

A review of *Characeae* (Charophyta) in Murmansk Region (Russia) with notes on a new record of *Chara virgata*

Ilona V. Blinova & Marja Koistinen

Blinova, I. V., Polar-Alpine Botanical Garden-Institute, Kola Research Centre of Russian Academy of Sciences, Kirovsk, Murmansk Region, Russia. E-mail: ilbli@yahoo.com

Koistinen, M., Finnish Museum of Natural History (Botany), P.O. Box 7, FI-00014 University of Helsinki, Finland. E-mail: marja.koistinen@helsinki.fi

Five species of Characeae are known in Murmansk Region from five biogeographic provinces (*Lps*, *Lt*, *Lim*, *Ks*, *Lv*). One of them, *Chara strigosa* A. Braun, is included in the Red Data Book of the Russian Federation. A new site for *C. virgata* Kütz. is described from a rich fen in the province of *Lim*. This is the second record of the species in the Region. The new site is situated about 100 km NW of the previous one in a lake near the White Sea coast. The status of this species in the Regional Red Data Book should be 'Vulnerable'.

Introduction

The Characeae are an important component in aquatic ecosystems of lakes and smaller water bodies (Coops 2002). In recent decades the role of this group has been re-assessed for conservation purposes in Europe because stoneworts are good indicators of water quality (Van den Berg & al. 1998, Blindow 2000, Båstrup-Spohr 2013). The occurrence of stoneworts in ecosystems is often associated with calcareous rocks which have an influence on water salinity and pH. Such places are infrequent in Fennoscandia (Langangen 1974, Langangen & al. 2002, Krämer 2002).

Most of the herbarium specimens of stoneworts from the extreme north-eastern part of Fennoscandia were collected in 1899–1934 by the Finnish botanists C. W. Fontell, K. Linkola, N. Söyrinki and A. Vaarama. Their specimens were identified or confirmed by the Characeae specialists C. Cedercreutz (Helsinki) in 1932–1938

and A. Langangen (Oslo) in 1996–1997, and four species were recognized (*Chara globularis*, *C. strigosa*, *Nitella flexilis*, *N. opaca*). The Characeae have been poorly studied in Murmansk Region and no review has so far been prepared. This paper presents the first synopsis of the family in the area.

Methods

Specimens of Characeae from Murmansk Region were examined in the Botanical Museum, Helsinki (H). They were not found in the main Russian herbaria (KPABG, LE and MW). However, some untreated specimens might be located in future in unsorted accessions. The voucher specimens collected from the new locality of *Chara virgata* have been deposited in H and in the herbarium of the Polar-Alpine Botanical Garden-Institute (KPABG). There was no information on

Characeae from Murmansk Region in the literature or unpublished materials (Letopisi prirody¹) of the Lapland Nature Reserve, the Kandalaksha Nature Reserve and the Pasvik Nature Reserve.

Characteristics of the cortex and stipulodes of the specimens were studied using a stereomicroscope Leica MZ12. Images of branchlets, stipulodes and cortical spines were prepared with the help of a Leica MZ6 stereomicroscope, a Leica DFC490 camera and a Leica Application Suite (LAS v.4.0) program.

New site for *Chara virgata*

Chara virgata is distributed in Europe, Africa, Northern, Central and South America, and Australia (Wood & Imahori 1965: 182, Casanova 2005, Bueno & al. 2011). It is one of the most frequently encountered *Charae* in Fennoscandia (Langangen 1974).

In 2013 *Chara virgata* was found in a small pool at the edge of rich fen near Apatity (67°32' N) in the central part of Murmansk Region, in the biogeographic province of *Lapponia Imandrae* (*Lim*) (Fig. 1). This rich fen has been known since 2001 when the orchid *Hammarbya paludosa*² was found near the middle of the fen (Blinova & al. 2002).

In the new locality the aquatic area occupied about 12 m². The depth of water was only 20 cm on account of the extremely hot summer. The water salinity³ was 47 mg/l and pH 7.4. There was a marked poor-rich gradient as seen in the soil reaction and the salt content in the rich fen, where the *Chara*-pool was located in an area of high-

er pH and salinity. Some neighboring plant communities with a similar high pH and salinity were populated by orchids (*Dactylorhiza incarnata*, *Gymnadenia conopsea*) and brown bog-rush (*Schoenus ferrugineus*). Further description of the neighboring rich fen is given by Blinova and Uotila (2013).

Chara virgata was dominant at the bottom of the pool (Fig. 2). Individuals had 13.7±4.5 cm long stems with (7)10–15(18) mm long internodes. Stipulode length was very variable between individuals and even between different nodes on the same plant. The cortex was triplostichous and tylacanthous with papillous spine cells (Fig. 3). The species shared this mire pool with the vascular plant *Utricularia minor* and with two mosses (*Limprichtia revolvens* and *Scorpidium scorpioides*) at the margins. Two sedges (*Carex lasiocarpa* and *C. rostrata*) were dominant at the edge of the pool and occasionally occurred in the water. Single plants of *Carex juncella*, *Menyanthes trifoliata* and *Saxifraga aizoides* were seen in addition. The well lit part of the area (25750 lx) is partly surrounded by low trees (*Betula subarctica*, *Pinus friesiana*, *Alnus kolaensis*, *Salix caprea*) and shrubs (*Juniperus sibirica*, *Salix* sp.).

The old record of this species from Murmansk Region (Volkova 1974) is from Lake Velikoje, about 100 km to the south-east, in the province of *Lapponia varsugae* (*Lv*). At that site *C. virgata* was a component of a riparian plant community dominated by the vascular plant *Stratiotes aloides* and the moss *Warnstorfia exannulata*. Interestingly enough the description probably includes the first and only find of *S. aloides* in Murmansk Region. It was however expected that *Stratiotes* would be found close to the southern and south-western borders of Murmansk Region (Selivanova-Gorodkova 1953).

Characeae in Murmansk Region

Most of the stonewort specimens from Murmansk Region are preserved in the Herbarium of the Finnish Museum of Natural History, Helsinki (H). They have been collected in *Lapponia petsamoensis* (*Lps*) and the eastern part of *Regio kuusamoensis* (*Ks*) during the period when the areas belonged to Finland.

¹ The Letopisi prirody or Chronicles of Nature is an annual document of significant information and research on a Zapovednik (Strict Nature Reserve) (Ostergren & Hollenhorst 2000).

² Nomenclature according to Czerepanov (1995) for vascular plants and Ignatov & Afonina for mosses (1992).

³ The following measurements were made: pH of the surface water directly in the field using a PH-009 (Kelilong Instruments) pen with a 0.0–14.0 scale divided into units of 0.1; soil salinity using a TDS 5 (HM Digital) pen with a 0–9990 mg/l scale divided into units of 1 mg/l; and illuminance in the habitat using a *Smart Sensor Digital Lux Meter AR813A* (1–100.000 Lx) divided into units of 1 Lx.



Fig. 1. A pool with *Chara virgata* at the edge of a rich fen near Apatity (Murmansk Region, Russia). The low water table is due to the anomalously warm and dry summer of 2013. Photo I. Blinova 26 August 2013.



Fig. 2. *Chara virgata* dominant in a pool at the edge of a rich fen near Apatity (Murmansk Region, Russia). Photo I. Blinova 26 August 2013.

In the Russian literature *N. flexilis* is mentioned for one lake near the tundra zone (in the basin of the Teriberka River) and *C. virgata* (under a synonymic name *C. delicatula*) is known from another lake in the central part of the Varsuga River basin (66°59' N) (Volkova 1974). These two Russian records correspond to the provinces *Lapponia tulomensis* (Lt) and *Lapponia Varsugae* (Lv). However, both records relate to difficult species pairs (*Nitella flexilis* / *N. opaca*, *Chara virgata* / *C. globularis*), and their occurrences need to be confirmed by herbarium specimens.

Altogether five species of Characeae are known from Murmansk Region, as listed below. They are from four sites geographically remote from each other (Fig. 4).

1. *Chara globularis* Thuill.

Ks, Salla [Kuolajärvi], Kutsajoki River basin, Lake Pyhäjärvi, Kenttälähti Bay, depth of water ca. 1 m, 24.VII.1934 A. Vaarama (H 5000465).

2. *Chara strigosa* A. Braun

Ks, [Salla] Kuolajärvi, Kutsajoki River basin, Lake Pyhäjärvi, 18. VIII.1925 K. Linkola (H 5000861).

Ks, Salla [Kuolajärvi], Kutsajoki River basin, Lake Pyhäjärvi, depth of water ca. 1.3 m, 20.VII.1934 A. Vaarama (H 5000854).

3. *Chara virgata* Kütz.

Lim, ca. 5 km east – south-east of Apatity, calcareous fen, 20.VIII.2013 I. Blinova (H 50007376, KPABG).

Lv, Varsuga River basin, Lake Velikoje (Volkova 1974).

4. *Nitella flexilis* (L.) C. Agardh

Ks, Salla [Kuolajärvi], Kutsajoki River basin, Lake Pyhäjärvi, depth of water ca. 2.5 m, 21.VII.1934 A. Vaarama (H 5001480).

Lt, Teriberka River basin, Lake Kanentjavr (Volkova 1974).

5. *Nitella opaca* (C. Agardh ex Bruzelius)

C. Agardh

Lps, Petsamon tunturit [Pechenga fjelds, South – south-west of Zapolyarnij], Kierghipori [Kiedgepoorre Hill], mountain stream with mud bottom, 23.VIII.1933 N. Söyrinki (H 5004002).

Lps, Petsamon tunturit [Pechenga fjelds, South-south-west of Zapolyarnij], Luottooav [Luotnoaivi Fjeld], small mountain lake with mud bottom, 16.VIII.1933 N. Söyrinki (H 5001354).

Lps, Petsamo [Town of Pechenga], Knaschenga [Näsykkä], 29.VIII.1899 C. W. Fontell (H 5001353).

Three species (*Chara globularis*, *C. virgata*, *Nitella opaca*) are relatively widely distributed in Fennoscandia, while two other species (*C. strigosa*, *N. flexilis*) are less frequent (Langangen 1974, Langangen & al. 2002, Blindow 2000). The association of stoneworts with a certain type of aquatic or mire vegetation is not yet completely understood. However, some lakes with *Chara*-dominated vegetation are classified under a special unit 3140 among freshwater habitats with standing water in Europe (European Commission 2013). Maristo (1941) described a particular botanical lake type (*Potamogeton filiformis* – *Chara* type) from the Kuusamo area, with *Chara strigosa* as one of the key species. This type corresponds to "humic *Chara*-lakes" rich in both humus and calcium (Blindow & Langangen 1995, Langangen 2000).

There is a need for data on vegetation types which match the occurrence of Characeae in Murmansk Region. The new site including a *Chara virgata* pool in Lim forms part of a calcareous fen complex and should be considered under habitat type 7230 Alkaline Fens (European Commission 2013). However the first description of the site with this species in Lv represents 3150 *Hydrocharition* type vegetation, which is very vulnerable and occurs only rarely in European lakes (Understanding water for wildlife 2007). Lake Pyhäjärvi, Ks, where three other stoneworts have been found (*Chara globularis*, *C. strigosa*, *Nitella flexilis*) may correspond to the *Hydrocharition* type vegetation as well. The northern occurrence of *Nitella flexilis* in Lt in Lake Kanentjavr with *Isoetes lacustris* (Volkova 1974) dominant may perhaps correspond to the mineral-poor unit 3110 – Oligotrophic Waters of Sandy Plains (*Littorelletalia uniflorae*). Such lakes are often classified as *Lobelia*-lakes (Maristo 1941, Langangen 2000, Szańkowski & Kłosowski 2006, Bociąg & al. 2011). This type seems to occur rarely in Murmansk Region. Confirmation is needed for the only occurrence of *Lobelia dortmanna* near where the Iova River entered the former Lake Kovdozero or south-west of Kovdozero; this record, based on various maps (Hultén 1971, Hultén & Fries 1986), was accepted in the Flora of Murmansk Region (Semenova-Tjan-Shanskaja 1965). No herbarium specimens were found in KPABG, H, LE, MW. However, already two

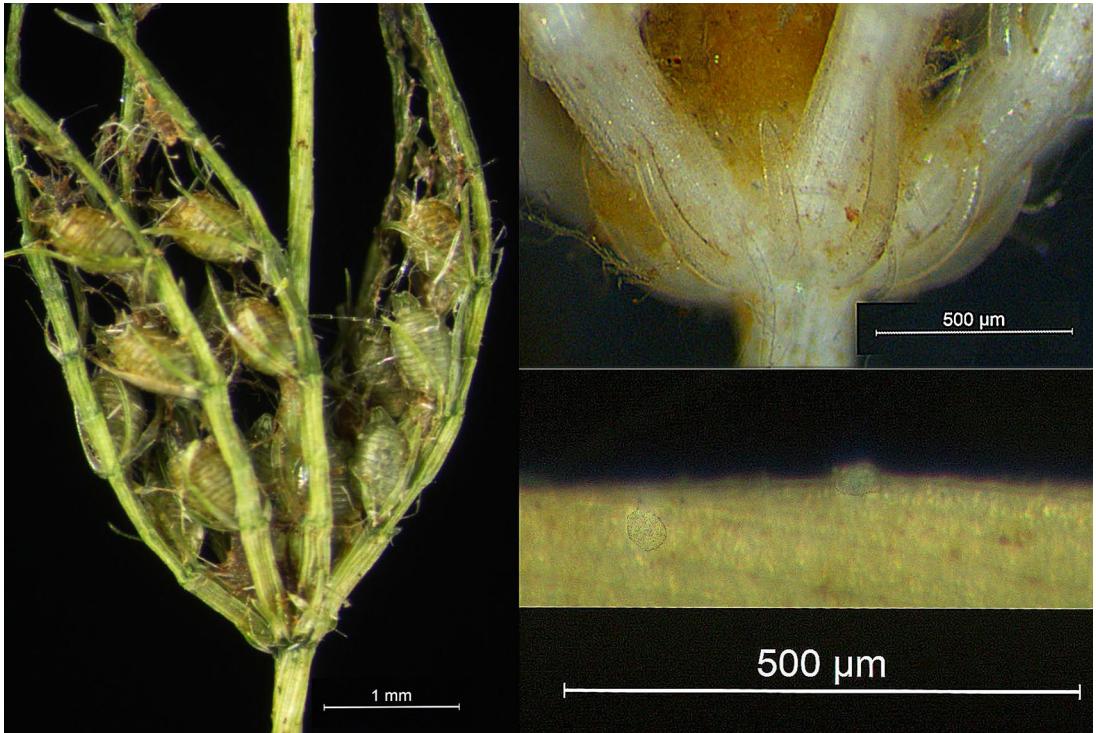


Fig. 3. *Chara virgata*: branchlet with fertile segments (left), two rows of stipulodes – well developed and rudimentary (top right), a part of the cortex with papillous spine cells (bottom right). From *I. Blinova* (H). The left image is made from dry material, the others from alcohol-preserved material. Photo M. Koistinen

sites (Lake Kovdozero and Lake Vuorijärvi) are given in the recent survey (Kostina & Filimonova 2009). Other diagnostic species (*Isoëtes lacustris*, *I. echinospora*) of *Lobelia*-lakes are known from a few occurrences scattered through Murmansk Region (Kuzeneva 1953, Hultén & Fries 1986). All these species are present in the Red Data Book of Murmansk Region (Konstantinova & al. 2003). Concerning the record of *N. flexilis* in Lake Kanentjavr it should be borne in mind that it might be an incorrect identification of *N. opaca*. Unfortunately, no herbarium specimens are available from this site to confirm the determination. Besides there are no vegetation data at all for records of *N. opaca* in *Lps*.

Two species of *Chara*, *C. filiformis* and *C. strigosa* are included in the Red Data Book of the Russian Federation (Bardunov & al. 2008). Because Russian botanists were unaware of the records made by Finnish botanists and of some reviews with maps for particular species (Cedercreutz 1938, Vaarama 1954, Langangen 2000),

C. strigosa is missing from the Red Data Book of Murmansk Region. It should be included with at least the same status 3 (rare) as it is accorded in the Red Data Book of the Russian Federation. However, *C. strigosa* has been collected only from one small lake in *Ks*, Lake Pyhäjärvi, and we recommend that it would be included in the Regional Data Book with the status Endangered (EN), even though Lake Pyhäjärvi is included in the Kutsa National Park and is under protection.

The status Least Concern (LC) is considered appropriate for *C. virgata* in Norway and Finland (Kålås & al. 2010, Koistinen 2010). In Murmansk Region the species is known from two sites with rare plant communities, and it is very unlikely that new populations will be found very often. In the parts of Norway and Finland adjacent to Murmansk Region the number of records is very low except for *Regio kuusamoënsis* (*Ks*). Two records of *C. virgata* are known from the neighboring Norwegian province of Finnmark, just north-west of the Kola Peninsula: 1) Sør-Va-

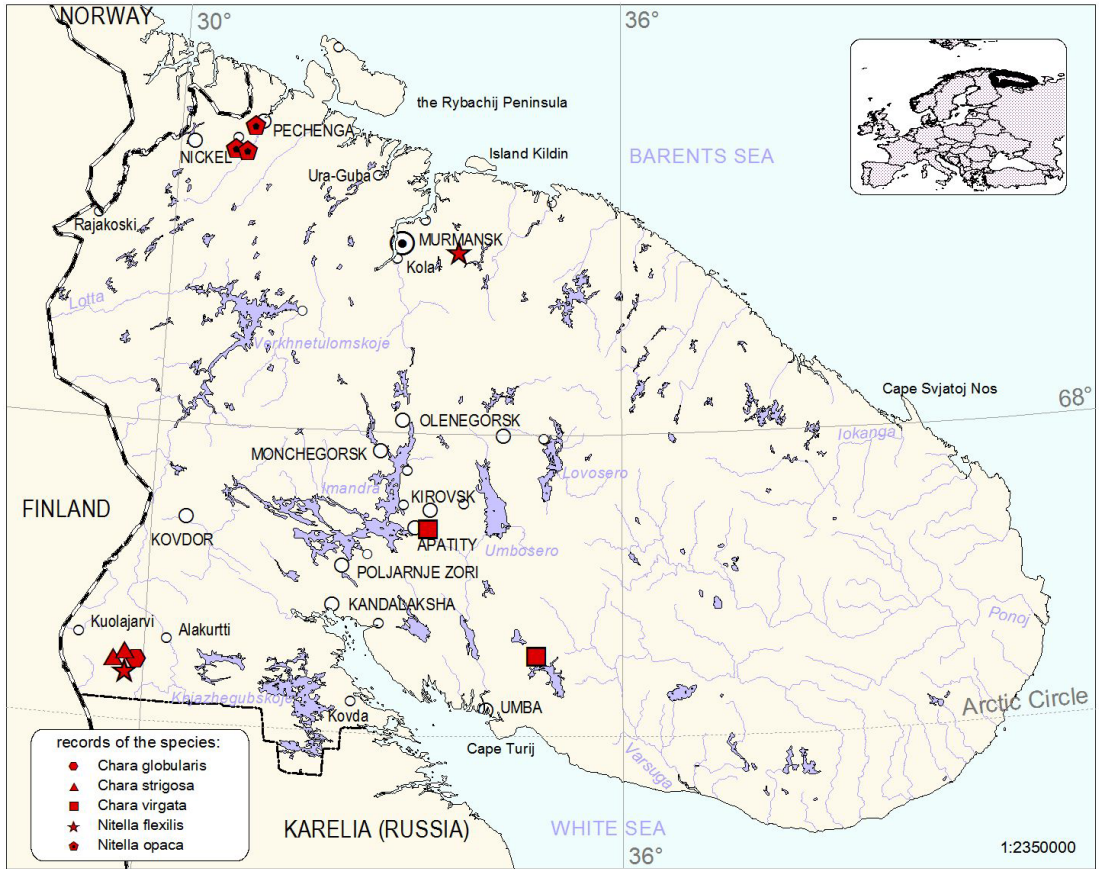


Fig. 4. Characeae sites in Murmansk Region, Russia.

ranger: Øvre Pasvik National Park, the River Pasvik (~69° N) (Alm & al. 1995), 2) Porsanger: Ailegasvuopmi, Selgesluoppal, (~70°) (TROM). In the adjacent northern parts of Finland there are two records from *Laponia inarenensis* (Li) and many from *Regio kuusamoënsis* (Ks) from where also other Characeae are known in the neighboring Russian part of Ks (Langangen & al. 2002). The nearest site in the Karelian part of Ks is Lake Krivoje (66°20' N) on Cape Kartesh, Chupa Bay (Zhakova, pers. comm.).

We suggest including *C. virgata* in the Red Data Book of Murmansk Region with the status Vulnerable (VU). One southern record reported by Volkova (1974) now needs to be checked as to whether it is still present. The newly discovered site is under threat. In spite of the fact that this area is intended by the regional Ministry for Nature Development to become a nature monu-

ment by 2038, the site near Apatity may disappear soon because of building construction to the east of the town.

More studies of this species and other Characeae in Murmansk Region are required. The sites to study first are (a) Lake Pyhäjärvi, (b) Lake Velikoje, (c) the River Iova basin near Lake Kovdozero in the southern part of Murmansk Region, (d) Lake Kanentjavr, (e) water bodies near the site where the rivers Näsykkäjoki and Pechengaja join, (f) the small mountain lakes and streams with mud bottom between Mt. Vilgiskodeoaiivi and Lake Luottnjavr, which are south of the town Zapoljarnij in the northern part of the Kola Peninsula. It should be taken into account that two sites are seriously damaged: Lake Kovdozero was enlarged as the Knjazhegubskoje reservoir in 1955–1957; the Zapoljarnij area is affected by several mines developed in 1955, and the Kola Super-

deep Bore Hole collapsed in 1970 and was closed in 2010. Other promising sites are some areas of the Pasvik Nature Reserve, e.g. (g) Lake Höyhenjärvi (partway along the River Patsojoki) and small lakes in the Menikkajoki River basin; and also parts of the Lapland Nature Reserve, e.g. (h) the River Chuna basin near Lake Chunozero and Lake Pusozero (between Salnye Tundry and Tuadash Tundry); and one place of the Kandalaksha Nature Reserve, i.e. (i) Lake Serkinskoje (Cape Turij) because *Potamogeton filiformis*, one of the key species of the *Chara* lakes is known from these areas (Kostina 2003, Kravchenko 2011, Kostina & Berlina 2012, MW).

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