**Calypogeia fissa** (Calypogeiaceae, Marchantiophyta)
in the Northwestern European Russia

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Abstract. *Calypogeia fissa* is a species poorly known in Russia, which description has not been published in native literature since 1936. It is reported for the first time for the mainland Leningrad Region from the Kurgalsky Peninsula, near the Russian-Estonian border. Previously it was collected in the Leningrad Region in Hogland Island, Gulf of Finland. These are the only known recent records of *C. fissa* from the Northwestern European Russia at its eastern limit of distribution in Europe. The species is represented in the study area by *C. fissa* f. *subintegrifolia*, which may be easily confused in the field with the other species of *Calypogeia* due to its mostly entire leaves. Morphological description and photographs of *C. fissa* from the Leningrad Region and its habitat in the Kurgalsky Peninsula are provided. Distribution, ecology, variation and differentiation of *C. fissa* are discussed.

**Keywords:** *Calypogeia fissa*, ecology, morphology, differentiation, distribution, taxonomy, variation, Kurgalsky Peninsula, Leningrad Region, Latvia, Republic of Karelia, Russia.

The genus *Calypogeia* Raddi still remains to be poorly studied in Russia. Recent works in European Russia have shown some hidden problems in differentiation of the well-known species, which arose from their superficial resemblance in the field caused by their leaf shape similarity and study of mostly dried specimens without oil bodies. Potemkin

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Резюме. *Calypogeia fissa* — недостаточно известный в России вид, описание которого не публиковалось в отечественной литературе с 1936 г. *Calypogeia fissa* впервые приводится для континентальной части Ленинградской области на основании прижизненных коллекций с Кургальского полуострова, расположенного близ границы с Эстонией. Ранее вид собирался в области на острове Гогланд, Финский залив. Это единственные известные современные находки *C. fissa* на северо-западе европейской части России на восточной границе распространения вида в Европе. На территории исследования вид представлен *C. fissa* f. *subintegrifolia*, которая при сборах может быть легко спутана с другими видами рода из-за преимущественно невыемчатых на верхушке листьев. Приведены описание и фотографии *C. fissa* из Ленинградской области и ее местобитания на Кургальском полуострове, а также характеристика распространения, экологии, изменчивости и отличий.

**Ключевые слова:** *Calypogeia fissa*, изменчивость, отличия, распространение, экология, Кургальский полуостров, Латвия, Ленинградская область, Республика Карелия, Россия.
et al. (2017) have described inadequate treatment of *C. azurea* Stotler et Crotz [formerly *C. trichomanis* (L.) Raddi, nom. rej.] in the Northwestern European Russia and adjacent territories, where it was identified mostly as *C. integristipula* Steph., rarely as *C. neesiana* (C. Massal. et Carestia) Müll. Frib., exceptionally as *C. suecica* (Arnell et J. Perss.) Müll. Frib. and *C. fissa*. New studies in 2017 revealed the first recent location of *C. fissa* in the mainland Leningrad Region, the Kurgalsky Peninsula, close to the Russian-Estonian border. Earlier findings of this species in Hogland Island located in the Gulf of Finland between the Finnish town of Kotka and the Estonian town of Kivõli were its only recent records in European Russia (Potemkin, Sofronova, 2009; Potemkin, Rozantseva, 2015). Previously it was reported in the Northwestern European Russia from the Leningrad Region and the Republic of Karelia by Arnell (1956). In this treatment *C. fissa* was listed for Russian parts of Karelian provinces *Ka* — *Karelia australis* located in northern part of Karelian Isthmus, the Leningrad Region, and *Kb* — *Karelia borealis* located in the Suojärvi Region of the Republic of Karelia. These data were probably based on records of Buch (1936), which were neglected by Schljakov (1979: 77, footnote 19), who stated that despite previous literature records the species is absent in the European part of the territory of the North of the USSR. The record of *C. fissa* for the Republic of Karelia was omitted in the generalization on Karelian liverworts by Bakalin (1999) also. The nearest records of *C. fissa* are known from southern Finland (Laaka-Lindberg et al., 2009) and from Latvia, near Riga (Potemkin et al., 2017). Description of *C. fissa* was not published in native literature since 1936 (Savicz, Ladyzhenskaya, 1936). Absence of modern description of *C. fissa* and its neglecting in a well-known monograph of Schljakov (1979) resulted in insufficient attention to this species in the field. The goal of this study was to provide morphological description of *C. fissa* from the Leningrad Region, discuss its ecology, morphological peculiarities, variability and differentiation to facilitate its new records in the Northwestern European Russia and adjacent territories.

**Material and Methods**

The study was based on fresh collections of *C. fissa* made in the Leningrad Region and results of previous studies of the species by the author. Four cited below specimens with oil bodies were found and identified in the study area. They were collected in minigrip (= ziplock) plastic bags to prevent desiccation. Photographs of alive plants from the Leningrad Region have been made by an Olympus Stylus Tough TG-3 and a Nikon Coolpix 7900 digital cameras.


*Studied plants* green to greyish and brownish green, translucent and somewhat glistening, (1.1)1.5–2.2(2.8) mm wide and (5)7–12(20) mm long, simple or with sporadic
ventral intercalary branches. Leaves incubous, imbricate or approximate, non decurrent or slightly to distinctly decurrent, ovate to cordate, obliquely cordate and oval, about as long as wide to $1–1.3 \times$ as long as wide, with subacute, acute to obtuse, occasionally ± notched, exceptionally acuminate apex; some leaves occasionally bilobed with ± deep sinus and acute lobes (Plates I: 1, 2, II: 1–4, 10, 11). Underleaves distant, elevated and sometimes incurved, ± arcuatly inserted and short decurrent, 0.95–1.25 $\times$ as wide as long, slightly wider than stem to $2 \times$ as wide as stem, 1/2–3/4 bilobed, with 1–2(3) tiers of cells from the base of sinus to the rhizoid-initial zone, sinus broad, mostly U-like, or sometimes rather narrow V-like, lobes mostly obtuse and terminated mostly by 2 cells or subacute, terminated by 1 cell, lateral margins usually with lateral tooth or protuberance; cells of underleaves moderately elongated or subsidiametric, rhizoid initial zone usually broad and ± narrow, with often abundant strongly branched rhizoids (Plate II: 5–11). Cells of leaves almost not differentiated near the margins and at the base, variable in size like in the other species of the genus (Plate II: 1–4, 12); thin-walled or with slightly thickened colorless or brownish walls, often with minute distinct trigones, apical and subapical cells subsidiametric ca. (20)25–30(40) $\times$ 25–40(55) μm, marginal cells in upper part of leaf ca. (20)25–30 $\times$ 25–35(40) μm; median cells mostly slightly elongated, ca. (20)25–40(50) $\times$ 35–55(65) μm, basal cells ca. (25)30–50(60) $\times$ 40–80(90) μm. Oil bodies greyish, present in all cells of leaves and underleaves, (2)3–7(10) per median cell of leaves, of 1–3 to many segments, rounded, ± oval and elongated ± botryoidal or linear of chain-like arranged segments, ca. 3–6 $\times$ 3–13 μm, segments ca. 1–1.5(2) μm in diam., often variable in size within an oil body (Plate II: 12). Gemmae common, often abundant (Plate I: 1), colorless, usually 1–2-celled, mostly broadly oval, ovoid and subspherical, ca. 17–25 $\times$ 25–35(45) μm. Autoicous or paroicous according to Schuster (1969) and Damsholt (2002), according to Paton (1999) autoicous. Only branches with anteridia were recorded in the studied specimens.

Distribution and Ecology

Calypogeia fissa has definite suboceanic distribution pattern. It is known from North America, Europe, North Africa and Asia with separation of its amphiatlantic and subpacific Asian populations. Its distribution in Europe is subatlantic and extends through the western part of the continent, the British Isles, western edge of Scandinavia and the Mediterranean region, Madeira, Azores, Canary Isles (Buczkowska, 2004a). Taxonomic status of Asian populations, distinguished by some authors following Schuster (1969) as a separate subspecies or species, needs a molecular study. In European Russia C. fissa is known from the Leningrad Region and the Republic of Karelia. Moreover, there are old not confirmed records from the North Urals and Ivanovskaya Promyshlennaya Oblast’ in the Central European Russia. It is recorded from the Caucasus, too (Potemkin, Sofronova, 2009).
In European Russia and adjacent territories *C. fissa* is certainly known from locations with humid microclimate, namely, from Hogland and Aland islands and areas adjacent to the Gulf of Finland and the Baltic Sea (Laaka-Lindberg et al., 2009, Potemkin, Rozantseva, 2015, Potemkin et al., 2017). In the study area *C. fissa* grows on ± wet humus-reach and sandy soils and rotten wood near temporary water courses in coastal communities with spruce, pine, alder, aspen, birch and other trees, often with ferns. It associates with *Pellia epiphylla*, *Chiloscyphus polyanthos*, *Scapania undulata* or *S. subalpina*, *Cephalozia bicuspidata* [misprinted as *C. loitlesbergeri* Schiffn. in Potemkin, Rozantseva (2015)], once mentioned with *Calypogeia muelleriana*. It is recorded also in rock crevice with seepage in association with *Scapania nemorea*. *Calypogeia fissa* often forms rather extensive mats due to frequent gemmae and not seen but probably regular spore production.

In Nordic countries the species is recorded from suboceanic territories of Norway, Sweden and Denmark. It occurs there at damp clay or sandy loose soil on banks and along ditches together with *Cephalozia bicuspidata*, *Nardia scalaris* Gray, *Diplophyllum albicans* (L.) Dumort., *Solenostoma gracillima* (Sm.) R. M. Schust. and *Scapania scandica* (Arnell et H. Buch) Macvicar. In woods, on rocks and rock faces, by stream, together with *Solenostoma obovatum* (Nees) R. M. Schust. and *Scapania undulata* (Damsholt, 2002).

**Variation and Differentiation**

Despite since Dillenius (1741) and Linne (1753) *Calypogeia fissa* was treated as a species with bifid leaves (Fig.), its morphological variability is much broader. The species includes morphotypes with notched and entire at apex leaves known as *C. fissa* f. *fissa* and f. *subintegrifolia* (C. E. O. Jensen) Damsh., respectively. Damsholt (2002: 467) mentioned *C. fissa* var. *intermedia* (C. E. O. Jensen) Jørg. with acuminate, rarely bidentate leaves and almost orbicular, large, deeply divided underleaves, usually lacking marginal projections or tooth. Plants from the Leningrad Region should be attributed to *C. fissa* f. *subintegrifolia* due to chiefly entire leaves and rather small underleaves with marginal tooth or projection. Similar plants were illustrated by Damsholt (2002: Fig. 176).

Buczckowska (2004b:140) differentiated the Polish plants of *C fissa* on the basis of leaf and underleaf shape as follows: leaves in *C. fissa* are usually relatively narrow, longer than wide, bidentate or sometimes entire and acute at apex; underleaves are deeply bilo-lobed, with teeth on lateral margins. Schumacker and Váňa (2005) keyed out this species from *C. azorica* Bischl., *C. azurea* and *C. muelleriana* as follows: leaves longer than wide, narrowly ovate, often shortly bidentate at apex or acute; underleaves 1.3–1.8 × wider than long, divided to 0.5–0.75 their length, with 1 lateral tooth or protuberance (at one or both sides); 2–3 cells between sinus base and rhizoidal plate.

Mentioned above remarkable distinctions of *C. fissa* do not work properly for *C. fissa* f. *subintegrifolia* occurring in the Leningrad Region. Leaves of our plants mostly entire or
Potemkin. Calypogeia fissa in the Northwestern European Russia

Plate. I. *Calypogeia fissa* (L.) Raddi from the Leningrad Region. 1 — gemmiparous plants, 2 — plants without gemmae, 3 — collecting place. Scale bars: 1 mm. All from Potemkin 120817-1518.
Plate II. *Calypogeia fissa* (L.) Raddi from the Leningrad Region. 1–4 — leaves, 5–9 — underleaves, 10–11 — shoot sectors with notched leaves, postical aspect, 12 — cells with oil bodies. Scale bars: 1–4 — 650 µm, 5–9 — 250 µm, 10–11 — 600 µm, 12 — 10 µm. All from Potemkin 120817-1518.
Potemkin. Calypogeia fissa in the Northwestern European Russia

not remarkably notched at the apex, often about as wide as long. Similar leaves may occur in C. azurea, C. muelleriana and C. suecica. Moreover C. sphagnicola may develop mod. densifolia-latifolia with notched at apexes leaves. These facts make us to pay primary attention to the underleaf shape and collecting of the genus in described above characteristic habitats of C. fissa. Oil body structure and color are important for differentiation of C. fissa from C. azurea having blue oil bodies and from C. sphagnicola and C. suecica with oil bodies of single or a few, mostly 2–4 segments. It is noteworthy that in our collections C. fissa was found once together with related C. muelleriana, from which it differs in regularly deeper bilobed underleaves with 1 marginal lateral tooth or protuberance on one or both sides and sporadically notched leaf apexes.

Unknown in Russia C. fissa var. intermedia may be confused with C. muelleriana. It is distinct from the latter in deeply bilobed underleaves and acuminate leaves.

Specimens examined (identified with oil bodies): Russia, Leningrad Region, Kingisepp District, Hogland Island, near Kappellahti Bay, on soil and over rotten wood in bottomland of temporary watercourse (60°04′42.780″N, 26°58′42.096″E) abundantly together with Scapania subalpina (Nees ex Lindem.) Dumort., Cephalozia bicuspidata (L.) Dumort., Pellia epiphylla (L.) Corda, 21 VII 2007, Potemkin, Kotkova Г-29-1 (РК-Н-21), LE, ibidem, on ground of partly buried shell hole in blueberry moss coastal pine forest (60°04′44.364″N, 26°58′39.324″E), with C. muelleriana (Schiffn.) Müll. Frib., 21 VII 2007, Potemkin, Kotkova Г-26-2 (PK-H-19), LE, ibidem, Mt. Haukkavuori, on soil in rock fissure with seepage (60°04′09.156″N, 26°58′37.524″E) together with Scapania nemorea (L.) Grolle, 1 VIII 2007, Potemkin, Kotkova Г-109 (PK-H-171), LE; Eastern part of Kurgalsky Peninsula, near Beloe Lake, on humus and sandy soil on bank of brook in mixed forest with black alder, spruce and birch (59°42′08.2″N, 28°07′26.1″E), with Scapania undulata (L.) Dumort., Chiloscyphus polyanthos (L.) Corda, Pellia epiphylla, Atrichum undulatum (Hedw.) P. Beauv., 23 VII and 12 VIII 2017, Potemkin 230717-1518, 120817-1518, LE.

Acknowledgments

I am grateful to Vasily G. Pchelitsev for organizing trips to the collecting place of Calypogeia fissa in Kurgalsky Peninsula and to Yuri B. Okolodkov for reading the manuscript and correcting the English. The study was carried out within the framework of the institutional research project AAAA-A18-118022090078-2 (“Herbarium collections of BIN RAS (history, conservation, investigation and replenishment)”) of the Komarov Botanical Institute of the Russian Academy of Sciences.
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Potemkin. Calypogeia fissa in the Northwestern European Russia


