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Finnish botanists and mycologists in the Arctic

Henry Väre

Abstract: Finnish botanists and mycologists have studied Arctic areas and timberline regions since the beginning of the 18th century. Most expeditions to the Kola Peninsula were made between 1800 and 1917 and until 1945 to Lapponia petsamoënsis on the western rim of the Kola Peninsula. Since those years, these areas have been part of the Soviet Union or Russia. Svalbard and Newfoundland and Labrador have been studied repeatedly as well, Svalbard since the 1860s and Newfoundland and Labrador since the 1930s. This article focuses on Finnish collections. These are deposited in the herbaria of Helsinki, Turku, and Oulu universities, except materials from the Nordenskiöld expeditions, which were mainly deposited in Stockholm. Concerning the Kola Peninsula, collections at Helsinki are the most extensive. The exact number of specimens is not known, but by rough estimation, the number is about 60 000, with an additional 110 000 observations included in the database. These expeditions have provided material to describe 305 new taxa to science, viz. 47 algae, 78 bryophytes, 25 fungi, 136 lichens, and 19 vascular plants. This number is an underestimate, as many new species have been described in several separate taxonomic articles. At least 63 persons have contributed to making these collections to Finnish herbaria. Of those, 52 are of Finnish nationality.

Key words: bryophytes, fungi, vascular plants, Finnish, Arctic.

Résumé : Les botanistes et les mycologues finlandais ont étudié les régions arctiques et les régions de limite forestière depuis le début du 18ème siècle. La plupart des expéditions à la presqu’île de Kola ont été faites entre 1800 et 1917 et jusqu’à 1945 à Lapponia petsamoënsis sur la côte ouest de la presqu’île de Kola. Depuis ces années, ces régions ont fait partie de l’Union soviétique ou de la Russie. Svalbard, Terre-Neuve et le Labrador ont été étudiés à plusieurs reprises aussi, Svalbard depuis les années 1860 et Terre-Neuve et le Labrador depuis les années 1930. Cet article porte sur les collections finlandaises. Celles-ci sont déposées dans les herbiers des universités de Helsinki, de Turku et d’Oulu, sauf le matériel des expéditions Nordenskiöld qui a été principalement déposé à Stockholm. En ce qui concerne la presqu’île de Kola, les collections à Helsinki sont les plus vastes. On ne connaît pas le nombre exact de spécimens, mais par l’estimation approximative le nombre est environ 60 000, avec 110 000 observations supplémentaires comprises dans la base de données. Ces expéditions ont fourni le matériel qui a servi à décrire 305 nouveaux taxa pour la science, à savoir 47 algues, 78 bryophytes, 25 champignons, 136 lichens et 19 plantes vasculaires. Ce nombre est une sous-estimation, puisque de nombreuses nouvelles espèces ont été décrites dans plusieurs articles taxonomiques. Au moins 63 personnes ont contribué à la création de ces collections aux herbiers finlandais. De ce nombre 52 sont de nationalité finlandaise.

Mots-clés : bryophytes, champignons, plantes vasculaires, finlandais, arctique.
Introduction

It is important to gather distribution data of biodiversity in the Arctic including metadata on information holdings, particularly as the Arctic is experiencing the effects of global warming at a much higher rate than other regions. For example, the Arctic Flora Inventory is a project that will develop a database containing information on the diversity and distribution of vascular plants in the Arctic. Circumpolar cooperation is essential to achieve this goal. As a member of the Arctic Flora Inventory, I present a review on historical information on Finnish botanical and mycological activities in the Arctic regions. Most of these expeditions aimed to provide museum specimens for taxonomical studies and species information. Arctic biodiversity was poorly known until the late 19th century and still is poorly known today for fungi and lichens. The Pan-arctic flora has brought a consensus concerning vascular plant taxonomy, but distribution information is still incomplete. In general, exploration of the Arctic began simultaneously during the 19th century. Finnish scientists especially pioneered exploration of the Kola Peninsula and Svalbard. Other countries with rich Arctic biological material in museums are Canada, Denmark (Greenland), Germany, Norway, Russia, Sweden, and the United States.

Biogeographically, Finland belongs to Fennoscandia. The country is located between 59°48’N and 70°05’N, mainly on the boreal coniferous zone. In the north, there are oroarctic extensions of Arctic tundra (Virtanen et al. 2015). The floristic composition of that area is essentially more similar to the Arctic than to the Alps (Väre et al. 2003). Due to close affinities of Arctic flora, there has been a long lasting interest by Finnish biologists in the Arctic regions, especially the Kola Peninsula. Expeditions have been carried out since the early 1800s.

Most old Finnish herbarium material was burned in the Great Fire of Turku in 1827, then the academic capital of Finland. After the disaster, the University was moved to Helsinki in 1828, the new capital of Finland since 1812. Natural historical collections were reestablished here (H). In addition, new herbaria were established in 1918 in Turku (TUR-A today), in 1919 (TUR and TUR-V), and in 1960 in Oulu (OULU). These all contain significant specimens from the Arctic.

This review is based on two excellent bibliographies on Finnish botanical and mycological literature (Saelan 1916; Collander et al. 1973), material deposited in Finnish museums, and inquiries to colleagues working at Finnish botanical museums and herbaria. Material that was collected by Adolf Erik Nordenskiöld’s expeditions are mainly kept at Stockholm (S), but some specimens are also at H. In the floristic database Kastikka of the Botanical Museum (University of Helsinki, Finnish Museum of Natural History), there are thousands of records on species, both observations made and specimens collected in the Kola Peninsula. The most notable records are given. Abbreviations of herbaria follow Index Herbariorum (https://www.google.fi/#q=index+herbariorum).

Northern Atlantic

Vascular plants

Anton Rolandsson Martin (1729–1785), born in Estonia to Finnish parents, was the first Finn and Linnaeus’s student to participate in an expedition to the Arctic region, in 1758 to Svalbard. He had defended his thesis Buxbaumia to Linnaeus, who arranged for Martin to travel onboard a whaling ship belonging to the Swedish Greenland Company. They were at sea for 3 months. Martin could visit a number of islets between 79° and 80°, but due to bad weather, just for a few hours (Martin 1882). He managed to collect Cochlearia groenlandica, Saxifraga cespitosa, Saxifraga oppositifolia, and algae Fucus vesiculosus and Ulva latissima (Martin 1758). These specimens may be deposited at LINN.
Anders Johan Malmgren (1834–1897) participated in three Svalbard expeditions. The 1861 expedition was led by Swedish Otto Torell and Adolf Erik Nordenskiöld who lead the 1864 and 1868 expeditions.

Adolf Erik Nordenskiöld (1832–1901) was born in Grand Duchy of Finland, Russia. Due to political reasons, he was ordered into exile in 1858 by Friedrich Wilhelm Rembert von Berg, governor-general of Finland, and lived since that time in Sweden. Nordenskiöld acted as a Professor of the Royal Swedish Academy and keeper of mineralogical collections at the Swedish Museum of Natural History, Stockholm. His well-known activities in the Arctic began in Sweden and expeditions were mainly founded by Swedish aristocrats and merchants, especially by Oscar Dickson (Nordenskiöld 1877b). Nordenskiöld often recruited Finnish biologists like A.J. Malmgren, J.A. Palmén, and M. Brenner.

In 1861, Malmgren was responsible for botany and zoology on these expeditions. Their ships the Aeolus and the Magdalena left Tromsø for Bear Island and continued on to Svalbard, north along the western coast and then back along the eastern coast. The itinerary (Chydenius 1865) lists 53 vascular plants, of which medicinally important Cochlearia [groenlandica] is mentioned five times. Lithographic landscape pictures from the expedition are enchanting. A.E. Nordenskiöld (see later) participated also in this expedition. On the northern coast of Spitsbergen, Malmgren found 60 vascular plants, 20 new to the area, together with 150 lichens, 50–60 bryophytes, and 30 algae (Malmgren 1863). Specimens collected by Malmgren are kept both at H and probably also at S. Malmgren (1862) compiled a list of all vascular plant species (93) of Svalbard known up to this point. That article was also published in English, including a comparison of species composition between the islands of Svalbard (Malmgren 1864). Malmgren also compiled a history of botanical studies on the islands. First observations were made by Friderich Marten (Spitzberghische Reisebeschreibung) in 1675 and the next ones by Daniel Solander, Robert Brown, and Christian Sommerfelt. Malmgren omitted A.R. Martin in his account of exploration of the islands of Svalbard.

Malmgren was also the botanist and zoologist on another expedition in 1864. Only two plants are mentioned this time, Cochlearia [groenlandica] from Bear Island and the very rare Polemonium pulchellum [boreale] from Svalbard, the latter with blue and white flowering individuals (Dunér and Nordenskiöld 1867).

Based on all material, Malmgren (1865) concluded that eastern Svalbard is floristically more closely related to North America and the western part to northern Scandinavia. He also presented all scientific results of the 1861 and 1864 expeditions (Malmgren 1867).

In 1868 Malmgren, Ernst Gustaf Reinhold Nauckhoff (1847–1919) and A.E. Nordenskiöld collected rich Miocene fossil material at Bellsund and Kingsbay. These were studied by Prof. Oswald Heer (1809–1883) in Zürich and published by him in 1869 in “Archives des Sciences physiques et naturelles, Genève”. The total number of named vascular plants was 131, of which eight were cryptogams. Heer honored the explorers by naming the genus Nordenskioldia and the species Sequoia nordenskioldii, Potamogeton nordenskioldii, and Tilia malmgrenii. These fossil discoveries had biogeographic connections to Chile, Europe, and North America. Ten new living vascular plant species were also found, bringing the new total number for Svalbard to 110 (Malmgren 1870). Today, that number is 184. On Bear Island alone, 33 vascular plants were discovered.

Nils Adolf Erik Nordenskiöld led several expeditions to the Arctic, the most famous being the discovery of the Northeast Passage in 1878–1879 aboard the steamship Vega. He participated on Svalbard expeditions in 1858 led by Sven Lovén and in 1861 led by Otto Torell. Nordenskiöld led the 1864, 1868, 1871, and 1872–1873 Svalbard expeditions, the 1870 and 1882–1883 expeditions to Greenland, the 1875 and 1876 expeditions to Arctic European Russia, and, in 1878–1879, the Vega expedition along the northern coast of Eurasia.
This was the first complete crossing of the Northeast Passage. Svalbard provided many Triassic and Tertiary fossils. Jurassic and carboniferous plant fossils were also found (Nordenskiöld 1863, 1866, 1877a). Most collections by Nordenskiöld are deposited at S.

The 1872–1873 expedition overwintered in Svalbard (Mosselbay), a first trial in the Arctic. The botanist was **Frans Reinhold Kjellman** (1846–1907), a docent at Uppsala University. He also compiled the itinerary (Kjellman 1875). Twenty-eight Carboniferous, two Jurassic, and 14 Cretaceous fossils of vascular plant genera were discovered at Bellsund. The Miocene vascular plant flora was also diverse, with 113 named taxa (Nordenskiöld 1874, 1875; Heer 1878). Heer described several fossil taxa collected during Nordenskiöld’s expeditions in his “Flora Fossil Arctica” published in seven volumes 1868–1883, which includes 398 plates.

The expedition collected plants at Dicksonbay, Sydkap, Kolbay, Fairhaven, Foulbay, Mosselbay, and Giesland. The first flowering plants collected at Mosselbay on 14 June 1873 were *Cardamine bellidifolia*, *Papaver nudicaule*, and *S. oppositifolia*. The flora of Svalbard consisted now of 115 species, of which A.J. Malmberg had listed the most. One novelty, *Pediculus lanata* var. *dasyantha* [P. *dasyantha*], was found during this time.

The Finnish–Swedish activity period led by Nordenskiöld was followed by 90 inactive years concerning Finnish botanists in the North Atlantic region. Emphasis was placed first on an exploration of the Kola Peninsula and then to Newfoundland and Labrador.

**Prof. Seppo Eurola** (1930–2016), University of Oulu, made plant ecological studies in Svalbard in 1964 and 1969 (Eurola 1968, 1971a, 1971b, 1972, 1974). Eurola (1968) studied tundra vegetation in the areas of Isfjorden and Hornsund in western Svalbard by analysing 58 sample plots of 25 m² and at Sveagruva of 1 m². Plot material and the other collections of bryophytes, lichens, and vascular plants are deposited at OULU. Eurola (1972) found germinable seeds in 60% of the 63 species collected. Based on field studies at northwestern Fennoscandia and in Svalbard, Eurola (1974) concluded that northwestern Fennoscandia represents a link to the circumpolar Arctic vegetation.


Several other Finns have visited Svalbard and collected plants, which are deposited at H, TUR, and OULU. Mikko and Pirkko Piirainen (Finnish Museum of Natural History, Botanical Museum) participated in a floristic mapping expedition in 2002, where they studied plants of the planned Colesdalven conservation area 20 km southwest of Longyearbyen. M. Piirainen collected in Svalbard also in 2010 (Fig. 1). In total, 142 vasculars plants were collected deposited at H but their current state of condition is not known.

**Algae**

In 1872–1873, Kjellman (1875) was especially interested in Arctic algae and collected at least 16 species.

**Johan Georg Robert Boldt** (1861–1923) reviewed the distribution of desmids in Finland, Greenland, Norway, Novaya Zemlya, northwest Russia, Siberia north of the Arctic Circle, Svalbard, and Sweden (Boldt 1887). He treated some groups of algae collected by Nordenskiöld in Greenland from 1885. Four species and 10 varieties were new to science, with 221 total taxa collected (Boldt 1888, 1893). Specimens collected by Boldt are deposited at H.

**Bryophytes**

Nordenskiöld collected bryophytes in 1858. Those were treated by Sextus Otto Lindberg (1835–1889) (Fig. 2) and are deposited at H. He identified 50 species including four hepatics.
New material was collected in 1861 and in 1864 by Malmgren, bringing the known number of bryophytes in Svalbard to 143. Eleven species, one subspecies, and 10 varieties were described as new to science (Lindberg 1867). Later, especially Seppo Eurola and Risto Virtanen (both OULU) collected bryophytes.

Fig. 1. Botanical expeditions to the Arctic have continued in the 2000s. (A) Abundance of *Eriophorum scheuchzeri* subsp. *arcticum* near Longyearbyen, Svalbard, 2010 (photo: Mikko Piirainen). (B) Coastal cliffs of Tri Ostrov Island in the Kola Peninsula, 2015 (photo: Alexander Sennikov).
Fig. 2. Finnish botanists and mycologists who have greatly contributed the knowledge of the Arctic plants and fungi. (A) Sextus Otto Lindberg studied bryophytes, (B) Petter Adolf Karsten fungi, (C) Alfred Oswald Kairamo (Kihlman until 1906) vascular plants, and (D) Viktor Ferdinand Brotherus bryophytes.
Fungi

Fungi collected during expeditions led by Nordenskiöld were sent to the leading mycologist of the time, Petter Adolf Karsten (1834–1917) (Fig. 2). He identified 62 taxa (H), of which 19 species and one subspecies were new to science, all microfungi on plants (Karsten 1872). New material was collected at least in 1964, 1966, 1969, 1977, 1980, 1983, 1988, and 2001 by Heli Heikkilä (TUR), Seppo Huhtinen (TUR), Paavo Kallio (1914–1992) (TUR), and Esteri Ohenoja (OULU, TUR) (Ohenoja 1971; Huhtinen 1987; Väre et al. 1992). Polaroscyphus spetsbergianus is a new genus and species resulting from these activities (Huhtinen 1987). Kosonen and Huhtinen (2008) discovered 24 species of wood-rotting basidiomycetes on construction timber and driftwood in Svalbard. Väre et al. (1992) studied endophytic root fungi in a number of plants collected in Svalbard.

Lichens

Lichens (H, UPS) collected by Nordenskiöld and Malmgren were studied by Thore Magnus Fries (1832–1913) (Nordenskiöld 1863). Lichens collected by Eurola and Virtanen are at OULU. Annina Launis (born Mäkelä) collected lichens in Svalbard in 2010 (H). Teuvo Ahti has collected especially lichens on the northeast coast of Iceland (H).

The Kola Peninsula

The Kola Peninsula was of special interest to Finnish botanists for a century. It was one of the least unexplored areas in Europe, almost inaccessible. In 1809, Finland was incorporated into the Russian Empire as an autonomous Grand Duchy and remained as such until 1917 when Finland declared its independence. During this era, it was possible to arrange expeditions to the Kola Peninsula. Geologically and floristically, the area was similar to Finland, and exploring the area was considered a national duty to Finnish biologists. The Kola Peninsula was divided into biogeographical regions (Fig. 2). Only the northern coastal area belongs to the Arctic vegetation zone with four regions: Lapponia petsamoensis (Lps), Lapponia tulomensis (Lt), Lapponia murmanica (Lm), and Lapponia ponojensis (Lp). Almost 40 Finnish scientists travelled to the Kola Peninsula collecting significant amounts of herbarium specimens. The specimens are mostly in H, but duplicates were distributed widely.

A narrow connection through Lps, the Pechenga (Petsamo) region to the Rybachy Peninsula (Kalastajasarento in Finnish) near the Arctic Ocean, remained accessible until 1945, when the Soviet Union invaded the area. Studies of that plantgeographical region continue to be active.

Pechenga and Rybachy Peninsula

In 1820, amateur botanist Jacob Fellman (1793–1875), a priest in northernmost Finland at Utsjoki in 1820–1831, was the first Finn to visit Lps and Lt, the Rybachy Peninsula, and the Ainov Islands (Heinäsaaret) west of the peninsula (Väre 2011). At Rybachy, he collected the extremely rare Chamorchis alpina (Blinova and Uotila 2011). In 1826, Fellman visited Pechenga, 20 km from the Arctic coast near the southern end of the Pechenga Bay. His collections are deposited at H (Väre 2011).

In July 1856, Anders Edwin Nylander (1831–1890) travelled together with Johan Magnus Gadd (1832–1891) from Inari along the Paatsjoki River to Pechenga and continued to Vayda-Guba (Vaitolahti) at the Rybachy Peninsula (all Lps). There they stayed for a few weeks and made excursions along the coast of the peninsula and to the Ainov Islands. The excursion was mainly zoological, but specimens of vascular plants and lichens were also collected (Nylander 1857).
Many Finnish botanists collected later in the area and published several communications. Arthur Wilhelm Granit (1871–1956) travelled with B. Poppius in 1897 (Granit 1948). In the floristic database Kastikka of the Botanical Museum (University of Helsinki, Finnish Museum of Natural History), there are 86 specimen records for him. Ernst Fredrik Häyrén (1878–1957) collected in 1925–1928, 1932, and 1937; 652 specimen records are found in Kastikka. Häyrén suggested a nature conservation area for Zemlyanoe (Pummanki) at the Rybachy Peninsula (Häyrén 1927). Häyrén also collected bryophytes in the 1920s (72 specimens).


Kaarlo Linkola (1888–1942) collected in 1925. He was the leader of the so-called Pechanga project, which performed field studies from 1927 to 1937. The project aimed to study plant biology and to describe vegetation associations in Lps. In the floristic database Kastikka, there are 107 specimen records by him. The project resulted in three dissertations. Aarno Kalela’s (1908–1977) title was “About meadows and meadow-like plant communities on the Rybachy Peninsula in Pechenga Lapland” (Kalela 1940). The number of the floristic observations made by him in Kastikka was in total 18145. Niilo Söyrinki’s (1907–1991) title was “Studies on the generative and vegetative propagation of seed plants in the alpine vegetation at Pechenga Lapland” (Söyrinki 1938, 1939), with 1156 collected specimens according to Kastikka. Tahvo Kontuniemi (1904–1980) studied the seed development of forest plants at the Pechenga subalpine belt (Kontuniemi 1932), and he collected 385 specimens according to Kastikka. Reino Kalliola (1909–1980) performed studies at Pechenga Mountains and resulted in 629 records to Kastikka. This project produced a considerable number of specimens and observations at Lps (Table 1).

Amateur lichenologist Veli Räsänen (1888–1953) made three excursions to the Pechenga area (Räsänen 1943). His collections are at H.

The Kola Peninsula

Amateur botanist Jacob Fellman (1793–1875), a priest in northernmost Finland at Utsjoki in 1820–1831, was the first Finn to study the flora of northernmost East Fennoscandia. In 1829, he visited the Kola Peninsula reaching Arctic areas at Lt near the river Kuolayoki and Kola village. He also visited the Rybachy Peninsula (Lt), Karelsgammen (today Vayda-Guba, Vaitolahti, Lps), and Pechenga (Lt). Carex atrata, Chamorchis alpina, Gnaephyllum norvegicum, Saxifraga alzoaides, and Silene wahlbergella were collected in 1829 (H). Fellman (1831, 1835) found 379 vascular plants of which 30 were new to the area of Russian Lapland. Fellman’s specimens are mainly deposited at H, but he also exchanged plants with foreign botanists. Fellman was among the first to focus on changes in the northern forest line when he discovered fossilized Pinus sylvestris roots above the timberline (Väre 2011).

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Table 1. Number of species and observations of four northernmost biogeographical provinces in the Kola Peninsula databased in the floristic database Kastikka, Finnish Museum of Natural History, Botanical Museum, University of Helsinki.
Fredrik Nylander (1820–1880) was the first Finnish botanist who critically studied the vascular plants of Finland. He collected plants mainly during the years 1842–1844, when he made three longer excursions to northeastern Fennoscandia (Väre 2008). In the Kola Peninsula, he collected at Lim, Lt, Lm, and Lp. In total, Nylander described 39 taxa consisting of 11 species, eight subspecies, and 30 varieties, of which 10 were collected in the arctic Kola Peninsula (Fr. Nylander 1843, 1844). He also collected 30 taxa to the “Herbarium Normale” edited by Elias Fries. The collecting localities are given in Väre (2008). In the Arctic Ocean area, Nylander visited Kitsa (Lt), Wainga (Vayenga, Severomorsk, Lt), Kildin (Kildin Island, Lt), Visalkina (Veselkina guba, Lm), Gavrilova (Gavrilovo, Lm), Litsa (Vostochnaya Litsa, Lm), Kukovicha (Mys Kakovikha, Kachalovka, Lp), Jokonga (Jokanga, Lm), Svatojnos/Promontorium sanctum/Heliganosen (Svyatoy Nos, Lp), Vostra Guba, (Vestra Guba, near Svyatoy Nos, Lp), and Kusmin-nos (Izba Kuz'mina, Lp). For abbreviations, see Fig. 3. Most of his specimens are deposited at H, some in St. Petersburg (LE), and at UPS in Sweden.

Nylander discovered several vascular plant taxa new to the Kola Peninsula (Ruprecht 1845; Hiitonen 1958) in addition to those he described as new to science, e.g., Aster ircutianus [A. sibiricus], Cenolophium Fischeri, Chrysanthemum arcticum [Arctanthemum arcticum], Eutrema Edwardsii, Ligularia sibirica, Myosotis silvatica [M. decumbens], Pedicularis sudetica, Pedicularis...
verticillata, Pleurogyne rotata [Lomatogonium rotatum], Polemonium coeruleum var. arcticum [P. bor-earle], Potentilla multifida [P. arctica], Pyrethrum bipinnatum [Chrysanthemum bipinnatum], Ranunculus pallasii, Ranunculus samojedorum [R. hyperboreus subsp. arnellii], Salix nummularia, and Static armeria var. sibirica [Armeria maritima subsp. sibirica]. Other noteworthy collections were Castilleja pallida, Gentiana aurea, Hedysarum obscurum [hedysaroides], Senecio aurantiacus [S. integrifolius], Senecio nemorensis var. octoglossus [S. nemorensis], and Valeriana capitata (Rupprecht 1845; Hiitonen 1958). Altogether, Nylander reported 45 new species to the Fennoscandian biogeographic area and he described 10 new vascular plant taxa collected in the Arctic (Väre 2008).

Nils Isak Fellman (1841–1902), son of Jacob Fellman, continued expeditions to the Kola Peninsula after his father and Fr. Nylander. Societas pro Fauna et Flora Fennica financed an expedition in 1861 (Fig. 3) to Russian Lapland; the botanist was N.I. Fellman and the mycologist was P.A. Karsten. In the Arctic zone, they visited the Kola village, Kola Bay, Olenji (Ostrov Malayy Olenyj), Kildin (Kildin Island), Titovka (Kitofka), and Subovi (all Lt). In the Arctic and northern boreal zones, they collected 505 species of vascular plants (Fellman 1869, 1882). In the 1863 expedition (Fig. 3), Fellman also visited some localities in the Arctic: Lp, Ponoi (Ponoy), Tripstrott (Ostrova Tri Ostrova), Pjalitsa (Pyalitsa), Svätoinos (Svyatoy Nos), and Lt, Kola village. The main material of these expeditions can be found at H.

Rich vouchers collected by N.I. Fellman were used to prepare both lichen and vascular plant exsiccate. Plantae arcticae exsiccateae consists of 370 numbers (Fellman 1864b). His main work, “Plantae vasculares in Lapponia orientalis sponte nascentes” (Fellman 1864a), lists 517 vascular plants. Relatively detailed information on localities is given; distribution data and corrections to works by his father and Fr. Nylander are also provided.

Prior to N.I. Fellman, the Kola Peninsula had been botanically studied by Nikolaus Ozeretkowski in 1771, by Lepechin, by J. Fellman in 1829, in 1837 by von Baer, Lehman, Ziwolka, and Röder, in 1839 by Bohtlingk and Schrenk, in 1840 by von Baer, Middendorf ja Pankewitsch, and in 1842, 1843, and 1844 by Fr. Nylander (Fellman 1882).


Prof. Alfred Oswald Kairamo (born A.O. Kihlman) (1858–1938) (Fig. 2) and Johan Axel Palmén (1845–1919) organized the Great Kola Expedition of 1887. V.F. Brotherus (Fig. 2) participated as a bryologist (Fig. 3). Kairamo’s main interest was the northern forest line formed by Betula pubescens. Details on the route are presented in Kihlman and Palmén (1890a, 1890b).

Kairamo’s main botanical publication is “Pflanzenbiologische Studien aus Russisch-Lappland” (Kihlman 1890). It presents the biology of several vascular plants but focuses on the formation of the forest line, which proved to be farther north than anticipated. The main conclusion was that the line is a result of strong drying winds during spring when the ground is still frozen. Evaporation begins but water cannot be taken up by roots, which results in drying of shoots. This factor is the basis for the Arctic and boreal border. Kairamo was also interested in pollination biology. At the Arctic zone, the proportion of wind-pollinated plants increased to 30% and the proportion of self-pollinating species was also found to be elevated (Kihlman 1888).

In 1889, Kairamo travelled in the Kola Peninsula along Lovozero, Lyavozero, Leejaur, Varzino (winter village), Kuroptjevsk (winter village), Jokonga (winter village), Lumbivka (winter village), and Orlov (Fig. 3). At Orlov, he made especially phenological observations. Kairamo lists some new Arctic species to the area: Hedysarum obscurum, Eutrema edwardsii, Salix rotundifolia, Ranunculus pallasii, Ligularia sibirica, Cotoneaster cinnabarinus, Valeriana capitata, Pyrethrum bipinnatum, Pedicularis sudetica, and Silene nemorensis (Kihlman 1892). A third
expedition took place in 1892. According to the University of Helsinki Botanical Museum’s action reports, Kairamo, Brotherus, and Palmén had donated 3831 vascular plants (1997 duplicates), 3160 bryophytes (2244 duplicates), 1247 lichens (715 duplicates), algae, 55 cones, 76 seed examples, and 70 wood discs by 1899. The number of new species and subspecies to the area was 61, of which three were new to science (Kihlman 1891).

Justus Elias Montell (1869–1954), forester and keeper of Åbo Akademi’s biological collections, travelled to Ponoy (Lp) in the eastern coast of the Kola Peninsula in 1899. He stayed in the area for the whole summer collecting herbarium specimens. In 1900, Montell donated to H 268 species of vascular plants, with 10 new species for the province, and 15 species of mosses from Lp (Uotila 2013). Specimens included Paeonia anomala for “Plantae Finlandiae Exsiccateae”. Montell published approximately 100 botanical notes (Väre 2004), but practically nothing on the plants of Lp, just a small floristic note (Montell 1904). His main collections are at TUR-A.

In 1872, bryologist Viktor Ferdinand Brotherus (1849–1929) (Fig. 2) received a grant from the Societas pro Fauna et Flora Fennica to study Russian Lapland. In the same summer, he travelled with his young schoolboy brother Arvid Hjalmar Brotherus (1855–1888) along the eastern and northern coasts of the Kola Peninsula (Brotherus 1873) collecting bryophytes and vascular plants. In April 1885, he donated to H “352 well prepared vascular plant specimens from Russian Lapland, e.g., Eritrichium villosum, new to the herbarium” (Uotila 2013).

In 1885, V.F. Brotherus again did bryological collecting in the Kola Peninsula. For the third time, Brotherus studied the area as a participant of the Great Kola Expedition in 1887 (see Kairamo). In his travelogue, Brotherus (1888a, 1888b) lists his collection localities and “best” vascular plants discovered. As new to the Kola Peninsula, Brotherus found Petasites laevigatus and Rumex acetosella subsp. graminifolius (Hiitonen 1958).

Alvar Fredrik von Fieandt (1885–1948) obtained a grant to study the geology of the Rybachy Peninsula and Kildin Island (von Fieandt 1912) north of the Kola Peninsula. The grant also covered the expenses of Fredrik Woldemar Klingstedt (1881–1964) as an assistant to study the flora of the area. Klingstedt collected plants and lichens at Lps and Lt, e.g., Kildin Island. He also published short notes on Salix hybrids (Klingstedt 1912, 1919). Floristic records (in total 469 from Lps and 444 from Lt) from his three field notebooks, preserved in the botanical archives at H, have been entered into the floristic database Kastikka (Uotila 2013). Recently, expeditions to the Kola Peninsula have been organised again. Alexander Sennikov collected vascular plants (H) in 2015, e.g., at Ponoy and in Tri Ostrov Islands off Ponoy (Fig. 1).

In total, the floristic database Kastikka contains 48 871 records from the northern biogeographical provinces of the Kola Peninsula (Fig. 3; Table 1). The figures indicate numbers of herbarium sheets (including duplicates) (SPE) and observations (OBS) as of 18 August 2016. Recently, 3600 herbarium specimens have been databased, but not yet added to Kastikka.

Algae
Fr. Nylander donated 41 algal specimens collected between 1842 and 1844 in the Kola Peninsula on the shores of the Arctic Ocean to H. The specimens were identified by Franz Josef Ruprecht (1814–1870) (Elfving 1921).

J.G.R. Boldt gave a note that he will identify desmids collected by V.F. Brotherus in 1885 (H), but the results were not published Boldt (1892).

Kaarlo Mainio Levander (1867–1943) explored microalgae at coastal lakes and at Jeretik Island (Ostrov Yeretik) in 1898 at the northwestern Kola Peninsula (Lt). Approximately 50 species were named (Levander 1901). He also collected vascular plants (H). Levander (1905)
identified microalgae collected by Kairamo and Frans Johan [John] Herman Lindén (1867–1914) from lakes at the Kola Peninsula. He also reviewed earlier algological studies. The number of species in the Kola Peninsula was 140. Levander (1916) examined also microalgae collected by Oscar Nordqvist (1858–1925) at the White Sea in 1886. Kairamo made an excursion to the Arkhangelsk Governorate in 1891 collecting at 76 localities. Oscar Fredrik Borge (1862–1938) determined 49 genera and 286 taxa of microalgae (Borge 1894). Four species and eight varieties were described as new to science. Many were collected close to the Arctic Ocean. Häyrén collected algae in the 1920s (39 specimens).

Bryophytes
Fr. Nylander collected bryophytes in 1842–1844. At H, there are at least 39 bryophyte specimens identified mainly by Carl Moritz Gottsche (1808–1892).
In 1872, V.F. Brotherus explored Russian Lapland. Material collected, including 354 Bryaceae, 138 Hepaticae, and 81 Sphagnum, was donated by him to H in 1886 (Uotila 2013). A second expedition to the Kola Peninsula took place in 1885 and Brotherus was awarded a grant for a bryological expedition. Together with the entomologist Klas Kristian Edgrén (1864–1904), he travelled first to Kandalaksha in June 1885. They studied the Chuna tundra for 8 days and the Khibiny Mts. for 5 days. The latter half of July was used for excursions to the Arctic coast of Lapponia tulomensis (Lt), to the Kildin Island, and to the eastern part of the Rybachy Peninsula (Brotherus 1886). Next spring, Brotherus donated to the herbarium 573 bryophyte specimens collected during the excursion (Uotila 2013). For the third time, Brotherus studied the Kola Peninsula as a participant in the Great Kola Expedition in 1887 (see Kairamo). In his travelogue Brotherus (1888a, 1888b) lists his collection localities and “best” vascular plants discovered. In the review “Musci Lapponiae Kolaensis”, 74 bryophytes are mentioned (Brotherus and Saelan 1890a, 1890b).

Fungi and lichens
Fr. Nylander also collected lichens and fungi, of which his brother William Nylander (1822–1899) described new species (Nylander and Saelan 1859), viz. Cetraria nigricans, Verrucaria grossa, and Sphaeria drabae.

The number of fungi collected by N.I. Fellman in the Kola Peninsula in 1861 totalled 425. Two genera and four species were described as new to science (Karsten 1866).
A large set of lichens collected by N.I. Fellman (Urbanavichus et al. 2008) were distributed in “Lichenes arctici exsiccatae”. It consists of 221 numbers (Fellman 1865). Specimens were determined by William Nylander. This material was the basis for his East Fennoscandian lichen flora. Amongst the 291 species of lichens, Nylander described 34 that were new to science (Nylander 1866).
Teuvo Ahti collected lichens especially at the Arctic Murmansk coast. This material is at H.

Arctic Siberia
Michael Friedrich Adams (1780–1829/1832) explored Siberia from 1806 to 1807. In 1806, while in Yakutsk, he heard of an intact woolly mammoth carcass near the mouth of the Lena River. There he collected also plants. Franz Josef Ruprecht (1814–1870) collected in 1841 at Indigiskaya Guba and Kolguyev Island, Kanin Peninsula. Some specimens of those expeditions are deposited at H.
A.E. Nordenskiöld explored Novaya Zemlya and Yenisei in 1875. Plants found on the upper course of the river Yenisey were listed (Nordenskiöld 1877a). At the Yamal Peninsula, 55 species of vascular plants were found. Algae were treated by Kjellman (1877).
The itinerary of the 1876 expedition to the river Yenisey includes only few plant records (Nordenskiöld and Theel 1877). One participant was the Finnish amateur botanist
Mårten Magnus Brenner (1843–1930). Swedish Hampus Wilhelm Arnell (1848–1932) (UPS) and Brenner (H) collected 700 plant species (Scheutz 1888). Arnell collected also bryophytes and Brenner lichens. Many species were described as new to science in Scheutz (1888), e.g., Carex brennerii [C. umbrosa subsp. sabynensis]. Brenner (1910) published his extensive records with collecting localities and phenological data much later. The first scientists at Yenisey were Germans Daniel Gottlieb Messerschmidt (1685–1735) in the 1720s and Johann Georg Gmelin (1709–1755) in 1739.

Nordenskiöld led the Vega expedition through the Arctic coast of Eurasia in 1878–1879. The Vega botanist was Kjellman. Botanical collections were made at several locations (Fig. 4). At the delta of the river Yenisei, Kjellman found 77 vascular plants, at Beli Ostrow 17 vascular plants, 80 lichens, and 20 bryophytes, at the Yamal Peninsula 21 vascular plants, at the Taymyr Peninsula 34, at Cape Chelyuskin 23, and at the river Lena delta 65. Species were recorded also in the winter by the coast near the place where Vega was stuck on ice and forced to overwinter. In the spring, Kjellman recorded 94 vascular plants from the same location. First flowering was recorded for Cochlearia fenestrata on 23 June 1879. There are eight botanic illustrations of vascular plants in the itinerary: ascomycetes, Draba alpina, Laminaria solidungula, Pleuropogon sabiniista, Rubus arcticus, Salix arctica, Sieversia glacialiskesta, and Thalassiophyllum clathrus (Nordenskiöld 1880, 1881).
Boldt (1885) identified 31 genera and 159 species of green algae collected by Nordenskiöld during the 1876 expedition to Yenisei, with 11 species described as new to science.

Lichens collected by Ernst Bernhard Almquist (1852–1946) were identified by Vainio (1909). Approximately 100 species were described as new to science. All are deposited at TUR-V.

Aimo Kaarlo Cajander (1879–1943) travelled with entomologist Robert Bertil Poppius (1894–1916) to the Lena River, Yakutia (Sakha Republic), in 1901, reaching the village of Tiksi near the river delta by boat. Cajander’s main interest was to study the succession of vegetation along the meandering rivers, from virgin sandy terrain to meadows to primeval forests (Cajander 1903). His dissertation includes many tables of plants. In two tables, Cajander lists approximately 75 vascular plants from the Arctic zone. Along the Lena River, he collected specimens of 830 vascular plant species, altogether 2942 specimens mounted on approximately 4500 sheets (Hämälä-Ahti 1970). Hämälä-Ahti provides the route and list of collection localities. Carex cajanderi Kük. (=C. bonanzensis Britton) was published as new to science. Cajander’s material is at H.

Geologist W. Ramsay and entomologist R. Poppius explored the Kanin Peninsula in 1903. Poppius collected vascular plants (H) and many are mentioned from the Arctic tundra in their report (Ramsay and Poppius 1904).

Senior Curator Risto Virtanen participated in three expeditions to Arctic Russia with vessels along the Arctic coast from the Kola Peninsula to Wrangel Islands in 1988, 1992, and 1994. Collections are at OULU.

Prof. Bruce Forbes has 30 years of experience in circumpolar field work, encompassing studies of rapid land use and climate change in Alaska, the Canadian High Arctic, various regions of northern Russia, and northernmost Fennoscandia, but mostly in the Yamal Peninsula, Russia. He has published several studies on changes in the Arctic vegetation (e.g., Pajunen et al. 2010; Myers-Smith et al. 2011; Forbes 2015; Virtanen et al. 2015). Anu Pajunen defended her thesis on willow-characterised shrub vegetation in tundra and its relationship to abiotic and biotic factors (e.g., Pajunen 2009; Pajunen et al. 2008, 2010) at University of Oulu under the supervision of Risto Virtanen, Bruce Forbes, and Jari Oksanen. She collected vascular plants (OULU) at the Yamal Peninsula.

Bryophytes

Arnell collected bryophytes during the 1876 Yenisei expedition. Hepatic collections totalling 96 species with locality information were published by Lindberg and Arnell (1889a), with one new genus, four species, and three varieties as new to science. The number of bryophyte species was 410, of which 29 species and 19 varieties were new to science (Lindberg and Arnell 1889b).

V.F. Brotherus indentified bryophytes collected during the Russian Polar expedition from 1900 to 1902 along the Arctic Ocean at several localities. Nine hepatics, three Sphagnum, and 45 mosses were collected, six new to northern Asia and Bryum taimyrense new to science (Brotherus 1910). Bryophytes collected by Risto Virtanen on his three expeditions to Arctic Russia are at OULU. A. Pajunen has collected bryophytes (OULU) in the Yamal Peninsula.

Fungi

Researcher Heikki Kotiranta (Finnish Environment Institute) has participated in several expeditions to Arctic Russia: to the Nenets Autonomous Okrug in 1992, the Taymyr peninsula (Norilsk, Khatanga, Ari-Mas) in 1993, the Yamal Peninsula in 1999, the Sakha Republic in 1999 (Tiksi) and 2006 (Verkhoyansk), the Chukchi Peninsula (Anadyr area) in 2009, and the Commander Islands (Bering Island) in 2015. He has specialized in fungi, Aphyllophorales s. lat. (H).
Kotiranta and Mukhin (2000) discovered 42 species of wood-inhabiting fungi in Tiksi, Sakha Republic, growing on timber in this treeless area. They studied also the xylotrophic basidial fungi in ruderal communities (Mukhin and Kotiranta 2001).

H. Kotiranta (H), Esteri Ohenoja (OULU), and Anna Liisa Ruotsalainen (OULU) participated in the International Symposium on Arctic and Alpine Mycology in Labytnangi (Nenets Autonomous Okrug) by the Kara Sea in 1996. E. Ohenoja collected at Sakha Republic and Tiksi in 1999 (OULU).

Lichens

**Edvard August Vainio** (1853–1929) was sent lichens collected at Novaya Zemlya (TUR-V) by H.W. Feilden in 1897 (Vainio 1898). Lichens (955 specimens) collected by Brenner during the Yenisei expedition in 1876 were identified by A.H. Magnusson (H in 1938). Rich sets of duplicates are at H. Leena Hämet-Ahti collected lichens at the Sakha Republic by the lower Kolyma River in 1979. Specimens are at H. Zhurbenko and Ahti (2005) reported a total of 42 *Cladonia* species from the Russian Arctic, mainly from the Taimyr Peninsula and Severnaya Zemlya. Lichenes collected by Risto Virtanen on his three expeditions to Arctic Russia are at OULU. A. Pajunen has collected lichens (H) at Yamal Peninsula.

**Northern Pacific**


**Arctic North America**

**John Richardson** (1787–1865) was a member of the **John Franklin** (1786–1847) Coppermine River expedition in 1819–1822, and in 1825–1827, he participated in the Franklin expedition to the mouth of the Mackenzie River. He also participated in Franklin’s search operation in 1847–1849 to eastern Arctic Canada. At H, there are some specimens labelled Arctic Sea, etc., collected by Richardson.

**Alaska to Northwest Territories**

**Vascular plants**

Leena Hämet-Ahti and Teuvo Ahti collected some 3000 specimens of vascular plants, 645 taxa with collection localities, in 1967 in Alaska, the Yukon, northern British Columbia, and Alberta (Hämet-Ahti 1971). Ahti has collected vascular plants also in the Noatak National Preserve (Brooks Range), Kotzebue, the Alaska Peninsula (Cold Bay), the Talkeetna Mountains, the Chugach, and White Mts, all in Alaska. In 2011, he collected at Unimak, the Aleutian Islands (H). Veikko and Marja Sorsa have collected a rich material from Alaska in the 1960s (H).

**Bryophytes, fungi, and lichens**

Ahti’s bryophyte collections from Alaska are at H. Heli Heikilä (TUR), Paavo Kallio (TUR), and Esteri Ohenoja (OULU) participated in the International Symposium on Arctic
and Alpine Mycology Point Barrow, Alaska, in 1980. Bryophytes, fungi, and vascular plants collected are at OULU and TUR. Seppo Huhtinen (TUR) and Tuomo Niemelä (H) have collected fungi at Kluane Lake (Yukon) and Inuvik and Yellowknife (Northwest Territories).

Teuvo Ahti (H) has collected especially lichens in Alaska. Ahti (1964) reported 203 macrolichens and their zonal distribution in boreal and arctic Ontario, 343 taxa from the Great Slave Lake region in the forest–tundra border of the interior of the Northwest Territories of Canada (Thomson et al. 1969), 356 from the Reindeer Preserve in the northwestern part of continental Northwest Territories (Ahti et al. 1973), 622 species and 10 subspecies and varieties of lichens, plus six species of lichenicolous fungi from Alaska, the Yukon, British Columbia, and Alberta, mainly along the Alaska Highway and some of its sideroads (Thomson and Ahti 1994) and 364 from Noatak National Preserve, Alaska (McCune et al. 2009). Ahti has collected lichens also at the Mackenzie Mountains, Yukon Kluane National Park, at Ontario, southern coast of Hudson Bay and at the Aleutian Islands in 2011. Ahti has collected also bryophytes and vascular plants during these expeditions. Specimens are deposited at H. Epigeic lichen communities of taiga and tundra regions were reviewed circumpolarly by Ahti and Oksanen (1990). It is based on extensive literature reviews and on field work performed by Ahti.

Newfoundland and Labrador

Vascular plants

Newfoundland and Labrador became of special interest to Finnish botanists in the late 1930s (Tanner 1938). Botanists focused on timberline studies (Hustich 1939, 1966), phytogeography (Hustich 1949a, 1949b, 1965a, 1965b), species inventories (Hustich 1962, 1963; Hustich and Pettersson 1944, 1945; Mäkinen and Kallio 1980), and introduced vascular plants (Hustich 1971, 1972). Ilkka Kukkonen has collected at Nunavut, Quebec (H, TUR)

Algae

Cedercreutz (1944) reported 229 species of algae collected by I. Hustich in 1937. Desmids collected by Ruth H. Moser in 1955, Edward T. Lawson in 1960, and Douglas Groves Harp in 1961 were reported by Croasdale and Grönblad (1964). Ten new varietes were described and 191 desmids were recorded for Labrador for the first time. All specimens should be at H, at least those collected by Hustich, but it is unclear how they have been preserved in the collections. Old microalgal material at H is in need of inventory.

Bryophytes

Risto Tuomikoski (1911–1989) collected in 1947 and 1949 several thousand bryophyte specimens from 53 localities in Newfoundland (H). The number of hepatic species was 116 (Buch and Tuomikoski 1955) and of mosses excluding Sphagnum 340 (Tuomikoski et al. 1973). Teuvo Ahti collected rich bryophyte material from Newfoundland in 1956. Timo Koponen collected in 1972. Primary material of these collections is deposited at H. Crum and Kallio (1966) studied bryophytes at Labrador and Ungava Peninsula (TUR).

Fungi and lichens

Mycologists have made significant identification studies and prepared species lists since the 1960s (e.g., Kallio and Kärenlampi 1966; Huhtinen 1982, 1985; Ohenoja and Ohenoja 2010). Heli Heikkilä (TUR), Seppo Huhtinen (TUR), Paavo Kallio (TUR), Tuomo Niemelä (H), Yrjö Mäkinen (TUR), Esteri Ohenoja (TUR, OULU) (born Kankainen), and Martti Ohenoja (OULU) are the principal recent Finnish collectors of fungi in Newfoundland and Labrador and Quebec. Most collections are from nearby timberline regions. Huhtinen (1982) reported 44 ascomycetes from central and northern Labrador. In his monograph of Hyaloscypha and allied genera, Huhtinen (1989) presents many records from the Northwest Territories, Quebec, and the Yukon.
Ahti studied lichen heath communities in 1956 (Ahti 1959). Lichen taxonomy has been the special interest of Teuvo Ahti, and he has significantly contributed to the lichenology of Newfoundland (for references, see Ahti 1983). Filip Högnabba collected lichens at Newfoundland in 2007 (H).

Greenland

Greenland in 1870 proved to offer rich fossil material to botanists of the Nordenskiöld expedition. Sven Berggren compiled a list of vascular plants and bryophytes, J.G. Agardh of macroalgae, and Berggren and Nordstedt of microalgae (Nordenskiöld 1870).

**Alfred Gabriel Nathorst** (1850–1921) was the responsible botanist in the 1883 expedition to Disco Bay, Greenland (Nordenskiöld 1885). Nathorst was in favour of a Nunatak theory and listed possible Nunatak plants: *Armeria sibirica, Campanula uniflora, Cassiope hypnoides, Cerastium alpinum, Luzula hyperborea* [confusa vel nivalis], *Oxystria digyna, Papaver nudicaule, Poa trichopoda* [tolmatchewii], *Potentilla nivea, Ramunculus pygmaeus, Saxifraga oppositifolia, Silene acaulis*, and *Trisetum subspicatum* [spicatum]. At “Sofia Bay” (name of the vessel) by the northwest coast, 100 plant species were found at Atanekerdlukissa, e.g., *Arnica alpina, Artemisia borealis, Erigeron compositus*, and *Veronica kjellmanii* [Puccinellia kjellmani], at King Oscars harbour 113 species, and at Ivigtut 32 alien plants, of which 29 were new to Greenland. Ivigut was a center of cryolite mining.

Nathorst collected Tertiary fossils at the Atanekerdlukin, Disco, Harön, and Patoot areas. Henry Väre collected 80 vascular plants at the Disco area in 2012 (H).

**Fungi and lichens**

Esteri Ohenoja (OULU) participated in the International Symposium on Arctic and Alpine Mycology in Greenland, Kangerlussuaq and Sisimiut in 2000. Bryophytes, fungi, lichens, and vascular plants are deposited to OULU. Filip Högnabba collected lichens of Greenland in 2005. *Cladonia scotteri* from Greenland was described as new to science and *Cladonia uliginosa* and *Cladonia farinacea* as new to Greenland (Hansen and Ahti 2011).

**Summary**

During a 200 year period until the present, Finnish botanists and mycologists have provided about 60,000 specimens in the Arctic deposited to the Finnish Museum of Natural History, Botanical Museum, and additionally about 50,000 observations made at the Kola Peninsula. Concerning the Arctic, the Kola Peninsula is floristically closely related to Scandinavia and consequently is a natural choice to be explored. However, after the 1917 revolution in Russia, that area has been almost inaccessible to foreign scientists until this millennium. At least 15 scientists have done significant collections in the area (Table 2). Most collections are deposited to H.

Other areas of interest have been especially Newfoundland and Labrador and also Svalbard. In addition, expeditions to Arctic North America and Greenland were of interest to Finnish botanists and mycologists (Table 2).

Concerning the Arctic Flora Inventory and other future needs of information, areas studied in the past should be revisited, and especially, areas east of Kanin and the Yamal peninsulas to the Beringean region should be studied intensively, and information published in the literature should be evaluated and databased. Many expeditions have provided detailed species lists with known locations, e.g., those performed by Kihlman and Nordenskiöld. Information on species abundances or coverage was generally not studied.
Table 2. Expeditions by Finnish botanists in the Arctic, material collected, and number of new taxa to science (herbaria acronyms follow Index Herbarium).

<table>
<thead>
<tr>
<th>Collector</th>
<th>Area</th>
<th>Year(s)</th>
<th>Herbaria</th>
<th>Material</th>
<th>New al taxa</th>
<th>New br taxa</th>
<th>New fu taxa</th>
<th>New li taxa</th>
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Note: al, algae; br, bryophytes; fo, fossils; fu, fungi; li, lichens; vp, vascular plants.
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