleostrov Isl., Rogachev Isl., Sennaya Guba

*Euphyllidorea phaeostigma* Schummel – Podyelniki, Poly

*Phyllidorea abdominalis* Staeger – Verkhnee Myagrozero

*Phyllidorea ferruginea* Meigen – Ernitskiy Isl., Vorobyi

*Phyllidorea fulvonervosa* Schummel – Bol. Lelikovskiy Isl.

*Phyllidorea longicornis* Schummel – Klimenicy, Lipovitsy, Shunevskiy Isl., Verkhnee Myagrozero, Vikshezero

*Phyllidorea squalens* Zetterstedt – Lipovitsy, Verkhnee Myagrozero

*Pilaria discicollis* Meigen – Klimenicy, Kurgenitsy, Podyelniki

*Erioptera lutea* Meigen – Vegoruksy

*Erioptera nielseni* de Meijere – Uzkaya Salma

*Molophilus ater* Meigen – Tolvuya

*Molophilus bihamatus* de Meijere – Klimenicy

*Molophilus flavus* Goetghebuer – Lipovitsy

*Molophilus griseus* Meigen – Kurgenitsy

*Molophilus medius* de Meijere – Lipovitsy

*Molophilus ochraceus* Meigen – Vikshezero

*Ormosia depilata* Edwards – Kizhi Isl., Lelikovo

*Ormosia ruficauda* Zetterstedt – Bol. Lelikovskiy Isl., Klimenicy, Vikshezero

*Ormosia staegeriana* Alexander – Klimenicy, Lipovitsy

*Rhypholophus varius* Meigen – Lipovitsy

*Gnophomyia viridipennis* Gimmerthal – Bol. Lelikovskiy Isl., Kopanets lake, Lipovitsy

*Neolimonia dumetorum* Meigen – Bol. Lelikovskiy Isl., Myagrozero

*Dicranomyia distendens* Lundström – Eglov Isl.

*Dicranomyia modesta* Meigen – Klimenicy, Paleostrov Isl., Poly, Vavlok Isl.

*Discobola annulata* L. – Turastamozero

*Discobola caesarea* Osten-Sacken – Bol. Lelikovskiy Isl.

*Limonia badia* Walker – Poly, Tipinitsy

*Limonia flavipes* Fabricius – Klimenicy, Shunevskiy Isl., Vorobyi  
*Limonia macrostigma* Schummel – Turastamozero, Yu. Oleny Isl.  
*Limonia phragmitidis* Schrank – Verkhnee Myagrozero  
*Limonia sylvicola* Schummel – Lipovitsy  
*Limonia trivittata* Schummel – Kurgenitsy, Volkostrov Isl.  
*Metalimnobia bifasciata* Schrank – Bol. Lelikovskiy Isl., Khvost Isl., Lipovitsy, Poly, Turastamozero, Uzkaya Salma, Vorobyi, Yu. Oleny Isl.  
*Metalimnobia quadrimaculata* L. – Turastamozero, Verkhnee Myagrozero, Vorobyi  
*Metalimnobia quadrinotata* Meigen – Bol. Lelikovskiy Isl., Turastamozero, Verkhnee Myagrozero, Yu. Oleny Isl.  
*Metalimnobia zetterstedti* Tjeder – Lipovitsy  
*Rhipidia maculata* Meigen – Klimenicy  
*Rhipidia uniseriata* Schiner – Lyudskoi Isl.

**Cylindrotomidae**

*Cylindrotoma distinctissima* Meigen – Poly, Vorobyi  
*Diogma glabrata* Meigen – Lipovitsy

**Tipulidae**

*Tipula affinis* Schummel – Eglov Isl., Paleostrov Isl.  
*Tipula autumnalis* Loew – Vorobyi  
*Tipula circumdata* Siebke – Tambitsy  
*Tipula confusa* Van der Wulp – Vorobyi  
*Tipula fascipennis* Meigen – Kazhma, Vavlok Isl.  
*Tipula fulvipennis fulvipennis* DeGeer – Klimenicy  
*Tipula humilis* Staeger – Bol. Lelikovskiy Isl., Kizhi Isl., Kosmozero, Podyelniki  
*Tipula irrorata* Macquart – Ernitskiy Isl., Tolvuya  
*Tipula laetabilis* Zetterstedt – Podyelniki  
*Tipula limitata* Schummel – Kosmozero  
*Tipula luna* Westhoff – Eglov Isl.  
*Tipula nubeculosa* Meigen – Oyatevschina  
*Tipula paludosa* Meigen – Vegoruksy  
*Tipula pruinosa pruinosa* Wiedemann – Vikshezero  
*Tipula pseudovariipennis* Czizek – Kizhi Isl.  
*Tipula scripta* Meigen – Bol. Lelikovskiy Isl., Lipovitsy  
*Tipula variicornis* Schummel – Lipovitsy, Poly, Vorobyi  
*Tipula variipennis* Meigen – Kizhi Isl., Tolvuya, Vorobyi  
*Prionocera turcica* Fabricius – Kizhi Isl., Klimenicy  
*Nephrotoma analis* Schummel – Vikshezero  
*Nephrotoma cornicina* L. – Kosmozero  
*Nephrotoma pratensis* L. – Shun'ga  
*Dicthenidia bimaculata* L. – Rogachev Isl., Turastamozero, Verkhnee Myagrozero  
*Tanyptera atrata* L. – Vorobyi

**Ptychopteridae**

*Ptychoptera minuta* Tonnoir – Klimenicy

**Psychodidae**

*Clytocerus ocellaris* Meigen – Vorobyi

**Dixidae**

*Dixella aestivalis* Meigen – Khvost Isl., Vikshezero  
*Dixella borealis* Martini – Tambitsy  
*Dixella hyperborea* Bergroth – Shunevskiy Isl.

**Culicidae**

*Anopheles maculipennis* Meigen – Kizhi Isl.  
*Culiseta alaskaensis* Ludlow – Shunevskiy Isl.



*Culiseta fumipennis* Stephens – Lipovitsy, Polyta, Uzkaya Salma  
*Culiseta ochroptera* Peus – Vorobyi  
*Coquillettidia richiardii* Ficalbi – Uzkaya Salma  
? *Aedes annulipes* Meigen – Vikshezero  
*Aedes behningi* Martini – Ernitskiy Isl.  
*Aedes cataphyla* Dyar – Ernitskiy Isl., Lelikovo, Sennaya Guba  
*Aedes cinereus* Meigen – Verkhnee Myagrozero, Vikshezero  
*Aedes communis* DeGeer – Ernitskiy Isl.  
*Aedes diantaeus* Howard, Dyar et Knab – Ernitskiy Isl., Lipovitsy, Shunevskiy Isl., Vikshezero  
*Aedes excrucians* Walker – Ernitskiy Isl., Lelikovo, Shunevskiy Isl., Vikshezero  
*Aedes intrudens* Dyar – Lyudskoi Isl  
*Aedes pionips* Dyar – Eglov Isl., Vikshezero  
*Aedes punctor* Kirby – Polyta, Vikshezero  
*Culex territans* Walker – Polyta, Verkhnee Myagrozero  
**Ceratopogonidae**  
*Clinohoelea unimaculata* Macquart – Klimenicy  
**Anisopodidae**  
*Sylvicola cinctus* Fabricius – Turastamozero  
*Sylvicola punctatus* Fabricius – Vorobyi  
**Scatopsidae**  
*Apiloscatopse flavicollis* Meigen – Tipinitsy  
**Bibionidae**  
*Dilophus femoratus* Meigen – Eglov Isl., Kuzaranda, Paleostrov Isl., Rogachev Isl., Vikshezero  
*Biblio clavipes* Meigen – Myagrozero  
*Biblio nigrirostris* Haliday – Eglov Isl., Ernitskiy Isl., Kainos Isl., Klimenicy, Kuivakhda Isl., Lelikovo, Lipovitsy, Lyudskoi Isl., Myal' Isl., Paleostrov Isl., Polyta, Sennaya Guba, Tipinitsy, Vikshezero, Yu. Oleny Isl.  
*Biblio pomonae* Fabricius – Vorobyi  
**Ditomyiidae**  
*Symmerus nobilis* Lackschewitz – Kosmozero  
**Diadocidiidae**  
*Diadocidia ferruginosa* Meigen – Bol. Lelikovskiy Isl., Kizhi Isl., Lyudskoi Isl., Myal' Isl., Polyta, Shunevskiy Isl., Tambitsy, Tipinitsy, Turastamozero, Vavlok Isl., Verkhnee Myagrozero, Vikshezero, Vorobyi  
*Diadocidia spinosula* Tollet – Lyudskoi Isl., Tipinitsy  
**Mycetophilidae**  
*Mycomya affinis* Staeger – Tambitsy, Tipinitsy, Turastamozero  
*Mycomya annulata* Meigen – Klimenicy, Lipovitsy, Myagrozero, Polyta, Tambitsy, Tipinitsy, Turastamozero  
*Mycomya brunnea* Dziedzicki – Tipinitsy  
*Mycomya cinerascens* Macquart – Myal' Isl., Tipinitsy  
*Mycomya collini* Edwards – Paleostrov Isl.  
*Mycomya egregia* Dziedzicki – Lyudskoi Isl.  
*Mycomya festivalis* Väisänen – Klimenicy  
*Mycomya fimbriata* Meigen – Turastamozero  
*Mycomya flavicollis* Zetterstedt – Podyelniki, Uzkaya Salma  
*Mycomya griseovittata* Zetterstedt – Vorobyi  
*Mycomya nigricornis* Zetterstedt – Myagrozero, Vorobyi  
*Mycomya nitida* Zetterstedt – Klimenicy, Kuivakhda Isl., Lelikovo, Lyudskoi Isl., Paleostrov Isl., Velikaya Niva, Vikshezero, Yu. Oleny Isl.

*Mycomya parudentata* Väisänen – Polyta, Tambitsy, Tipinitsy, Turastamozero  
*Mycomya parva* Dziedzicki – Lyudskoi Isl.  
*Mycomya penicillata* Dziedzicki – Myagrozero, Turastamozero, Vorobyi  
*Mycomya permixta* Väisänen – Lipovitsy, Myagrozero, Polyta, Tambitsy, Tipinitsy, Turastamozero  
*Mycomya prominens* Lundström – Paleostrov Isl.  
*Mycomya pseudoapicalis* Landrock – Klimenicy  
*Mycomya ruficollis* Zetterstedt – Klimenicy, Vikshezero  
*Mycomya shermani* Garrett – Myagrozero, Polyta, Tambitsy, Tipinitsy  
*Mycomya siebecki* Landrock – Tambitsy, Tipinitsy  
*Mycomya sp4* (cf. *penicillata*) – Turastamozero  
*Mycomya trilineata* Zetterstedt – Bol. Lelikovskiy Isl., Kurgenitsy, Podyelniki, Turastamozero, Verkhnee Myagrozero, Volkostrov Isl.  
*Mycomya trivittata* Zetterstedt – Klimenicy, Lyudskoi Isl., Paleostrov Isl., Tipinitsy, Vikshezero  
*Mycomya wankowiczii* Dziedzicki – Lyudskoi Isl., Turastamozero, Yu. Oleny Isl.  
*Mycomya winnertzi* Dziedzicki – Paleostrov Isl.  
*Neoempheria pictipennis* Haliday – Tipinitsy  
*Neoempheria tuomikoskii* Väisänen – Vikshezero  
*Acnemia angusta* A. Zaitzev – Kopanets lake, Vikshezero  
*Acnemia nitidicollis* Meigen – Bol. Lelikovskiy Isl., Kopanets lake, Kosmozero, Kurgenitsy, Lyudskoi Isl., Oyatevshina, Podyelniki, Polyta, Turastamozero, Uzkaya Salma, Velikaya Niva, Vorobyi, Voynavolok  
*Allocotocera pulchella* Curtis – Eglov Isl., Klimenicy, Oyatevshina, Turastamozero, Uzkaya Salma  
*Leptomorphus subforcipatus* A. Zaitzev & Ševčík – Vorobyi  
*Leptomorphus walkeri* Curtis – Kopanets lake  
*Megalopelma nigroclavatum* Strobl – Lyudskoi Isl.  
*Monoclona rufilatera* Walker – Bol. Lelikovskiy Isl., Kizhi Isl., Kurgenitsy, Oyatevshina, Turastamozero, Vikshezero, Volkostrov Isl.  
*Neuratelia nemoralis* Meigen – Lelikovo, Velikaya Niva  
*Phthiria humilis* Winnertz – Turastamozero  
*Polylepta borealis* Lundström – Kopanets lake  
*Polylepta guttiventris* Zetterstedt – Klimenicy, Lipovitsy, Polyta, Shunevskiy Isl., Tambitsy, Tipinitsy, Turastamozero, Volkostrov Isl., Yu. Oleny Isl.  
*Sciophila fenestella* Curtis – Lyudskoi Isl., Oyatevshina, Podyelniki, Uzkaya Salma, Vikshezero, Vorobyi  
*Sciophila geniculata* Zetterstedt – Klimenicy, Oyatevshina  
*Sciophila hirta* Meigen – Podyelniki  
*Sciophila nigronitida* Landrock – Kizhi Isl., Vorobyi  
*Sciophila persubtilis* Polevoi – Oyatevshina, Turastamozero  
*Sciophila thoracica* Staeger – Eglov Isl., Ernitskiy Isl., Turastamozero, Vorobyi  
*Sytemna nitidula* Edwards – Ernitskiy Isl.  
*Sytemna relictata* Lundström – Vikshezero  
*Sytemna setigera* Lundström – Lyudskoi Isl.  
*Sytemna stylatoides* A. Zaitzev – Lyudskoi Isl., Vorobyi  
*Apolephthisa subincana* Curtis – Lyudskoi Isl., Podyelniki, Turastamozero, Velikaya Niva  
*Boletina basalis* Meigen – Ernitskiy Isl., Kizhi Isl., Kuivakhda Isl., Lyudskoi Isl., Myal' Isl., Oyatevshina, Tolvuya, Velikaya Niva, Vorobyi  
*Boletina cincticornis* Walker – Kizhi Isl., Oyatevshina, Velikaya Niva, Vorobyi  
*Boletina dissipata* Plassmann – Klimenicy  
*Boletina edwardsi* Chandler – Turastamozero

*Boletina gripha* Dziedzicki – Klimenicy, Lyudskoi Isl., Oyatevschina, Tipinitsy, Tolvuya, Turastamozero, Velikaya Niva, Verkhnee Myagrozero, Vikshezero, Volkostrov Isl., Vorobyi  
*Boletina griphoides* Edwards – Oyatevschina, Turastamozero  
 ? *Boletina gusakovae* A. Zaitzev – Tambitsy, Tipinitsy, Turastamozero  
*Boletina kivachiana* Polevoi & Hedmark – Turastamozero  
*Boletina lundstroemi* Landrock – Turastamozero  
*Boletina moravica* Landrock – Turastamozero, Verkhnee Myagrozero  
*Boletina nigricans* Dziedzicki – Kizhi Isl., Klimenicy, Oyatevschina  
*Boletina nigrofusca* Dziedzicki – Klimenicy  
*Boletina nitida* Grzegorzec – Kainos Isl., Turastamozero  
*Boletina pinusia* Maximova – Ernitskiy Isl.  
*Boletina populina* Polevoi – Klimenicy, Oyatevschina, Turastamozero, Velikaya Niva, Vorobyi  
*Boletina sciarina* Staeger – Kizhi Isl., Turastamozero  
*Boletina silvatica* Dziedzicki – Turastamozero  
*Boletina subtriangularis* Polevoi & Hedmark – Turastamozero  
*Boletina takagii* Sasakava et Kimura – Turastamozero  
*Boletina triangularis* Polevoi – Oyatevschina  
*Boletina trivittata* Meigen – Klimenicy, Lipovitsy, Myagrozero, Poly, Tambitsy, Tipinitsy  
*Boletina villosa* Landrock – Tambitsy  
*Coelosia tenella* Zetterstedt – Bol. Lelikovski Isl., Turastamozero  
*Coelosia truncata* Lundström – Vorobyi  
*Dziedzickia marginata* Dziedzicki – Myagrozero  
*Gnoriste apicalis* Meigen – Kizhi Isl.  
*Gnoriste bilineata* Zetterstedt – Klimenicy  
*Grzegorzecia collaris* Meigen – Oyatevschina  
*Palaeodocosia vittata* Coquillett – Bol. Lelikovski Isl., Lipovitsy, Tipinitsy  
*Saigusaia flaviventris* Strobl – Kopanets lake, Lipovitsy  
*Synapha fasciata* Meigen – Eglov Isl., Ernitskiy Isl., Khvost Isl.  
*Synapha vitripennis* Meigen – Kainos Isl., Lipovitsy  
*Docosia gilvipes* Walker – Lyudskoi Isl.  
*Ectrepesthoneura colyeri* Chandler – Myagrozero, Uzkaya Salma, Vikshezero, Vorobyi  
*Ectrepesthoneura hirta* Winnertz – Eglov Isl., Kizhi Isl., Lyudskoi Isl., Oyatevschina, Podyelniki, Vikshezero, Vorobyi  
*Ectrepesthoneura ovata* Ostroverkhova – Uzkaya Salma  
*Ectrepesthoneura pubescens* Zetterstedt – Oyatevschina, Velikaya Niva, Vikshezero, Vorobyi  
*Ectrepesthoneura referta* Plassmann – Velikaya Niva  
*Leia bilineata* Winnertz – Volkostrov Isl.  
*Leia cylindrica* Winnertz – Vorobyi  
*Leia picta* Meigen – Poly  
*Leia subfasciata* Meigen – Ernitskiy Isl., Lipovitsy, Lyudskoi Isl., Oyatevschina, Vikshezero  
*Leia winthemi* Lehmann – Uzkaya Salma, Volkostrov Isl.  
*Rondaniella dimidiata* Meigen – Turastamozero  
*Tetragoneura sylvatica* Curtis – Eglov Isl.  
*Dynatosoma fuscicorne* Meigen – Kopanets lake, Podyelniki, Turastamozero  
*Dynatosoma nigromaculatum* Lundström – Turastamozero  
*Dynatosoma reciprocum* Walker – Vikshezero  
*Dynatosoma thoracicum* (s. Zaitzev) – Paleostrov Isl., Uzkaya Salma  
*Epicypta aterrima* Zetterstedt – Ernitskiy Isl., Verkhnee Myagrozero  
*Mycetophila abiecta* Laštovka – Bol. Lelikovski Isl., Vikshezero

*Mycetophila alea* Laffoon – Tambitsy, Tipinitsy, Turastamozero, Vorobyi  
*Mycetophila attonsa* Laffoon – Yu. Oleny Isl.  
*Mycetophila blanda* Winnertz – Myagrozero, Tipinitsy, Vorobyi  
*Mycetophila brevitarsata* Laštovka – Uzkaya Salma  
*Mycetophila confluens* Dziedzicki – Turastamozero, Vorobyi  
*Mycetophila curviseta* Lundström – Uzkaya Salma  
*Mycetophila deflexa* Chandler – Lipovitsy, Turastamozero  
*Mycetophila estonica* Kurina – Tipinitsy  
*Mycetophila fungorum* DeGeer – Bol. Lelikovskiy Isl., Klimenicy, Kosmozero, Kurgenitsy, Paleostrov Isl., Polya, Tipinitsy, Turastamozero, Vikshezero, Vorobyi  
*Mycetophila gemerensis* Ševčík & Kurina – Vorobyi  
*Mycetophila gibbula* Edwards – Turastamozero, Yu. Oleny Isl.  
*Mycetophila hetschkoi* Landrock – Lipovitsy, Turastamozero  
*Mycetophila ichneumonea* Say – Bol. Lelikovskiy Isl., Klimenicy, Kosmozero, Lipovitsy, Paleostrov Isl., Podyelniki, Tambitsy, Tipinitsy, Turastamozero, Verkhnee Myagrozero, Volkostrov Isl., Vorobyi  
*Mycetophila laeta* Walker – Tipinitsy  
*Mycetophila lubomirskii* Dziedzicki – Tambitsy  
*Mycetophila luctuosa* Meigen – Klimenicy, Lipovitsy, Myagrozero, Tambitsy, Turastamozero, Vavlok Isl., Yu. Oleny Isl.  
*Mycetophila magnicauda* Strobl – Turastamozero  
*Mycetophila morosa* Winnertz – Turastamozero  
*Mycetophila nigrofusca* Dziedzicki – Kopanets lake, Turastamozero  
*Mycetophila ocellus* Walker – Klimenicy, Turastamozero, Verkhnee Myagrozero  
*Mycetophila perpallida* Chandler – Myagrozero, Paleostrov Isl., Polya, Tipinitsy, Turastamozero  
*Mycetophila schnabli* Dziedzicki – Lipovitsy, Polya, Tipinitsy  
*Mycetophila signata* Meigen – Lipovitsy  
*Mycetophila signatoides* Dziedzicki – Lyudskoi Isl., Myagrozero, Polya, Tambitsy, Tipinitsy  
*Mycetophila sordida* Van der Wulp – Tambitsy  
*Mycetophila stolidi* Walker – Lyudskoi Isl.  
*Mycetophila stricklandi* Laffoon – Bol. Lelikovskiy Isl., Turastamozero  
*Mycetophila strigata* Staeger – Vorobyi  
*Mycetophila strigatoides* Landrock – Nizhneje Myagrozero, Turastamozero, Vikshezero  
*Mycetophila strobli* Laštovka – Klimenicy, Kosmozero, Lyudskoi Isl., Tipinitsy, Turastamozero, Vikshezero  
*Mycetophila stylata* Dziedzicki – Bol. Lelikovskiy Isl.  
*Mycetophila sublunata* A. Zaitzev – Klimenicy, Paleostrov Isl., Tipinitsy, Verkhnee Myagrozero  
*Mycetophila subsigillata* A. Zaitzev – Bol. Lelikovskiy Isl., Paleostrov Isl., Tambitsy, Tipinitsy, Turastamozero  
*Mycetophila triangulata* Dziedzicki – Vorobyi  
*Mycetophila trinotata* Staeger – Kurgenitsy, Turastamozero, Vorobyi  
*Mycetophila uschaica* Subbotina & Maksimova – Polya  
*Phronia braueri* Dziedzicki – Turastamozero, Volkostrov Isl.  
*Phronia caliginosa* Dziedzicki – Polya, Tambitsy  
*Phronia cinerascens* Winnertz – Turastamozero, Vikshezero  
*Phronia disgrega* Dziedzicki – Lyudskoi Isl., Myagrozero, Vikshezero  
*Phronia egregia* Dziedzicki – Tipinitsy, Turastamozero  
*Phronia exigua* Zetterstedt – Turastamozero  
*Phronia flavipes* Winnertz – Tambitsy

*Phronia forcipata* Winnertz – Bol. Lelikovskiy Isl., Lyudskoi Isl., Oyatevschina, Volkostrov Isl  
*Phronia forcipula* Winnertz – Klimenicy  
*Phronia gagnei* Chandler – Bol. Lelikovskiy Isl., Klimenicy  
*Phronia maculata* Dziedzicki – Lipovitsy, Tipinitsy, Uzkaya Salma  
*Phronia nigricornis* Zetterstedt – Uzkaya Salma  
*Phronia nigripalpis* Lundström – Kizhi Isl., Kopanets lake, Vikshezero, Volkostrov Isl., Vorobyi  
*Phronia nitidiventris* Van der Wulp – Tambitsy, Turastamozero  
*Phronia notata* Dziedzicki – Turastamozero  
*Phronia persimilis* Hackman – Khvost Isl., Turastamozero, Vikshezero  
*Phronia siebeckii* Dziedzicki – Uzkaya Salma  
*Phronia signata* Winnertz – Tambitsy  
*Phronia strenua* Winnertz – Bol. Lelikovskiy Isl., Klimenicy, Lelikovo, Shunevskiy Isl., Turastamozero, Volkostrov Isl., Vorobyi  
*Phronia taczanowskii* Dziedzicki – Turastamozero  
*Phronia tenuis* Winnertz – Polya, Tambitsy, Yu. Oleny Isl.  
*Phronia vitrea* Plassmann – Polya  
*Phronia willistoni* Dziedzicki – Bol. Lelikovskiy Isl.  
*Platurocypta punctum* Stannius – Bol. Lelikovskiy Isl., Klimenicy, Lyudskoi Isl., Turastamozero, Vorobyi  
*Platurocypta testata* Edwards – Bol. Lelikovskiy Isl., Kizhi Isl., Kosmozero, Kurgenitsy, Tipinitsy, Turastamozero, Vorobyi, Yu. Oleny Isl.  
*Sceptonia concolor* Winnertz – Lipovitsy  
*Sceptonia costata* Van der Wulp – Myagrozero, Turastamozero  
*Sceptonia demeijerei* Bechev – Vorobyi  
*Sceptonia flavipuncta* Edwards – Ernitskiy Isl.  
*Sceptonia fumipes* Edwards – Turastamozero, Vorobyi  
*Sceptonia fuscipalpis* Edwards – Tambitsy, Turastamozero, Vikshezero  
*Sceptonia hamata* Ševčík – Bol. Lelikovskiy Isl., Turastamozero  
*Sceptonia longisetosa* Ševčík – Oyatevschina  
*Sceptonia membranacea* Edwards – Klimenicy, Polya  
*Sceptonia nigra* Meigen – Bol. Lelikovskiy Isl., Ernitskiy Isl., Kuivakhda Isl., Turastamozero, Volkostrov Isl., Vorobyi, Yu. Oleny Isl.  
*Sceptonia pilosa* Bukowski – Bol. Lelikovskiy Isl., Kuivakhda Isl., Lyudskoi Isl., Turastamozero  
*Sceptonia regni* Chandler – Turastamozero  
*Trichonta atricauda* Zetterstedt – Vikshezero  
*Trichonta concinna* Gagné – Tambitsy  
*Trichonta conjungens* Lundström – Tipinitsy  
*Trichonta excisa* Lundström – Volkostrov Isl.  
*Trichonta hamata* Mik – Yu. Oleny Isl.  
*Trichonta subfusca* Lundström – Turastamozero  
*Trichonta vulcani* Dziedzicki – Lipovitsy  
*Trichonta vulgaris* Loew – Turastamozero  
*Zygomyia angusta* Plassmann – Lyudskoi Isl.  
*Zygomyia kiddi* Chandler – Oyatevschina  
*Zygomyia notata* Stannius – Oyatevschina, Paleostrov Isl., Vorobyi  
*Zygomyia pseudohumeralis* Caspers – Bol. Lelikovskiy Isl., Oyatevschina, Podyelniki, Shunevskiy Isl., Tipinitsy, Turastamozero, Uzkaya Salma, Volkostrov Isl., Vorobyi  
*Zygomyia semifusca* Meigen – Turastamozero  
*Zygomyia valida* Winnertz – Kurgenitsy, Turastamozero, Vorobyi

*Zygomyia zaitzevi* Chandler – Bol. Lelikovskiy Isl., Klimenicy, Vorobyi  
*Allodia alternans* Zetterstedt – Klimenicy, Turastamozero  
*Allodia anglofennica* Edwards – Kizhi Isl., Lipovitsy, Polya, Tambitsy, Verkhnee Myagrozero  
*Allodia czernyi* Landrock – Tambitsy  
*Allodia foliifera* Strobl – Turastamozero  
*Allodia lugens* Wiedemann – Myal' Isl., Tipinitsy  
*Allodia ornatcollis* Meigen – Kurgenitsy  
*Allodia pyxidiiformis* A. Zaitzev – Turastamozero  
*Allodiopsis domestica* Meigen – Klimenicy, Tambitsy  
*Allodiopsis gracai* Ševčík & Papp – Klimenicy  
*Allodiopsis rustica* Edwards – Polya, Tipinitsy, Verkhnee Myagrozero  
*Notolopha cristata* Staeger – Klimenicy, Lipovitsy, Tambitsy, Tipinitsy, Verkhnee Myagrozero  
*Myrosia maculosa* Meigen – Tipinitsy  
*Synplasta karelica* A. Zaitzev – Turastamozero  
*Synplasta pseudingeniosa* A. Zaitzev – Tambitsy  
*Synplasta sintenisi* Lackschewitz – Myal' Isl.  
*Anatella flavomaculata* Edwards – Volkostrov Isl.  
*Brachypeza armata* Winnertz – Kopanets lake  
*Brachypeza bisignata* Winnertz – Lyudskoi Isl., Nizhneje Myagrozero  
*Brevicornu bellum* Johansen – Turastamozero  
*Brevicornu fasciculatum* Lackschewitz – Kizhi Isl., Lyudskoi Isl., Turastamozero, Volkostrov Isl.  
*Brevicornu fuscipenne* Staeger – Klimenicy, Turastamozero, Vorobyi  
*Brevicornu griseicolle* Staeger – Kosmozero, Turastamozero, Volkostrov Isl., Vorobyi  
*Brevicornu griseolum* Zetterstedt – Bol. Lelikovskiy Isl.  
*Brevicornu improvisum* A. Zaitzev – Turastamozero  
*Brevicornu nigrofuscum* Lundström – Turastamozero  
*Brevicornu parafennicum* A. Zaitzev – Turastamozero, Vorobyi  
*Brevicornu serenum* Winnertz – Bol. Lelikovskiy Isl., Kopanets lake, Turastamozero  
*Brevicornu sericoma* Meigen – Bol. Lelikovskiy Isl., Kizhi Isl., Vavlok Isl.  
*Cordyla brevicornis* Staeger – Klimenicy, Paleostrov Isl., Polya, Turastamozero, Vorobyi  
*Cordyla crassicornis* Meigen – Lipovitsy, Polya, Tambitsy, Tipinitsy, Turastamozero  
*Cordyla fasciata* Meigen – Turastamozero  
*Cordyla fissa* Edwards – Vorobyi  
*Cordyla flaviceps* Staeger – Myagrozero, Turastamozero, Uzkaya Salma, Vorobyi  
*Cordyla insons* Laštovka et Matile – Lipovitsy, Turastamozero, Vorobyi  
*Cordyla nitens* (s. Zaitzev) Winnertz – Tipinitsy, Turastamozero  
*Cordyla nitidula* Edwards – Oyatevschina  
*Cordyla parvipalpis* Edwards – Turastamozero, Uzkaya Salma  
*Cordyla pseudomurina* (in prep.) – Lipovitsy  
*Cordyla pusilla* Edwards – Kizhi Isl., Lyudskoi Isl., Polya, Tambitsy, Turastamozero, Vorobyi  
*Cordyla semiflava* Staeger – Turastamozero  
*Exechia cincta* Winnertz – Tipinitsy  
*Exechia confinis* Winnertz – Turastamozero, Yu. Oleny Isl.  
*Exechia contaminata* Winnertz – Klimenicy, Paleostrov Isl., Polya, Tambitsy, Tipinitsy  
*Exechia dizona* Edwards – Tambitsy, Tipinitsy  
*Exechia dorsalis* Staeger – Myagrozero, Polya, Tambitsy, Turastamozero, Velikaya Niva  
*Exechia exigua* Lundström – Paleostrov Isl., Tipinitsy, Turastamozero  
? *Exechia macula* Chandler – Kurgenitsy

*Exechia nigroscutellata* Landrock – Klimenicy, Paleostrov Isl.  
*Exechia parva* Lundström – Tambitsy, Turastamozero, Verkhnee Myagrozero  
*Exechia parvula* Zetterstedt – Poly, Tipinitsy  
*Exechia pectinivalva* Stackelberg – Vorobyi  
*Exechia pseudocincta* Strobl – Klimenicy, Tambitsy  
*Exechia repanda* Johansen – Turastamozero, Volkostrov Isl.  
*Exechia separata* Lundström – Poly, Tipinitsy  
*Exechia seriata* Meigen – Klimenicy  
*Exechia spinuligera* Lundström – Vorobyi  
*Exechia subfrigida* Laštovka & Matile – Poly  
*Exechia unifasciata* Lackschewitz – Poly  
*Exechiopsis aemula* Plassmann – Turastamozero  
*Exechiopsis crucigera* Lundström – Yu. Oleny Isl.  
*Exechiopsis davatchii* Matile – Turastamozero  
*Exechiopsis lackschewitziana* Stackelberg – Lipovitsy, Tambitsy  
*Exechiopsis praedita* Plassmann – Oyatevschina  
*Exechiopsis subulata* Winnertz – Verkhnee Myagrozero  
*Pseudobrachypeza helvetica* Walker – Poly, Tambitsy, Tipinitsy  
*Pseudorymosia fovea* Dziedzicki – Turastamozero  
*Rymosia fasciata* Meigen – Turastamozero  
*Rymosia setiger* Dziedzicki – Tipinitsy  
*Rymosia signatipes* Van der Wulp – Kurgenitsy, Lipovitsy  
*Tarnania fenestralis* Meigen – Klimenicy  
*Tarnania tarnanii* Dziedzicki – Klimenicy, Lipovitsy, Poly, Tambitsy, Tipinitsy, Turastamozero

#### **Bolitophilidae**

*Bolitophila dubia* Siebke – Velikaya Niva  
*Bolitophila modesta* Lackschewitz – Lipovitsy, Tambitsy, Velikaya Niva  
*Bolitophila nigrolineata* Landrock – Poly, Tambitsy, Volkostrov Isl.  
*Bolitophila oclusa* Edwards – Klimenicy, Poly  
*Bolitophila saundersi* Curtis – Velikaya Niva

#### **Keroplastidae**

*Macrocera angulata* Meigen – Ernitskiy Isl., Klimenicy, Kuivakhda Isl., Lelikovo, Myal' Isl.  
*Macrocera centralis* Meigen – Klimenicy, Tipinitsy  
*Macrocera fasciata* Meigen – Podyelniki  
*Macrocera fascipennis* Staeger – Rogachev Isl.  
*Macrocera lutea* Meigen – Tipinitsy, Yu. Oleny Isl.  
*Macrocera maculata* Meigen – Vikshezero  
*Macrocera parva* Lundström – Klimenicy  
*Macrocera phalerata* Meigen – Vavlok Isl., Vikshezero  
*Macrocera pilosa* Landrock – Velikaya Niva  
*Macrocera stigma* Curtis – Klimenicy, Shunevskiy Isl., Vavlok Isl.  
*Macrocera stigmoides* Edwards – Podyelniki, Poly  
*Macrocera vittata* Meigen – Turastamozero  
*Rocetelion humerale* Zetterstedt – Klimenicy  
*Isoneuromyia semirufa* Meigen – Podyelniki  
*Keroplastus tipuloides* Bosc – Oyatevschina  
*Macrorrhyncha flava* Winnertz – Podyelniki, Volkostrov Isl., Vorobyi  
*Neoplatyura flava* Macquart – Bol. Lelikovskiy Isl., Kopanets lake, Podyelniki, Uzkaya Salma  
*Orfelia bicolor* Macquart – Podyelniki, Turastamozero, Vorobyi  
*Orfelia falcata* A. Zaitzev – Lyudskoi Isl.

*Orfelia fasciata* Meigen – Paleostrov Isl., Vavlok Isl.  
*Orfelia ochracea* Meigen – Lipovitsy  
*Pyratula zonata* Zetterstedt – Ernitskiy Isl., Kuivakhda Isl., Lelikovo, Lyudskoi Isl., Paleostrov Isl., Sennaya Guba, Vikshezero, Yu. Oleny Isl.  
*Urytalpa dorsalis* Staeger – Ernitskiy Isl.

#### **Bombyliidae**

*Anthrax anthrax* Schrank – Kizhi Isl., Oyatevshchina  
? *Villa paniscus* Rossi – Kurgenitsy, Podyelniki, Vorobyi

#### **Asilidae**

*Dioctria hyalipennis* Fabricius – Eglov Isl., Verkhnee Myagrozero  
*Cyrtopogon lateralis* Fallén – Uzkaya Salma  
*Leptogaster cylindrica* DeGeer – Vegoruksy  
*Laphria flava* L. – Klimenicy, Nizhneje Myagrozero  
*Choerades gilva* L. – Kazhma  
*Choerades tenebraus* Esipenko – Verkhnee Myagrozero  
*Neoitamus socius* Loew – Oyatevshchina, Podyelniki, Uzkaya Salma  
*Machimus atricapilus* Fallén – Kurgenitsy, Podyelniki, Vorobyi

#### **Scenopinidae**

*Scenopinus vitripennis* Meigen – Kizhi Isl.

#### **Therevidae**

? *Thereva inornata* Verrall – Lipovitsy, Shun'ga  
*Thereva microcephala* Loew – Uzkaya Salma

#### **Rhagionidae**

*Rhagio annulatus* DeGeer – Kainos Isl.  
*Rhagio lineola* Fabricius – Bol. Lelikovskiy Isl., Eglov Isl., Kosmozero, Kurgenitsy, Lipovitsy, Myagrozero, Oyatevshchina, Podyelniki, Polya, Turastamozero, Vavlok Isl.  
*Rhagio maculatus* DeGeer – Eglov Isl., Kainos Isl., Lipovitsy, Polya, Vorobyi, Yu. Oleny Isl.  
*Rhagio scolopaceus* L. – Eglov Isl., Ernitskiy Isl., Kizhi Isl., Lelikovo, Lipovitsy, Myagrozero, Polya, Rogachev Isl., Sennaya Guba, Vegoruksy, Vorobyi  
*Chrysopilus nubecula* Fallén – Klimenicy, Kosmozero, Kurgenitsy, Oyatevshchina, Vorobyi  
*Symphoromyia crassicornis* Panzer – Kuzaranda

#### **Stratiomyidae**

*Beris morrisoni* Dale – Eglov Isl., Khvost Isl., Kizhi Isl., Klimenicy, Kosmozero, Lelikovo, Paleostrov Isl., Rogachev Isl., Vavlok Isl., Velikaya Niva, Yu. Oleny Isl.  
*Microchrysa polita* L. – Kizhi Isl.  
*Sargus rufipes* Wahlberg – Oyatevshchina, Polya  
*Stratiomys chamaeleon* L. – Velikaya Niva  
*Stratiomys singularior* Harris – Shun'ga  
*Odontomyia hydroleon* L. – Tolvuya  
*Odontomyia tigrina* Fabricius – Sennaya Guba  
*Oplodontha viridula* Fabricius – Velikaya Guba  
*Neopachygaster meromelas* Dufour – Kopanets lake, Oyatevshchina

#### **Xylomyidae**

*Xylomya czekanovskii* Pleske – Khvost Isl., Klimenicy, Kopanets lake, Podyelniki, Polya, Tambitsy, Tipinitsy

#### **Tabanidae**

*Chrysops caecutiens* L. – Polya, Uzkaya Salma  
*Chrysops divaricatus* Loew – Lipovitsy, Podyelniki, Polya, Turastamozero, Uzkaya Salma, Vikshezero  
*Chrysops nigripes* Zetterstedt – Lipovitsy, Polya, Uzkaya Salma  
*Chrysops relictus* Meigen – Oyatevshchina, Podyelniki, Sennaya Guba, Turastamozero



*Chrysops sepulcralis* Fabricius – Vegoruksy  
*Chrysops sp1* – Oyatevshina  
*Chrysops viduatus* Fabricius – Lipovitsy, Podyelniki, Poly, Turastamozero, Uzkaya Salma  
*Hybomitra arpadi* Szilády – Lipovitsy, Poly, Uzkaya Salma  
*Hybomitra bimaculata* Macquart – Lipovitsy, Poly, Turastamozero, Uzkaya Salma  
*Hybomitra borealis* Fabricius – Lipovitsy, Poly, Uzkaya Salma  
*Hybomitra confiformis* Chvála et Moucha – Lelikovo  
*Hybomitra distinguenda* Verrall – Lipovitsy, Poly, Uzkaya Salma  
*Hybomitra kaurii* Chvála et Lyneborg – Uzkaya Salma  
*Hybomitra lundbecki* Lyneborg – Lipovitsy, Poly, Uzkaya Salma  
*Hybomitra montana* Meigen – Uzkaya Salma  
*Hybomitra muehlfeldi* Brauer – Lipovitsy, Oyatevshina, Podyelniki, Poly, Turastamozero, Uzkaya Salma  
*Hybomitra nigricornis* Zetterstedt – Turastamozero, Volkostrov Isl.  
? *Tabanus bromius* L. – Turastamozero  
*Tabanus glaucopsis* Meigen – Vorobyi  
*Tabanus maculicornis* Zetterstedt – Lipovitsy, Poly, Uzkaya Salma  
*Atylotus fulvus* Meigen – Kopanets lake, Podyelniki, Uzkaya Salma  
*Heptatoma pellucens* Fabricius – Oyatevshina, Uzkaya Salma  
*Haematopota pluvialis* L. – Oyatevshina, Podyelniki, Poly, Turastamozero  
**Xylophagidae**  
*Xylophagus ater* Meigen – Kizhi Isl., Vorobyi  
*Xylophagus cinctus* DeGeer – Velikaya Niva  
**Brachystomatidae**  
*Gloma fuscipennis* Meigen – Lipovitsy  
*Heleodromia immaculata* Haliday – Lipovitsy  
*Trichopeza albocincta* Boheman – Yu. Oleny Isl.  
**Dolichopodidae**  
*Dolichopus claviger* Stannius – Khvost Isl., Kopanets lake, Nizhneje Myagzero, Podyelniki  
*Dolichopus discifer* Stannius – Bol. Lelikovskiy Isl., Eglov Isl., Klimenicy, Kopanets lake, Kurgenitsy, Lelikovo, Lipovitsy, Myagzero, Oyatevshina, Podyelniki, Poly, Uzkaya Salma, Vegoruksy, Verkhnee Myagzero, Vorobyi  
*Dolichopus lepidus* Staeger – Ernitskiy Isl., Lelikovo, Lyudskoi Isl., Nizhneje Myagzero, Podyelniki  
*Dolichopus nigripes* Fallén – Ernitskiy Isl.  
*Dolichopus nitidus* Fallén – Ernitskiy Isl., Kizhi Isl., Klimenicy, Sennaya Guba, Vegoruksy  
*Dolichopus notatus* Staeger – Kizhi Isl.  
*Dolichopus pennatus* Meigen – Oyatevshina, Vorobyi  
*Dolichopus picipes* Meigen – Bol. Lelikovskiy Isl., Klimenicy, Kopanets lake  
*Dolichopus plumipes* Scopoli – Kizhi Isl., Klimenicy, Kopanets lake, Kurgenitsy, Kuzaranda, Shunevskiy Isl., Tipinitsy, Vegoruksy, Volkostrov Isl.  
*Dolichopus popularis* Wiedemann – Eglov Isl.  
*Dolichopus simplex* Meigen – Bol. Lelikovskiy Isl., Kizhi Isl., Klimenicy  
*Dolichopus trivialis* Haliday – Kosmozero, Vorobyi  
*Dolichopus unguulatus* L. – Eglov Isl., Kizhi Isl., Podyelniki, Vorobyi  
*Dolichopus wahlbergi* Zetterstedt – Oyatevshina  
*Dolichopus zetterstedti* Stenhammar – Eglov Isl., Kurgenitsy, Vegoruksy  
*Hercostomus aerosus* Fallén – Bol. Lelikovskiy Isl., Eglov Isl., Ernitskiy Isl., Khvost Isl., Klimenicy, Lelikovo, Lipovitsy, Shunevskiy Isl., Vikshezero  
*Hercostomus angustifrons* Staeger – Ernitskiy Isl., Lelikovo, Lyudskoi Isl.

*Hercostomus celer* Meigen – Vikshezero  
*Hercostomus chalybeus* Wiedemann – Eglov Isl., Kizhi Isl., Kurgenitsy, Podyelniki  
*Hercostomus metallicus* Stannius – Eglov Isl., Khvost Isl., Klimenicy, Lyudskoi Isl.,  
 Polya, Sennaya Guba, Shunevskiy Isl., Vikshezero  
*Hercostomus nigrilamellatus* Macquart – Shunevskiy Isl.  
*Hercostomus sahlbergi* Zetterstedt – Turastamozero  
*Hydrophorus praecox* Lehmann – Kuzaranda  
*Dolichophorus kerteszi* Lichtwardt – Lelikovo, Lyudskoi Isl.  
*Rhaphium crassipes* Meigen – Oyatevshchina, Vorobyi  
*Rhaphium elegantulum* Meigen – Kopanets lake  
*Rhaphium lanceolatum* Loew – Kizhi Isl.  
 ? *Rhaphium riparium* Meigen – Vorobyi  
*Syntormon bicolorellum* Zetterstedt – Vorobyi  
*Syntormon tarsatus* Fallén – Kurgenitsy  
*Neurigona abdominalis* Fallén – Eglov Isl., Kizhi Isl.  
*Neurigona pallida* Fallén – Bol. Lelikovskiy Isl., Kainos Isl., Kopanets lake, Kosmozero,  
 Kurgenitsy, Lipovitsy, Myagrozero, Podyelniki, Polya  
*Neurigona quadrifasciata* Fabricius – Eglov Isl., Khvost Isl., Klimenicy, Kopanets lake,  
 Kurgenitsy, Oyatevshchina, Shunevskiy Isl., Turastamozero, Vavlok Isl., Volkostrov  
 Isl., Yu. Oleny Isl.  
*Chrysotus cilipes* Meigen – Nizhneje Myagrozero  
*Chrysotus neglectus* Wiedemann – Vorobyi  
*Campsicnemus curvipes* Fallén – Bol. Lelikovskiy Isl.  
*Campsicnemus scambus* Fallén – Bol. Lelikovskiy Isl., Lelikovo, Lipovitsy, Myagrozero,  
 Podyelniki, Polya, Sennaya Guba, Shunevskiy Isl., Tambitsy, Tipinitsy, Vorobyi  
**Empididae**  
*Rhamphomyia anomalina* Zetterstedt – Vorobyi  
*Rhamphomyia galacoptera* Strobl – Kizhi Isl.  
*Rhamphomyia lividiventris* Zetterstedt – Uzkaya Salma  
 ? *Rhamphomyia modesta* Wahlberg – Yu. Oleny Isl.  
*Rhamphomyia nigripennis* Fabricius – Khvost Isl., Lelikovo, Yu. Oleny Isl.  
*Rhamphomyia nigripes* Strobl – Vikshezero  
*Rhamphomyia obscuripennis* Meigen – Ernitskiy Isl., Kuivakhda Isl., Sennaya Guba  
*Rhamphomyia sp2 (cf. hybotina)* – Paleostrov Isl.  
*Rhamphomyia spinipes* Fallén – Tambitsy  
*Rhamphomyia stigmata* Macquart – Vikshezero  
*Rhamphomyia sulcatina* Collin – Oyatevshchina  
 ? *Rhamphomyia tipularia* Fallén – Kopanets lake  
*Rhamphomyia trigemina* Oldenberg – Kizhi Isl.  
*Rhamphomyia umbripennis* Meigen – Ernitskiy Isl., Kizhi Isl., Lyudskoi Isl., Oyatev-  
 schina, Vorobyi  
*Empis bicuspidata* Collin – Lelikovo  
*Empis borealis* L. – Kizhi Isl., Klimenicy  
*Empis livida* L. – Vorobyi  
*Empis prodromus* Loew – Lelikovo  
*Empis stercorea* L. – Eglov Isl.  
*Empis tessellata* Fabricius – Eglov Isl., Kizhi Isl., Kurgenitsy, Lelikovo, Oyatevshchina, Pale-  
 ostrov Isl., Rogachev Isl., Sennaya Guba, Vegoruksy, Vikshezero, Vorobyi, Yu. Oleny Isl.  
*Hilara sp1 (cf. canescens)* – Vegoruksy  
*Chelipoda albisetia* Zetterstedt – Kosmozero, Yu. Oleny Isl.  
*Chelipoda inexpactata* Tuomikoski – Lipovitsy  
*Chelipoda vocatoria* Fallén – Lipovitsy

*Phyllodromia melanocephala* Fabricius – Bol. Lelikovskiy Isl., Khvost Isl., Kopanets lake, Podyelniki

? *Hemerodromia melangyna* Collin – Kurgenitsy, Yu. Oleny Isl.

*Hemerodromia raptorica* Meigen – Kurgenitsy, Vorobyi

### **Hybotidae**

*Hybos femoratus* Müller – Eglov Isl., Ernitskiy Isl., Klimenicy, Lipovitsy, Polyá

*Hybos grossipes* L. – Bol. Lelikovskiy Isl., Eglov Isl., Khvost Isl., Klimenicy, Kopanets lake, Kosmozero, Kurgenitsy, Kuzaranda, Lipovitsy, Myagrozero, Nizhneje Myagrozero, Oyatevshina, Paleostrov Isl., Polyá, Tambitsy, Tipinitsy, Turastamozero, Uzkaya Salma, Verkhnee Myagrozero, Volkostrov Isl., Vorobyi

*Trichinomyia flavipes* Meigen – Lipovitsy, Myagrozero, Tambitsy, Turastamozero, Uzkaya Salma, Vorobyi

*Trichina bilobata* Collin – Lipovitsy

*Trichina clavipes* Meigen – Kosmozero

*Bicellaria intermedia* Lundbeck – Bol. Lelikovskiy Isl., Kurgenitsy

*Bicellaria nigra* Meigen – Kuivakhda Isl., Verkhnee Myagrozero

*Oedalea holmgreni* Zetterstedt – Vikshezero

*Oedalea stigmatella* Zetterstedt – Lyudskoi Isl.

*Oedalea zetterstedti* Collin – Lipovitsy

*Euthyneura myrtilli* Macquart – Lipovitsy, Velikaya Niva

*Ocydromia glabricula* Fallén – Paleostrov Isl., Podyelniki, Tambitsy, Tipinitsy, Velikaya Niva

*Leptozeza borealis* Zetterstedt – Kurgenitsy, Oyatevshina

*Leptozeza flavipes* Meigen – Eglov Isl., Klimenicy, Kuivakhda Isl., Podyelniki, Vorobyi

? *Platypalpus calceatus* Meigen – Vorobyi

*Platypalpus candicans* Fallén – Eglov Isl., Khvost Isl.

*Platypalpus ciliaris* Fallén – Khvost Isl., Klimenicy, Kopanets lake, Polyá, Tambitsy, Uzkaya Salma, Vorobyi

*Platypalpus cursitans* Fabricius – Kizhi Isl., Lyudskoi Isl., Oyatevshina, Sennaya Guba, Tolvuya, Vorobyi

? *Platypalpus difficilis* Frey – Bol. Lelikovskiy Isl.

*Platypalpus ecalceatus* Zetterstedt – Eglov Isl., Ernitskiy Isl., Khvost Isl., Klimenicy, Kuivakhda Isl., Lyudskoi Isl., Myagrozero, Myal' Isl., Polyá

*Platypalpus exilis* Meigen – Eglov Isl., Klimenicy, Paleostrov Isl., Vavlok Isl.

*Platypalpus longicornis* Meigen – Turastamozero, Vorobyi

? *Platypalpus longicornoides* Chvála – Sennaya Guba

*Platypalpus luteus* Meigen – Kainos Isl., Lipovitsy, Podyelniki, Polyá, Vorobyi

*Platypalpus macula* Zetterstedt – Lipovitsy, Vavlok Isl.

*Platypalpus major* Zetterstedt – Kopanets lake, Tipinitsy

*Platypalpus nigratarsis* Fallén – Myagrozero

*Platypalpus nonstriatus* Strobl – Klimenicy

*Platypalpus pectoralis* Fallén – Bol. Lelikovskiy Isl., Podyelniki, Polyá, Tipinitsy, Turastamozero, Uzkaya Salma, Verkhnee Myagrozero

*Platypalpus pseudorapidus* Kovalev – Kizhi Isl., Oyatevshina, Vorobyi

*Platypalpus scandinavicus* Chvála – Oyatevshina

*Platypalpus stigmatellus* Zetterstedt – Klimenicy, Tambitsy

? *Platypalpus tuomikoskii* Chvála – Turastamozero

*Tachypeza fennica* Tuomikoski – Vikshezero, Vorobyi

*Tachypeza fuscipennis* Fallén – Vorobyi

*Tachypeza heeri* Zetterstedt – Lipovitsy, Oyatevshina, Polyá, Volkostrov Isl.

*Tachypeza nubila* Meigen – Eglov Isl., Kurgenitsy, Lipovitsy, Polyá, Vavlok Isl., Vorobyi

*Tachypeza truncorum* Fallén – Lipovitsy, Polyá

*Tachydromia aemula* Loew – Khvost Isl.

*Drapetis parilis* Collin – Nizhneje Myagrozzero

### **Lonchopteridae**

*Lonchoptera fallax* de Meijere – Klimenicy, Lelikovo, Lyudskoi Isl.

*Lonchoptera lutea* Panzer – Kizhi Isl., Vegoruksy, Vorobyi

### **Platypozidae**

*Microsania pectipennis* Meigen – Bol. Lelikovskiy Isl., Klimenicy

*Callomyia amoena* Meigen – Klimenicy, Lyudskoi Isl., Myal' Isl.

*Callomyia speciosa* Meigen – Eglov Isl., Lyudskoi Isl.

*Agathomyia elegantula* Fallén – Lipovitsy

*Polyporivora ornata* Meigen – Poly

*Polyporivora picta* Meigen – Tipinitsy

*Platypeza consobrina* Zetterstedt – Myagrozzero

*Platypeza fasciata* Meigen – Myagrozzero

*Platypozina connexa* Boheman – Tipinitsy

### **Phoridae**

*Anevriina thoracica* Meigen – Kizhi Isl.

### **Pipunculidae**

*Chalarus holosericeus* Meigen – Podyelniki

? *Chalarus spurius* Fallén – Podyelniki

*Verrallia aucta* Fallén – Eglov Isl., Khvost Isl., Rogachev Isl., Turastamozero

*Nephrocerus flavicornis* Zetterstedt – Oyatevshina

*Tomosvaryella geniculata* Meigen – Lipovitsy

*Dorylomorpha maculata* Walker – Kurgenitsy, Podyelniki, Verkhnee Myagrozzero

? *Cephalops semifumosus* Kowarz – Turastamozero

? *Eudorylas terminalis* Thomson – Turastamozero

### **Syrphidae**

*Paragus albifrons* Fallén – Vorobyi

*Paragus bicolor* Fabricius – Eglov Isl., Vorobyi

*Paragus finitimus* Goeldlin – Sennaya Guba, Tolvuya, Vikshezero

*Paragus pecchiolii* Rondani – Vikshezero

*Paragus tibialis* Fallén – Oyatevshina

*Baccha elongata* Fabricius – Bol. Lelikovskiy Isl., Eglov Isl., Lelikovo, Paleostrov Isl.,

Poly, Tipinitsy, Turastamozero, Velikaya Guba, Verkhnee Myagrozzero, Volkostrov Isl.

*Platycheirus albimanus* Fabricius – Kuivakhda Isl., Kurgenitsy, Lyudskoi Isl., Vikshezero

*Platycheirus angustatus* Zetterstedt – Sennaya Guba

*Platycheirus clypeatus* Meigen – Kosmozzero, Lelikovo, Lyudskoi Isl., Nizhneje Myagrozzero, Sennaya Guba, Tipinitsy

*Platycheirus europaeus* Goeldlin, Maibach & Speight – Vikshezero

*Platycheirus fulvoventris* Macquart – Eglov Isl., Rogachev Isl.

*Platycheirus granditarsus* Förster – Bol. Lelikovskiy Isl., Klimenicy, Kurgenitsy, Nizhneje Myagrozzero, Podyelniki, Turastamozero, Volkostrov Isl.

*Platycheirus immarginatus* Zetterstedt – Kosmozzero

*Platycheirus occultus* Goeldlin, Maibach & Speight – Turastamozero

*Platycheirus peltatus* Meigen – Kizhi Isl., Velikaya Niva

*Platycheirus rosarum* Fabricius – Eglov Isl., Kizhi Isl.

*Platycheirus scambus* Staeger – Kopanets lake, Velikaya Niva

*Platycheirus scutatus* Meigen – Kosmozzero, Kurgenitsy

*Xanthandrus comtus* Harris – Tipinitsy, Uzskaya Salma

*Melanostoma mellinum* L. – Eglov Isl., Khvost Isl., Kopanets lake, Kosmozzero, Kurgenitsy, Kuzaranda, Lelikovo, Nizhneje Myagrozzero, Podyelniki, Rogachev Isl., Turastamozero, Velikaya Niva, Verkhnee Myagrozzero, Vikshezero, Volkostrov Isl., Vorobyi

*Melanostoma scalare* Fabricius – Eglov Isl., Ernitskiy Isl., Klimenicy, Lelikovo, Lipovitsy, Lyudskoi Isl., Oyatevshina, Paleostrov Isl., Polya, Sennaya Guba, Tipinitsy, Turastamozero, Uzkaya Salma, Vorobyi  
*Melangyna compositarum* Verrall – Turastamozero, Verkhnee Myagrozero  
*Melangyna umbellatarum* Fabricius – Khvost Isl., Kizhi Isl., Vorobyi  
*Meligramma guttata* Fallén – Klimenicy  
*Leucozona glaucia* L. – Kurgenitsy, Nizhneje Myagrozero, Turastamozero, Velikaya Niva, Verkhnee Myagrozero, Vorobyi  
*Leucozona inopinata* Doczkal – Uzkaya Salma  
*Leucozona laternaria* Müller – Khvost Isl., Kurgenitsy, Nizhneje Myagrozero, Paleostrov Isl., Rogachev Isl.  
*Leucozona lucorum* L. – Kizhi Isl., Oyatevshina, Velikaya Niva  
*Epistrophe flava* Doczkal & Schmid – Eglov Isl.  
*Epistrophe grossulariae* Meigen – Turastamozero, Vorobyi  
*Eriozona erratica* L. – Tambitsy  
*Scaeva pyrastris* L. – Vegoruktsy, Velikaya Niva, Vorobyi  
*Scaeva selenitica* Meigen – Kurgenitsy, Nizhneje Myagrozero, Turastamozero, Verkhnee Myagrozero  
*Meliscaeva cinctella* Zetterstedt – Lipovitsy, Turastamozero, Vikshezero, Vorobyi  
*Didea fasciata* Macquart – Lipovitsy, Uzkaya Salma  
*Didea intermedia* Loew – Eglov Isl., Kurgenitsy, Turastamozero, Vegoruktsy  
*Dasysyrphus hilaris* Zetterstedt – Eglov Isl., Vikshezero  
*Dasysyrphus pinastri* DeGeer – Eglov Isl., Vikshezero  
*Dasysyrphus tricinctus* Fallén – o. B.Klimeckiy, Klimenicy, Kopanets lake, Nizhneje Myagrozero, Oyatevshina, Turastamozero, Velikaya Niva, Vorobyi  
*Dasysyrphus venustus* Meigen – Eglov Isl., Vikshezero  
*Episyrphus balteatus* DeGeer – Kizhi Isl., Kosmozero, Oyatevshina, Turastamozero, Uzkaya Salma, Vikshezero, Vorobyi  
*Eupeodes bucculatus* Rondani – Turastamozero, Vorobyi  
*Eupeodes corollae* Fabricius – Nizhneje Myagrozero  
*Eupeodes latifasciatus* Macquart – Klimenicy  
*Eupeodes lundbecki* Soot Ryen – Velikaya Niva, Vorobyi  
*Eupeodes nitens* Zetterstedt – Turastamozero  
*Syrphus admirandus* Goeldlin – Vikshezero  
*Syrphus ribesii* L. – Eglov Isl., Khvost Isl., Turastamozero, Vikshezero, Vorobyi  
*Syrphus torvus* Osten-Sacken – Eglov Isl., Kizhi Isl., Nizhneje Myagrozero, Vorobyi  
*Syrphus vitripennis* Meigen – Eglov Isl., Vikshezero  
*Parasyrphus annulatus* Zetterstedt – Velikaya Niva  
*Parasyrphus lineolus* Zetterstedt – Nizhneje Myagrozero  
*Parasyrphus nigratarsis* Zetterstedt – Vikshezero  
*Sphaerophoria batava* Goeldlin – Eglov Isl., Podyelniki, Vikshezero  
*Sphaerophoria interrupta* Fabricius – Kizhi Isl., Kosmozero, Lyudskoi Isl., Vikshezero, Vorobyi  
*Sphaerophoria menthastri* L. – Kuzaranda, Paleostrov Isl.  
*Sphaerophoria philantha* Meigen – Kurgenitsy, Sennaya Guba, Vikshezero  
*Sphaerophoria scripta* L. – Eglov Isl., Kizhi Isl., Klimenicy, Kosmozero, Kuzaranda, Lelikovo, Lyudskoi Isl., Nizhneje Myagrozero, Oyatevshina, Podyelniki, Rogachev Isl., Sennaya Guba, Tipinitsy, Turastamozero, Vertilovo, Vikshezero, Volkostrov Isl., Vorobyi  
*Sphaerophoria taeniata* Meigen – Kizhi Isl., Kuzaranda, Podyelniki, Rogachev Isl., Vorobyi  
*Sphaerophoria virgata* Goeldlin – Eglov Isl., Tipinitsy

*Xanthogramma pedissequum* Harris – Rogachev Isl., Vorobyi  
*Xanthogramma stackelbergi* Violovitsh – Khvost Isl., Rogachev Isl.  
*Ceriana conopsoides* L. – Turastamozero  
*Chrysotoxum arcuatum* L. – Velikaya Guba, Vikshezero  
*Chrysotoxum bicinctum* L. – Eglov Isl., Khvost Isl., Kuzaranda, Rogachev Isl., Turastamozero, Vikshezero, Vorobyi  
*Chrysotoxum fasciolatum* DeGeer – Kosmozero  
*Chrysotoxum festivum* L. – Shun'ga  
*Rhingia borealis* Ringdahl – Oyatevschina, Velikaya Niva  
*Rhingia campestris* Meigen – Kizhi Isl., Tolvuya  
*Hammerschmidtia ferruginea* Fallén – Klimenicy, Velikaya Niva  
*Neoascia geniculata* Meigen – Vikshezero  
*Neoascia tenur* Harris – Eglov Isl., Ernitskiy Isl., Kizhi Isl., Klimenicy, Kurgenitsy, Lelikovo, Lyudskoi Isl., Sennaya Guba, Vikshezero  
*Sphegina clunipes* Fallén – Klimenicy, Kopanets lake, Lipovitsy  
*Sphegina sibirica* Stackelberg – Kizhi Isl., Klimenicy, Tipinitsy, Vavlok Isl., Vikshezero  
*Pipizella certa* Violovitsh – Rogachev Isl.  
*Pipizella viduata* L. – Klimenicy, Kuzaranda, Lyudskoi Isl., Rogachev Isl., Turastamozero, Vikshezero  
*Pipiza austriaca* Meigen – Lelikovo, Velikaya Niva  
*Pipiza bimaculata* Meigen – Lelikovo, Paleostrov Isl.  
*Pipiza noctiluca* L. – Velikaya Niva, Vikshezero, Yu. Oleny Isl.  
*Pipiza quadrimaculata* Panzer – Velikaya Guba, Vikshezero  
*Orthonevra erythrogona* Malm – Sennaya Guba  
*Orthonevra stackelbergi* Thompson & Torp – Klimenicy, Vikshezero  
? *Chrysogaster virescens* Loew – Sennaya Guba  
*Cheilosia carbonaria* Egger – Oyatevschina, Vikshezero  
*Cheilosia flavipes* Panzer – Kizhi Isl., Tolvuya  
*Cheilosia frontalis* Loew – Kizhi Isl.  
*Cheilosia gigantea* Zetterstedt – Klimenicy  
*Cheilosia illustrata* Harris – Eglov Isl., Kizhi Isl., Kosmozero, Kurgenitsy, Nizhneje Myagrozero, Oyatevschina, Rogachev Isl., Vorobyi  
*Cheilosia impressa* Loew – Ernitskiy Isl.  
*Cheilosia longula* Zetterstedt – Myagrozero, Nizhneje Myagrozero, Turastamozero, Velikaya Niva  
*Cheilosia mutabilis* Fallén – Kurgenitsy, Podyelniki, Rogachev Isl., Turastamozero, Vegoruksy, Velikaya Niva, Verkhnee Myagrozero, Volkostrov Isl.  
*Cheilosia pagana* Meigen – Eglov Isl., Kizhi Isl., Kurgenitsy, Lelikovo, Nizhneje Myagrozero, Oyatevschina, Podyelniki, Rogachev Isl., Tolvuya, Vikshezero, Vorobyi  
*Cheilosia pubera* Zetterstedt – Klimenicy, Oyatevschina, Sennaya Guba  
*Cheilosia rotundiventris* Becker – Kizhi Isl.  
*Cheilosia scutellata* Fallén – Velikaya Niva  
*Cheilosia sootryeni* Nielsen – Vikshezero  
*Cheilosia variabilis* Panzer – Kainos Isl.  
*Cheilosia vernalis* Fallén – Kizhi Isl., Lelikovo, Nizhneje Myagrozero, Velikaya Niva, Vorobyi  
? *Cheilosia vicina* Zetterstedt – Vikshezero  
*Cheilosia vulpina* Meigen – Kizhi Isl., Klimenicy  
*Chamaesyphus scaevoides* Fallén – Ernitskiy Isl., Paleostrov Isl.  
*Volucella bombylans* L. – Eglov Isl., Khvost Isl., Kizhi Isl., Lelikovo, Lyudskoi Isl., Oyatevschina, Rogachev Isl., Sennaya Guba, Volkostrov Isl.

*Volucella pellucens* L. – Eglov Isl., Khvost Isl., Nizhneje Myagrozero, Podyelniki, Rogachev Isl., Turastamozero  
*Sericomyia lappona* L. – Podyelniki, Uzkaya Salma  
*Sericomyia nigra* Portschinsky – Nizhneje Myagrozero  
*Sericomyia silentis* Harris – Dianova Gora, Tambitsy, Turastamozero  
*Eristalis abusiva* Collin – Kosmozero, Kurgenitsy  
*Eristalis anthophorina* Fallén – Shun'ga  
*Eristalis arbustorum* L. – Lipovitsy, Nizhneje Myagrozero, Verkhnee Myagrozero, Vorobyi  
*Eristalis cryptarum* Fabricius – Tolvuya  
*Eristalis horticola* DeGeer – Kizhi Isl.  
*Eristalis interrupta* Poda – Eglov Isl., Nizhneje Myagrozero, Turastamozero, Vegoruksy, Velikaya Niva, Verkhnee Myagrozero, Vorobyi  
*Eristalis intricaria* L. – Shun'ga, Vegoruksy  
*Eristalis obscura* Loew – Eglov Isl., Kurgenitsy, Nizhneje Myagrozero, Turastamozero, Verkhnee Myagrozero, Vikshezero, Vorobyi  
*Eristalis oestracea* L. – Kizhi Isl.  
*Eristalis rupium* Fabricius – Oyatevschina, Podyelniki, Turastamozero  
*Eristalis tenax* L. – Turastamozero, Vegoruksy  
*Myathropa florea* L. – Eglov Isl., Podyelniki, Turastamozero  
*Anasimyia interpuncta* Harris – Lelikovo  
*Anasimyia lineata* Fabricius – Eglov Isl., Podyelniki  
*Anasimyia lunulata* Meigen – Uzkaya Salma, Vikshezero, Vorobyi  
*Helophilus affinis* Wahlberg – Lyudskoi Isl., Nizhneje Myagrozero, Oyatevschina, Podyelniki, Turastamozero, Vavlok Isl., Vikshezero, Volkostrov Isl., Vorobyi  
*Helophilus hybridus* Loew – Kurgenitsy, Lelikovo, Lyudskoi Isl., Nizhneje Myagrozero, Podyelniki, Tipinitsy, Turastamozero, Volkostrov Isl.  
*Helophilus pendulus* L. – Eglov Isl., Kizhi Isl., Kurgenitsy, Nizhneje Myagrozero, Oyatevschina, Paleostrov Isl., Podyelniki, Rogachev Isl., Shun'ga, Turastamozero, Vegoruksy, Verkhnee Myagrozero, Vikshezero, Volkostrov Isl., Vorobyi  
*Helophilus trivittatus* Fabricius – Kizhi Isl., Kurgenitsy  
*Parhelophilus consimilis* Malm – Rogachev Isl., Volkostrov Isl., Vorobyi  
*Eumerus strigatus* Fallén – Nizhneje Myagrozero, Rogachev Isl., Velikaya Niva  
*Microdon miki* Doczkal & Schmid – Kosmozero  
*Criorrhina asilica* Fallén – Poly, Velikaya Niva, Vikshezero  
*Blera fallax* L. – Lipovitsy, Vegoruksy  
*Xylota abiens* Meigen – Podyelniki  
*Xylota caeruleiventris* Zetterstedt – Poly  
*Xylota florum* Fabricius – Eglov Isl., Nizhneje Myagrozero, Podyelniki, Vegoruksy, Verkhnee Myagrozero  
*Xylota jakutorum* Bagatshanova – Eglov Isl.  
*Xylota meigeniana* Stackelberg – Eglov Isl., Klimenicy, Kurgenitsy, Kuzaranda, Nizhneje Myagrozero, Podyelniki, Poly, Turastamozero  
*Xylota segnis* L. – Eglov Isl., Kosmozero, Kuzaranda, Nizhneje Myagrozero, Podyelniki, Vegoruksy, Velikaya Niva, Verkhnee Myagrozero  
*Xylota sylvarum* L. – Khvost Isl., Lipovitsy, Oyatevschina, Poly, Turastamozero  
*Xylota tarda* Meigen – Eglov Isl., Khvost Isl., Nizhneje Myagrozero, Oyatevschina, Podyelniki, Tambitsy, Verkhnee Myagrozero  
*Xylota xanthocnema* Collin – Klimenicy, Verkhnee Myagrozero  
*Chalcosyrphus nemorum* Fabricius – Kosmozero, Podyelniki, Rogachev Isl., Uzkaya Salma  
*Chalcosyrphus rufipes* Loew – Eglov Isl.

*Chalcosyrphus valgus* Gmelin – Klimenicy  
*Syrirta pipiens* L. – Kosmozero  
*Spilomyia diophtalma* L. – Kurgenitsy, Oyatevschina, Podyelniki, Turastamozero, Uzkaya Salma, Vorobyi  
*Temnostoma angustistriatum* Krivosheina – Klimenicy, Kosmozero, Rogachev Isl., Tipinitsy, Vikshezero  
*Temnostoma apiforme* Fabricius – Klimenicy, Kosmozero, Rogachev Isl., Turastamozero, Velikaya Niva, Verkhnee Myagrozero, Vikshezero, Yu. Oleny Isl.  
*Temnostoma carens* Gaunitz – Eglov Isl.  
*Temnostoma sericomylaeforme* Portschinsky – Eglov Isl., Kizhi Isl., Kurgenitsy, Rogachev Isl., Turastamozero, Uzkaya Salma, Vegoruktsy  
*Temnostoma vespiforme* L. – Eglov Isl., Klimenicy, Lipovitsy, Oyatevschina, Paleostrov Isl., Rogachev Isl., Turastamozero, Velikaya Niva, Yu. Oleny Isl.

### **Conopidae**

*Conops quadrifasciatus* DeGeer – Bol. Lelikovskiy Isl., Oyatevschina, Podyelniki, Turastamozero, Verkhnee Myagrozero, Vorobyi  
*Myopa buccata* L. – Vikshezero  
*Sicus ferrugineus* L. – Eglov Isl., Kizhi Isl., Kurgenitsy, Nizhneje Myagrozero, Oyatevschina, Podyelniki, Sennaya Guba, Vegoruktsy, Verkhnee Myagrozero, Vorobyi

### **Chloropidae**

*Gaurax dubius* Macquart – Lelikovo  
*Elachiptera cornuta* Fallén – Bol. Lelikovskiy Isl., Eglov Isl., Ernitskiy Isl., Kurgenitsy, Lelikovo, Lyudskoi Isl., Myagrozero, Podyelniki, Sennaya Guba  
*Elachiptera tuberculifera* Corti – Lelikovo, Lyudskoi Isl., Myagrozero, Nizhneje Myagrozero  
*Lasiambia palposa* Fallén – Vorobyi  
*Siphonella oscinina* Fallén – Vorobyi  
*Tricimba cincta* s.l. – Vorobyi  
*Oscinella cariciphila* Collin – Sennaya Guba  
*Oscinella frit* L. – Lelikovo  
*Oscinella pusilla* Meigen – Myagrozero, Sennaya Guba  
*Rhopalopterum fasciola* Meigen – Kurgenitsy  
*Rhopalopterum femorale* Collin – Lelikovo, Lyudskoi Isl.  
*Dicraeus fennicus* Duda – Kurgenitsy  
*Meromyza ornata* Wiedemann – Lelikovo  
? *Meromyza pluriseta* Peterfi – Sennaya Guba  
*Meromyza saltatrix* L. – Lelikovo, Sennaya Guba  
*Cetema cereris* Fallén – Nizhneje Myagrozero, Podyelniki, Vorobyi  
*Cetema myopinum* Loew – Oyatevschina  
*Chlorops frontosus* Meigen – Lelikovo  
*Chlorops hypostigma* Meigen – Oyatevschina  
*Chlorops limbata* Meigen – Ernitskiy Isl., Klimenicy, Kurgenitsy, Lipovitsy, Polyta, Sennaya Guba  
*Chlorops meigenii* Loew – Eglov Isl., Ernitskiy Isl., Khvost Isl., Klimenicy, Kuivakhda Isl., Lyudskoi Isl., Paleostrov Isl., Polyta, Vikshezero  
*Chlorops planifrons* Loew – Khvost Isl.  
*Chlorops ringens* Loew – Vorobyi  
? *Chlorops rossicus* Smirnov – Polyta  
*Chlorops scalaris* Meigen – Kuzaranda, Sennaya Guba  
*Chlorops speciosa* Meigen – o. B.Klimeckiy, Eglov Isl., Klimenicy, Nizhneje Myagrozero, Podyelniki, Vikshezero  
*Chlorops troglodytes* Zetterstedt – o. B.Klimeckiy, Podyelniki, Vorobyi



*Thaumatomyia glabra* Meigen – Kuzaranda, Sennaya Guba  
*Thaumatomyia hallandica* Anderson – Kuzaranda, Lelikovo, Sennaya Guba  
*Thaumatomyia notata* Meigen – Kuzaranda  
*Thaumatomyia rufa* Macquart – Lelikovo, Sennaya Guba  
*Thaumatomyia trifasciata* Zetterstedt – Kurgenitsy  
*Aphanotrigonum trilineatum* Meigen – Sennaya Guba  
*Eribulus nana* Zetterstedt – Sennaya Guba  
*Incertella albipalpis* Meigen – Kuzaranda  
*Speccafrons halophila* Duda – Sennaya Guba

#### **Milichiidae**

*Phyllomyza equitans* Hendel – Sennaya Guba  
*Phyllomyza securicornis* Fallén – Rogachev Isl., Vorobyi  
*Neophyllomyza acyglossa* Villeneuve – Lyudskoi Isl.

#### **Ephydriidae**

*Discomyza incurva* Fallén – Lyudskoi Isl.  
? *Psilopa stackelbergi* Nartshuk – Vikshezero  
*Dichaeta caudata* Fallén – Lelikovo, Oyatevshchina, Sennaya Guba  
*Notiphila aquatica* Becker – Klimenicy  
*Nostima picta* Fallén – Bol. Lelikovskiy Isl.  
*Linnellia stenhammari* Zetterstedt – Myagrozero  
*Coenia curvicauda* Meigen – Rogachev Isl., Sennaya Guba, Vikshezero  
*Coenia palustris* Fallén – Lelikovo

#### **Drosophilidae**

*Stegana baechlii* Laštovka & Maca – Turastamozero  
*Stegana furta* L. – Ernitskiy Isl., Kizhi Isl., Lelikovo, Rogachev Isl., Sennaya Guba  
*Chymomyza fuscimana* Zetterstedt – Turastamozero  
*Drosophila eskoi* Lakovaara & Lankinen – Yu. Oleny Isl.  
*Drosophila histrio* Meigen – Kainos Isl., Uzkaya Salma, Vavlok Isl.  
*Drosophila littoralis* Meigen – Yu. Oleny Isl.  
*Drosophila phalerata* Meigen – Tambitsy, Verkhnee Myagrozero  
*Drosophila testacea* von Roser – Lipovitsy, Tipinitsy, Turastamozero, Verkhnee Myagrozero, Yu. Oleny Isl.  
*Drosophila transversa* Fallén – Kizhi Isl., Polya, Turastamozero, Uzkaya Salma, Verkhnee Myagrozero, Volkostrov Isl., Vorobyi  
*Hirtorosophila trivittata* Strobl – Lipovitsy  
*Lordiphosa fenestrarum* Fallén – Kizhi Isl.  
*Lordiphosa hexasticha* Papp – Podyelniki  
*Lordiphosa nigricolor* Strobl – Kizhi Isl.  
*Scaptomyza consimilis* Hackman – Tipinitsy, Turastamozero  
*Scaptomyza graminum* Fallén – Tipinitsy  
*Scaptomyza pallida* Zetterstedt – Kizhi Isl., Nizhneje Myagrozero, Vegoruksy, Vorobyi

#### **Diastatidae**

*Diastata nebulosa* Fallén – Lipovitsy

#### **Chamaemyiidae**

*Chamaemyia aestiva* Tanasijtshuk – Ernitskiy Isl., Lelikovo, Myagrozero  
*Chamaemyia elegans* Panzer – Ernitskiy Isl., Lelikovo, Lyudskoi Isl., Myal' Isl., Sennaya Guba  
*Chamaemyia geniculata* Zetterstedt – Lelikovo  
*Chamaemyia juncorum* Fallén – Kurgenitsy, Lyudskoi Isl., Myagrozero, Sennaya Guba  
*Chamaemyia polystigma* Meigen – Kurgenitsy, Lelikovo

#### **Lauxaniidae**

*Homoneura interstincta* Fallén – Uzkaya Salma  
*Homoneura lamellata* Becker – Lipovitsy, Polya, Turastamozero

*Homoneura tenera* Loew – Khvost Isl., Lyudskoi Isl., Turastamozero, Vikshezero  
*Minettia helvola* Becker – Khvost Isl., Lipovitsy, Podyelniki, Polya, Tambitsy, Turastamozero, Verkhnee Myagrozero  
*Minettia loewi* Schiner – Ernitskiy Isl., Klimenicy, Lipovitsy, Polya, Tipinitsy  
*Minettia longipennis* Fabricius – Eglov Isl., Khvost Isl., Kizhi Isl., Kosmozero, Lipovitsy, Lyudskoi Isl., Myal' Isl., Nizhneje Myagrozero, Oyatevschina, Podyelniki, Polya, Sennaya Guba, Vegoruksy, Vorobyi  
*Minettia lupulina* Fabricius – Kainos Isl., Khvost Isl., Kizhi Isl., Klimenicy, Nizhneje Myagrozero, Oyatevschina, Sennaya Guba, Shunevskiy Isl., Tipinitsy, Verkhnee Myagrozero, Vikshezero, Volkostrov Isl., Vorobyi  
*Tricholauxania praeusta* Fallén – Bol. Lelikovskiy Isl., Eglov Isl., Kopanets lake, Oyatevschina, Podyelniki, Shunevskiy Isl., Turastamozero, Verkhnee Myagrozero, Volkostrov Isl.  
*Cnemacantha muscaria* Fallén – Kizhi Isl., Sennaya Guba  
*Meiosimyza affinis* Zetterstedt – Klimenicy, Myal' Isl., Verkhnee Myagrozero, Yu. Oleny Isl.  
*Meiosimyza decempunctata* Fallén – Eglov Isl., Ernitskiy Isl., Kainos Isl., Myal' Isl., Nizhneje Myagrozero, Podyelniki, Tipinitsy, Vavlok Isl.  
*Meiosimyza decipiens* Loew – Khvost Isl., Klimenicy, Sennaya Guba, Uzkaya Salma  
*Meiosimyza illota* Loew – Kizhi Isl., Vikshezero  
*Meiosimyza mihalyii* Papp – Vorobyi  
*Meiosimyza platycephala* Loew – Lipovitsy, Lyudskoi Isl., Podyelniki  
*Meiosimyza rorida* Fallén – Bol. Lelikovskiy Isl., Eglov Isl., Ernitskiy Isl., Kainos Isl., Kizhi Isl., Klimenicy, Kopanets lake, Kuivakhda Isl., Kurgenitsy, Myal' Isl., Podyelniki, Polya, Sennaya Guba, Shunevskiy Isl., Turastamozero, Vavlok Isl., Vegoruksy, Verkhnee Myagrozero, Volkostrov Isl., Yu. Oleny Isl.  
*Meiosimyza subfasciata* Zetterstedt – Kizhi Isl., Kurgenitsy, Vikshezero  
*Poecilolycia vittata* Walker – Ernitskiy Isl., Oyatevschina  
*Sapromyza amabilis* Frey – Polya  
*Sapromyza basalis* Zetterstedt – Lipovitsy, Oyatevschina, Podyelniki, Polya, Tambitsy, Turastamozero, Verkhnee Myagrozero, Yu. Oleny Isl.  
*Sapromyza hyalinata* Meigen – Bol. Lelikovskiy Isl., Ernitskiy Isl., Klimenicy, Kopanets lake, Lelikovo, Lipovitsy, Lyudskoi Isl., Myagrozero, Myal' Isl., Oyatevschina, Paleostrov Isl., Podyelniki, Polya, Rogachev Isl., Sennaya Guba, Shunevskiy Isl., Turastamozero, Vavlok Isl., Velikaya Niva, Volkostrov Isl., Vorobyi, Yu. Oleny Isl.  
*Sapromyza opaca* Becker – Vorobyi  
*Sapromyza sexpunctata* Meigen – Khvost Isl., Kosmozero, Nizhneje Myagrozero, Oyatevschina, Podyelniki, Turastamozero, Vorobyi  
*Sapromyza zetterstedti* Hendel – Lipovitsy, Uzkaya Salma  
*Calliopum aeneum* Fallén – Kuzaranda  
*Calliopum elisae* Meigen – Kuzaranda, Nizhneje Myagrozero, Sennaya Guba, Tipinitsy, Turastamozero  
*Lauxania cylindricornis* Fabricius – Ernitskiy Isl., Kainos Isl., Kizhi Isl., Kurgenitsy, Kuzaranda, Lelikovo, Lyudskoi Isl., Nizhneje Myagrozero, Sennaya Guba, Tolvuya, Uzkaya Salma, Vavlok Isl., Vegoruksy, Vikshezero, Vorobyi

#### **Micropezidae**

*Rainieria latifrons* Loew – Lipovitsy

*Micropeza corrigiolata* L. – Tolvuya

#### **Neriidae**

*Neria cibaria* L. – Eglov Isl.

*Neria commutata* Czerny – Eglov Isl., Ernitskiy Isl., Lelikovo, Paleostrov Isl., Rogachev Isl., Tipinitsy

#### **Acartophthalmidae**

*Acartophthalmus bicolor* Oldenberg – Lyudskoi Isl.

### **Anthomyzidae**

? *Anthomyza dissors* Collin – Kopanets lake

*Anthomyza gracilis* Fallén – Kizhi Isl.

### **Clusiidae**

*Hendelia beckeri* Czerny – Lyudskoi Isl., Shunevskiy Isl., Vikshezero

*Clusiodes albimanus* Meigen – Kopanets lake, Lipovitsy, Shunevskiy Isl., Turastamozero

*Clusiodes apicalis* Zetterstedt – Ernitskiy Isl., Uzkaya Salma

*Clusiodes geomyzinus* Fallén – Oyatevschina

*Clusiodes pictipes* Zetterstedt – Oyatevschina, Vorobyi

*Clusiodes ruficollis* Meigen – Lyudskoi Isl.

*Clusia flava* Meigen – Klimenicy, Lipovitsy, Oyatevschina, Poly, Uzkaya Salma, Vikshezero

### **Megamerinidae**

*Megamerina dolium* Fabricius – Kopanets lake, Kurgenitsy, Poly, Vikshezero

### **Oдиниidae**

*Odinia ornata* Zetterstedt – Turastamozero

### **Opomyzidae**

*Anomalochaeta guttipennis* Zetterstedt – Shunevskiy Isl.

*Opomyza punctella* Fallén – Podyelniki

*Geomyza hackmani* Nartshuk – Nizhneje Myagrozero

*Geomyza tripunctata* Fallén – Lyudskoi Isl.

### **Pallopteridae**

*Temnosira saltuum* L. – Kizhi Isl., Myal' Isl., Paleostrov Isl., Rogachev Isl., Sennaya Guba, Vikshezero

*Toxoneura modesta* Meigen – Nizhneje Myagrozero

*Toxoneura trimacula* Meigen – Podyelniki, Tipinitsy

### **Dryomyzidae**

*Dryomyza decrepita* Zetterstedt – Ernitskiy Isl., Klimenicy, Vorobyi

*Neuroctena anilis* Fallén – Bol. Lelikovskiy Isl., Kizhi Isl., Rogachev Isl., Yu. Oleny Isl.

### **Phaeomyiidae**

*Pelidnoptera fuscipennis* Meigen – Turastamozero

### **Sciomyzidae**

*Pherbellia albocostata* Fallén – Klimenicy, Lipovitsy, Oyatevschina, Podyelniki, Poly, Turastamozero, Uzkaya Salma

*Pherbellia alpina* Frey – Lipovitsy

*Pherbellia argyra* Verbeke – Lelikovo, Sennaya Guba

*Pherbellia brunnipes* Meigen – Sennaya Guba

*Pherbellia dubia* Fallén – Ernitskiy Isl., Kizhi Isl., Lipovitsy, Podyelniki, Vorobyi

*Pherbellia griseola* Fallén – Bol. Lelikovskiy Isl., Kazhma, Lelikovo, Sennaya Guba

*Pherbellia obtusa* Fallén – Kizhi Isl., Shunevskiy Isl., Uzkaya Salma, Vavlok Isl.

*Pherbellia pallidiventris* Fallén – Kopanets lake, Kosmozero, Lipovitsy, Paleostrov Isl., Podyelniki, Velikaya Niva

*Pherbellia schoenherrri* Fallén – Kurgenitsy, Vorobyi

*Pherbellia sordida* Hendel – Kurgenitsy, Sennaya Guba, Shunevskiy Isl.

*Pherbellia ventralis* Fallén – Kurgenitsy

*Pteromicra angustipennis* Staeger – Ernitskiy Isl.

*Pteromicra glabricula* Fallén – Ernitskiy Isl., Sennaya Guba, Shunevskiy Isl., Vikshezero

*Colobaea distincta* Meigen – Shunevskiy Isl.

*Renocera pallida* Fallén – Ernitskiy Isl., Klimenicy, Shunevskiy Isl., Vikshezero

*Renocera strobli* Hendel – Vikshezero

*Anticheta atriseta* Loew – Shunevskiy Isl., Vikshezero

*Ectinocera borealis* Zetterstedt – Uzkaya Salma

*Tetanocera amurensis* Hendel – Klimenicy  
*Tetanocera arrogans* Meigen – Ernitskiy Isl., Khvost Isl., Kizhi Isl., Klimenicy, Kurgenitsy, Lelikovo, Sennaya Guba, Tolvuya, Vegoruksy  
*Tetanocera elata* Fabricius – Bol. Lelikovskiy Isl., Kizhi Isl., Podyelniki, Sennaya Guba, Tipinitsy, Velikaya Niva, Volkostrov Isl., Vorobyi  
*Tetanocera ferruginea* Fallén – Kizhi Isl., Klimenicy, Tipinitsy, Vorobyi  
*Tetanocera freyi* Stackelberg – Kurgenitsy, Tipinitsy, Volkostrov Isl.  
*Tetanocera fuscinervis* Zetterstedt – Ernitskiy Isl., Lelikovo, Lyudskoi Isl.  
*Tetanocera hyalipennis* von Roser – Kurgenitsy, Vorobyi  
*Tetanocera montana* Day – Kazhma, Kurgenitsy  
*Tetanocera phyllophora* Melander – Ernitskiy Isl., Kizhi Isl., Myagrozero, Nizhneje Myagrozero, Tipinitsy, Verkhnee Myagrozero  
*Tetanocera robusta* Loew – Bol. Lelikovskiy Isl., Kurgenitsy, Rogachev Isl., Shunevskiy Isl., Tipinitsy  
*Euthycera chaerophylli* Fabricius – Nizhneje Myagrozero  
*Trypetoptera punctulata* Scopoli – Bol. Lelikovskiy Isl., Dianova Gora, Khvost Isl., Kurgenitsy, Lipovitsy, Myagrozero, Podyelniki, Tipinitsy, Turastamozero, Vegoruksy, Velikaya Guba, Velikaya Niva, Vorobyi, Yu. Oleny Isl.  
*Pherbina coryleti* Scopoli – Bol. Lelikovskiy Isl., Ernitskiy Isl., Kizhi Isl., Kurgenitsy, Tipinitsy  
*Psacadina zernyi* Mayer – Sennaya Guba  
*Elgiva cucularia* L. – Kurgenitsy, Sennaya Guba  
*Ilione lineata* Fallén – Kurgenitsy, Vorobyi  
*Hydromya dorsalis* Fabricius – Vikshezero  
*Limnia paludicola* Elberg – Kurgenitsy, Oyatevschina, Polya, Tipinitsy, Uzkaya Salma, Velikaya Guba, Verkhnee Myagrozero  
*Limnia unguicornis* Scopoli – Nizhneje Myagrozero, Rogachev Isl.  
*Sepedon spinipes* Scopoli – Kizhi Isl., Klimenicy, Lelikovo, Sennaya Guba, Volkostrov Isl.  
*Dichetophora finlandica* Verbeke – Volkostrov Isl.  
*Tetanura pallidiventrif* Fallén – Klimenicy

### **Sepsidae**

*Themira annulipes* Meigen – Kizhi Isl., Kuzaranda, Nizhneje Myagrozero, Oyatevschina, Vorobyi  
*Themira germanica* Duda – Bol. Lelikovskiy Isl.  
*Themira leachi* Meigen – Nizhneje Myagrozero  
*Nemopoda nitidula* Fallén – Rogachev Isl., Vikshezero  
*Sepsis cynipsea* L. – Kizhi Isl., Kuzaranda, Sennaya Guba  
*Sepsis orthocnemis* Frey – Myagrozero, Nizhneje Myagrozero  
*Sepsis punctum* Fabricius – Bol. Lelikovskiy Isl., Kizhi Isl., Nizhneje Myagrozero, Vikshezero

### **Heleomyzidae**

? *Borboropsis puberula* Zetterstedt – Vorobyi  
*Neoleria ruficeps* Zetterstedt – Myagrozero  
*Morpholeria ruficornis* Meigen – Bol. Lelikovskiy Isl.  
*Scoliocentra amplicornis* Czerny – Kurgenitsy, Turastamozero  
*Suillia apicalis* Loew – Khvost Isl., Turastamozero  
*Suillia atricornis* Meigen – Bol. Lelikovskiy Isl., Klimenicy, Lipovitsy, Paleostrov Isl., Polya, Tambitsy, Tipinitsy, Turastamozero, Verkhnee Myagrozero, Vikshezero, Yu. Oleny Isl.  
*Suillia bicolor* Zetterstedt – Bol. Lelikovskiy Isl., Klimenicy, Kopanets lake, Lipovitsy, Myagrozero, Paleostrov Isl., Polya, Tambitsy, Tipinitsy, Turastamozero, Uzkaya Salma, Vavlok Isl., Vegoruksy, Verkhnee Myagrozero, Volkostrov Isl., Yu. Oleny Isl.

*Suillia flava* Meigen – Eglov Isl., Nizhneje Myagrozero, Oyatevschina, Turastamozero, Uzkaya Salma, Vorobyi

*Suillia flavifrons* Zetterstedt – Bol. Lelikovskiy Isl., Klimenicy, Poly, Tambitsy

*Suillia fuscicornis* Zetterstedt – Myal' Isl., Paleostrov Isl., Podyelniki, Tambitsy, Turastamozero, Verkhnee Myagrozero, Yu. Oleny Isl.

*Suillia humilis* Meigen – Bol. Lelikovskiy Isl., Lipovitsy, Uzkaya Salma, Verkhnee Myagrozero, Vorobyi

*Suillia laevifrons* Loew – Bol. Lelikovskiy Isl., Myagrozero, Podyelniki, Poly, Tipinitsy, Turastamozero, Volkostrov Isl., Vorobyi

*Suillia mikii* Pokorny – Paleostrov Isl.

*Suillia nemorum* Meigen – Turastamozero

*Suillia parva* Loew – Podyelniki, Tipinitsy

*Suillia quadrilineata* Czerny – Verkhnee Myagrozero

### **Sphaeroceridae**

*Crumomyia pedestris* Meigen – Klimenicy

### **Psilidae**

*Chamaepsila atra* Meigen – Eglov Isl., Kizhi Isl., Klimenicy, Kuivakhda Isl., Lelikovo, Lyudskoi Isl., Sennaya Guba, Vikshezero, Vorobyi

*Chamaepsila humeralis* Zetterstedt – Kizhi Isl., Rogachev Isl., Vorobyi

? *Chamaepsila nigra* Fallén – Kizhi Isl.

*Chamaepsila nigricornis* Meigen – Vorobyi

*Chamaepsila pallida* Fallén – Kurgenitsy

*Chamaepsila pectoralis* Meigen – Kopanets lake, Podyelniki

? *Chamaepsila rosae* Fabricius – Kizhi Isl., Vorobyi

*Psila fimetaria* L. – Eglov Isl., Khvost Isl., Rogachev Isl.

*Psila merdaria* Collin – Sennaya Guba, Vikshezero

*Loxocera nigrifrons* Macquart – Myal' Isl.

*Chyliza vittata* Meigen – Kosmozero

### **Tanypezidae**

*Strongylophthalmyia pictipes* Frey – Kopanets lake, Poly, Vavlok Isl.

*Strongylophthalmyia ustulata* Zetterstedt – Bol. Lelikovskiy Isl., Kopanets lake, Lipovitsy, Podyelniki, Poly

*Tanypeza longimana* Fallén – Kopanets lake, Nizhneje Myagrozero, Podyelniki, Tipinitsy

### **Lonchaeidae**

? *Dasiops occultus* Collin – Vavlok Isl.

*Lonchaea laxa* Collin – Uzkaya Salma

*Lonchaea patens* Collin – Verkhnee Myagrozero

### **Ulidiidae**

*Homalocephala angustata* Wahlberg – Podyelniki, Vegoruksy, Verkhnee Myagrozero, Vikshezero

*Homalocephala biumbrata* Wahlberg – Kurgenitsy, Podyelniki, Tambitsy

*Melieria crassipennis* Fabricius – Bol. Lelikovskiy Isl.

*Herina frondescentiae* L. – Kuzaranda

### **Tephritidae**

*Urophora cuspidata* Meigen – Lelikovo

*Urophora jaceana* Hering – Lelikovo, Rogachev Isl., Sennaya Guba

? *Urophora mauritanica* Macquart – Vikshezero

? *Urophora solstitialis* L. – Lelikovo, Nizhneje Myagrozero, Oyatevschina, Sennaya Guba, Vorobyi

*Urophora stigma* Loew – Kuzaranda, Sennaya Guba

*Rhagoletis cerasi* L. – Nizhneje Myagrozero, Oyatevschina, Podyelniki, Vorobyi

*Euleia heraclei* L. – Rogachev Isl.  
*Myoleja lucida* Fallén – Kainos Isl., Klimenicy, Rogachev Isl., Vavlok Isl.  
*Cryptaciura rotundiventris* Fallén – Eglov Isl., Rogachev Isl., Volkostrov Isl.  
*Chaetorellia jaceae* Robineau-Desvoidy – Eglov Isl., Kuzaranda, Lelikovo, Paleostrov Isl., Rogachev Isl., Sennaya Guba, Vikshezero, Vorobyi  
*Chaetorellia loricata* Rondani – Eglov Isl., Kizhi Isl., Kurgenitsy, Lelikovo, Lyudskoi Isl., Rogachev Isl., Sennaya Guba  
*Chaetostomella cylindrica* Robineau-Desvoidy – Bol. Lelikovskiy Isl., Eglov Isl., Khvost Isl., Kizhi Isl., Kosmozero, Kuzaranda, Lelikovo, Oyatevshchina, Podyelniki, Rogachev Isl., Tolvuya, Turastamozero, Vertilovo, Vikshezero, Vorobyi  
? *Terellia gynaecochroma* Hering – Rogachev Isl.  
*Terellia plagiata* Dahlbom – Volkostrov Isl., Vorobyi  
*Terellia ruficauda* Fabricius – Kurgenitsy  
*Terellia tussilaginis* Fabricius – Kazhma  
*Terellia winthemi* Meigen – Poly  
*Orellia scorzonerae* Robineau-Desvoidy – Lelikovo, Lyudskoi Isl., Sennaya Guba  
*Xyphosia miliaria* Schrank – Verkhnee Myagrozero  
? *Campiglossa daronici* Loew – Vikshezero  
*Tephritis angustipennis* Loew – Tipinitsy  
*Tephritis conura* Loew – Kizhi Isl.  
*Tephritis hyoscyami* L. – Poly  
**Hippoboscidae**  
*Ornithomya chloropus* Bergroth – Klimenicy, Uzkaya Salma  
*Lipoptena cervi* L. – Tipinitsy  
**Fanniidae**  
*Fannia parva* Stein – Vorobyi  
*Fannia polychaeta* Stein – Poly  
*Fannia posticata* Meigen – Podyelniki  
*Fannia ringdahlana* Collin – Vikshezero  
*Fannia rondanii* Strobl – Vikshezero  
*Fannia serena* Fallén – Rogachev Isl.  
*Fannia sociella* Zetterstedt – Nizhneje Myagrozero, Podyelniki, Turastamozero, Verkhnee Myagrozero  
*Fannia spathiophora* Malloch – Lyudskoi Isl., Poly, Vikshezero  
**Muscidae**  
*Mydaea affinis* Myade – Poly, Uzkaya Salma  
*Mydaea humeralis* Robineau-Desvoidy – Eglov Isl.  
*Mydaea orthonevra* Macquart – Lipovitsy  
*Mydaea ortonevra* Macquart – Turastamozero  
*Mydaea urbana* Meigen – Turastamozero  
? *Helina depuncta* Fallén – Podyelniki  
*Helina evecta* Harris – Eglov Isl., Khvost Isl., Nizhneje Myagrozero, Podyelniki, Poly, Vegoruksy  
*Helina impuncta* Fallén – Eglov Isl.  
*Helina pubiseta* Zetterstedt – Lipovitsy, Poly  
*Helina subvittata* Seguy – Eglov Isl.  
*Graphomyia maculata* Scopoli – Kurgenitsy  
? *Spilogona carbonella* Zetterstedt – Lipovitsy  
*Spilogona contractifrons* Zetterstedt – Eglov Isl., Podyelniki, Poly, Vegoruksy  
? *Spilogona karelica* Tiensuu – Podyelniki  
*Coenosia intermedia* Fallén – Lipovitsy, Podyelniki

*Coenosia mollicula* Fallén – Podyelniki, Turastamozero, Uzkaya Salma, Verkhnee Myagrozero  
*Coenosia rufipalpis* Meigen – Khvost Isl., Podyelniki  
*Coenosia trilineella* Zetterstedt – Khvost Isl., Uzkaya Salma  
*Thricops albibasalis* Zetterstedt – Eglov Isl., Uzkaya Salma  
*Thricops cunctans* Meigen – Eglov Isl., Khvost Isl., Rogachev Isl., Verkhnee Myagrozero  
*Thricops diaphanus* Wiedemann – Turastamozero, Uzkaya Salma, Vikshezero  
*Thricops genarum* Zetterstedt – Podyelniki  
*Thricops lividiventris* Zetterstedt – Podyelniki  
*Thricops longipes* Zetterstedt – Eglov Isl.  
*Thricops nigrifrons* Robineau-Desvoidy – Eglov Isl.  
*Thricops nigritellus* Zetterstedt – Lyudskoi Isl.  
*Thricops semicinereus* Wiedemann – Eglov Isl., Lipovitsy, Nizhneje Myagrozero, Turastamozero, Vegoruksy  
? *Drymeia hamata* Fallén – Nizhneje Myagrozero  
*Hydrotaea borussica* Stein – Lipovitsy, Poly, Turastamozero, Uzkaya Salma, Vorobyi  
*Hydrotaea militaris* Meigen – Lipovitsy  
*Hydrotaea pandellei* Stein – Eglov Isl., Kosmozero, Lipovitsy, Oyatevschina, Poly, Turastamozero, Uzkaya Salma  
*Hydrotaea pellucens* Portschinsky – Ernitskiy Isl., Kosmozero, Uzkaya Salma  
*Hydrotaea velutina* Robineau-Desvoidy – Turastamozero  
*Muscina levida* Harris – Eglov Isl., Podyelniki  
*Phaonia angelicae* Scopoli – Eglov Isl., Lipovitsy, Nizhneje Myagrozero, Poly, Turastamozero  
*Phaonia errans* Meigen – Lipovitsy, Poly, Uzkaya Salma  
*Phaonia pallida* Fabricius – Turastamozero  
? *Morellia hortorum* Fallén – Podyelniki, Poly, Uzkaya Salma  
*Morellia podagrica* Loew – Lipovitsy, Poly, Uzkaya Salma  
*Mesembrina mystacea* L. – Lipovitsy  
*Mesembrina resplendens* Wahlberg – Bol. Lelikovskiy Isl., Klimenicy, Lipovitsy, Poly, Turastamozero, Uzkaya Salma  
*Stomoxys calcitrans* L. – Podyelniki  
**Anthomyiidae**  
*Botanophila brunnelinea* Zetterstedt – Nizhneje Myagrozero  
*Botanophila fugax* Meigen – Nizhneje Myagrozero  
*Botanophila hucketti* Ringdahl – Nizhneje Myagrozero  
*Hydrophoria lancifer* Harris – Eglov Isl., Lipovitsy, Turastamozero, Vegoruksy  
*Zaphne ambigua* Fallén – Podyelniki  
*Zaphne caudata* Zetterstedt – Eglov Isl., Podyelniki  
*Anthomyia monilis* Meigen – Ernitskiy Isl., Kizhi Isl., Kuivakhda Isl., Lelikovo, Lyudskoi Isl., Myal' Isl., Sennaya Guba, Shunevskiy Isl., Turastamozero, Vorobyi  
*Anthomyia plurisetosa* Brullé – Oyatevschina  
*Anthomyia pluvialis* L. – Vorobyi  
*Anthomyia procellaris* Rondani – Rogachev Isl.  
*Eutrichota frigida* Zetterstedt – Poly  
*Pegomya circumspolaris* Ackland et Griffiths – Turastamozero  
*Pegomya flavoscutellata* Zetterstedt – Lipovitsy  
*Pegomya fulgens* Meigen – Podyelniki  
*Pegomya geniculata* Bouché – Lipovitsy, Poly, Uzkaya Salma  
*Pegomya incisiva* Stein – Podyelniki  
*Pegomya maculata* Stein – Lipovitsy, Turastamozero  
*Pegomya pulchripes* Loew – Podyelniki

*Pegomya scapularis* Zetterstedt – Polyta, Turastamozero  
*Pegomya zonata* Zetterstedt – Lipovitsy  
*Pegoplata infirma* Meigen – Nizhneje Myagrozero  
*Pegoplata juvenilis* Stein – Eglov Isl.  
*Heterostylodes pilifera* Zetterstedt – Podyelniki  
*Delia coarctata* Fallén – Nizhneje Myagrozero  
*Delia fabricii* Holmgren – Nizhneje Myagrozero  
*Delia florilega* Zetterstedt – Nizhneje Myagrozero  
*Delia lophota* Pandellé – Turastamozero  
*Delia platura* Meigen – Nizhneje Myagrozero, Turastamozero

#### **Scathophagidae**

*Parallelomma vittatum* Meigen – Kopanets lake, Lelikovo, Lyudskoi Isl., Paleostrov Isl., Turastamozero  
*Leptopa filiformis* Zetterstedt – Khvost Isl.  
*Cordilura albipes* Fallén – Eglov Isl., Kurgenitsy, Lipovitsy, Rogachev Isl., Velikaya Niva, Vikshezero  
*Cordilura ciliata* Meigen – Kopanets lake, Kurgenitsy, Rogachev Isl., Vorobyi  
*Cordilura picipes* Meigen – Bol. Lelikovskiy Isl., Eglov Isl., Ernitskiy Isl., Kizhi Isl., Lyudskoi Isl.  
*Cordilura pubera* L. – Kizhi Isl., Tipinitsy, Velikaya Niva  
*Cordilura pudica* Meigen – Klimenicy  
*Megaphthalma pallida* Fallén – Bol. Lelikovskiy Isl., Kopanets lake, Kurgenitsy, Lyudskoi Isl., Myagrozero, Tambitsy, Turastamozero, Uzkaya Salma, Velikaya Niva, Vikshezero, Volkostrov Isl., Vorobyi  
*Hexamitocera loxocerata* Fallén – Tolvuya  
*Nanna armillata* Zetterstedt – Vorobyi  
*Nanna flavipes* Fallén – Kizhi Isl., Lyudskoi Isl., Oyatevshchina  
*Nanna inermis* Becker – Klimenicy  
*Cleigastra apicalis* Meigen – Kurgenitsy, Lelikovo  
*Conisternum obscurum* Fallén – Vorobyi  
*Scathophaga furcata* Say – Klimenicy, Lyudskoi Isl., Myagrozero  
*Scathophaga inquinata* Meigen – Rogachev Isl., Vorobyi  
*Scathophaga stercoraria* L. – Kizhi Isl., Kuzaranda  
*Scathophaga suilla* Fabricius – Ernitskiy Isl., Kizhi Isl., Oyatevshchina, Tambitsy, Vorobyi  
*Chaetosa punctipes* Meigen – Kizhi Isl., Kopanets lake, Lelikovo, Sennaya Guba  
*Microprosopa pallidicauda* Zetterstedt – Kopanets lake, Tipinitsy  
*Hydromyza livens* Fabricius – Podyelniki  
*Staegeria kunzei* Zetterstedt – Klimenicy, Vorobyi  
*Pogonota barbata* Zetterstedt – Klimenicy, Kopanets lake, Kurgenitsy, Tipinitsy, Vegoruksy, Verkhnee Myagrozero

#### **Calliphoridae**

*Bellardia viarum* Robineau-Desvoidy – Kizhi Isl.  
*Calliphora vomitoria* L. – Podyelniki  
*Cynomya mortuorum* L. – Eglov Isl., Kizhi Isl.  
*Eurychaeta palpalis* Robineau-Desvoidy – Oyatevshchina  
*Lucilia bufonivora* Moniez – Eglov Isl., Podyelniki

#### **Sarcophagidae**

*Amobia oculata* Zetterstedt – Podyelniki  
*Metopia grandii* Venturi – Podyelniki  
*Agria mamillata* Pandellé – Oyatevshchina, Vorobyi  
*Brachicoma devia* Fallén – Eglov Isl., Nizhneje Myagrozero, Oyatevshchina, Podyelniki, Vorobyi



*Sarcophaga albiceps* Meigen – Nizhneje Myagrozero, Podyelniki, Vegoruksy  
*Sarcophaga aratrix* Pandellé – Eglov Isl., Klimenticy, Nizhneje Myagrozero, Vikshezero  
*Sarcophaga caerulescens* Zetterstedt – Eglov Isl., Nizhneje Myagrozero, Vorobyi  
*Sarcophaga carnaria* L. – Paleostrov Isl.  
*Sarcophaga haemorrhoides* Böttcher – Nizhneje Myagrozero  
*Sarcophaga melanura* Meigen – Rogachev Isl.  
*Sarcophaga schuetzei* Kramer – Eglov Isl.  
*Sarcophaga sexpunctata* Fabricius – Eglov Isl.  
*Sarcophaga similis* Meade – Kizhi Isl., Podyelniki  
*Sarcophaga socrus* Rondani – Sennaya Guba  
*Sarcophaga subulata* Pandellé – Podyelniki  
*Sarcophaga uliginosa* Kramer – Eglov Isl., Vikshezero  
*Sarcophaga vagans* Meigen – Oyatevschina  
*Sarcophaga variegata* Scopoli – Eglov Isl., Kizhi Isl., Oyatevschina, Rogachev Isl., Vikshezero, Vorobyi

### **Tachinidae**

? *Paratryphera barbatula* Rondani – Podyelniki  
 ? *Winthemia quadripustulata* Fabricius – Turastamozero  
*Bactromyia aurulenta* Meigen – Podyelniki  
*Aplomya confinis* Fallén – Turastamozero  
*Allophorocera ferruginea* Meigen – Nizhneje Myagrozero  
*Exorista larvarum* L. – Podyelniki  
*Medina collaris* Fallén – Podyelniki  
*Medina multispina* Herting – Podyelniki  
*Medina separata* Meigen – Podyelniki  
 ? *Actia pilipennis* Fallén – Podyelniki, Vorobyi  
*Ceromya silacea* Meigen – Eglov Isl., Lipovitsy, Podyelniki, Poly, Turastamozero, Uzkaya Salma  
*Tachina fera* L. – Nizhneje Myagrozero, Oyatevschina  
*Tachina grossa* L. – Turastamozero  
*Nowickia marklini* Zetterstedt – Eglov Isl., Nizhneje Myagrozero, Podyelniki, Rogachev Isl., Turastamozero  
*Ernestia rudis* Fallén – Eglov Isl.  
*Eurithia connivens* Zetterstedt – Podyelniki  
*Halidaya aurea* Egger – Podyelniki  
*Eriothrix rufomaculatus* DeGeer – Vorobyi  
*Voria ruralis* Fallén – Eglov Isl.  
*Thelaira nigripes* Fabricius – Nizhneje Myagrozero, Podyelniki, Vegoruksy  
 ? *Thelaira solivaga* Harris – Oyatevschina  
*Subclytia rotundiventris* Fallén – Turastamozero  
*Gymnosoma nudifrons* Herting – Paleostrov Isl.  
*Phasia aurulans* Meigen – Vorobyi  
*Phasia hemiptera* Fabricius – Klimenticy  
 ? *Phasia mesnili* Draber-Monko – Vikshezero  
*Lophosia fasciata* Meigen – Kurgenitsy, Lipovitsy  
*Cylindromyia brassicaria* Fabricius – Vorobyi  
*Cylindromyia interrupta* Meigen – Eglov Isl., Kurgenitsy, Podyelniki, Verkhnee Myagrozero.

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### 3.7 Localities in Zaonezhye area used in species lists of vascular plants, bryophytes, lichens, fungi and insects, and their toponyms

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The accuracy of collection localities given on the labels of herbarium specimens and insect collections, as well in the literature, is very variable. In most cases the geographical names have been taken from maps in use during particular historical periods. Several place names have changed over time. All found localities, where species have been recorded in Zaonezhye area, are included in the table, with their known toponyms. At present, many villages in the table have been abandoned.

All place names indicated on old labels could not be found from Mullonen et al. (2013) or other sources (printed papers, maps, internet sources), and such names are excluded from the table. In some cases two or more places have the same name, and they are excluded as well.

Coordinates (if not otherwise mentioned) indicate the center of the settlement, lake, island, peninsula, etc. The actual collection place is located within the locality given and usually well-marked on the maps or in its more or less immediate vicinity (labels often include words like “near”, “close”, “next to”, etc.).

\* Russian names are given according to: Mullonen, I.I., Azarova, I.V. & Gerd, A.S. 2013. Муллонен И. И., Азарова И. В., Герд А. С. Свод топонимов Заонежья [Catalog of geographical place names of Zaonezhye]. Karelian Research Center of Russian Academy of Sciences. Petrozavodsk. 251 p. (In Russian).

English (shortened in parentheses)	Russian name*	Spelling variants and Finnish names	Type of the place	Decimal coordinates
Azhepnavolok	Ажепнаволоок	Azhepnavolok Asheb Ажеп Ажебнаволоок	Peninsula	62.628826 N; 34.962074 E

Bolnichnyi	Больничный		Village	62.251903 N; 35.039493 E
Bolshoi Klimenetsky Bolshoi Klimetskiy (B. Klim., Bol. Klim.)	Большой Климецкий	Limosaari Klimskij Klimetskoi Klimenetskiy Б.Клименицкий	Island	61.969199 N; 35.261581 E
Bolshoi Lelikovski (B. Lelik., Bol. Lelik.)	Большой Леликовский		Island	61.963382 N; 35.129745 E
Boyarstchina	Боярщина	Boyarschina	Village	62.070505 N; 35.197037 E
Bukolnikovskiy	Букольниковский		Island	62.006502 N; 35.199783 E
Butenevo	Бутенево	Бутенева	Village	62.532975 N; 35.363165 E
Chelozero	Челозеро		Lake	62.416746 N; 34.983793 E
Dianova Gora	Дианова Гора Диановы Горы	Dianova-Gora Dianowa-Gora	Village	62.632001 N; 34.648367 E
Dolgiy	Долгий		Island	62.111704 N; 35.267761 E
Eglov	Еглов		Island	62.134774 N; 35.164249 E
Ernitskiy	Ерницкий		Island	61.989196 N; 35.168057 E
Fedotovo	Федотово		Village	62.660191 N; 34.682274 E
Fomino	Фомино		Village	62.561743 N; 34.887663 E
Garnitsy (Pervye & Vtorye)	Гарницы (Первые и Вторые)	Garnitsa Limoluoto	Twin village on B. Klim.	61.978328 N; 35.213344 E
Gabostrov	Габостров	Гавостров	Island	62.483694 N; 34.557043 E
Gizhozero	Гижозеро	Гажозеро Гижезеро	Lake	62.469416 N; 35.084604 E
Gryz	Грыз		Island	62.022556 N; 35.222379 E
Gryznavolok	Грызनावолок		Cape on B. Klim.	62.022556 N; 35.222379 E
Izbushechnyi	Избушечный	Избушечник	Island	62.111657 N; 34.954397 E
Kainos	Кайнос		Island	62.584217 N; 35.405647 E
Kalgostrov	Калгостров	Калгов	Island	62.004324 N; 35.128652 E
Kanev	Канев	Колгостров	Island	62.010591 N; 35.215688 E
Karasozero	Карасозеро		Village and lake	62.407075 N; 34.890936 E
Kaskoselga	Каскосельга		Village	62.246321 N; 35.467176 E
Kazhma	Кажма		Village	62.550795 N; 34.839851 E

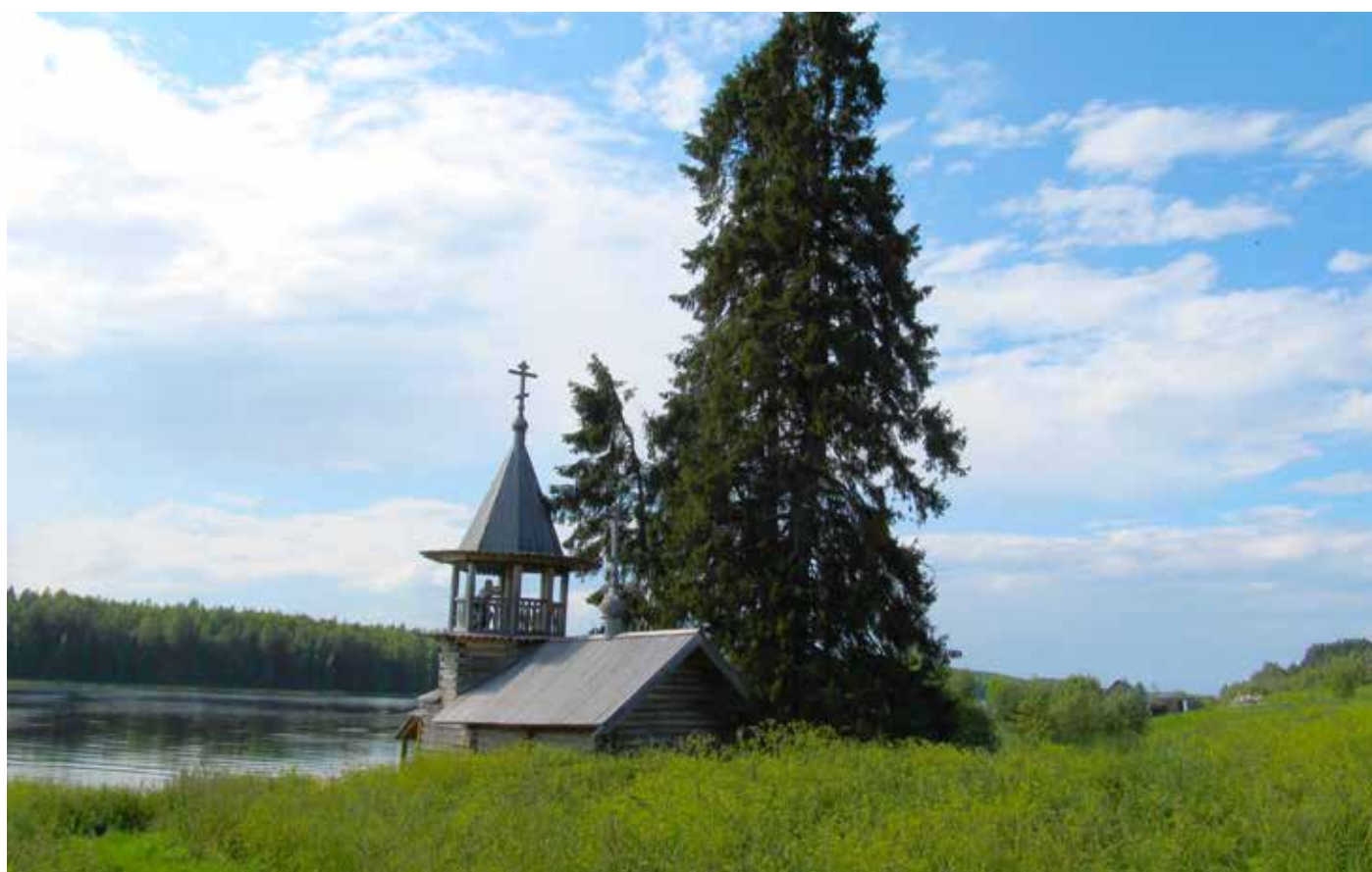
Kizhi	Кизи	Kischi Kiischi Kishi	Island	62.084754 N; 35.213453 E
Khvost	Хвост		Island	62.149371 N; 35.152435 E
Klim Nos	Клим Нос	Клим	Peninsula	62.552257 N; 35.343228 E
Klimenitsy	Клименицы		Village on B. Klim. (former monastery)	61.849696 N; 35.180698 E
Kopanetz	Копанец	Kopanets	Lake	62.033892 N; 35.124841 E
Korbozero	Корбозеро		Lake	62.206441 N; 35.287818 E
Koselga	Косельга		Village on B. Klim.	62.003596 N; 35.321121 E
Kosmozero	Космозеро		Lake	62.447286 N; 34.941034 E
Kosmozero	Космозеро		Village	62.334634 N; 35.057163 E
Krokhino	Крохино		Village	62.363944 N; 35.270308 E
Kuivakhda	Куйвахда	Куйвахба	Island	61.959308 N; 35.170975 E
Kurgenitsy	Кургеницы		Village on B. Klim.	62.071655 N; 35.286457 E
Kuzaranda	Кузаранда	Kusaranda Kuusiranta	Village	62.374627 N; 35.525054 E
Ladmozero	Ладмозеро		Lake	62.536845 N; 34.683295 E
Ladmozero	Ладмозеро		Village	62.56553 N; 34.664413 E
Lambasruchey	Ламбасручей	Lambas Ruchei	Village	62.287764 N; 34.876731 E
Lambinskie	Ламбинские		Isles	61.957767 N; 35.09107 E
Lelikozero	Леликозеро		Village and lake	62.303488 N; 34.93185 E
Lichkov	Личков			See: Lyudskoy
Lizhma	Лижма		Village	62.378977 N; 34.515067 E
Lipovitsy	Липовицы		Village	62.115029 N; 35.060123 E
Longasy	Лонгасы		Village on B. Klim.	61.988603 N; 35.210739 E
Lyudskoi Lyudskoy	Людской	Личков Lichkov	Island	61.965502 N; 35.175376 E
Lukova	Лукова		Bay on B. Klim.	61.913642 N; 35.188769v
Medvedevo	Медведево	Медведева	Village	62.532611 N; 34.852555 E
Medvezhia Gora	Медвежья Гора	Медвежица	Hill an B. Klim.	61.891034 N; 35.217605 E
Megostrov	Мегостров	Мег	Island	62.563731 N; 35.42894 E
Meloiguba	Мелойгуба		Village and bay	62.512201 N; 34.588486 E

Mizhostrov	Мижостров Межостров	Mezhostrov Миж	Village and island	62.289042 N; 34.831215 E
Motalovo	Моталово		Village on B. Klim.	61.974821 N; 35.237151 E
Myal'	Мяль		Island	62.000035 N; 35.147269 E
Mysh'i	Мышьи		Isles	62.013107 N; 35.080665 E
Nikonova Gora	Никонова Гора		Village	62.573608 N; 34.824744 E
Nizhnee Myagzero	Нижнее Мягозеро		Village and lake	62.512977 N; 34.769135 E
Okatovstchina	Окатовщина	Okatovschina	Village	62.586729 N; 34.921611 E
Orozh	Орож		Island	61.985826 N; 35.200828 E
Oyatevstchina	Оятевщина Оятовщина	Oyatevschina	Village	62.082301 N; 35.180677 E
Padmzero	Падмозеро	Padmosero	Lake	62.493025 N; 35.170732 E
Paleostov	Палеостров	Палей	Island	62.565773 N; 35.252533 E
Petry	Петры		Village on B. Klim.	62.026242 N; 35.247021 E
Pod'elniki Podyelniki	Подъельники		Village	62.110299 N; 35.169004 E
Polya	Поля		Village	62.304761 N; 35.299123 E
Pryalichinskaya	Пряличинская Прялицынская	Pojalitsinskaja	Village	62.492318 N; 35.283284 E
Putkzero	Путкозеро		Lake	62.497105 N; 35.090828 E
Radkolie Radkolye	Радколье	Radkol'e	Cape on B. Lelik.	61.943054 N; 35.098279 E
Radkolie	Радколье	Radkol'e	Island	61.995407 N; 35.1872 E
Rechka	Речка		Village	62.095981 N; 35.178617 E
Rechnoy	Речной		Island	62.590887 N; 35.211506 E
Regimatka	Региматка		Village	62.515407 N; 34.887147 E
Rogachev	Рогачев		Island	62.12555 N; 35.185621 E
Rogostrov	Рогостров		Island	62.002221 N; 35.185387 E
Rugozero	Ругозеро	Ruuhijärvi	Lake	62.15173 N; 34.94471 E
Sennaya Guba	Сенная Губа	Sennoguba Heinälahti	Village on B. Klim. and bay	61.995891 N; 35.208143 E
Seredka	Середка		Village on B. Klim.	62.044124 N; 35.245565 E
Severnyi Myshyi	Северный Мыший		Island	62.015097 N; 35.078784 E
Severnyi Sokoliiy	Северный Соколий		Island	62.371764 N; 34.749412 E



Shiltya	Шильтя		Village	62.411273 N; 35.174178 E
Shunevskiy	Шуневский		Island	62.139556 N; 35.21371 E
Shun'ga Shunga	Шуньга Шунга	Sunku Schungu	Village	62.594115 N; 34.93187 E
Schsuchia	Щучья		Bay on B. Klim.	61.856936 N; 35.207616 E
Spirovka	Спировка		Village	62.437613 N; 35.133151 E
Sypun Gora	Сыпун-Гора		Hill	62.572901 N; 34.696694 E
Tambitsy	Тамбицы		Village	62.229184 N; 35.55747 E
Telpozzero	Тельпозеро		Village and lake	62.613468 N; 34.885905 E
Telyatnikovo	Телятниково		Village	62.047867 N; 35.20233 E
Terekhovo	Терехово		Village	62.318605 N; 35.065858 E
Tipinitsy	Типиницы		Village	62.189107 N; 35.414819 E
Tolvuya	Толвуйа	Tulvoja Tolvoja Tulwoja Tolwoja	Village	62.51028 N; 35.285149 E
Tolvuyskiy Bor	Толвуйский Бор		Village	62.503503 N; 35.241239 E
Tolstyí Navolok	Толстый наволо́к		Cape	62.298311 N; 35.575323 E
Turastamozero	Турастамозеро	Turastam	Village and lake	62.552306 N; 34.714546 E
Unitsa	Уница	Unitza	Village	62.597279 N; 34.460144 E
Unitskaya Guba	Уницкая Губа		Bay of Lake Onega	62.486782 N; 34.583397 E
Ust'-Yandoma	Усть-Яндома	Устьяндома Ustjandoma	Village	62.173124 N; 35.272083 E
Uzkie Salmy	Узкие Салмы Узкая Салма	Uzkaya Salma	Village	62.135474 N; 34.930992 E
Uzkie	Узкие		Village	62.437475 N; 34.958559 E
Vablok	Ваблок	Вавлок Ваблокостров	Island	62.575909 N; 35.410805 E
Vanchozero	Ванчозеро	Вангозеро	Lake	62.529951 N; 34.800377 E
Varnavolok	Варнаволо́к		Cape	62.162788 N; 35.462198 E
Vegoruksa Vegoruksy	Вегорукса Вегоруксы	Vegarus Wigorus Вегарукса	Village	62.218831 N; 34.883711 E
Vekhkozero	Вехкозеро		Lake	62.136668 N; 35.115797 E
Velikaya Guba	Великая Губа	Velikaja-guba Velikaja Guba Suurlahti	Village and bay	62.251825 N; 35.068103 E

Velikaya Niva	Великая Нива	Velikaja Niva	Village	62.362816 N; 35.223443 E
Verkhnee Myagrozero	Верхнее Мягрозеро		Village and lake	62.482016 N; 34.819946 E
Vertilovo	Вертилово		Village	62.00665 N; 35.181214 E
Voinavolok	Войнаволок		Village and peninsula	61.97791 N; 35.33571 E
Volkostrov	Волкостров	Волк Volk Ostrov Susisaari	Island	62.112554 N; 35.207836 E
Vorob' i Vorobyi	Воробыи		Village on B. Klim.	62.056191 N; 35.251095 E
Voroninskoe	Воронинское		Village	62.471389 N; 35.205934 E
Zaselezhye	Засележье	Zaselezje Засережье	Village	62.519262 N; 35.366265 E
Zimnyaya	Зимняя		Mountain	62.386252 N; 35.052639 E
Zharnikovo	Жарниково		Village	62.056789 N; 35.207882 E
Zubovo	Зубово	Zubova	Village	62.103317 N; 35.177155 E
Yam	Ям		Island	61.992243 N; 35.1928 E
Yuzhnyi Oleniy (Yu. Oleniy)	Южный Олений	Yuzhny Oleny	Island	62.045831 N; 35.363579 E



Abandoned villages in Zaonezhye Peninsula (Photo Boris Rayevsky).



Karelian and Finnish botanists and entomologists on the Ekolog ship. July 2004. In front: Alexei Kravchenko (left), and Pertti Uotila (right); behind, left to right: Andrei Humala, Alexei Polevoi, Jevgeni Jakovlev (Photo Tapio Lindholm).



Karelian botanists on the shore of Lake Onega. Losyi Islands. July 2004. Left to right: Elena Gnatyuk, Alexei Kravchenko and Oleg Kuznetsov (Photo Tapio Lindholm).



*Aconitum septentrionale* – an eastern («Siberian») species which can be found from Zaonezhye close to the western limit of its distribution area (Photo Tapio Lindholm).



*Polemonium caeruleum* in blossom on meadows along the Kuzaranda shore of Lake Onega (Photo Tapio Lindholm).



Luxuriant shore meadow of *Allium schoenoprasum* and *Melampyrum nemorosum* on the shore of Lukova Bay (Photo Pertti Uotila).



*Rauno Ruuhijärvi* (in front) and *Mikko Piirani* (behind) on the Kuzaranda shore of Lake Onega. The adults of Black-veined White butterfly (*Aporia crataegi*) are very abundant on mineralized soils (Photo Pertti Uotila).





Ecolog, the ship of the Karelian Research Center of Russian Academy of Sciences  
(Photo Tapio Lindholm).



Sunset in Vegoruksa Bay of Lake Onega (Photo Boris Rayevsky).



*Tapio Lindholm (Photo Jevgeni Jakovlev).*



*Olli Manninen* (left) and *Alexei Kravchenko* (right) found a rare fungus, *Piloporia sajanensis* in herb-rich spruce forest in the vicinity of Uzkie Salmy (Photo Jevgeni Jakovlev).



Andrei Humala (left) and Alexei Polevoi (right) in herb-rich spruce forest with *Aconitum septentrionale* (Photo Jevgeni Jakovlev).



## DOCUMENTATION PAGE

<i>Publisher</i>	Finnish Environment Institute			<i>Date</i> March 2015
<i>Author(s)</i>	Tapio Lindholm, Jevgeni Jakovlev and Alexei Kravchenko (eds.)			
<i>Title of publication</i>	<b>Biogeography, landscapes, ecosystems and species of Zaonezhye Peninsula, in Lake Onega, Russian Karelia</b>			
<i>Publication series and number</i>	Reports of the Finnish Environment Institute 40/2014			
<i>Theme of publication</i>				
<i>Parts of publication/ other project publications</i>	The publication is available in the internet: <a href="http://www.syke.fi/publications">www.syke.fi/publications</a>   <a href="http://helda.helsinki.fi/syke">helda.helsinki.fi/syke</a>   <a href="http://www.bpan.fi">www.bpan.fi</a>			
<i>Abstract</i>	<p>Zaonezhye Peninsula (Zaonezhsky Peninsula; Заонежский полуостров in Russian transcription) is situated on the northwestern coast of Lake Onega in the Republic of Karelia, Russia. The territory of Zaonezhye is unique in that it contains nearly every type of terrain and unconsolidated sediment known in the vast expanses of northwest Russia. It is also eastern part of Fennoscandian shield. It is characterized by a high diversity of basic limestone and carbonate rocks that determine the fertility of local soils as well as the unique diversity of habitats, flora and fauna. Numerous rare calciphile plant and lichen species are found here, as well as rich, eutrophic wetlands. Long-term farming and animal husbandry have led to a large number of grassland communities in the area. As a result, a mosaic structure of diverse habitats has evolved here. Europe's second largest lake, Lake Onega, with its clear and deep waters also affect the local climate, making it milder.</p> <p>This report provides for the first time detailed species lists of vascular plants, bryophytes, lichens, wood-growing fungi and insects covering the entire Zaonezhye Peninsula, Kizhi archipelago and other adjacent islands.</p> <p>The most important sites for protection were observed, and six new nature monuments in the southern and southeasteast parts of Zaonezhye Peninsula are recommended to be established.</p> <p>This publication contents following articles characterizing nature of Zaonezhye area: 1. Geology and physical geography: 1.1. Geological description, 1.2. Geomorphology and Quaternary deposits, 1.3. Hydrological characteristics, 1.4. Soil cover, 1.5. Palaeogeography, 1.6. Existing and planned protected areas; 2. Landscapes and ecosystems: 2.1. Modern landscapes of Zaonezhye, 2.2. Landscape structure, 2.3. Structure of the forest covered land and forest stands, 2.4. Forest structures, 2.5. Mires, 2.6. Meadows; 3. Flora and fauna: 3.1. Vascular plants, 3.2. Bryophyte flora, 3.3. Species list of lichens and allied fungi, 3.4. Red listed and indicator lichens, 3.5. Aphyllophoroid fungi and 3.6. Insect fauna. 3.7. Localities in Zaonezhye area used in species lists of vascular plants, bryophytes, lichens, fungi and insects, and their toponyms.</p>			
<i>Keywords</i>	geology, palaeogeography, landscapes, forest, mires, meadows, vascular plants, bryophytes, lichens, wood-growing fungi, insects, biodiversity, nature conservation, Zaonezhye Peninsula, Kizhi archipelago, Onega Lake, Republic of Karelia			
<i>Financier/ commissioner</i>	Nordic Council of Ministers; Ministries of the Environment of Finland, Norway, Sweden; Ministries for Foreign Affairs of Finland, Norway and Sweden, Directorate of regional protected areas of the Republic of Karelia			
	ISBN 978-952-11-4404-2 (pbk.)	ISBN 978-952-11-4405-9 (PDF)	ISSN 1796-1718 (print.)	ISSN 1796-1726 (online)
	<i>No. of pages</i> 359	<i>Language</i> English	<i>Restrictions</i> public	<i>Price (incl. tax 8 %)</i>
<i>For sale at/ distributor</i>	Finnish Environment Institute (SYKE), neuvonta P.O. Box 140, FI-00251 Helsinki, Finland, Email: <a href="mailto:neuvonta.syke@ymparisto.fi">neuvonta.syke@ymparisto.fi</a>			
<i>Financier of publication</i>	Finnish Environment Institute (SYKE), P.O. Box 140, FI-00251 Helsinki, Finland Phone +358 295 251 000			
<i>Printing place and year</i>	Juvenes Print, 2015			

## ЛИСТ ОПИСАНИЯ ПУБЛИКАЦИИ

Издатель	Институт окружающей среды Финляндии			Время публикации март 2015
Автор(ы)	Тапио Линдхольм, Евгений Яковлев и Алексей Кравченко (ред.)			
Название публикации	<b>Biogeography, landscapes, ecosystems and species of Zaonezhye Peninsula, in Lake Onega, Russian Karelia</b> (Биогеография, ландшафты, экосистемы и виды Заонежского полуострова Онежского озера, республика Карелия)			
Название и номер серии публикаций	Доклады Института Окружающей Среды Финляндии 40 / 2014			
Тематика публикации				
Части публикации/ другие публикации, вышедшие в рамках этого же проекта	Настоящее издание доступно в Интернете по адресу: <a href="http://www.syke.fi/publications">www.syke.fi/publications</a>   <a href="http://helda.helsinki.fi/syke">helda.helsinki.fi/syke</a>   <a href="http://www.bpan.fi">www.bpan.fi</a>			
Резюме	<p>Заонежье – Заонежский полуостров, занимающий срединную часть северного берега Онежского озера, и примыкающие к нему многочисленные острова, располагается в Республике Карелия, на восточной окраине Скандинавского щита. Это уникальная природная территория, где можно найти почти все типы рельефа и рыхлых отложений четвертичного возраста, развитых на Северо-Западе России. Выходы основных пород с высоким содержанием углеродистого вещества обуславливают высокое плодородие местных почв, и как следствие – исключительно богатую природу с высоким уровнем разнообразия флоры и фауны. В лесах и на лугах встречаются многие редкие виды растений и лишайников, приуроченные к кальцефильным местообитаниям. Очень богата флора евтрофных травяных болот. Близость Онеги – чистого глубоководного озера, второго по величине в Европе, оказывает благотворное влияние на климат. Благодаря богатству почв и сравнительно мягкому климату, территория Заонежье давно освоена человеком, и здесь широко распространены луговые сообщества, мозаично чередующиеся с различными типами лесных и болотных местообитаний.</p> <p>В данной публикации впервые приводятся подробные списки видов сосудистых растений, мхов, лишайников, древообитающих грибов и насекомых, охватывающие всю территорию Заонежского полуострова, Кижского архипелага и других прилегающих островов.</p> <p>Определены имеющие наибольшую природоохранную ценность участки на юге и юго-востоке полуострова, где рекомендуется создать шесть новых памятников природы.</p> <p>Книга содержит следующие разделы, характеризующие природу Заонежского полуострова: 1. Геология и география: 1.1.Геологическое строение, 1.2. Геоморфология и четвертичные отложения, 1.3. Гидрографическая сеть, 1.4. Почвенный покров, 1.5. Палеогеография, 1.6. Существующие и планируемые особо охраняемые территории; 2. Ландшафты, экосистемы и биогеография: 2.1. Современные ландшафты, 2.2. Ландшафтная структура, 2.3. Лесной покров, 2.4. Структура насаждений, 2.5. Болота, 2.6. Луга; 3. Флора и фауна: 3.1. Высшие сосудистые растения, 3.2. Мхи, 3.3 Лишайники (список видов), 3.4. Редкие и уязвимые виды лишайников, 3.5. Древообитающие грибы и, 3.6. Фауна насекомых. и 3.7. Указатель географических названий и топонимов для упоминаемых в списках видов мест находок высших сосудистых растений, мохообразных, лишайников, грибов и насекомых.</p>			
Ключевые слова	геология, палеогеография, ландшафты, лес, болота, луга, высшие сосудистые растения, мхи, лишайники, древообитающие грибы, насекомые, биоразнообразие, охрана природы, Заонежский полуостров, Кижский архипелаг, Онежское озеро, республика Карелия.			
Финансирующая организация/ заказчик	Совет Министров стран Северной Европы; Министерства окружающей среды Финляндии, Норвегии и Швеции; Министерства Иностранных дел Финляндии, Норвегии и Швеции, Дирекция ООПТ регионального значения республики Карелия.			
	ISBN 978-952-11-4404-2- (сшитое)	ISBN 978-952-11-4405-9 (PDF)	ISSN 1796-1718 (печатанное)	ISSN 1796-1726 (сетевое)
	Количество страниц 360	Язык Английский	Ограничения Открытая печать	Цена (вкл. НДС 8 %)
Продавец/ дистрибьютор публикации	Институт Окружающей Среды Финляндии (SYKE), P.O. Box 140, FI-00251 Helsinki, Finland, Email: <a href="mailto:neuvonta.syke@ymparisto.fi">neuvonta.syke@ymparisto.fi</a>			
Финансирование публикации	Институт Окружающей Среды Финляндии (SYKE), P.O. Box 140, FI-00251 Helsinki, Finland Finnish Environment Institute (SYKE), P.O. Box 140, FI-00251 Helsinki, Finland Телефон: + 358 0295 251 000			
Место и год издания	Juvenes Print, 2015			



## KUVAILULEHTI

<i>Julkaisija</i>	Suomen ympäristökeskus		Julkaisu-aika maaliskuu 2015	
<i>Tekijä(t)</i>	Tapio Lindholm, Jevgeni Jakovlev ja Alexei Kravchenko (toim.)			
<i>Julkaisun nimi</i>	<b>Biogeography, landscapes, ecosystems and species of Zaonezhye Peninsula, in Lake Onega, Russian Karelia</b> (Äänisenniemen alueen biogeografia, maisemat ja lajisto. Ääninen, Venäjän Karjala)			
<i>Julkaisusarjan nimi ja numero</i>	Suomen ympäristökeskuksen raportteja 40/2014			
<i>Julkaisun teema</i>				
<i>Julkaisun osat/ muut saman projektin tuottamat julkaisut</i>	Julkaisu on saatavana internetistä: <a href="http://www.syke.fi/julkaisut">www.syke.fi/julkaisut</a>   <a href="http://helda.helsinki.fi/syke">helda.helsinki.fi/syke</a>   <a href="http://www.bpan.fi">www.bpan.fi</a>			
<i>Tiivistelmä</i>	<p>Äänisenniemi, venäjäksi Заонежский полуостров, sijaitsee Äänisen luoteisosassa Karjalan tasavallassa Venäjällä. Äänisenniemi on maaperällisesti monimuotoinen ja siellä on lähes kaikkia maaston tyypejä ja irtaimia maalajeja, joita esiintyy laajalla Venäjän alueella. Se on myös itäistä osaa Fennoskandian kilvestä. Alueelle ovat tyypillisiä kalkkikivi ja muut emäksiset kivilajit, mistä johtuu maaperän rehevyys sekä elinympäristöjen ja lajiston rikkaus. Lukuisia kalkinvaatija putkilokasveja ja jäkälää esiintyy täten alueella. Alueella on myös runsaasti lettosoiita. Pitkäaikainen asutushistoria ja sen karja- ja maatalous on luonut alueelle runsaasti maatalousmaata, joka nyt on niittyinä. Tämä lisää Äänisenniemen elinympäristökirjoa. Euroopan toiseksi suurin järvi Ääninen, jossa on syvä ja kirkas vesi, tuo oman leudomman paikallisilmaston Äänisenniemelle.</p> <p>Tämä raportti sisältää runsaasti uutta tietoa putkilokasveista, sammalista, jäkälästä, käävistä ja hyönteisistä Äänisenniemeltä ja siihen liittyviltä saarilta, mukaan lukien Kižin saarelta.</p> <p>Suojelun kannalta tärkeimpiä alueita inventoitiin ja kuutta uutta suojelualuetta ehdotetaan perustettavaksi Äänisenniemen eteläosiin.</p> <p>Tämä julkaisu käsittää seuraavat artikkelit Äänisenniemen alueelta. 1. Geologia ja fysikaalinen maantiede: 1.1. Geologinen kuvaus. 1.2. Geomorfologia ja jääkauden luomat kerrostumat, 1.3. Alueen hydrologinen luonnehdinta, 1.4. Maaperä, 1.5. Palaeomaantiede, 1.6. Suojelualueet ja ehdotetut suojelualueet; 2. Maisemat ja ekosysteemit: 2.1. Äänisenniemen nykyiset maisemat, 2.2. Maisemien rakenne, 2.3. Metsäpeitteisten alueiden rakenne ja metsiköt, 2.3. Metsien rakenne, 2.5. Suot, 2.6. Niityt; 3. Flora and fauna: 3.1. Putkilokasvit, 3.2. Sammalet, 3.3. Jäkälät ja jäkälänkaltaiset sienet, 3.4. Uhanalaiset ja indikaattorijäkälät, 3.5. Käävät, 3.7. Hyönteisfauna, 3.7. Paikat Äänisenniemellä, joissa tehtiin lajihavainnot.</p>			
<i>Asiasanat</i>	geologia, muinaismaantiede, metsät, suot, niityt, putkilokasvit, sammalet, jäkälät, käävät, hyönteiset, luonnon monimuotoisuus, Äänisenniemi, Kizhin saaristo, Ääninen, Karjalan tasavalta			
<i>Rahoittaja/ toimeksiantaja</i>	Pohjoismainen ministerineuvosto, Suomen, Norjan ja Ruotsin ympäristö- ja ulkoasiainministeriöt			
	ISBN 978-952-11-4404-2 (pbk.)	ISBN 978-952-11-4405-9 (PDF)	ISSN 1796-1718 (pain.)	ISSN 1796-1726 (verkkokj.)
	<i>Sivuja</i> 360	<i>Kieli</i> Englanti	<i>Luottamuksellisuus</i> julkinen	<i>Hinta</i>
<i>Julkaisun jakelu</i>	Suomen ympäristökeskus (SYKE), neuvonta PL 140, 00251, Helsinki Sähköposti: <a href="mailto:neuvonta.syke@ymparisto.fi">neuvonta.syke@ymparisto.fi</a>			
<i>Julkaisun kustantaja</i>	Suomen ympäristökeskus (SYKE), syke.fi PL 140, 00251, Helsinki Puh. 0295 251 000			
<i>Painopaikka ja -aika</i>	Juvenes Print, 2015			

## PRESENTATIONSBLAD

Utgivare	Finlands miljöcentral		Datum mars 2015	
Författare	Tapio Lindholm, Jevgeni Jakovlev och Alexei Kravchenko (eds.)			
Publikationens titel	<b>Biogeography, landscapes, ecosystems and species of Zaonezhye Peninsula, in Lake Onega, Russian Karelia</b> (Biogeografi, landskapen, ekosystem och arter av Zaonezhye halvön, i Onega Sjön, ryska Karelen)			
Publikationsserie och nummer	Finlands miljöcentrals rapporter 40/2014			
Publikationens tema				
Publikationens delar/ andra publikationer inom samma projekt	Publikationen finns på internet: <a href="http://www.syke.fi/publikationer">www.syke.fi/publikationer</a>   <a href="http://helda.helsinki.fi/syke">helda.helsinki.fi/syke</a>   <a href="http://www.bpan.fi">www.bpan.fi</a>			
Sammandrag	<p>Zaonezhie halvön, Заонежский полуостров på ryska och i finska Äänisenniemi, ligger i Karelska republiken, på den östra delen av Fennoscandia skölden. Halvön omfattar den mellersta delen av den norra Onega kusten, och de närbelägna öarna. Zaonezhie är ett unikt naturområde med nästan alla typer av Kvartära tidens jordarter och jordformer som har formats i nordvästra Rysland. Tack vare berggrundets höga halt av kalksten och andra alkalina bergarter är jorden i trakten särskild bördig. Till följd av det är naturen i området ovanligt rikt med en stor mångfald av flora av sällsynta växtarter och lavar och fauna. På Zaonezhie områden finns så artrika skogar, men också mycket myrar och dessutom rikmyrar.</p> <p>Närheten till Onega sjön, dess djup och klar vatten, den näst största sjön i Europa, har en gynnsam effekt på lokala klimatet. Tack vare den bördiga jorden och relativt milda klimatet har området en lång jordbrukshistoria. Många forna åkrar är nuförtiden naturnära ängar. Zaonezhie är ett särskilds mångfaldigt område tack för dess areal och belägenhet.</p> <p>I denna publikation finns de första detaljerade listor över arter av kärlväxter, mossor, lavar, svampar och insekter över hela territoriet i Zaonezhie halvön, Kizhi skärgård och andra närliggande öar.</p> <p>Inventeringen omfattar de största bevarandevärda områden av södra och sydöstra halvön, där det rekommenderas att grunda sex nya naturskyddsområden.</p> <p>Boken beskriver naturen på Zaonezhie halvön i följande avsnitt: 1. Geologi och geografi: 1.1. Geologisk beskrivning, 1.2. Geomorfologi och kvartära sediment, 1.3. Vattensystem, 1.4. Jordmån, 1.5. Paleogeografi, 1.6. Befintliga och planerade skyddsområden; 2. Landskap, ekosystem och biogeografi: 2.1. Moderna landskap, 2.2. Landskapets struktur, 2.3. Skogstäckte, 2.4. Skogarnas stånd struktur, 2.5. Myrar, 2.6. Ängar; 3. Flora och fauna 3.1. Kärlväxter, 3.2. Mossor, 3.3 Lavar och lavartade svampar 3.4. Sällsynta och sårbar lav arter, 3.5. Tickor och 3.6. Insekt fauna. och 3.7. Index för geografiska namn och ortnamn som nämnts i förteckningen över olika typer av förekomster av flora och fauna.</p>			
Nyckelord	geologi, paleogeografi, landskapen, skogar, myrar, ängar, kärlväxter, mossor, lavar, tickor, insekter; naturens mångfald, Naturskydd, Zaonezhie halvön, Kizhi skärgård, Onega sjön, Republiken Karelia			
Finansiär/ uppdragsgivare	Nordiska ministerrådet, miljö- och utrikesministerierna i Finland, Norge och Sverige, Directorate of regional protected areas of the Republic of Karelia			
	ISBN 978-952-11-4404-2 (pbk.)	ISBN 978-952-11-4405-9 (PDF)	ISSN 1796-1718 (print)	ISSN 1796-1726 (online)
	Sidantal 360	Språk engelska	Offentlighet Offentlig	Pris (inneh. moms 8 %)
Beställningar/ distribution	Finlands miljöcentral (SYKE), PB 140, 00251 Helsingfors, Epost: <a href="mailto:neuvonta.syke@ymparisto.fi">neuvonta.syke@ymparisto.fi</a>			
Förläggare	Finlands miljöcentral (SYKE), PB 140, 00251 Helsingfors Tel. 0295 251 000			
Tryckeri/tryckningsort -år	Juvenes Print, 2015			



The BPAN project promotes and supports the establishment of a representative network of protected areas in the Barents Region. Protected area networks are an important tool for biodiversity conservation as well as climate change adaptation and mitigation. A representative network of protected areas safeguards biodiversity, supports natural ecosystems and maintains ecosystem services.

The BPAN project started in 2011 as an initiative of the nature protection subgroup of the BEAC Working Group on Environment. The project has been implemented by nature conservation authorities, scientific institutes and nature conservation NGOs in Finland, Sweden, Norway and Northwest Russia.

Within the project, five regional pilot projects have been implemented in high conservation value areas of Northwest Russia. All of these areas are under threat from human activities. In Karelia, the pilot project has been implemented on Zaonezhye Peninsula.

Zaonezhye Peninsula has a distinctive and diverse natural heritage, which has been recognised for a long time. Although its unique habitats are included in regional nature conservation plans, documentation necessary for the establishment of a protected area has been lacking. At the same time high conservation value forests have been under threat from logging.

This publication gives an overview of Zaonezhye Peninsula. It discusses geology, hydrology and landscapes. It also describes present-day species of vascular plants, bryophytes, lichens, wood-growing fungi and insects on the Zaonezhye Peninsula and its adjacent islands, as well as earlier records from the peninsula since the end of the 19th century. We hope that the information on these pages will promote the protection of hundreds of red-listed species and valuable habitats in the Zaonezhye area.

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**BPAN**

Barents Protected Area Network



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