Finnish botanists in the mires of Olonets region in Russian Karelia during the Second World War

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SUMMARY

In this article we compile wartime botanical information about mires in Olonets region (Russian Karelia) and compare it with new data collected as part of the Finnish-Russian cooperation in mire research. We also describe the historical background of both the local economy and the visits of Finnish botanists, which date back to the days of the Grand Duchy of Finland and the Russian Empire but were most active during the Second World War. For Finnish mire research, these excursions have allowed important comparisons between the mostly degraded rich fens of southern Finland and largely pristine examples in Olonets region. In the 2000s, 176 vascular plant and 53 moss species, corresponding to 40–50 % of the Karelian mire flora, have been recorded in this area; more than 20 different mire plant communities (associations) have been identified; and one site has been confirmed as the oldest studied mire in East Fennoscandia (12,700 years). The understanding arising from this research is especially important for nature conservation work in the Republic of Karelia.

KEY WORDS: flora, history, Kolatselkä, rare plants, rich fen, stratigraphy, vegetation, Vieljärvi

INTRODUCTION

The aim of this study was to compile wartime botanical information about mires in Olonets region (Russian Karelia) in order to make it available for the present and future mire research community, and to analyse changes in the flora and vegetation of the rich fens around Kolatselkä village and in Vieljärvi municipality. We also analysed the development of rich fens. An important goal was to assess the biodiversity and conservation value of the mires, in order to promote their protection and better understand the state of Finnish rich fens (Lindholm & Heikkilä 2005). For Finnish mire research it was important to compare the largely degraded rich fens in southern Finland with the fens in Olonets region, where they are largely pristine (Lindholm & Heikkilä 2006a, Kaakinen & Kokko 2012). Our study of the history of Finnish botany in the region during the Second World War (Savola 2000) was not only interesting, but also an important part of the Finnish-Russian cooperation in mire research (Heikkilä *et al*. 2015). We also noticed that mires and their utilisation have been politically important. The story of natural history studies in Finland and Russia before, during and after wartime is not well known even inside these countries. Therefore, in writing this article, we aim to make this part of the history of mire studies more widely known (Joosten *et al*. 2017).

BACKGROUND

When the Grand Duchy of Finland was an autonomic part of the Russian Empire (1809–1917), Finnish natural scientists often went on expeditions to the east. A number of these scientists were botanists. The scientific advisors for the Grand Dukes of Finland encouraged Finnish exploration of areas east of the border with Russia (Vasander 2010), and this created knowledge and a tradition of research in Olonets and Russian Karelia.

The Russian Revolution and Finnish independence in 1917 caused a 25-year gap in the study of natural science by Finnish researchers on the eastern side of the border. Fortunately, there was still interest in this research when a possibility to study the area known as East Karelia in Finland (corresponding approximately to the present Republic of Karelia of the Russian Federation) arose during the so-called Continuation War of 1941–1944. The idea was highly favoured and a large number of researchers were recruited and provided with abundant grants. This is how East Karelia became the focus of the first interdisciplinary research project in Finland (Laine 1993a, 1993b).

In 1941 the Ministry of Education set up the State Scientific Committee for East Karelia (more detail in Vasander 2010), largely on the basis of published articles about East Karelia and its similarity to

Finland (e.g. Auer 1941, Eskola 1941, Linkola 1941). This committee approved research projects for the summer of 1942. The Finnish military administration in East Karelia could give permission only for research that was important to the administration and could not be postponed. One of the seven focus areas for research was geobotany and mires. This was intended to promote agriculture and forestry, and was placed under united command. Captain (later Major) Professor of Botany Mauno J. Kotilainen was available for the task.

Even though learned societies, especially the biological society ‘Vanamo’ (known as Botanical and Zoological Society ‘Vanamo’ at that time), were active in the botanical study of East Karelia, there were practical aspects to consider. For the summer of 1942 the Finnish Society of Peatland Cultivation received a grant from the State Scientific Committee for East Karelia to support mire research by three of its researchers. Mauno J. Kotilainen led this research as a botanist for the Finnish Society of Peatland Cultivation. In 1943 the mire research was funded by the Finnish Cultural Foundation.

The military administration supported the research that began in 1942. Other members of the group were Professor of Botany Harry Waris, M.Sc. Jukka Lounamaa, M.Sc. Lars Fagerström and M.Sc. Hans Luther. According to Kotilainen, mire research was greatly beneficial in helping to determine whether it was possible to drain mires for cropping and fuel peat extraction. This type of research was included in the activities of the Finnish Society of Peatland Cultivation within Finland, although the brief historical information available does not mention East Karelia (Huokuna 1994). Kotilainen’s expedition was smaller than originally planned, with ten men, and they studied 3351 ha of mires in the area south of Paatene. About half of this area was suitable or highly suitable for cultivation (Laine 1993a, 1993b).

In the summers of 1942 and 1943 Jukka Lounamaa and Harry Waris studied Kolatselkä area, especially the mires (Waris & Lounamaa 1942, 1943; Lounamaa 1961). They made observations on almost 50 mires, most of which were rich fens due to the calcareous bedrock. Lounamaa (1961) published on the vegetation and flora of 36 mires.

Many Finnish botanists visited the Vieljärvi ‘glacial valley’ (Urtal in German) during the war, under the supervision of Mauno J. Kotilainen. During the summer of 1942 Lars Fagerström studied the ‘glacial valley’ for a week.

Fagerström and Hans Luther investigated the valley mires and grove slope vegetation more thoroughly in July 1943. They surveyed and mapped the valley mire vegetation in detail and gathered extensive data on the flora (Fagerström 1942, Fagerström & Luther 1943). Only the observations of flora for the Vieljärvi area have been published (Fagerström & Luther 1945) (Figures 1 and 2).

The earliest botanical observations in the Kolatselkä area were made before the Russian Revolution, by Kaarlo Linkola on short trips during the summers of 1914 and 1915. He published materials from the Grand Duchy of Finland side of Lake Hiisjärvi, near Kolatselkä. The forest crofters’ cottage meadow of Leppälä had the greatest number of species recorded for any site (Linkola 1916).

In the last few years, these wartime research sites - especially those north of Petrozavodsk - have been under investigation again in an attempt to find biotopes and species recorded during the war and earlier (e.g. Savola 2000, Savola & Vainio 2002, Savola & Ruuhijärvi 2004, Savola 2006). There has also been versatile research in the former Finnish strict nature reserve of Hiisjärvi and its surrounding area (Ala-Risku 2002, Ala-Risku *et al*. 2002), and comparison of the findings with records from the 1930s (Brandt 1933, Tuomikoski 1935, Pankakoski 1939). Russian botanists from the Institute of Biology and Forest Research Institute of the Karelian Research Centre, Russian Academy of Sciences, have participated in the recent Finnish expeditions alongside their own projects.

The mires of Kolatselkä were also studied recently as part of the Finnish-Russian cooperation for nature conservation financed by the Finnish-Russian Working Group for Nature Conservation, which operates under the Ministry of the Environment of Finland and the Ministry of Natural Resources and Ecology of the Russian Federation. The Karelian partner was the Laboratory for Mire Ecosystems, Institute of Biology of the Karelian Research Centre, Russian Academy of Sciences; and the main partner from Finland was the Finnish Environment Institute. There were different types of small-scale expeditions in 2001, 2007, 2008, 2011, 2014 and 2015. The purpose of these expeditions was to discover the current state of the rich fen vegetation and flora that the Finnish wartime botanists studied during the summers of 1942 and 1943, as well as that of the flora of vanishing habitats of traditional village agriculture. The basis for these activities was Kaarlo Linkola’s doctoral thesis (Linkola 1916) and nature reserve surveys that proposed the conservation of Hiisjärvi (Linkola 1926), which was designated as a strict nature reserve in 1938. Also relevant here are the mire flora research of Antero Pankakoski in Hiisjärvi in the 1930s (Pankakoski 1939) and the observations of the ‘wartime botanists’ in Kolatselkä and Vieljärvi (Figure 1).

Figure 1. Locations of the studied areas. 1: Kolatselkä; 2: Vieljärvi; 3: Hiisjärvi. The western red line indicates the present state boundary, and the eastern red line the boundary before the Second World War.

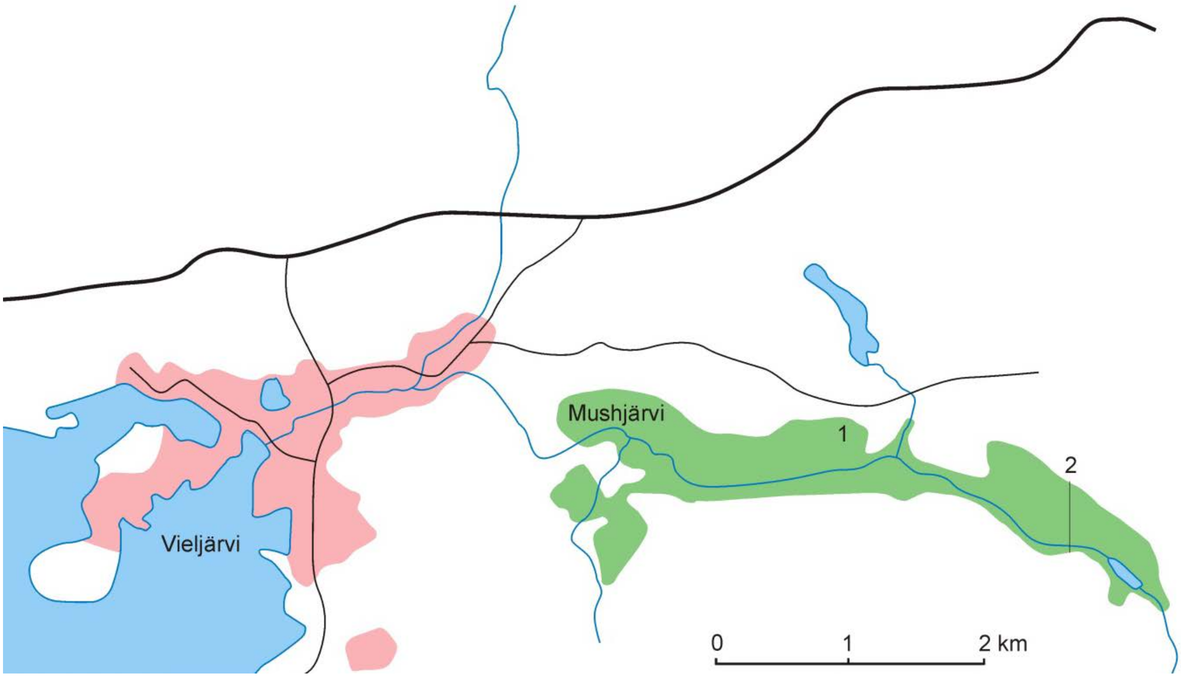

Figure 2. The rich fen (green) east of Vieljärvi village (red). 1: the studied area east of Lake Mushjärvi; 2: the profile studied by Fagerström & Luther (1943).

Since the war there have been some visits to the Vieljärvi 'glacial valley'. Small Russian expeditions went near the village in 1993 and 1999; and Jaakko Savola from Finland visited the rich fen east of the former Lake Mushjärvi, whose water level was lowered before the war to create meadows (Savola 2000). In addition to our expeditions in Kolatselkä we went hiking in the eastern part of the 'glacial valley', which had not been explored since the war, for one day in 2007 and another in 2011. We studied the vicinity of the Fagerström & Luther (1943) vegetation profile, and observed the flora farther east of Lake Mushjärvi. There were a couple of old ditches at the western side of this area but they had not drained the mire. On the other hand, beavers had built a dam in the stream at the southern margin of the mire, partly destroying the southern edge of the rich fen. The main goal of these expeditions was to re-examine the mires in Kolatselkä studied by Lounamaa and Waris, and to discover the current state of the mires (Heikkilä *et al*. 2008, Kuznetsov & Grabovik 2010, Heikkilä *et al*. 2010, Heikkilä *et al*. 2015).

Our expeditions have taken us through the still-pristine mires that were studied during the war, as well as a few mires which had not been discovered in the 1940s. Like the wartime botanists we studied all the different mire biotopes that we found, in groups of 3–8 persons. We collected data about the vascular plant and bryophyte flora, probably covering most of the species. Specimens of critical and phyto-geographically interesting species have been deposited in the herbarium of the Karelian Research Centre (PTZ).

HISTORY OF KOLATSELKÄ VILLAGE

Kolatselkä is a small village situated at the north end of Lake Tulmozero (Tulemajärvi), halfway between Petrozavodsk and Sortavala. It was an agricultural village, but the long history of farming in the area ended when the last agricultural entrepreneur ceased operating a few years ago. Around the village there is now heavy felling in secondary forests with a high proportion of deciduous trees and a large quantity of timber.

There used to be haematite mines in the area around Kolatselkä. The haematite was refined into iron in the local smelting plant, whose ruins can be found two kilometres north of the village on the west bank of the River Kollaanjoki (Figure 3).

Figure 3. The Kolatselkä smelting plant in 1942 (photo: SA-kuva; CC BY 4.0 license).

THE NATURE OF THE KOLATSELKÄ AREA

The bedrock in the Kolatselkä area is composed of Proterozoic dolomites, marble, greenstone and diabase. This bedrock is part of a long, narrow seam running from north to south in the midst of an alkaline rock type (Figure 4). The alkaline bedrock makes the area a hotspot for groves and rich fens.

According to the Finnish or Nordic view, the area is clearly south boreal (e.g. Ahti *et al*. 1968, Lindholm & Heikkilä 2006b). In the Russian classification it is middle taiga (e.g. Kobyakov & Jakovlev 2013), which is practically the same in this case.

As a result of the richness of the bedrock, the forests are exuberant and productive with notable diversity (see Kalela 1944). The forests are currently mixed stands with a notable proportion of deciduous trees, which have grown up since the felling required by the ironworks. They are not natural forests and must previously have been pasture land, but they have developed naturally since their establishment.

The landscape has hills rising to 77–133 m above sea level. Morainic formations vary in thickness and there is exposed bedrock in just a few places. In the valleys there are several mires, as well as lakes and ponds. Due to the alkaline bedrock and abundant groundwater the pH of the mire water is typically high (6.5–7.5 according to Lounamaa 1961). The area has about 20 % paludification and an abundance of mire forests. Most of the mires are bryales-herb-open mires, wooded bryales-herb mires, or alkaline fens and corresponding wooded mires. Because of the small-scale topographical characteristics of the terrain, the mires are typically small (1–2 ha) and the largest extend to 20–30 ha. Most of the mires are hydrologically undisturbed.

VIELJÄRVI VILLAGE AND ITS NATURE

Vieljärvi village is situated 52 km southwest of Pryazha (Prääsä), on the east shore of Lake Vieljärvi. The village is near the Petrozavodsk–Sortavala Highway 21. The dialect in Vieljärvi is the Vitele dialect of the Karelian language, which is close to Finnish - one reason for the interest of Finnish botanists in studying the mires. The first mention of the village in literature is from the 1600s, and during the Continuation War (1941–1944) it was occupied by Finnish troops.

The Vieljärvi region has special bedrock. Beneath an almost 100 m thick layer of till, there is Devonian sedimentary rock. The rock is alkaline, which causes the luxuriant vegetation in the 'glacial valley' bottom to differ from that of the surrounding area. The valley lies to the east and southeast of Vieljärvi, it is more than 30 km long and over 100 m deep at its deepest point (Kotilainen 1944a, 1944b). At the bottom of the 'glacial valley' there is a large (> 300 ha) rich fen, which is in an almost completely natural state (Figure 5) with fertile swamps in its western part, in the area of the former Lake Mushjärvi. On the lower parts of the steep slopes surrounding this fen there are luxuriant groves and abundant springs. During the war there were fine birch-rich fens with *Saxifraga hirculus* in the centre of Vieljärvi village, but after the war they were cleared for agriculture. Vieljärvi is just outside the Fennoscandian Shield formed of acidic Archaean rocks (Kotilainen 1944a).

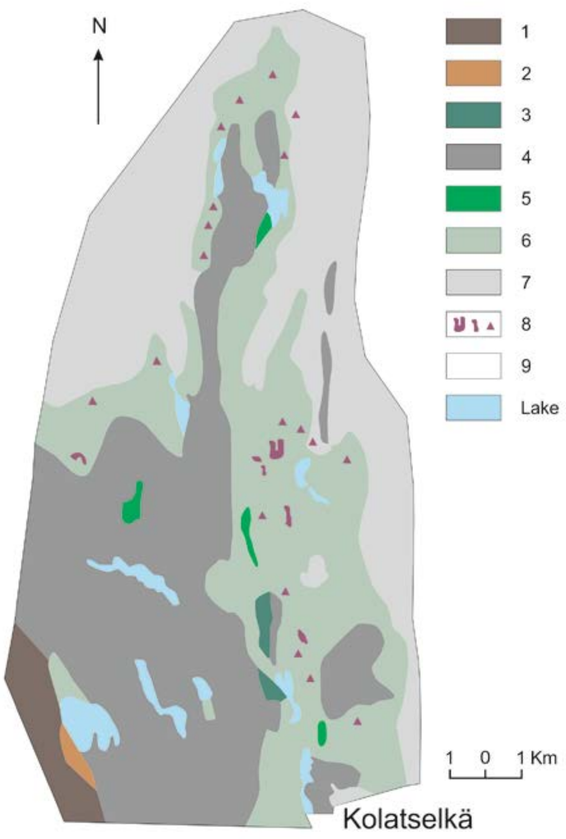

Figure 4. The bedrock in the area north of Kolatselkä village. 1: granite and rapakivi; 2: contact zone of granite and rapakivi; 3: greenstones; 4: metadiabase; 5: schists containing carbon; 6: dolomite and marble; 7: granites; 8: hematite (Zhyelobovsky 1933).

RESULTS OF THE WARTIME AND RECENT STUDIES

In 1942 and 1943, K.J. Lounamaa and Harry Waris studied the rich fens of the Tulemajärvi and Kolatselkä area (Lounamaa 1961). They found the westernmost localities of the eastern species *Ligularia sibirica* near the 1920 Treaty of Tartu border between Finland and the Soviet Union. *Thelypteris palustris*, *Tofieldia pusilla*, *Carex capitata*, *Carex heleonastes*, *Carex appropinquata*, *Carex buxbaumii* and *Carex livida*, which are rare species in southern boreal Fennoscandia, were also found in this area; along with *Cypripedium calceolus*, *Epipactis palustris*, *Epipactis helleborine*, *Dactylorhiza traunsteineri*, *Hammarbya paludosa*

Figure 5. Flooded rich fen east of Vieljärvi in 2007. Researchers, from left to right: Hanna Kondelin, Vladimir Antipin, Sergey Znamenski, Aulikki Laine, Oleg Kuznetsov and Terhi Ala-Risku (photo: Raimo Heikkilä).

and *Malaxis monophyllos*, which are rare in Finland, and six other orchid species which are protected in Russia. Other interesting species were *Salix rosmarinifolia*, *Bistorta major*, *Pedicularis sceptrum-carolinum* and *Inula salicina*. *Salix repens*, mentioned by Waris and Lounamaa, must have been a small *S. rosmarinifolia*. There is no valid record of *Salix repens* in the Republic of Karelia.

In Lounamaa's publication (1961) there is a short description of the 36 mires studied (Figure 6), plus a list of vascular plants and mosses together with vegetation tables for rare plant communities. Numerous plant species favouring calcareous substrates and rare in Finland, and some species on the border of their natural distribution range, were recorded in the study area. Among these are *Saussurea alpina*, *Myrica gale*, *Ligularia sibirica* (Figure 7) and *Bistorta major*. Lounamaa's research revealed that the area is exceptionally rich in species and the mires are very diverse. Altogether, there were 218 mire and moist meadow vascular plant species - of which 151 were typical mire species - and 46 moss species, many of which are rare and endangered (Table A1 in the Appendix).

In the 1950s and 1960s many mires on the west side of Kolatselkä village were cleared for agriculture. Now they are undergoing rapid afforestation. The mires on the eastern and northern

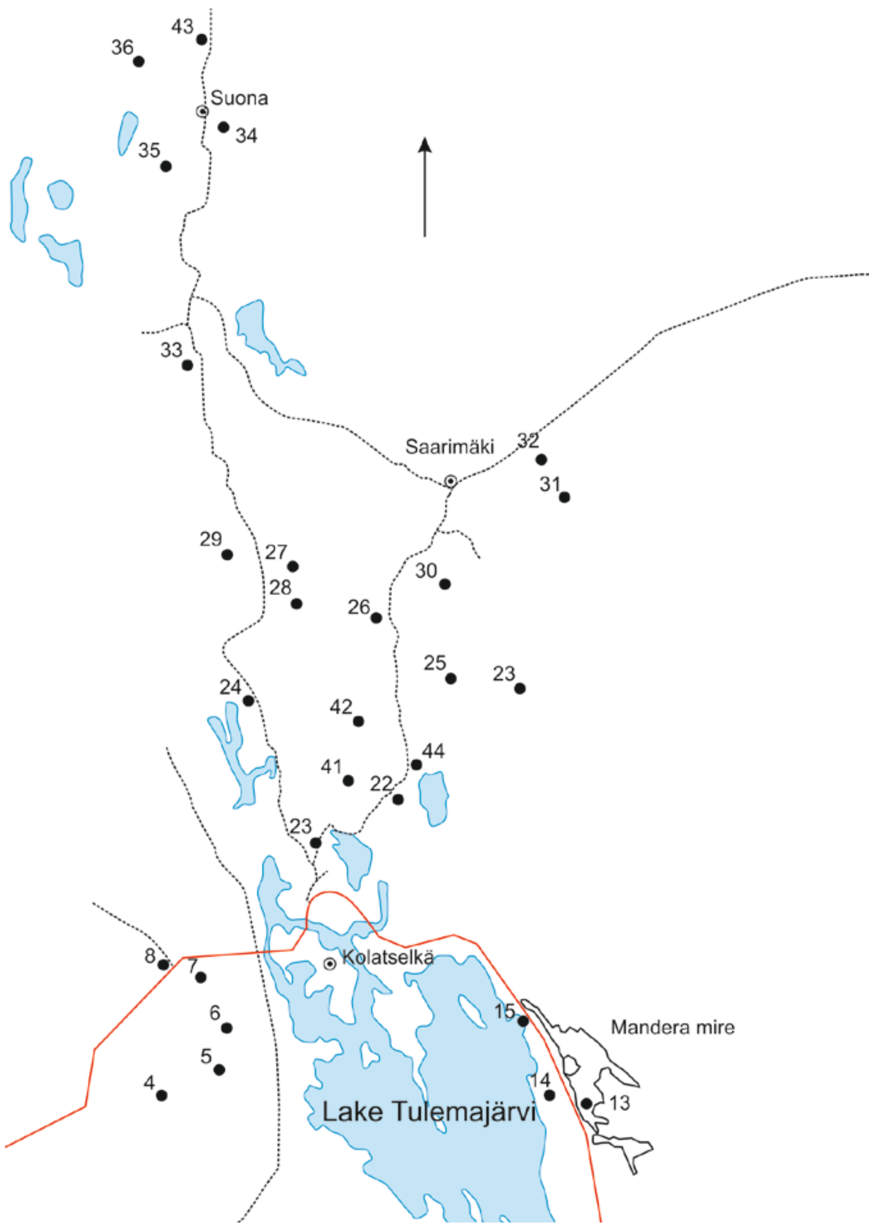

Figure 6. The mires studied by Lounamaa (1961) (numbers 1–36) and additional mires studied in the 2000s (other numbers).

Figure 7. *Ligularia sibirica* in Mire 30 in 2007 (photo: Raimo Heikkilä).

sides of the village are mostly in their natural state. They were more open during the war years of 1942 and 1943 because they were used as hayfields and pastures. This use must have affected the conditions for plant species.

The research in the 2000s showed that the mire vegetation and flora had stayed basically the same as during the war years but was trending towards the natural state, especially the tree stands (Kuznetsov & Grabovik 2010). Many sites had more tree stands in the 2000s than during the war when they were mowed and used as pasture (Znamenskiy & Kuznetsov 2005).

In the new research, partially on mires not visited in the 1940s, some species were discovered that Lounamaa and Waris did not find - possibly due to factors such as mire use, mowing and grazing. The newly discovered species were *Carex elata* subsp. *omskiana, Carex rhynchophysa, Carex vesicaria, Rhynchosphora fusca*, *Juncus stygius, Lycopus europaeus*, *Lythrum salicaria* and *Stellaria palustris*.

Demonstrating the diversity and species richness of Kolatselkä's mires (e.g. Figures 8 and 9) is the discovery, in the 2000s, of 176 vascular plant species (Table A1), which corresponds to over half of Karelia's mire vascular plant species; and 53 species of mosses (Table A2), which is around 40 % of Karelia's mire moss species (Kuznetsov & Grabovik 2010). This list includes some species from forested mires which were not studied by Lounamaa. Four species - *Cypripedium calceolus* (Figure 10), *Dactylorhiza traunsteineri*, *Myrica gale* and *Rhynchosphora fusca* - are listed in the Russian Federation Red Book (KMK Scientific Publications Partnership 2008). The last two species are western and more common in Finland than in Karelia. Indeed, although *Myrica gale* is common on the Baltic sea coast of Finland, Karelia is its north-easternmost locality in Europe.

Besides comparing vegetation and flora, some new mire massifs have been studied and palaeo-ecological research involving coring to examine peat profiles has been carried out (Figures 11, 12). The mires began to form when forests, ponds or lakes were paludified. The greatest thickness of the peat deposits in the studied mires is seven metres. A small rich fen, 50 m in diameter with 5.5 m of peat, on the northern shore of Lake Särkijärvi a few kilometres northeast of Kolatselkä has turned out to be the oldest studied mire in East Fennoscandia with a calibrated age of 12,700 years (Mäkilä *et al*. 2013). The wartime botanists also cored the mires but their purpose was to assess the suitability of the mires for cultivation by defining peat types and the stage of decomposition.

The vegetation of mires studied in Kolatselkä region can be categorised into over 20 different plant communities (associations) on the basis of ecology, topology and regional species groups (Kuznetsov 2003). *Molinia caerulea - Sphagnum warnstorfii*, *Molinia caerulea - Scorpidium cossonii* and *Trichophorum cespitosum - Campylium stellatum* associations are fairly common in this area, as in some other parts of Fennoscandia. On the other hand, the species-rich *Carex panicea - Campylium stellatum* and *Carex buxbaumii - Scorpidium cossonii* associations that can be found on some of the mires in Kolatselkä are rare in Karelia and Finland.

Vieljärvi rich fen mire system covers an area of more than 300 ha. According to Finnish classification (Ruuhijärvi & Lindholm 2006) there are several rich fen site types: rich birch fen, rich flark fen, warnstorfii rich fen, rich swamp fen, rich spring fen, rich spruce fen and rich pine fen. The vegetation is very diverse and there is a high number of species. *Saxifraga hirculus*, *Stellaria crassifolia*, *Epipactis palustris, Bistorta major*, *Pedicularis sceptrum-carolinum* and *Thelypteris palustris* grow abundantly here. *Malaxis monophyllos* can also be found in several places. *Hamatocaulis vernicosus* covers vast areas in the ground layer.

Figure 8. Tapio Lindholm in a flooded rich fen in mire in Mire 31 in 2008. *Cicuta virosa* is abundant (photo: Raimo Heikkilä).

Figure 9. Rich flark fen in Mire 33 in 2007 (photo: Raimo Heikkilä).

Figure 10. Oleg Kuzetsov in a luxuriant thin-peated rich fen with e.g. *Cypripedium calceolus* in Mire 36 in 2008 (photo: Raimo Heikkilä).

Figure 11. Raimo Heikkilä and Oleg Kuznetsov coring Mire 14 close to Kolatselkä village in 2008 (photo: Tapio Lindholm).

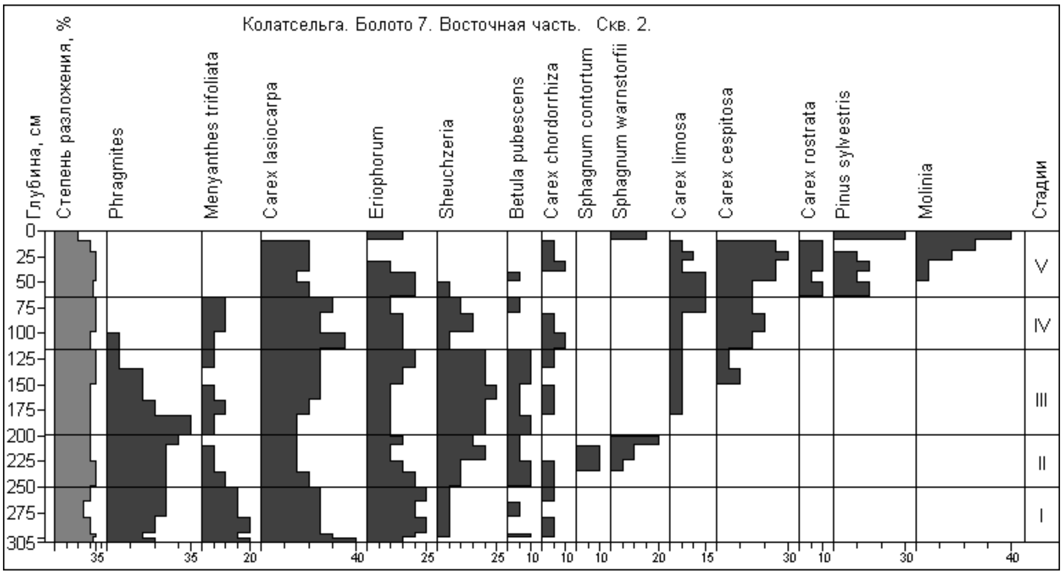

Figure 12. Macrosubfossil diagram of the eastern margin of the rich fen west of Kolatselkä village (Number 7, Lounamaa 1961).

CONCLUSION

One of the flaws of Finnish mire research is its strong nationally introverted nature. There has not been nearly enough comparative research on mires in nearby countries, which would have helped us to see our mire nature as part of the larger mire world. The study of the Olonets mires has improved our understanding of Finland's mires in this wider context, especially in the case of south boreal rich fens (see Kaakinen & Kokko 2012). Only fragments of this mire type are left in Finland, and they are often under strong influences from their surroundings (Heikkilä 1987). The study of pristine southern boreal rich fens in Karelia helps to clarify the state of southern Finnish examples and the measures needed to preserve their biodiversity, as well as to protect the southern boreal rich fens in Sweden and Norway. The research has also been significant in establishing the importance of the areas in Karelia for nature conservation. We found that the rich fens both around Kolatselkä and in Vieljärvi were in a much more natural state than similar habitats in southern Finland, and thus very valuable for mire biodiversity. It is hoped that they will be protected in near future.

The cooperation with the Karelian Research Centre has been important. The understanding that comes from these results will hopefully influence the nature conservation work of the Republic of Karelia. In this way the work of the wartime botanists has been updated for the 2000s.

As this article and its sources show, after the collapse of the Soviet Union it was possible to visit Karelia again and there was enthusiasm to do botanical work. But now it seems that, as people are getting older, botanists are visiting Karelia less frequently. It is important not to let the paths of mire researchers become overgrown. Thus, we need to find different ways to motivate young researchers and nature enthusiasts from Finland and other countries to continue the work that has been ongoing for more than a century. Russian researchers should also be encouraged to study Karelia's mires. For the Finnish this would be an excellent opportunity to compare and learn the Russian mire research tradition (Lindholm 2013a, 2013b; Lindholm 2015, Masing *et al*. 2010). An appropriate basis could also be comparison of the classification of mires and joint publications (Heikkilä *et al*. 1997, Antipin *et al*. 1997, Heikkilä *et al*. 2001, Galanina 2006, Galanina & Heikkilä 2007). Every new and modern approach to mire research is also welcome. But there should always be time for the botanical approach because it helps with comparisons and the matters in question, and simply because it is fun.

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Appendix

Table A1. Vascular plant flora of mires around Kolatselkä village. The nomenclature follows Lampinen & Lahti (2017), and it will be used in Retkeilykasvio (*Flora of Finland*), to be published in 2018.

Species	Lounamaa (1961)	Kuznetsov & Grabovik (2010) and data of authors
Agrostis canina L.	+	+
Alnus glutinosa (L.) Gaertn.	+	+
A. incana (L.) Moench	+	+
Andromeda polifolia L.	+	+
Angelica sylvestris L.	+	+
Betula nana L.	+	+
B. pendula Roth	+	+
B. pubescens Ehrh.	+	+
Bistorta major S. F. Gray	+	+
Calamagrostis canescens (Weber) Roth	-	+
C. epigejos (L.) Roth	+	+
C. neglecta (Ehrh.) G. Gaertn., B. Mey. & Scherb.	+	+
C. phragmitoides Hartm.	+	+
Calla palustris L.	-	+
Calluna vulgaris (L.) Hull	+	+
Caltha palustris L.	+	+
Carex acuta L.	-	+
C. appropinquata Schumach.	+	+
C. buxbaumii Wahlenb.	+	+
C. canescens L.	+	+
C. capillaris L.	+	+
C. capitata L.	+	+
C. cespitosa L.	+	+
C. chordorrhiza L. f.	+	+
C. diandra Schranck	+	+
C. dioica L.	+	+
C. echinata Murray	+	+
C. elata subsp. *omskiana* (Meinsh.) Jalas	-	+
C. flava L.	+	+
C. globularis L.	+	+
C. heleonastes L. f.	+	+
C. lasiocarpa Ehrh.	+	+
C. limosa L.	+	+
C. livida (Wahlenb.) Willd.	+	+
C. nigra subsp. *juncella* (Fr.) Lemke	+	+
C. nigra subsp. *nigra* (L.) Reichard	+	+
C. panicea L.	+	+
C. pauciflora Lightf.	+	+
C. paupercula Michx.	+	+
C. rhynchophysa Fisch., C. A. Mey & Avé-Lall.	-	+
C. rostrata Stokes	+	+
C. vaginata Tausch	+	+

Species	Lounamaa (1961)	Kuznetsov & Grabovik (2010) and data of authors
C. vesicaria L.	-	+
C. viridula var. *bergrothii* (Palmgr.) B. Schmid	+	+
C. viridula var. *pulchella* (Lönnr.) B. Schmid	-	+
C. viridula var. *viridula* Michx.	+	+
Chamaedaphne calyculata (L.) Moench	+	+
Chamaenerion angustifolium (L.) Scop.	+	+
Cicuta virosa L.	+	+
Cirsium heterophyllum (L.) Hill	+	+
C. palustre (L.) Scop.	+	+
Comarum palustre L.	+	+
Convallaria majalis L.	+	+
Corallorhiza trifida Châtel.	+	+
Crepis paludosa (L.) Moench	+	+
Cypripedium calceolus L.	+	+
Dactylorhiza incarnata (L.) Soó	+	+
D. maculata subsp. *fuchsii* (Druce) Hyl.	-	+
D. maculata subsp. *maculata* (L.) Soó	+	+
D. majalis subsp. *lapponica* (Laest. ex Hartm.) H. Sund	+	+
Daphne mezereum L.	+	+
Deschampsia cespitosa (L.) P. Beauv.	+	+
Drosera anglica Huds.	+	+
D. rotundifolia L.	+	+
Dryopteris carthusiana (Vill.) H. P. Fuchs	+	+
D. cristata (L.) A. Gray	+	+
D. expansa (C. Presl) Fraser-Jenk. & Jermy	-	+
Eleocharis palustris (L.) Roem. & Schult.	-	+
E. quinqueflora (Hartmann) O. Schwarz	+	+
Elymus caninus (L.) L.	+	+
Empetrum nigrum L.	+	+
Epilobium palustre L.	+	+
Epipactis helleborine (L.) Crantz	+	+
E. palustris (L.) Crantz	+	+
Equisetum fluviatile L.	+	+
E. hyemale L.	+	+
E. palustre L.	+	+
E. pratense Ehrh.	-	+
E. sylvaticum L.	+	+
Eriophorum angustifolium Honck.	+	+
E. gracile W. D. J. Koch ex Roth	+	+
E. latifolium Hoppe	+	+
E. vaginatum L.	+	+
Festuca rubra L.	+	+
Filipendula ulmaria (L.) Maxim.	+	+
Frangula alnus Mill.	+	+
Galium palustre L.	+	+
G. uliginosum L.	+	+
Geranium sylvaticum L.	+	+

Species	Lounamaa (1961)	Kuznetsov & Grabovik (2010) and data of authors
Gymnadenia conopsea (L.) R. Br.	+	+
Hammarbya paludosa (L.) Kuntze	+	+
Hierochloë hirta subsp. *arctica* (J. Presl) G. Weim.	+	+
Juncus filiformis L.	+	+
J. stygius L.	-	+
Juniperus communis L.	+	+
Lathyrus palustris L.	+	+
L. pratensis L.	+	+
Ligularia sibirica (L.) Cass.	+	+
Linnaea borealis L.	-	+
Luzula pilosa (L.) Willd.	-	+
Lycopus europaeus L.	-	+
Lysimachia europaea (L.) U. Manns. & Anderb.	+	+
L. thyrsiflora L.	-	+
L. vulgaris. L.	+	+
Lythrum salicaria L.	-	+
Maianthemum bifolium (L.) F. W. Schmidt	+	+
Malaxis monophyllos (L.) Sw.	+	+
Melampyrum pratense L.	+	+
Menyanthes trifoliata L.	+	+
Milium effusum L.	-	+
Molinia caerulea (L.) Moench	+	+
Moneses uniflora (L.) A. Gray	-	+
Myosotis scorpioides L.	-	+
Myrica gale L.	+	+
Neottia ovata (L.) Bluff & Fingerh.	+	+
Oxalis acetosella L.	+	+
Paris quadrifolia L.	+	+
Parnassia palustris L.	+	+
Pedicularis palustris L.	+	+
Pedicularis sceptrum-carolinum L.	+	+
Petasites frigidus (L.) Fr.	+	+
Peucedanum palustre (L.) Moench	+	+
Phalaroides arundinacea (L.) Rauschert	+	+
Phegopteris connectilis (Michx.) Watt	+	+
Phragmites australis (Cav.) Trin. ex Steud.	+	+
Picea abies (L.) H. Karst.	+	+
Pinus sylvestris L.	+	+
Pinguicula vulgaris L.	+	+
Poa palustris L.	-	+
P. pratensis L.	-	+
Polygala amarella Crantz	+	+
Potentilla erecta (L.) Raeusch.	+	+
Prunus padus L.	+	+
Pyrola minor L.	+	+
P. rotundifolia L.	+	+
Ranunculus acris L.	+	+

Species	Lounamaa (1961)	Kuznetsov & Grabovik (2010) and data of authors
Rhododendron tomentosum Harmaja	+	+
Rhynchospora alba (L.) Vahl	+	+
R. fusca (L.) W. T. Aiton	-	+
Ribes nigrum L.	+	+
Rosa cinnamomea L.	+	+
Rubus arcticus L.	+	+
R. chamaemorus L.	+	+
R. saxatilis L.	+	+
Rumex acetosa L.	+	+
Salix aurita L.	+	+
S. caprea L.	+	+
S. cinerea L.	+	+
S. lapponum L.	+	+
S. myrsinifolia Salisb.	-	+
S. myrtilloides L.	+	+
S. pentandra L.	+	+
S. phylicifolia L.	+	+
S. repens subsp. *rosmarinifolia* (L.) Andersson	+	+
Saussurea alpina (L.) DC.	+	+
Scheuchzeria palustris L.	+	+
Scirpus sylvaticus L.	+	+
Scutellaria galericulata L.	+	+
Selaginella selaginoides (L.) P. Beauv. ex Schrank & Mart.	+	+
Solidago virgaurea L.	+	+
Sorbus aucuparia L.	+	+
Sparganium natans L.	-	+
Stellaria palustris Ehrh. ex Hoffm.	-	+
Thelypteris palustris Schott	+	+
Tofieldia pusilla (Michx.) Pers.	+	+
Trichophorum alpinum (L.) Pers.	+	+
T. cespitosum (L.) Hartm.	+	+
Triglochin palustris L.	+	-
Utricularia intermedia Hayne	+	+
U. minor L.	+	+
Vaccinium microcarpum (Turcz. ex Rupr.) Schmalh.	+	+
V. myrtillus L.	+	+
V. oxycoccos L.	+	+
V. uliginosum L.	+	+
V. vitis-idaea L.	+	+
Viola epipsila Ledeb.	+	+
V. palustris L.	+	+
Number of species	151	176

Table A2. List of mosses on mires around Kolatselka. The nomenclature follows Ulvinen *et al*. (2002).

Species	Lounamaa (1961)	Data of authors
Aulacomnium palustre (Hedw.) Schwägr.	+	+
Brachythecium rivulare Schimp.	+	+
Bryum pseudotriquetrum (Hedw.) P. Gaertn. et al.	-	+
Bryum weigelii Spreng.	+	+
Calliergon cordifolium (Hedw.) Kindb.	+	+
Calliergon giganteum (Schimp.) Kindb.	+	+
Calliergonella cuspidata (Hedw.) Loeske	-	+
Campylium protensum (Brid.) Kindb.	-	+
Campylium stellatum (Hedw.) Lange & C.E.O. Jensen	+	+
Cinclidium stygium Sw.	+	+
Climacium dendroides (Hedww.) F. Weber & D. Mohr	+	+
Dicranum bergeri Blandow ex Hoppe	-	+
Dicranum bonjeanii De Not.	+	+
Dicranum scoparium Hedw.	+	+
Fissidens adianthoides Hedw.	+	+
Hamatocaulis vernicosus (Mitt.) Hedenäs	+	+
Helodium blandowii (F. Weber & D. Mohr) Warnst.	+	+
Hylocomium splendens (Hedw.) Schimp.	+	+
Loeskypnum badium (Hartm.) H.K.G. Paul	-	+
Meesia triquetra (Richt.) Ångstr.	+	+
Paludella squarrosa (Hedw.) Brid.	+	+
Plagiomnium elatum (Bruch & Schimp.) T. Kop.	-	+
Plagiomnium ellipticum (Brid.) T. Kop.	-	+
Pleurozium schreberi (Willd. ex Brid.) Mitt.	+	+
Polytrichastrum longisetum (Sw. ex Brid.) G.L. Sm.	+	-
Polytrichum strictum Menzies ex Brid.	+	+
Pseudobryum cinclidioides (Huebener) T. Kop.	+	-
Pseudo-calliergon lycopodioides (Brid.) Hedenäs	+	+
Pseudo-calliergon trifarium (F. Weber & D. Mohr) Loeske	+	+
Rhizomnium pseudopunctatum (Bruch & Schimp.) T. Kop.	-	+
Rhytidiadelphus triquetrus (Hedw.) Warnst.	+	+
Scorpidium cossoni (Schimp.) Hedenäs	-	+
Scorpidium revolvens (Sw. ex Anonymous) Rubers	+	+
Scorpidium scorpioides (Hedw.) Limpr.	+	+
Sphagnum angustifolium (C.E.O. Jensen ex Russow) C.E.O. Jensen	+	+
S. balticum (Russow) Russow ex C.E.O. Jensen	-	+
S. capillifolium (Ehrh.) Hedw.	-	+
S. centrale C.E.O. Jensen ex Arnell & C.E.O. Jensen	+	+
S. contortum Schultz	+	+
S. fallax (H. Klinggr.) H. Klinggr.	+	-
S. fimbriatum Wilson	+	-
S. fuscum (Schimp.) H. Klinggr.	+	+
S. magellanicum Brid.	+	+
S. majus (Russow) C.C.O. Jensen	-	+
S. obtusum Warnst.	+	+

Species	Lounamaa (1961)	Data of authors
S. papillosum Lindb.	+	-
S. platyphyllum (Lindb. ex Braithw.) Sull. ex Warnst.	-	+
S. russowii Warnst.	-	+
S. squarrosum Crome	-	+
S. subfulvum Sjörs	-	+
S. subsecundum Nees	+	+
S. teres	+	+
S. warnstorfii Russow	+	+
Splachnum ampullaceum Hedw.	+	+
Straminergon stramineum (Dicks. ex Brid.) Hedenäs	-	+
Thuidium recognitum (Hedw.) Lindb.	-	+
Tomentypnum nitens (Hedw.) Loeske	+	+
Warnstorfia exannulata (W. Gümbel) Loeske	+	+
Warnstorfia fluitans (Hedw.) Loeske	+	+
Warnstorfia sarmentosa (Wahlenb.) Hedenäs	+	+
Warnstorfia tundrae (Arnell ex. Lindb. & Arnell) Loeske	-	|+
Number of species	42	56