

## The bryophytes of Glasgow Botanic Gardens

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### ABSTRACT

The bryophytes (mosses and liverworts) growing wild in the Glasgow Botanic Gardens, Scotland have not previously been the subject of a detailed survey. As part of the current wildlife surveys of the gardens, recent field visits have attempted to address this shortfall. Records have been made for the general grounds, trees, built infrastructure and the contiguous banks of the River Kelvin, where old woodland and rock exposure occur. During this survey, 70 bryophyte species were found, bringing the total number recorded in the gardens over recent years to 88. Observations from inside the glasshouses indicate that there is potentially high interest in overseas bryophytes brought in with plants. A number of locally rare or uncommon species have been recorded, and of note are two non-native species which appear to be spreading. There remains the potential for more species to be found both about the extensive grounds and inside the glasshouses.

### INTRODUCTION

The mosses and liverworts (bryophytes *sensu lato*) of Glasgow Botanic Gardens, Scotland do not appear to have been the subject of a detailed survey by expert bryologists. However, there have been some occasional observations made over the past few decades, and more recent visits by the author have helped to increase the site's total number of mosses and liverworts. There is also considerable interest (known and potential) as regards the bryophytes growing inside the actual glasshouses.

A list of bryophytes occurs in an old publication about the Botanic Gardens (Sherry, 1902), where the species listed are noted as occurring "in various parts of the Greenhouses and the others are under cultivation in the Gardens from time to time". A total of 67 species is listed (11 liverworts, four *Sphagnum* spp. and 52 other mosses). No locations are provided but a list of fungi in the same publication notes locations such as "In Mossery" and "Winter Gardens". It does not appear that this list represents bryophytes found growing wild, and a number of species listed would be highly unlikely to do so, and there are many expected common species that are not listed. However, no non-native species are mentioned.

The gardens support a range of habitats ranging from the garden beds and lawns, to the built infrastructure (outside and inside), and the diverse range of trees. In

addition, the northern boundary of the gardens, and the arboretum, occur along the River Kelvin valley with its more semi-natural woodland structure and some rock outcrops.

### METHODS

The current survey commenced in late 2018 and involved three visits by the author to the gardens, the latest being in late 2021. Identifications have been from field determination mostly confirmed by later microscopic examination. The author also made casual records following visits in the 1990s and early 2000s (19 of these species were not recorded during the current survey). Additionally there was one record made by Richard Weddle in 2017 and earlier Gerry Rodway made two records in the 1960s.

The following describes some of the bryological features of the different zones in the gardens. The names follow the new 2021 Census Catalogue (Blockeel *et al.*, 2021).

### RESULTS

During the recent survey, 70 bryophyte species were found in Glasgow Botanic Gardens, bringing the total number recorded in the gardens over the past *ca.* 60 years to 88 (Table 1). The following discusses some of the bryological features of the different habitats in the gardens. The taxonomy follows Blockeel *et al.* (2021).

#### Garden beds and lawns

This large area was not sampled in any detail. Because the garden beds are subject to frequent disturbance from gardening activities and are nutrient-enriched, the potential for long established bryophytes is limited, although there is potential for more ephemeral colonists. The latter include frequent common pottia (*Tortula truncata*) and cylindrical beard-moss (*Didymodon insulanus*), and locally bulbil-forming mosses such as *Bryum dichotomum* and *Pohlia annotina*. Also on disturbed soil, very small but fruiting pocket-mosses appear to be green pocket-moss (*Fissidens viridulus*). The occasional rockery can provide a more stable niche for bryophyte establishment (see stonework below).

Old plant pot colonists include golden thread-moss (*Leptobryum pyriforme*) and crescent-cup liverwort (*Lunularia cruciata*). *L. pyriforme* was collected from pots in the garden in 1920 by Donald Patton (specimen in the Glasgow University herbarium) and it was also recorded by Gerry Rodway in 1960.

Scientific Name	Common Name	Earliest	Latest	No. of Records
<b>Liverworts</b>				
<i>Calypogeia fissa</i>	common pouchwort	1994	1998	2
<i>Calypogeia muelleriana</i>	Mueller's pouchwort	2021	2021	1
<i>Cephalozia bicuspidata</i>	two-horned pincerwort	1994	1994	3
<i>Conocephalum conicum</i> agg.	great scented liverwort	1994	2021	1
<i>Diplophyllum albicans</i>	white earwort	1994	2021	2
<i>Lophocolea bidentata</i>	bifid crestwort	1994	2018	2
<i>Lophocolea bispinosa</i>	great crestwort	2019	2019	1
<i>Lophocolea heterophylla</i>	variable-leaved crestwort	1994	1994	1
<i>Lunularia cruciata</i>	crescent-cup liverwort	1960	2018	1
<i>Mesoptychia turbinata</i>	top notchwort	2000	2000	2
<i>Metzgeria furcata</i>	forked veilwort	2018	2019	2
<i>Metzgeria violacea</i>	blueish veilwort	2019	2019	1
<i>Pellia endiviifolia</i>	endive peltia	2018	2018	1
<i>Pellia epiphylla</i>	overleaf peltia	1994	1994	1
<i>Radula complanata</i>	even scalewort	2018	2018	1
<i>Scapania nemorea</i>	grove earwort	2021	2021	1
<i>Tricholepidozia tetradactyla</i>	Long's threadwort	2018	2018	1
<b>Mosses</b>				
<i>Amblystegium serpens</i>	creeping feather-moss	1994	2018	3
<i>Atrichum undulatum</i>	common smoothcap	1994	2018	2
<i>Barbula unguiculata</i>	bird's-claw beard-moss	2019	2019	1
<i>Brachytheciastrum velutinum</i>	velvet feather-moss	1994	1994	1
<i>Brachythecium rutabulum</i>	rough-stalked feather-moss	1994	2018	3
<i>Bryoerythrophyllum recurvirostrum</i>	red beard-moss	2018	2018	1
<i>Bryum alpinum</i>	alpine thread-moss	1994	1994	1
<i>Bryum argenteum</i>	silver-moss	1994	2018	2
<i>Bryum capillare</i>	capillary thread-moss	1994	2018	3
<i>Bryum dichotomum</i>	bicoloured bryum	1995	2021	1
<i>Calliergonella cuspidata</i>	pointed spear-moss	1994	2018	2
<i>Campylopus introflexus</i>	heath star moss	1994	2018	3
<i>Ceratodon purpureus</i>	redshank	1994	2018	2
<i>Cirriphyllum piliferum</i>	hair-pointed feather-moss	2021	2021	1
<i>Cratoneuron filicinum</i>	fern-leaved hook-moss	1997	1998	1
<i>Dichodontium pellucidum</i>	transparent fork-moss	1994	2018	3
<i>Dicranella cerviculata</i>	red-neck forklet-moss	1963	1963	1
<i>Dicranella heteromalla</i>	silky forklet-moss	2018	2018	1
<i>Dicranoweisia cirrata</i>	common pincushion	1994	2018	2
<i>Dicranum scoparium</i>	broom fork-moss	1994	1994	1
<i>Didymodon insulanus</i>	cylindric beard-moss	1994	2018	3
<i>Ditrichum heteromallum</i>	curve-leaved ditrichum	2018	2018	1
<i>Eucladium verticillatum</i>	whorled tufa-moss	1994	1998	4
<i>Fissidens bryoides</i>	lesser pocket-moss	1994	2018	4
<i>Fissidens dubius</i>	rock pocket-moss	2021	2021	1
<i>Fissidens taxifolius</i>	common pocket-moss	2018	2018	1
<i>Fissidens viridulus sensu lato</i>	green pocket-moss	2021	2021	1
<i>Grimmia pulvinata</i>	grey-cushioned grimmia	2018	2018	1
<i>Homalia trichomanoides</i>	blunt feather-moss	2019	2021	2
<i>Hygroamblystegium fluviatile</i>	brook-side feather-moss	2019	2019	1
<i>Hypnum andoi</i>	mamillate plait-moss	1994	2018	2
<i>Hypnum cupressiforme</i> var. <i>cupressiforme</i>	cypress-leaved plait-moss	1994	2018	2
<i>Kindbergia praelonga</i>	common feather-moss	1994	2018	3
<i>Leptobryum pyriforme</i>	golden thread-moss	1960	2018	2
<i>Lewinskya affinis</i>	wood bristle-moss	2018	2019	2
<i>Mnium hornum</i>	swan's-neck thyme-moss	1994	2018	2

<i>Orthodontium lineare</i>	cape thread-moss	2000	2000	2
<i>Orthotrichum anomalum</i>	anomalous bristle-moss	2018	2018	1
<i>Orthotrichum diaphanum</i>	white-tipped bristle-moss	2018	2019	2
<i>Orthotrichum tenellum</i>	slender bristle-moss	2019	2019	1
<i>Oxyrrhynchium hians</i>	Swartz's feather-moss	2000	2018	3
<i>Philonotis fontana</i>	fountain apple-moss	2018	2018	1
<i>Plagiomnium rostratum</i>	long-beaked thyme-moss	2019	2021	2
<i>Plagiomnium undulatum</i>	hart's-tongue thyme-moss	2018	2018	1
<i>Plagiothecium succulentum</i>	juicy silk-moss	1994	1998	3
<i>Plenogemma phyllantha</i>	frizzled pincushion	2018	2018	1
<i>Pogonatum urnigerum</i>	urn haircap	2021	2021	1
<i>Pohlia annotina</i>	pale-fruited thread-moss	2018	2018	1
<i>Polytrichum formosum</i>	bank haircap	1994	1994	1
<i>Polytrichum longisetum</i>	slender haircap	2018	2018	1
<i>Polytrichum commune</i>	common haircap	2018	2018	1
<i>Pseudotaxiphyllum elegans</i>	elegant silk-moss	1994	1994	1
<i>Racomitrium aciculare</i>	yellow fringe-moss	2019	2019	1
<i>Rhizomnium punctatum</i>	dotted thyme-moss	2017	2017	1
<i>Rhynchostegium confertum</i>	clustered feather-moss	1994	2019	8
<i>Rhynchostegium riparioides</i>	long-beaked water feather-moss	2019	2019	1
<i>Rhytidiadelphus squarrosus</i>	springy turf-moss	2018	2018	1
<i>Schistidium apocarpum</i> sensu lato	sessile grimmia	2018	2018	1
<i>Schistidium crassipilum</i>	thickpoint grimmia	2018	2018	1
<i>Schistidium rivulare</i>	river grimmia	2019	2019	1
<i>Streblotrichum convolutum</i>	lesser bird's-claw beard-moss	2018	2018	1
<i>Syntrichia latifolia</i>	water screw-moss	2018	2018	1
<i>Tetraphis pellucida</i>	pellucid four-tooth moss	1997	1998	1
<i>Thamnobryum alopecurum</i>	fox-tail feather-moss	2018	2019	2
<i>Tortula muralis</i>	wall screw-moss	2018	2018	1
<i>Tortula truncata</i>	common pottia	2021	2021	1
<i>Ulota bruchii</i>	Bruch's pincushion	2021	2021	1
<i>Weissia controversa</i>	green-tufted stubble-moss	2018	2019	1
<i>Zygodon conoideus</i>	lesser yoke-moss	2018	2018	1
<i>Zygodon rupestris</i>	park yoke-moss	2021	2021	1
<i>Zygodon viridissimus</i>	green yoke-moss	2000	2001	2

**Table 1.** Liverworts and mosses recorded from Glasgow Botanic Gardens, Scotland. All records by the author except those for 2017 (by Richard Weddle) and the 1960s (by Gerry Rodway).

The lawns are well manicured and the majority remain short-cropped all year, but some are well shaded. A typical range of mosses occurs including the often abundant springy turf-moss (*Rhytidiadelphus squarrosus*) and, less abundantly, common feather-moss (*Kindbergia praelonga*); in shaded locations hart's-tongue thyme-moss (*Plagiomnium undulatum*) can be prominent and pointed spear-moss (*Calliergonella cuspidata*) picks out poorly draining areas.

### Trees

Of particular interest are the mature trees along the open avenues (where there tends to be more light, in contrast to shaded woodland areas). Here, typical common epiphytes on the trunks are found, such as mamillate plait-moss (*Hypnum andoi*), common pincushion (*Dicranoweisia cirrata*), wood bristle-moss (*Lewinskya affine*), capillary thread-moss (*Bryum capillare*) and the liverwort forked veilwort (*Metzgeria furcata*). Other less common (or less commonly recorded) finds include

yoke-mosses (*Zygodon* spp.), frizzled pincushion (*Plenogemma phyllantha*), white-tipped bristle-moss (*Orthotrichum diaphanum*), water screw-moss (*Syntrichia latifolia*) and the liverwort even scalewort (*Radula complanata*).

### Built Infrastructure

The outside brick and mortar walls, and metalwork, and associated infrastructure present hard structures for some colonists. Stone or brick substrates (including some rockery stones) support grey-cushioned *Grimmia* (*Grimmia pulvinata*), wall screw-moss (*Tortula muralis*), thickpoint *Grimmia* (*Schistidium crassipilum*), anomalous bristle-moss (*Orthotrichum anomalum*), cylindrical beard-moss (*Didymodon insulanus*), green-tufted stubble-moss (*Weissia controversa* s.l.) and curve-leaved ditrichum (*Ditrichum heteromallum*). Roofs and some paths support the diminutive silver-moss (*Bryum argenteum*) with its distinctive silvery leaf tips.

A small crestwort (*Lophocolea* sp.) liverwort growing on a crumbling south-facing wall behind the potting sheds was collected and has been confirmed as the rare *L. bispinosa*, a non-native species known from the southern hemisphere. The plants examined were all male.

A flooded gutter of one glasshouse supports mats of common haircap (*Polytrichum commune*), but one fruiting population proved to be the locally rare slender haircap (*P. longisetum*) in a most unusual location.

The Kibble Palace was the subject of interest last century with the finding of a couple of exotic species. *Hypopterygium atrotheca* (now known as *H. tamarisci*) was described by H.N. Dixon from material sent to him from the “fernery” by Robert Grierson in 1928. The *Hypopterygium* was first collected by James Stirton back in 1913, and it can still be seen today in the Filmy Fern House. More recently *Zoopsis liukiensis* was found growing on tree fern stems (Wallace, 1976). On a recent brief visit to the Filmy Fern House a number of luxurious thalloid liverworts could be readily seen growing amongst the ferns, including a *Marchantia* sp. and a probable relative of veilwort (family *Pallaviciniaceae*) such as a *Symphyogyna* sp. Other liverworts noted here include a pouchwort (*Calypogeia* sp.), which is close to *C. neesiana*, and a crestwort (*Lophocolea* sp.) relative, similar to *Heteroscyphus tridentatus* (from south-east Asia).

#### **Banks of River Kelvin**

Along the northern boundary of the core gardens the riverbank slope supports dense woodland. Here, a number of exotic trees and shrubs on the upper bank grade to more semi-natural woodland on the lower and steeper slopes. However, being north-facing and with often much beech (*Fagus sylvatica*) and some evergreen shrubs, the ground flora is heavily shaded.

Shaded old stumps and branches are usually carpeted in bryophytes, often much rough-stalked feather-moss (*Brachythecium rutabulum*) and common feather-moss (*Kindbergia praelonga*) with some clustered feather-moss (*Rhynchostegium confertum*), cypress-leaved plait-moss (*Hypnum cupressiforme*), creeping feather-moss (*Amblystegium serpens*) plus the crestworts *Lophocolea bidentata* and *L. heterophylla*

On the ground and often about tree bases, in usually damp and clayey places, mosses include hart’s-tongue thyme-moss (*Plagiommium undulatum*), common smoothcap (*Atrichum undulatum*), swan’s-necked thyme-moss (*Mnium hornum*), cylindrical beard-moss (*Didymodon insulanus*), lesser pocket-moss (*Fissidens bryoides*), common pocket-moss (*F. taxifolius*), and thalloid liverworts such as great scented liverwort (*Conocephalum conicum* s.l.), crescent-cup liverwort (*Lunularia cruciata*) and *Pellia* spp.

The inundated rocks and tree roots by the water’s edge were briefly sampled and revealed a range of aquatic influenced species, including long-beaked water

feather-moss (*Rhynchostegium riparioides*) and river Grimmia (*Schistidium rivulare*), and occasionally brook-side feather-moss (*Hygroamblystegium fluviatile*) and on tree roots blunt feather-moss (*Homalia trichomanoides*).

Records of local interest from the valley slopes, often on rock outcrops, include whorled tufa-moss (*Eucladium verticillatum*), rock pocket-moss (*Fissidens dubius*) and the liverworts top notchwort (*Mesoptychia turbinata*) and grove earwort (*Scapania nemorea*), several being indicators of more basic rocks. An *Orthodontium* sp. was found at one sandstone outcrop fuelling speculation that it could be the now very rare native thread-moss *Orthodontium gracile*, but unfortunately sectioning of the nerve showed it to be the spreading non-native cape thread-moss (*O. lineare*).

Of particular interest were a few glistening pale green patches on clayey soils of the embankment by the footpath below the filmy fern houses. Closer inspection revealed them to be a tiny liverwort with deeply divided leaves, which appeared to be a threadwort (*Telaranea* spp.). DNA analysis at the Royal Botanic Garden Edinburgh confirmed it as being the recently renamed Long’s threadwort (*Tricholepidozia tetradactyla*), a very rare non-native liverwort with only two previous British records, both from botanic gardens: one at the Royal Horticultural Society Garden at Wisley, Surrey, England and the other from the Younger Botanic Garden (Benmore Botanic Garden) near Dunoon, Argyll, Scotland. DNA analysis revealed it to be an exact match with plant material from the latter location. Inspection of the author’s past collections revealed that a puzzling sample of an unnamed member of family *Lepidoziaceae* (“*Kurzia* sp.”), found on the Kelvin banks at Kelvingrove (a mile or so downriver) in 2016, was in fact the same species indicating its ability to spread widely and amplifying the interest of this find.

#### **CONCLUSIONS**

The list in Table 1 is a further example of the wide diversity of taxa to be found in Glasgow Botanic Gardens as other papers in this series have revealed. However, given the range of habitats present it is likely that the total could be increased with more detailed sampling.

A good range of commoner species is to be found as well as number of species of local interest, ranging from native relics to species from overseas. The *Lophocolea bispinosa* and *Tricholepidozia tetradactyla* finds are of special local note, but it might be expected that other exotic colonists are to be found in or near the gardens. The interiors of the actual glasshouses in particular would reward the more enthusiastic expert bryologist, but there remains plenty of scope for finding new and interesting records both in and around the gardens.

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