

***Campylopus introflexus* (Hedw.) Brid. an alien addition to the bryophyte flora of Geneva**

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Campylopus introflexus (Hedw.) Brid. (Leucobryaceae) is one of only three well-documented invasive bryophyte species in Europe, the others being *Orthodontium lineare* Schw agr. and *Scopelophila cataractae* (Mitt.) Broth. (Razgulyaeva *et al.*, 2001). *Campylopus introflexus* originates from the Southern Hemisphere (Hassel & S oderstr om, 2005) where it is considered to be native in the southern regions of South America and Africa, parts of Australia and certain islands in the Pacific, Atlantic and Indian Oceans (Frahm & Stech, 2006; Gradstein & Sipman, 1978; Klinck, 2010; Klinck, 2009). *Campylopus introflexus* was first recorded in Europe in 1941, in Great Britain (Richards, 1963; Richards & Smith, 1975). Since its first appearance in Europe it has rapidly spread and is now common in many western European countries (see Sparrius & Koojiman, 2011). It is not clear how or from where *C. introflexus* arrived in Europe. It is not known whether it arrived first in Britain and then spread to the rest of Europe from there, or if the British record was just the first observation of this species and it was already present in other localities. It may have arrived in Europe in a number of ways. Fragments or spores could have been brought by travellers coming from its native ranges to Europe or it could have been carried between continents on ships and introduced via imported goods by way of packaging material (mosses are used to pack fragile goods or food (Glime, 2007)). Glime (2007) reports that *C. introflexus* is used in parts of the Malay Peninsula as stuffing for mattresses and pillows, though records have not been found to show that these are imported to Europe.

Morphology and Ecology

Campylopus introflexus grows in dark green cushions or loose tufts and has stems up to 5-6 cm long (Ahrens *et al.*, 2000; Hallingb ack *et al.*, 2007). The lanceolate leaves taper to long, toothed hyaline hair-points which are mostly reflexed to a 90  angle when dry, making it easily recognisable in the field (Smith, 2004) (Fig. 1). It is often confused with its close relative, *C. pilifer* Brid. (Frahm & Stech, 2006); the latter is distinguished by its erect, hyaline hair-points when dry and it has a smaller ecological tolerance and is more thermophytic (Gradstein & Sipman, 1978). Spore capsules are common in *C. introflexus* in the North and West of England (Atherton *et al.*, 2010; Richards & Smith, 1975) and in Sweden (Hallingb ack *et al.*, 2007), but appear to be rare on the rest of the European continent and have not yet been found in populations in Switzerland (Urmi *et al.*, 2007).

Campylopus introflexus is a pioneer species of disturbed habitats (Gradstein & Sipman, 1978). It can be found on bare peat after it has been cut, burned or ploughed (Smith, 2004; Urmi *et al.*, 2007) but it can also occur on mine waste, rotting logs, old fence posts, on the side of tracks (Atherton *et al.*, 2010),



Fig. 1. The morphology of *Campylopus introflexus* showing the reflexed hyaline hair-points. Photos by Laurent Burgisser.

in coastal sand dunes or on inland cliffs (DAISIE, 2009). This species appears to grow best in acidic conditions and thus is often found in areas affected by atmospheric pollution (DAISIE, 2009). It has been shown that the invasiveness of *C. introflexus* in drift sands depends on the amount of nitrogen and organic matter in the soil, and in certain areas it thrives due to increases in the concentration of ammonia in the atmosphere (Sparrius & Kooijman, 2011). This species is now most abundant in the north-western oceanic parts of Europe and it is rapidly spreading eastwards (DAISIE, 2009). Its rapid expansion is due to its dispersal capabilities (Hassel & S oderstr om, 2005). It can spread over long distances via spores and spread locally by its leaves which easily break into fragments and are dispersed by wind as well as by grazing animals, people or vehicles (Hasse, 2007; Hassel & S oderstr om, 2005).

***Campylopus introflexus*, newly arrived in Geneva**

Campylopus introflexus was first recorded for Switzerland in 1980 in the canton of Solothurn (Urmi *et al.*, 2007), only 39 years after it was first recorded for Europe. It then migrated across the central plateau of Switzerland to the East (Urmi *et al.*, 2007). According to the NISM (Nationale Inventar der Schweizer Moosflora) online atlas *C. introflexus* is present in the following cantons: Aargau, Basel-Landschaft, Bern, Jura, Lucerne, Neuch atel, Schwyz, Solothurn, St. Gallen, Thurgau, Uri, Vaud and Z urich (NISM, 2011). Its highest documented locality is at 1700 m in Lucerne and its lowest at 330 m in Aargau (NISM, 2011).

In 2010 an inventory of the bryophytes of Moulin-de-Vert (a protected area in the Commune of Cartigny) was done by ECOTEC (a private environmental office in Geneva mandated by the Direction G en erale de la Nature et du Paysage (DGNP) of the Etat de Gen eve) as part of long-term study of the biodiversity in the area. Using a previous inventory as a basis (Ciaramelli, 2004), areas of bryological interest were surveyed from April to August 2010. During the inventory, *C. introflexus* was discovered for the first time in the Canton of Geneva at two sites within the Moulin-de-Vert (in the North and South Prairies, Fig. 2). Both these prairie sites are xeric zones that are of conservation priority within the canton. Both populati-



Fig. 2. The locality of the first discovery of *Campylopus introflexus* in the Canton of Geneva. Photos by Laurent Burgisser.

ons were relatively small at the time they were found. In both sites *C. introflexus* grew in loose cushions on rocky ground on the border of small bucolic forests (Moulin-de-Vert, 06.08.2010, Burgisser, Hinden & Martinez, No. 100806.09, G). Upon consultation with the DGNP, the population *C. introflexus* was removed from the sensitive North Prairie.

Potential threats to Moulin-de-Vert

Campylopus introflexus has caused a lot of damage in the north-western oceanic regions of Europe where it is most common. In the Netherlands extensive areas of sandy dune grasslands have been overgrown by the species (Vogels *et al.*, 2005) and it has effectively replaced the specialised lichen and grass species in these areas. In Germany, also on coastal dunes, a study has shown the encroachment on the area by *C. introflexus* has caused a decrease in the number of individuals of the grasshopper *Myrmeleotettix maculatus* Thunb. (Schirmel, 2009). *Campylopus introflexus* has been found to negatively affect the regeneration of *Calluna vulgaris* (L.) Hull. in heathlands in England (Equihua & Usher, 1993) and cause a displacement of certain species of carabid beetles and spiders on coastal dunes on the Baltic island of Hiddensee, Germany (Schirmel *et al.*, 2010).

The origin of the plants found in the Moulin-de-Vert is uncertain. The nearest record for this species is 116km away in Sainte-Croix in the canton of Vaud (NISM, 2011). Recent restoration works in the Moulin-de-Vert necessitated the use of heavy machinery that was borrowed from further a field and which could have carried fragments of these plants on them.

The population left on the South Prairie was restricted to a small area (~40cm²) and no sporophytes were found. It was therefore recommended to monitor this population to see at what speed it spreads (Hinden *et al.*, 2010). Urmi *et al.* (2007) state that the presence of *C. introflexus* in Switzerland is not yet important enough to threaten the displacement of other species with similar habitat requirements; the species is more of a nuisance in the oceanic regions of Europe, as mentioned above. Within the Moulin-de-Vert *C. introflexus* was found in areas that are of restricted access, but grazing animals do forage in both areas and should this moss later spread to areas

where it could be trampled by walkers. This could become problematic, especially in sites like the North Prairie which are rich in lichen species which could potentially be threatened by the presence of *C. introflexus*. The population in the South Prairie is currently being monitored to see if it is enlarging or spreading.

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Dicranum tauricum Sapjegin (Dicranaceae) new for the Canton of Geneva, Switzerland.

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Abstract

Dicranum tauricum Sapjegin, alternatively known as *Orthodicranum tauricum* (Sapjegin) Smirnova, is newly reported from the canton of Geneva. It is found on native and non-native trees planted in the Botanical Garden and adjacent public parks on the northern shore of Lac Léman (Lake Geneva). Geneva populations grow as scattered tufts of a few stems that are up to 15 mm in height. Vegetative propagules were observed on broken leaf apices of *in situ* populations of *D. tauricum* in Geneva and on both the broken leaf apices and leaf-tip fragments of this species grown in *in vitro* culture.

Introduction

Dicranum tauricum Sapjegin, a small acrocarpous moss in the Dicranaceae, is found in Europe and North America where it grows mainly on tree trunks or rotten wood as compact cushions or tufts (Nebel & Philippi, 2000; Hedenäs & Bisang, 2004; Smith, 2004; Enroth, 1989). This species has stems up to 40 mm tall and it can be recognised by its lanceolate, erect and mostly straight leaves that are stiff and fragile in the upper part (see illustrations and treatment in Ignatova & Fedosov, 2008), a characteristic it shares with both *D. viride* Sull. & Lesq. and *D. fragilifolium* Lindb. *Dicranum tauricum* differs from the two latter species, and in fact from all other European members of *Dicranum* subgen. *Orthodicranum* Bruch & Schimp., by its lack of stereid bands in the costa, seen in cross-section (Hegewald, 1991a: 118). *Dicranum tauricum* is dioicous (separate male and female plants) and, across many parts of its range, it is rarely found in fruit. The propagation and dispersal of this species, at least on a local scale, is effected by vegetative propagules (perennial protonemal gemmae - see Duckett *et al.*, 1998; Duckett & Ligrone, 1992) or by fragmentation of the plants themselves, namely of the leaf tips (Enroth, 1989). Propagules have been seen developing on protonema filaments, and from broken leaf apices and leaf-tip fragments in culture and on the broken leaf apices of plants in wild populations in Geneva (Fig. 1).

The recognition of the genus *Orthodicranum* in floras and regional treatments differs with some authors recognising it at the generic level and others as a synonym of *Dicranum* (Allen 1998; Corley *et al.*, 1982; Enroth, 1989; Hill *et al.*, 2006; Ignatova, & Fedosov, 2008). Herein, to accord with the Bryophyte Redlist of Switzerland (Schnyder *et al.*, 2004) all *Dicranum* subgen. *Orthodicranum* Bruch & Schimp. members are treated under the genus *Dicranum*.

Dicranum tauricum in Europe

Dicranum tauricum was considered a boreal and montane-sub-oceanic species (Gradstein, 1970; Hegewald 1972) but Enroth (1989), on evaluating the distribu-