

Cinclidotus aquaticus (Hedw.) Bruch & Schimp. (Cinclidotaceae) in the canton of Geneva

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Cinclidotus aquaticus is a rheophile (a species that likes to live in fast moving water) that grows mostly on submerged calcareous rocks, boulders or man-made (concrete) structures in rivers of calcareous source. It is found completely to partially submerged with a preference for areas where the water is turbulent, fast-flowing and presumably well-oxygenated (see Bailly et al., 2004). It is easy to recognise by its growth in blackish-green patches (sometimes as "carpets", Fig. 1) that are composed of plants with tough stems, of up to 10-12 cm in length, its falcate-secund leaves, of 5-6 mm in length (Fig. 2) that have a bistratose border of 2-3 cells in width and a large nerve (up to 1/3 the width of the leaf base). It is morphologically closest to *C. danubius* Schiffner & Baumgartner although this latter species has smaller, lanceolate, mucronate leaves with an excurrent nerve, a thinner nerve at the leaf base (1/5 the width of the leaf base) and a wider bistratose leaf border (5-6 cells in width) than *C. aquaticus*.

Cinclidotus aquaticus in Switzerland

Cinclidotus aquaticus is reported by Amann et al. (1912) from the cantons of Appenzell Innerrhoden, Argau, Bern, Grabunden, Jura, Schwyz, Tessin, and Vaud. Data from herbarium specimens as well as from recent collections that were accumulated as part of the *Nationales Inventars der Schweizer Moosflora* (NISM) project (see <http://www.nism.uzh.ch/index.php>) revealed that this species was



Figure 1. Population of *Cinclidotus aquaticus* (Hedw.) Bruch & Schimp. on rocks in the Versoix river, Geneva, in low water.



Figure 2. *Cinclidotus aquaticus* (Hedw.) Bruch & Schimp. showing its characteristic falcate-secund leaves.

River	No. of Stations	No. stations with <i>C. aquaticus</i>	Abundance of <i>C. aquaticus</i>
Aire	15	0	--
Allemogne	6	6	abundant
Allondon	14	12	abundant
Arve	16	6	medium abundant
nant d'Avril	3	0	--
Drize	6	0	--
Hermance	16	0	--
Laire	14	0	--
Rhône	8	0	--
Roulave	8	0	--
Seymaz	19	0	--
Versoix	15	12	abundant

Table 1: River survey 2009-2010. Number of stations studied per river, the number of stations where *C. aquaticus* was observed per river and the abundance of this species per river. Each station was ca. 20 long and abundance per station was quantified using 5 classes, from absent to abundant, based on the cover of populations per station. The estimate of abundance per river is given based on the abundance estimates per station: "--" signifies that the species was absent from the river; *abundant* signifies medium to high cover (large population found across the area surveyed), *medium abundant* signifies medium cover (large population in a few places within the area surveyed).

known from herbarium specimens (pre-1980) from 1 to 12 localities in the cantons of Appenzell Innerrhoden, Argau, Bern, Geneva, Glarus, Neuchâtel, Tessin, Vaud, Zürich. Since 1980 it has been recorded from between 1 and 7 localities in the cantons of Appenzell Innerrhoden, Argau, Bern, Geneva, Glarus, Neuchâtel, Tessin, Vaud and Zürich (NISM, 2010; Bagutti & Hofmann, 2007).

Of the four species of *Cinclidotus* P. Beauv. known from Switzerland (*C. aquaticus*, *C. danubius*, *C. fontinaloides* (Hedw.) P. Beauv. and *C. riparius* (Host ex Brid.) Arn.) only *C. aquaticus* appears on the Red List of Swiss Bryophytes (Schnyder et al., 2004), in the IUCN category "endangered" (EN). A species previously treated under *Cinclidotus* as *C. mucronatus* (Brid.) Guim., now recognised under the name *Dialytrichia mucronata* (Brid.) Broth. is also listed as being critically endangered (CR) within the country (Schnyder et al., 2004).

Cinclidotus aquaticus in the canton of Geneva

Historically, *C. aquaticus* was reported from the Versoix river "Bords de la Versoix" and from the Rhône near Vernier and Loëx (Guinet, 1888; Burgisser & Price, 2005). In the context of the bryophyte inventory project of Geneva (<http://www.naturalistes-romands.ch/bryo-ge/index.html>), a collaboration between the Conservatoire et Jardin botaniques de la Ville de Genève and the Direction Générale de la Nature et du Paysage (DGNP), two river surveys were conducted within the canton in 2005 and 2009-2010. These two projects investigated the

presence / absence of *Cinclidotus* and other aquatic or sub-aquatic bryophytes in the Allondon, Seymaz and Versoix (Chabanon, 2005) and the distribution, abundance and ecology of *Cinclidotus* in 12 water courses across the canton of Geneva (see Table 1) with respect to river conditions such as flow-rate (m³/s), pollution levels, current speed (m/s), substrate, position within river (immersed or not) and river eco-morphology such as the characteristics of the river bed or presence of boulders (Vivien, 2010; Vivien & Price, in prep.).

Cinclidotus aquaticus was found to be both frequent and abundant in the Allemogne, Allondon and Versoix rivers where it grows, often in very large carpets, on large rocks, boulders and concrete structures within the river systems (Fig. 1). It is especially frequent where there is a fast current (average around 3 m³/s), such as in cascades, and on submerged rocks or boulders. This species was first noted for the Allondon by Chabanon (2005). It was newly recorded from the Arve and Allemogne in the canton of Geneva in 2009-2010 (Vivien, 2010). During 2009-2010 this species was not re-recorded from the Rhône, something that maybe linked to changes in the river characteristics caused by the construction of the barrage at Verbois. Interestingly, despite the mention of *C. aquaticus* from Geneva in Guinet (1888) no herbarium specimens of this species were found in G. An information sheet on *C. aquaticus* in the canton of Geneva can be found at the following address: <http://www.naturalistes-romands.ch/bryo-ge/Fiches.html>.

Observations made in 2005 and 2009-2010 indicate that *C. aquaticus* is common and abundant within the canton of Geneva and that, despite its rather small size, the canton of Geneva contains a population of *C. aquaticus* that could be of national interest. Low-level monitoring of this species within the canton will be carried out in the future with the aim of ensuring that any marked changes in its abundance are identified quickly.

Determination key for *Cinclidotus* in Geneva

The genus *Cinclidotus* is characterized, amongst other things, by the presence of a border at the margin of the leaves composed of a multi-stratose layer of cells from 2 to ca. 5-6 cells in width. For determinations it is necessary to make transverse cross-sections of the leaves. Since most species encountered in the canton were sterile or only very rarely found in fruit the key is based on vegetative characters only.

1. Leaves linear-lanceolate, widest at the leaf base, leaves falcate-secund, sometimes only weakly so, or more or less straight with a nerve 1/3 to 1/5 the width of leaf at leaf base. **2**
- 1'. Leaves ovate or ovate-lanceolate, widest above leaf base, leaves not falcate-secund, nerve up to 1/5 of width of leaf at leaf base. **3**
2. Leaves falciform-secund, nerve 1/3 of the width of the leaf base, leaf apex acute, leaves with bistratose border of 2-3 cells in width . . . **C. aquaticus**
- 2'. Leaves straight or weakly hook-shaped (occurring in young leaves at stem/branch tips), not secund (apices pointing in all directions), nerve from 1/4

to 1/5 of the width of the leaf base, leaf ending in a small mucron (excurrent costa), leaves bordered by bistratose border up to 5-6 cells in width.

- **C. danubicus**
3. Leaves ovate-lanceolate with an acute apex and a well-developed multi-stratose, circular leaf border, leaves keeled, twisted and contorted when dry. **C. fontinaloides**
- 3'. Leaves ovate with an obtuse apex and a well-developed bistratose (tri-stratose in places) oval-shaped leaf border of 2-6 cells in width, leaves not or only weakly keeled, leaves not much changed when dry. **C. riparius**

The species *Dialytrichia mucronata*, not included in the key above, differs from *Cinclidotus* by its leaf papillae, its leaves that are spirally twisted when dry and its hyaline cells at leaf base. It is distinctive in both its leaf shape (ligulate) and in its slightly revolute leaf margins that form a multi-stratose border. *Dialytrichia mucronata* grows on trees (roots and trunks), and occasionally rocks, at the edge of rivers.

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