Conservation status of bryophytes in the Wye Valley 2016

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Introduction

In early 2016, the opportunity arose to survey bryophytes in the Gloucestershire part of the Wye Valley at Symonds Yat, through a grant from the Gloucestershire Naturalists' Society. The focus of the survey was to document the number of populations of *Anomodon longifolius* but the opportunity was taken to document known populations of other notable taxa, compile past records and survey additional areas for which there were no recent records. To maximise potential to find populations of *A. longifolius*, the main effort involved survey of the cliffs from Yat Rock south and west as far as the Whippington Brook and east along Coldwell Rocks. In addition, the sandstone and conglomerate boulder fields of the area south of Yat Rock referred to by Armitage (1914) as the Upper Plateau, was surveyed in some detail. The entire survey was carried out by visual inspection of bryophyte habitats, concentrating on the larger rock faces and boulders. No attempt was made to establish a standardised survey protocol but rather the aim was to cover as much ground as possible in the time available. Survey of Coldwell Rocks was limited due to the presence of nesting peregrines (*Falco peregrinus*).

The Wye Valley has always been the most popular focus for bryologists visiting Gloucestershire generating a total of nearly 2000 records involving nearly 300 species, which represents nearly 30% of the UK bryophyte flora. The most popular area for visiting bryologists has been The Slaughter to see the best known stand of *A. longifolius* (Hearn 1989, Wade 1954, Paton 1968) and a small number of other species, but there has been no systematic survey since work by Eleanor Armitage in the early part of the 20th century (Armitage 1914). Surveys of Bowler's Hole south-west of Yat Rock (Martin 2005) and Court Wood south of Coldwell Rocks (Martin 2004) served to highlight the species diversity of the area. This article describes the current conservation status of bryophytes in the area, based on compilation of past records and the results of this survey, a comparison is made with the bryophytes records given by Armitage (1914) and suggestions made as a basis for a monitoring protocol.

The bryophyte habitats represented on the western side of the site grade from top to bottom (from the centre of the upper plateau to the Rive Wye) as follows (including information from Peterken and Mountford 2005):

- The upper plateau and slopes with thin, dry, clayey rendzina soils either with limestone rubble and often with outcrops of limestone bedrock forming blocks resembling small units of limestone pavement or with shallow to deep, moderately acid, loamy soils derived from old red sandstone till where in places there are sandstone or conglomerate boulders of varying sizes. There are numerous small streams and flushes through this area and in a few places these form reasonably extensive wetlands or sheltered and humid areas, provide additional bryophyte habitat.
- The main, vertical limestone cliffs, which vary from high, dry, largely bare faces to complex faces with hollows, caves and occasional seepages, including some tufa formation. Valleys leading up into these are typically much more humid, while promontories are often very exposed and dry.
- The steeply sloping ground below the cliff with flushed, fertile clay loam mixed with limestone rubble, often fairly humid and locally with flushes or seepages.
- The lower ground on or just above the Wye floodplain with moist, clay loam soils derived from colluvial and alluvial deposits, mostly densely grassy with a scrubby, *Rubus*-dominated ground flora and little bryophyte diversity, although the epiphytic flora may be diverse.

The sequence to the east, crossing Coldwell Rocks is similar, although much of the lower levels lies outside Gloucestershire. The high cliffs are much more shaded and heavily vegetated than those to the west, both with large mosses, particularly *Thamnobryum alopecurum* and extensive carpets of *Neckera complanata* and with vascular plants including ferns and *Umbilicus rupestris*.

The bryophyte flora

The bryophyte flora of the upper Wye Valley is remarkable, species which although not of national conservation concern are scarce or local in the county, such as *Marchesinia mackaii*, *Porella arboris-vitae* and *Scorpiurium circinnatum* are abundant throughout much of the area, as are a number of notable species, such as *Cololejeunea calcarea*, *C. rossettiana*, *Gymnostomum calcareum* and *Plasteurhynchium striatulum*, all of which occur south into Monmouthshire (Bosanquet 2003) In addition, there are notable aspects to some of the more abundant species, such as frequent fruiting of *Tortella tortuosa*, abundant epiphytic populations of *Neckera crispa* growing on the trunks of trees along the bottom of the valley with *Platygyrium repens* at the only British site where both gemmiferous and fertile plants of this species occur together and a bifid form of *Plagiochila britannica* often found in the shade of rocks and boulders.

Areas such as the Herefordshire part of Huntsham Hill with extensive conglomerate boulder fields and the cliffs of Lady Park Wood to the south support a number of species which are not known from the Gloucestershire part of the Wye Valley. In many cases, species have been reported as occurring at Symonds Yat in Gloucestershire but available evidence suggests that these may have occurred beyond the county boundary. Further to this, it appears likely that some records are the result of typographic or other errors.

- The only report of *Gymnostomum aeruginosum* from Gloucestershire is “rare on steep shady limestone rocks”, Symonds Yat (Armitage 1914), it is not listed by Blackstock *et al*. (2005) and may be an error.
- The only record of *Barbilophozia attenuata* from the area is described as “abundant on siliceous [Old Red Sandstone] boulders, Huntsham Hill” in 1954 (**NMW**) (Knight 1920), without further information. Knight (1920) appears confident that this was collected from the Gloucestershire part of Huntsham Hill but it may be that this record should be re-assigned to Herefordshire.
- The report of *Isopterygiopsis pulchella* is considered to be an error (Lansdown 2014).
- The report (Armitage 1914) of *Grimmia montana* is considered to be an error (Lansdown 2014).
- *Dichodontium* species were reported by Knight (1914) and Armitage (1914) (**CHM**) but none of the records involved fruiting material and so it has not been possible to confirm the identification of these records to species level.
- *Jungermannia pumila* was reported from Lady Park Wood (Hearn 1988), but this may be an error for *J. atrovirens* (Lansdown 2014).
- *Pterogonium gracile* was reported from Lady Park Wood (**CHM**) (Wade 1954), but it seems likely that this record refers to the Monmouthshire part of the wood, although it is known from Huntsham Hill in Herefordshire (Armitage 1914) and could occur in Gloucestershire.
- *Phaeoceros laevis* was collected by Eustace Jones from Lady Park Wood (**NMW**) and this is considered to have been within Gloucestershire (Knight 1920). However Lady Park Wood, including all of E.W. Jones’s study area is mainly in Monmouthshire.
- Records of *Leucobryum* from the area were originally assigned to *L. glaucum*, however all material which has microscopically confirmed has been *L. juniperoideum* (Lansdown 2014), including hundreds of stands spread over a few hectares in the woods on the Upper Plateau, south of Yat Rock. The former should not be considered to occur here unless it can be formally confirmed.

- *Thuidium delicatulum* was reported from The Slaughter in 1988 but this record is not supported by a voucher and must be treated as unconfirmed.
- *Dicranella rufescens* was reported from Symonds Yat in the early twentieth century (Armitage 2014, Knight 2014); it has recently been found to be locally abundant in parts of the Forest of Dean and should be treated as Least Concern in Gloucestershire. It was originally classed as Vulnerable in Gloucestershire (Lansdown 2014) but increased recording has shown that this assessment should be revised to LC
- Although *Fossombronia pusilla* appears to have undergone a massive decline in parts of Gloucestershire (Lansdown 2014) particularly east of the River Severn, it has been recorded from Coldwell Rocks (**NMW**) and Symonds Yat (**NMW**) in the past (Armitage 1914, Knight 1914) and was found scattered over the upper plateau on clay banks and wet ground where paths are crossed by seepages and streams. It was originally classed as Endangered in Gloucestershire (Lansdown 2014) but because of the populations found during this survey, this assessment is revised here to LC
- *Scapania nemorea* was reported from sandstone at Symonds Yat (**NMW**) (Armitage 1914) and persists on conglomerate boulders on the Upper Plateau. It was originally classed as Near Threatened in Gloucestershire (Lansdown 2014) but because of the populations found during this survey, this assessment is revised here to LC.
- *Tortella nitida* is abundant in the Symonds Yat area (**CHM**, **NMW**) (Armitage 1914, Knight 1914, Martin 2005, Lansdown 2014). It was originally classed as Vulnerable in Gloucestershire (Lansdown 2014) but because of the populations found during this survey (Figure 10), this assessment is revised here to LC.

The following codes are used in this article:

CR - Critically Endangered (IUCN 2001)
DD - Data Deficient (IUCN 2001)
EN - Endangered (IUCN 2001)
LC(NR) - Least Concern in Gloucestershire but of national conservation concern so that Gloucestershire populations are of national conservation importance
NR - Nationally Rare (Pescott 2016)
NS - Nationally Scarce (Pescott 2016)
NT - Near Threatened (IUCN 2001)
REa - Regionally Extinct (Lansdown 2014) and likely to be truly extinct in Gloucestershire
REb - Regionally Extinct (Lansdown 2014) but likely to be overlooked and to still persist in Gloucestershire
Sch 8 - protected on Schedule 8 of the Wildlife and Countryside Act 1981 (and amendments)
VU - Vulnerable (IUCN 2001)

Letters in bold (e.g. **NMW**) indicate herbaria and follows the codes of Index Herbariorum (Thiers 2016).

Species	British status	Current county status	former county status
Anomodon longifolius	Sch 8, VU, NR	EN	
Entosthodon pulchellus	NT, NS	VU	
Seligeria campylopoda	NT, NR	VU	
Amblystegium confervoides	NS	LC(NR)	EN A2a
Campylophyllum calcareum	NS	LC(NR)	
Cololejeunea rossettiana	NS	VU	
Conardia compacta	NS	VU	
Entosthodon muhlenbergii	NS	REb	
Fissidens rivularis	NS	LC(NR)	
Grimmia orbicularis	NS	EN	

Gymnostomum calcareum	NS	VU	
Plasteurhynchium striatulum	NS	LC(NR)	
Platydictya jungermannioides	NS	VU	
Pleurochaete squarrosa	NS	LC(NR)	
Seligeria pusilla	NS	LC(NR)	
Thuidium recognitum	NS	REb	
Rhodobryum roseum		REa	
Fissidens crispus		REb	
Hedwigia ciliata		REb	
Pogonatum nanum		CR	
Plagiomnium cuspidatum		EN	
Campylopus fragilis		VU	REa
Cynodontium bruntonii		VU	
Dicranodontium denudatum		VU	not recorded
Entosthodon obtusus		VU	REb
Fissidens celticus		VU	REa
Leptodontium flexifolium		VU	
Lophocolea fragrans		VU	not recorded
Metzgeria conjugata		VU	
Metzgeria pubescens		VU	
Orthothecium intricatum		VU	
Ptychomitrium polyphyllum		VU	
Reboulia hemisphaerica		VU	
Saccogyna viticulosa		VU	REb
Scleropodium tourettii		VU	
Trichocolea tomentella		VU	
Chiloscyphus pallescens		NT	
Cololejeunea calcarea		NT	
Sciuro-hypnum plumosum		NT	
Bryum canariense		DD	
Bryum pallescens		DD	
Didymodon spadiceus		DD	
Riccardia multifida		DD	
Schistidium rivulare		DD	
Dicranella rufescens		LC	VU
Fossombronia pusilla		LC	EN
Scapania nemorea		LC	NT
Tortella nitida		LC	VU

Species are listed in order of their level of conservation concern, first species of national conservation concern and then species of county conservation concern (Lansdown 2014) and alphabetically within each conservation status class.

Species of national conservation concern

Amblystegium confervoides
UK: NS
Gloucestershire: EN A2a - revised here to LC(NR)

There are two specimens of this species from the Gloucestershire part of the Wye Valley at Symonds Yat in the herbarium of the National Museum and Galleries of Wales (**NMW**) and it is known to occur west of the area in Monmouthshire (Bosanquet 2003). Since publication of the Red Data Book (Lansdown 2014), further populations of *A. confervoides* have been found and during this survey it was found at scattered locations throughout the survey area. It seems likely that it would be appropriate to downgrade the threat status of this species in Gloucestershire to Least Concern, in which case it is likely that the populations in Gloucestershire could be of national conservation value and it should be re-assigned to LC(NR).

Anomodon longifolius
UK: Sch 8, VU B2ab(i-v) (Hodgetts 2011), NR (Pescott 2016)
Gloucestershire: EN D

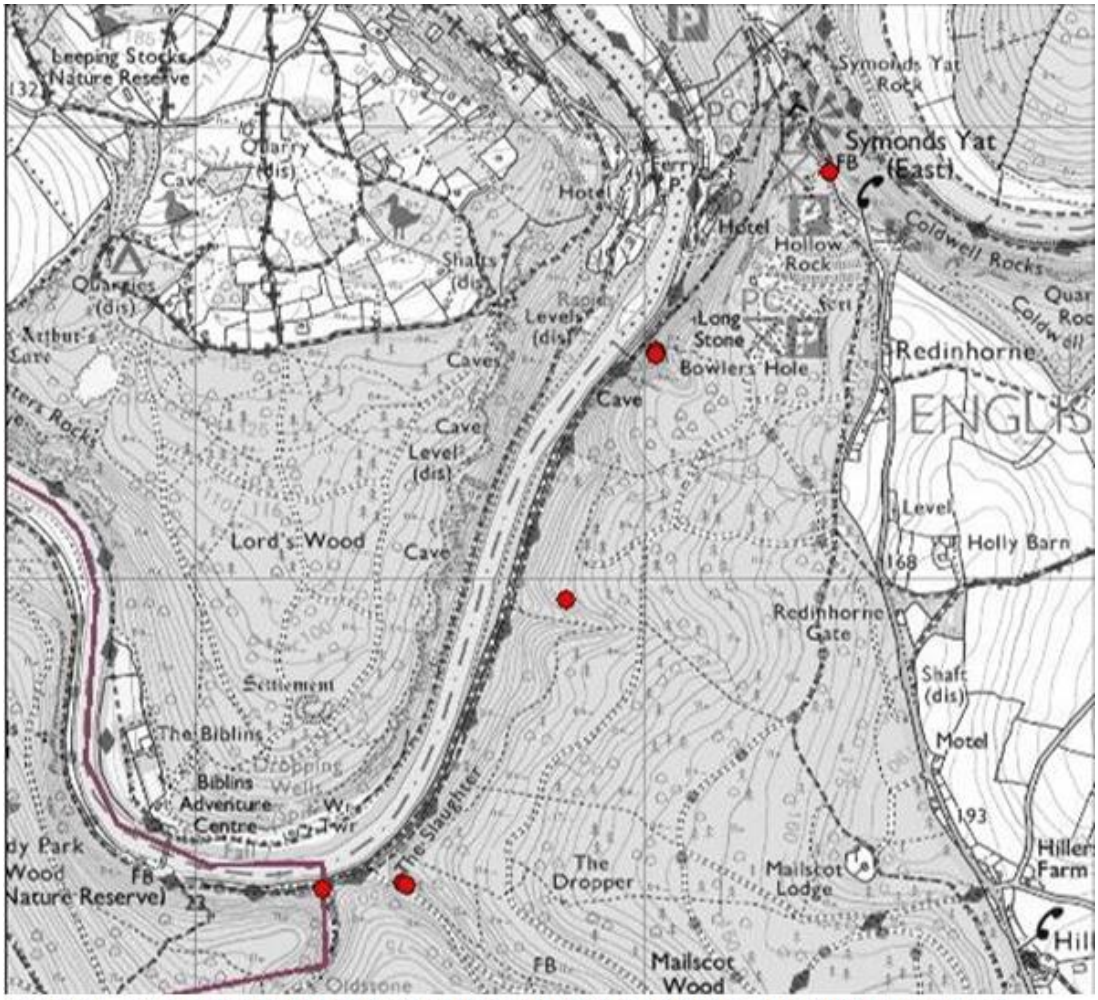

Figure 1 Distribution of *Anomodon longifolius* (populations numbered from north to south in the text)

Figure 2 Location of *A. longifolius* population 1

Figure 3 Location of *A. longifolius* population 2, showing two stands

A. longifolius has been recorded for a long time from the Wye Valley, most records from Gloucestershire appear to refer to a single population on The Slaughter, at the downstream end of the Whippington Brook, although there is a reference to a population at the Symonds Yat railway station (Lansdown 2014). Prior to this survey, two populations were known to persist in the Wye Valley and a small number of populations in Monmouthshire (Bosanquet 2012). This survey documented a total of five populations, including the two known beforehand:

Figure 4 Location of *A. longifolius* population 3

1. A very small population on a low bedrock outcrop south-east of Yat rock
2. An extended population immediately north of Bowler's Hole, involving an interrupted stand c120 x 40 cm shaded by *Taxus baccata*, on an area of cliff extending out into the valley, plus a very small patch of a few strands on a sloping boulder.
3. A population in very good condition, about half way between Bowler's Hole and the Whippington Brook in the mouth of a shallow cave on rock shelves.
4. The largest population; three large patches mainly over a shelf in vertical cliff under tree shade on The Slaughter. The part of the population recorded previously (Lansdown 2014) was still in good condition, on the same cliff face another two stands were found, one covering approximately 2 x 2 m to the east of the cave and a third on a ledge above the cave between these two in two small stands.

5. The longest-known population at the downstream end of the Whippington Brook was damaged in the past by over-collecting and half was necrotic in 2014. During 2016, it was half-buried in gravel by Forestry Enterprise “tidying up” the area.

In the Wye Valley *A. longifolius* occurs on dry, steep or vertical limestone rock-faces in locations with a fairly dense tree canopy, particularly of yew (*Taxus baccata*). It most often occurs with *Anomodon viticulosus*, *Neckera complanata* and *Thamnobryum alopecurum*, as well as a range of other taxa including *Asplenium trichomanes*, *Cololejeunea rosettiana*, *Gymnostomum calcareum*, *Hedera helix*, *Isothecium myosuroides*, Lepraria sp., *Melica uniflora*, *Mercurialis perennis*, *Orthothecium intricatum*, *Porella platyphylla* and *Rhynchostegiella tenella*.

Figure 5 Location of *A. longifolius* population 4, showing two stands: the population found in 2014 on the western part of the cliff face (above) and the population found during this survey to the east of the cave (below)

Figure 6 Location of *A. longifolius* population 5, showing the population as it was in 2014 (above), where the blue polygon shows the location of *A. longifolius* plants and the yellow rectangle the line of the gravel in 2016 and the situation in 2016 (below), where the orange rectangle shows the location of the image taken in 2014

A. longifolius is dioicous and capsules are unknown in the UK (Blockeel *et al*. 2014). It is described as reproducing by stoloniferous branchlets (Löbel, Snäll and Rydin 2009) but dispersal of these must rely on an animal vector, possibly such as wrens (*Troglodytes troglodytes*) transporting these branchlets between areas of suitable habitat. Such dispersal must be exceedingly rare and for practical purposes, without intervention, the populations described here must be considered to represent the potential population of this species in the area. Monitoring of the conservation condition of *A. longifolius* in the Wye Valley must therefore involve an assessment of the condition of each of these populations. Each population should be mapped using photographs (Figures 2-6) and this repeated on a regular basis, initially at least once in every five year period. Visual comparison should be made between the extent of *A. longifolius* at each site and an assessment of the condition of the plant, noting issues such as necrosis, competition from other plants etc. It is likely that the survival of the population at the downstream end of the Whippington Brook will have been compromised by the deposition of gravel in 2016. This gravel should be removed, but options for using the gravel to maintain humidity around remaining plants should be investigated.

Campylophyllum calcareum
UK: NS
Gloucestershire: LC(NR)

C. calcareum was recorded from The Slaughter at Symond's Yat in 1911, 1914, 1954 and 1965 (Lansdown 2014) and occurs along the valley in Monmouthshire (Bosanquet 2003). It

is not uncommon in places along the abandoned railway line along the Wye on stones on the ground with species such as *Anomodon viticulosus*, *Eurhynchium striatum*, *Marchesinia mackaii*, *Neckera complanata*, *Plagiomnium rostratum* and *Rhynchostegiella tenella*.

Cololejeunea rossettiana
UK: NS
Gloucestershire: VU A2a

In Gloucestershire, *C. rossettiana* occurs in the Avon Gorge and in the Forest of Dean either in scowles and former quarries, such as the Devil's Chapel (Knight 1920), Orepool, Puzzle Wood and The Delves or along the Wye Valley, where it has been reported from Ban-y-Gor woods, quarries near Bearse Common (Knight 1920), Lady Park Wood both in in Monmouthshire (Bosanquet 2003) and in Gloucestershire (Knight 1920), on The Slaughter (Armitage 1914, Knight 1920), Symonds Yat (**NMW**) and Coldwell Rocks (**CHM**, **NMW**) (Lansdown 2014).

26 populations were found as part of this survey. It was less frequent than *C. calcarea* along cliffs south of Bowler's Hole, but was very abundant around Bowler's Hole and the only member of the genus north of these and at Coldwell Rocks. It was typically recorded growing over bare rock, less often over *Thamnobryum alopecurum*, *Marchesinia mackaii* or very occasionally other species such as *Homalothecium sericeum*, *Neckera complanata* or *Rhynchostegiella tenella*. Most populations (17) were on otherwise bare vertical cliff faces, mainly in areas with slightly or much elevated humidity, particularly in "bays" in the cliff face; some populations were in or near cave entrances, some on shelving rock and one on a boulder. More than half (14) of the populations were growing with *Thamnobryum alopecurum*, other frequent associates include *Anomodon viticulosus*, *Marchesinia mackaii*, *Neckera complanata* and *Rhynchostegiella tenella*, *Cololejeunea calcarea*, *Lepraria* sp., *Metzgeria conjugata*, *M. furcata* and *Neckera crispa* were occasional and a wide range of species recorded only rarely: *Anomodon longifolius*, *Asplenium trichomanes*, *Ctenidium molluscum*, *Didymodon rigidulus*, *Eucladium verticillatum*, *Gymnostomum calcareum*, *Homalothecium sericeum*, *Isothecium alopecuroides*, *Lactuca muralis*, *Lejeunea cavifolia*, *Mnium stellare*, *Orthothecium intricatum*, *Phyllitis scolopendrium*, *Plagiochila porelloides*, *Plasteurhynchium striatulum*, *Porella platyphylla*, *Scorpiurium circinnatum*, *Stachys sylvatica*, *Tortella nitida*, *T. tortuosa* and *Umbilicus rupestris*.

Monitoring of populations on Coldwell Rocks should be straightforward and based on finding a similar number of rosettes in a given area. Between Bowler's Hole and The Slaughter monitoring will be much more difficult because *C. rossettiana* cannot be distinguished from *C. calcarea* in the field and yet there is a need to devise a non-destructive monitoring protocol.

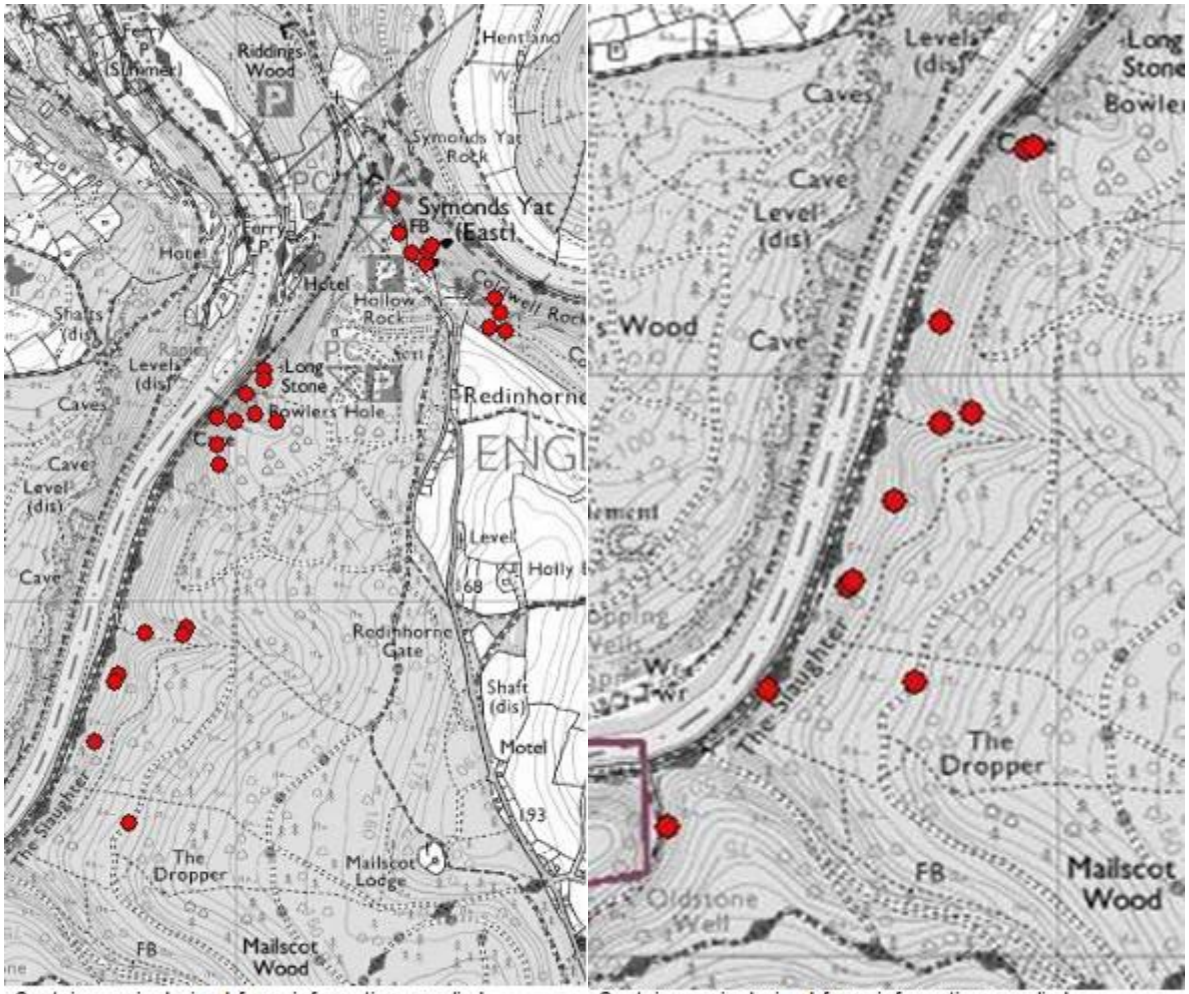

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Figure 7 Distribution of *Cololejeunea rossettiana* (left) and *C. calcarea* (right)

<u>*Conardia compacta*</u>
UK: NS
Gloucestershire: VU D2

C. compacta has been reported from three sites in the Wye Valley, an unspecified location "under overhanging rocks" at Symonds Yat (**NMW**) (Knight 1914, Sutton 1925), the wall of a deserted cottage "below Coldwell Rocks" (**CHM**, **NMW**) (Knight 1914) and on the east face of the valley south of the Slaughter in Lady Park Wood (Lansdown 2014). The population on The Slaughter is large and in very good condition, but is the only population currently known in the Wye Valley. "A history of the county of Gloucestershire" (Baggs and Jurica 1996) states that south-east of Symonds Yat rock there was a cottage on waste land by the river below Coldwell rocks in the early 17th century and several more cottages were built there in the 18th. However, several fell into ruin before 1866 and some were apparently demolished a few years later to make way for the Ross-Monmouth railway; the last cottage was abandoned in the early 20th century. The area below Coldwell Rocks has not been searched recently for this species but this should be a priority.

The population on The Slaughter needs to be monitored to ensure that it does not decline, as well as identifying appropriate action should a decline be observed. The abandoned cottages below Coldwell Rocks should be searched for this species as a priority.

Entosthodon muhlenbergii
UK: NS
Gloucestershire: REb

Until recently *E. pulchellus* and *E. muhlenbergii* were both often recorded as *Funaria calcarea* (S.D.S. Bosanquet pers. comm.). In Gloucestershire *E. muhlenbergii* was recorded from Symonds Yat between 1900 and 1906 (**NMW**) (Armitage 1914, Knight 1914) but it has not been recorded since. Suitable habitat along the cliff tops between Coldwell Rocks, Yat Rock and Bowler's Hole has been searched and it appears likely that this species has been lost from this area as a consequence of the increase in tree cover.

Entosthodon pulchellus
UK: NT (Hodgetts 2011), NS (Pescott 2016)
Gloucestershire: VU D2

In Gloucestershire, *E. pulchellus* has reliably been recorded only from the Avon Gorge and from Symonds Yat (Lansdown 2014). It was not mapped as occurring in the Wye Valley by Blockeel *et al*. (2014), but specimens (**NMW**) and material currently growing on Yat Rock have been confirmed as this species. It still occurs as a population of about 30 plants, most fertile, in earth-filled crevices in sloping to vertical bedrock exposures in area much used by the public with *Bryum dichotomum*, *Didymodon insulanus* and *Encalypta vulgaris*.

The population of *E. pulchellus* on Yat Rock appears to survive well under current conditions. However there is almost no potential for it to spread and it appears very vulnerable to any changes to the site. Regular counts of the number of plants and confirmation of fruiting will be adequate to indicate the condition of this population, but the lack of other populations in the area is a concern.

Fissidens rivularis
UK: NS
Gloucestershire: LC(NR)

Before 2000 *F. rivularis* was recorded from streams in the woods north of Brockweir (**CHM**) (Saunders and Wallace 1938) and Highmeadow Woods. Since 2000 it has been recorded from five sites; Coldwell Rocks, Knockalls Inclosure, The Slaughter, The Tuffs and The Hudnalls NNR. A record from the River Wye at Symonds Yat is probably reliable (Lansdown and Pankhurst 1996, Lansdown and Pankhurst 1996a) but is not supported by a voucher.

Grimmia orbicularis
UK: NS
Gloucestershire: EN A1ac

G. orbicularis was reported from Symonds Yat (Armitage 1914) but has not been recorded since. There is a need for specific surveys to relocate this species.

Gymnostomum calcareum
UK: NS
Gloucestershire: VU D2

G. calcareum has been widely collected from the Wye Valley where it has been recorded from the Devil's Pulpit, Lady Park Wood, Mailscot Wood, Symonds Yat and The Slaughter (**BIRM**, **BM**, **BRIST**, **CHM**, **E**, **LIV**, **NMW** and private herbaria) (Armitage 1914, Knight 1914, Whitehouse and Crundwell 1992, Bosanquet 2003, Martin 2005, Lansdown 2014), it is widespread between Bowler's Hole and the Whippington Brook (Figure 8) and 20 populations were documented through this survey. It was typically recorded in wet conditions, either where there is seepage over rock faces or where humidity is high in recesses, sheltered areas and often on shallow soil over rock. It was most often recorded on vertical faces, but also in hollows and on small bedrock exposures in an earth bank. I was most frequently recorded with *Eucladium verticillatum*, *Fissidens taxifolius*, *Leiocolea turbinata*, *Tortella tortuosa* and *Thamnobryum alopecurum*, less often with *Ctenidium molluscum*, *Eurhynchium striatum*, *Jungermannia atrovirens*, *Kindbergia praelonga*, *Neckera crispa*, *Pellia endiviifolia*, *Polystichum setiferum*, *Plagiochila porelloides*, and *Trichostomum brachydontium* and rarely with a wide range of species. Populations along The Slaughter were fruiting, mainly with capsules "in pin" in May 2016.

Plasteurhynchium striatulum
UK: NS
Gloucestershire: LC(NR)

P. striatulum has been recorded from Ban-y-gor Woods (Lansdown 2014) and the Symonds Yat area of the Wye Valley in Gloucestershire (**CHM**, **NMW**) (Armitage 1914, Knight 1914, Sutton 1926, Wade 1954, Martin 2005). It was sufficiently abundant throughout much of the area surveyed to the extent that it was impractical to record different populations and its distribution has not been mapped. It was most frequent on boulders at the base of the cliffs between Bowler's Hole and The Slaughter and on the base of the cliffs themselves.

Figure 8 Distribution of *Gymnostomum calcareum*

Platydictya jungermannioides
UK: NS
Gloucestershire: VU D2

In Gloucestershire, *P. jungermannioides* has only been recorded from the Wye Valley, around Symonds Yat and The Slaughter (**CHM**, **NMW**) (Armitage 1914, Sutton 1926), where it was last recorded in 2005 (**NMW**) (Rothero 2006); it also occurs in Lady Park Wood in Monmouthshire (Bosanquet 2003). It was not recorded during this survey and there is a need for specific surveys to assess whether it still occurs in this area.

Pleurochaete squarrosa
UK: NS
Gloucestershire: LC(NR)

P. squarrosa was recorded from Yat Rock (**NMW)** by Armitage (1914, Knight 1914). A search failed to find it here and there no longer appears to be suitable habitat in the area due to a combination of trampling pressure and improvement of the grassland around the car park at Yat Rock.

Seligeria campylopoda
UK: NT (Hodgetts 2011), NR (Pescott 2016)
Gloucestershire: VU D2

Prior to taxonomic clarification in 2004 (Blockeel *et al*. 2000), *S. campylopoda* was reported as *S. recurvata* from rocks along the Wye Valley (**CHM**, **NMW**) (Armitage 1914, Knight

1914), particularly near the Devil's Pulpit and Symond's Yat. However, there is true *S. recurvata* on Old Red Sandstone just south of Monmouth (S.D.S. Bosanquet pers. comm.) and its potential presence in Gloucestershire cannot be excluded. Since 2000, *S. campylopoda* has been recorded from Bowlers Hole (Martin 2005), Highmeadow Woods, Court Wood (**NMW**) (Rothero 2006) and alongside the track below Bowler's Hole. No populations were found as part of this study, but the typical habitat of this species was not a priority. Some stones which formerly held populations now no longer do and it seems likely that *S. campylopoda* is very mobile, such that only a thorough, targeted survey of potentially suitable habitat could hope to provide an accurate indication of its conservation status at any given time. There is a need for a specific study of the population dynamics of S. campylopoda which would include documenting the type of substrate on which it occurs, locating populations and tracking their persistence on individual rocks and mapping its distribution, to enable informed conservation action. Without such research, it is not possible to assess its conservation status.

Seligeria pusilla
UK: NS
Gloucestershire: LC(NR)

A single small population of *S. pusilla* was found on shaded bedrock above the Whippington Brook during this survey. It is likely to be more widespread in the area but is very easily overlooked. The Cotswolds are a stronghold for this species (Lansdown 2914, Blockeel *et al*. 2014) and there is no reason to expect it to be rare on the limestone of the Wye Valley.

Thuidium recognitum
UK: NS
Gloucestershire: REb

In Gloucestershire, *T. recognitum* has only ever been recorded from the Forest of Dean, mainly around Symonds Yat (**CHM**, **NMW**) (Armitage 1914, Knight 1914) and near the Devil's Pulpit (**NMW**). Potentially suitable habitat remains in the Symonds Yat area, particularly where large boulders or outcrops of limestone form beds resembling limestone pavement, these were searched as part of this survey but *T. recognitum* was not found. The populations in the Wye Valley represent the most south-easterly populations in Britain and are of high conservation importance. There is a need for specific surveys to relocate this species.

Species of county conservation concern

Bryum canariense
Gloucestershire: DD

B. canariense has been recorded from The Slaughter and Coldwell Rocks but not since 1954 (**CHM**, **NMW**) (Lansdown 2014). A number of *Bryum* populations were found in suitable habitat in earthy crevices in cliff faces both between Yat Rock and The Slaughter and on Coldwell Rocks, but none were fruiting and they could not therefore be confirmed as this species. There is a need for specific surveys to relocate this species.

Bryum pallescens
Gloucestershire: DD

B. pallescens has been recorded from Symonds Yat (**CHM**) but not since 1912 (Lansdown 2014). There is a need for specific surveys to relocate this species.

Campylopus fragilis
Gloucestershire: REa revised here to VU D2

Prior to this survey, *C. fragilis* had been recorded twice in Gloucestershire, from a sandy bank at Hilcot (**CHM**) (Knight 1914) and in grass by the Buckstone (**BBSUK**) (Hearn 1989). During this survey it was found in two areas on conglomerate boulders on the Upper Plateau with a range of species characteristic of this habitat such as *Campylopus flexuosus*, *Diplophyllum albicans*, *Hypnum jutlandicum*, *Leucobryum juniperoideum*, *Mnium hornum*, *Polytrichum formosum* and *Saccogyna viticulosa* and *Scapania gracilis*.

Chiloscyphus pallescens
Gloucestershire: NT

A population of *C. pallescens* found alongside a stream at Coldwell Rocks in 2011 is the only record from the area (Lansdown 2014), a specimen collected in the Lady Park Ecological Reserve (**NMW**), reported as Gloucestershire, is actually from the Monmouthshire side of the border.

Cololejeunea calcarea
Gloucestershire: NT

All *Cololejeunea* populations found were checked microscopically, where large scattered populations occurred, a number of small samples was taken and checked. *C. calcarea* has been recorded from two sites in the Forest of Dean outside the Wye Valley; Mitcheldean (**NMW**) and the Devil's Chapel (Lansdown 2014), otherwise all records are from the Wye Valley, ranging from Lancaut (**NMW**) and "by the River Wye near Tidenham" (**CHM**), through the Monmouthshire section (Bosanquet 2003) to The Slaughter (**CHM**, **NMW**) (Armitage 1914, Paton and Warburg 1965) and Lady Park Wood (Knight 1920). During this survey it was fairly abundant between Bowler's Hole and The Slaughter (Figure XX). It is of note that no populations of *C. calcarea* were found north or east of Bowler's Hole and there are no historic reports of it from Coldwell Rocks, suggesting that the data collected during this survey accurately reflect its distribution on the Wye.

Eleven populations were documented as part of this survey, scattered from Bowler's Hole to The Slaughter (Figure 7). Only on The Slaughter did it directly occur with *C. rossettiana* and there it was found in mixed colonies. Most populations were on bare parts of vertical cliff faces, one population was on a vertical face of a boulder and one was growing over *Thamnobryum alopecurum*. It usually occurred in more humid areas such as in more sheltered parts of the cliff or where water seeps over the rock. Five populations were on cliff faces which supported no other plant species, the most frequent species associated with other populations were *Neckera crispa* and *Thamnobryum alopecurum*, with *Anomodon viticulosus*, *Cololejeunea rossettiana*, *Ctenidium molluscum*, *Eucladium verticillatum*, *Marchesinia mackaii*, *Metzgeria pubescens*, *Neckera complanata* and *Tortella tortuosa* occasional, as well as *Asplenium trichomanes*, *Didymodon insulanus*, *D. rigidulus*, *Gymnostomum calcareum*, *Leiocolea turbinata*, *Lejeunea cavifolia*, *L. lamacerina*, *Lepraria* sp., *Metzgeria conjugata*, *Mnium stellare*, *Rhynchostegiella tenella* and *Tortella nitida* recorded only once each
Populations in Gloucestershire are the south-easternmost populations of its UK range (Blockeel *et al*. 2014) and it is possible that monitoring these populations on the edge of its range could serve to indicate national population trends. However there is a need to find a non-destructive method, such as simply documenting the persistence of individual stands of *Cololejeunea* species in certain areas.

Cynodontium bruntonii
Gloucestershire: VU D2

C. bruntonii was reported from conglomerate boulders by Armitage (1914) and a small population was found on a conglomerate boulder on the Upper Plateau south of Yat Rock during this survey.

Dicranodontium denudatum
Gloucestershire: New county record VU D2

Large populations of *D. denudatum* were found in Fagus sylvatica woodland on the Upper Plateau on conglomerate boulders with *Campylopus flexuosus*, *Fagus sylvatica* sapling, *Hypnum jutlandicum*, *Leucobryum juniperoideum*, *Mnium hornum*, *Polytrichum formosum* and *Rubus* sp. This is a new record for Gloucestershire with the nearest populations in Carmarthenshire (Bosanquet 2005, Blockeel *et al*. 2014).

Didymodon spadiceus
Gloucestershire: DD

D. spadiceus was reported from Symonds Yat (**CHM**) (Knight 1914) in the early part of the 20th century but the record was not confirmed with fruiting material. There is a need for specific surveys to try to establish whether this species actually does occur in Gloucestershire.

Entosthodon obtusus
Gloucestershire: REa revised here to VU D2

E. obtusus was reported from Symonds Yat in 1914 (**NMW**) (Armitage 1914, Knight 1914) but not since. During this survey, a large population was found on a steep clay bank beside a turning area on a forestry track with *Calypogeia arguta*, *Calypogeia fissa*, *Campylopus introflexus*, *Cephalozia bicuspidata*, *Deschampsia flexuosa*, *Diplophyllum albicans*, *Hypericum pulchrum* and *Viola riviniana*. This is the only population currently known in Gloucestershire but it is likely that it is under-recorded in parts of the Forest of Dean.

Fissidens celticus
Gloucestershire: REa revised here to VU D2

F. celticus was reported from clay by a stream through a wood near Luxley in 1968 (NMW) (Hill *et al*. 2008) but not since. During this survey a small population was found on a steep, wet stream bank in coniferous woodland with *Calypogeia arguta*, *Hookeria lucens* and *Thuidium tamariscinum*, on the Upper Plateau south of Yat Rock.

Fissidens crispus
Gloucestershire: REb

There is a single record of *F. crispus* from Gloucestershire, it was recorded from behind the railway station at Symonds Yat in 1957 (**NMW**). The railway station closed in 1958 and was demolished in 1965 (Stevens 2011). The site is now a car park. It is likely that this species persists elsewhere in the area but there is a need for specific surveys to find it.

Hedwigia ciliata
Gloucestershire: REb

H. ciliata was reported by Armitage (1914) probably referring to *H. stellata* (see Lansdown 2014) from conglomerate, presumably in the woods south of Yat Rock. It was not found during this survey and there is a need for specific surveys to relocate this species.

Leptodontium flexifolium
Gloucestershire: VU D2

L. flexifolium was reported from the upper woods south of Yat Rock (Armitage 1914, Knight 1914). It was not found during this survey and there is a need for specific surveys to relocate this species.

Lophocolea fragrans
Gloucestershire: New county record VU D2

During this survey, a very small population of *L. fragrans* was found on a sheltered face of a large sandstone boulder on a mainly bare face of the boulder with *Isothecium myosuroides* and *Mnium hornum*. This is a new record for Gloucestershire with the nearest populations further west in Monmouthshire (Bosanquet 2005, Blockeel *et al*. 2014).

Metzgeria conjugata
Gloucestershire: VU D2

M. conjugata has been recorded from five sites in Gloucestershire two to the east of the River Severn from which it has been lost, as well as Old Park Wood near Lydney (**NMW**) (Lansdown 2014), the Hudnalls where it persists (Lansdown 2014) and the area from Bowler's Hole south to The Slaughter (Armitage 1914, Knight 1914, Martin 2005, Lansdown 2014) where 13 populations were documented as part of this survey (Figure 9). Most populations were on exposed vertical cliff faces on promontories, occasionally on boulders and often in areas where *Scorpiurium circinnatum* occurs at the bottom of cliffs. The most frequent associated species were *Anomodon viticulosus*, *Cololejeunea rossettiana*, *Marchesinia mackaii*, *Neckera complanata*, *N. crispa* and *Thamnobryum alopecurum*, less often with *Ctenidium molluscum*, *Lejeunea cavifolia*, *Mnium stellare*, *Plagiochila porelloides*, *P. arboris-vitae*, *Rhynchostegiella tenella*, *Scorpiurium circinnatum* and *Tortella nitida* and rarely with a range of other species.

Metzgeria pubescens
Gloucestershire: VU D2

In Gloucestershire, *M. pubescens* is known only from the Symonds Yat area of the Wye Valley in (Figure 9), (**BM**, **CHM**, **NMW**) (Armitage 1914, Knight 1920, Paton 1968) as well as in the adjacent Lady Park Wood in Monmouthshire (Bosanquet 2003). It appears to be rare throughout the Wye Valley but may be under-recorded as it is very easily overlooked. The populations in the Wye Valley are the southernmost populations in Britain (Blockeel et al. 2014).

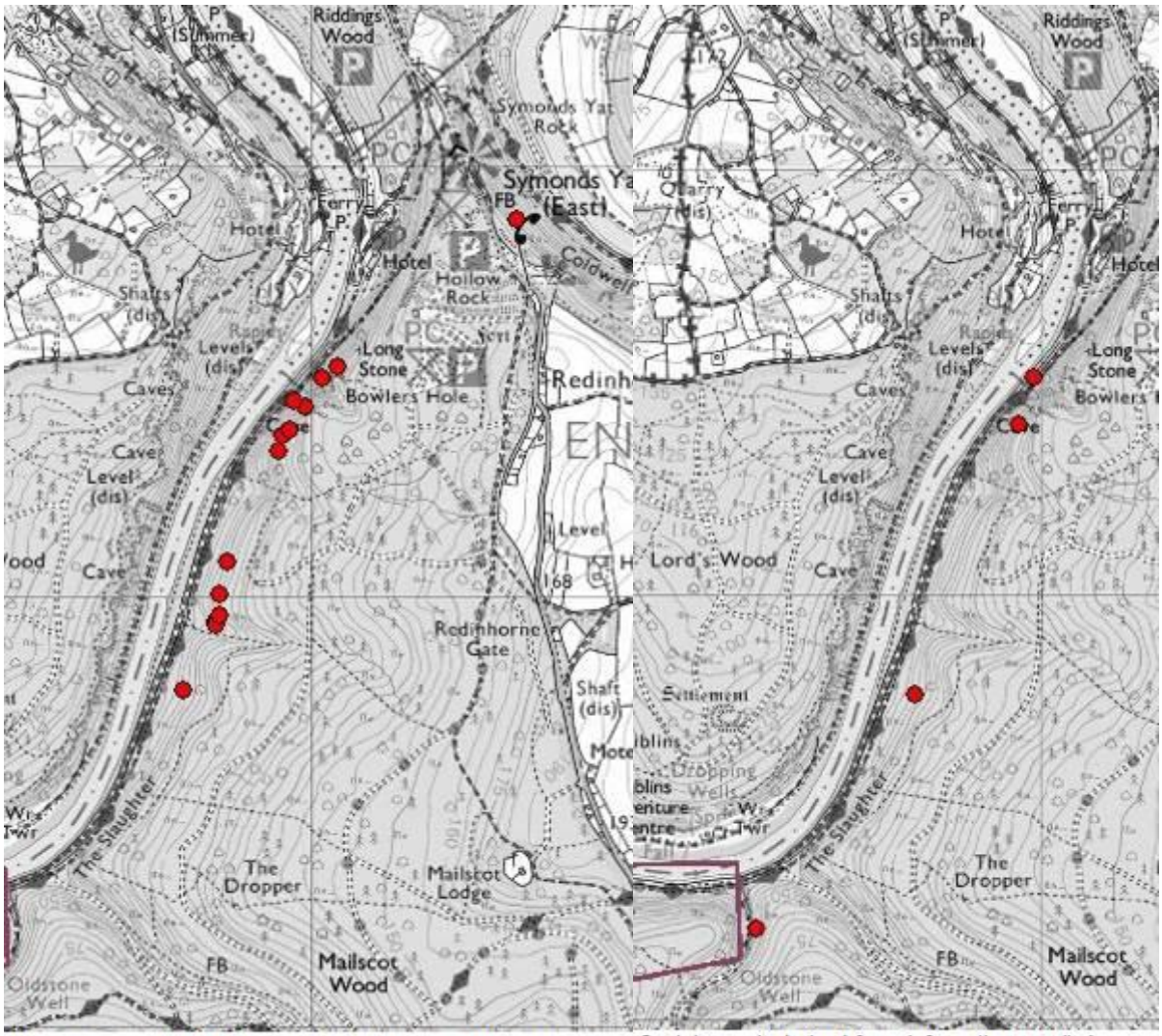

Figure 9 Distribution of *Metzgeria conjugata* (left) and *M. pubescens* (right)

Orthothecium intricatum
Gloucestershire: VU D2

In Gloucestershire, *O. intricatum* has been recorded from two sites, both in the Wye Valley, from limestone rocks at Tidenham (Knight 1914) and from the Symonds Yat area (**CHM**) (Armitage 1914), particularly The Slaughter (Wade 1954). It also occurs between these two areas in Lady Park Wood in Monmouthshire (Bosanquet 2003). It has probably been lost from Somerset and Devon (Blockeel et al. 2014) and so the Wye Valley populations now probably represent the south-easternmost populations in the UK. Five populations were found as part of this survey, two in the northern part of Coldwell Rocks (Figure 10) but most around The Slaughter. All except one of these were in hollows in cliff faces or in the entrances to caves, one was on the vertical face of a small bedrock exposure in a seepage where water flowed over the rock face. In all cases it occurred with *Thamnobryum alopecurum* and in most with *Neckera crispa* and *Eucladium verticillatum*, other frequent associates include *Tortella tortuosa*, *Leiocolea turbinata* and *Fissidens adianthoides*, with single records of *Asplenium trichomanes*, *Bryoerythrophyllum recurvirostrum*, *Ctenidium*

molluscum, *Gymnostomum calcareum*, *Isothecium myosuroides*, *Lepraria* sp., *Neckera complanata*, *Phyllitis scolopendrium*, *Plagiochila porelloides*, *Rhynchostegiella tenella*, *Tortella nitida* and *Trichostomum brachydontium*.

Plagiomnium cuspidatum

Gloucestershire: EN A2a

P. cuspidatum was reported from Symonds Yat in the early part of the twentieth century (**CHM, NMW**) (Armitage 1914, Knight 1914). It was recently recorded from Bowlers Hole (Martin 2005) which may represent the same population.

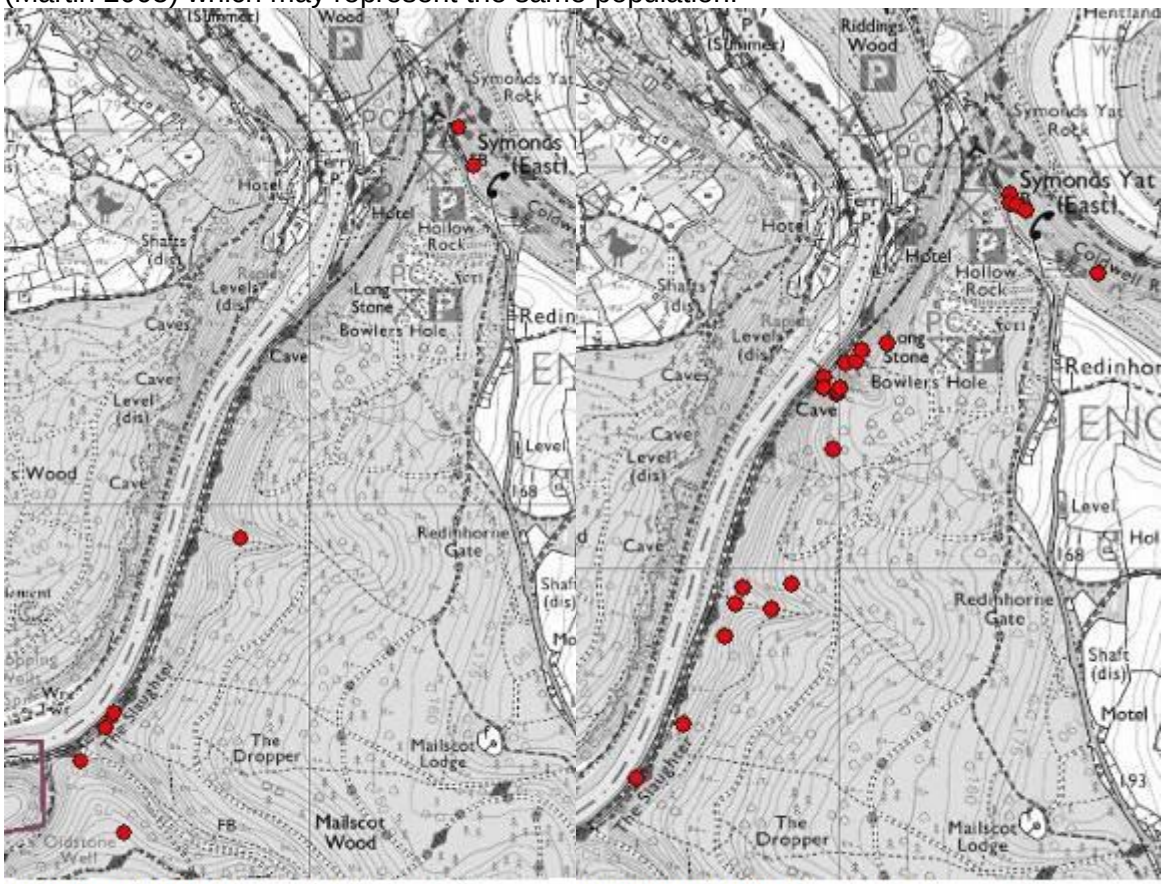

Figure 10 Distribution of *Orthothecium intricatum* (left) and *Tortella nitida* (right)

Pogonatum nanum

Gloucestershire: CR A2a

P. nanum was recorded from Symonds Yat in the early part of the twentieth century (Armitage 1914, Knight 1914) at a time when it occurred widely through the Forest of Dean and locally to the east of the River Severn. Searches have failed to find any populations in the Wye Valley and it may have been lost from the area, as it has from most of the county (Lansdown 2014).

Ptychomitrium polyphyllum
Gloucestershire: VU D2

P. polyphyllum was recorded from Symonds Yat (**NMW**) by Armitage (1914) but has not been recorded in Gloucestershire since. There is a need for specific surveys to relocate this species.

Reboulia hemisphaerica
Gloucestershire: VU D2

R. hemisphaerica was reported from Symonds Yat by Armitage (1914, Knight 1920) and a scattered population found in 2014 on the track marking the north-western edge of the county at Symonds Yat. However this population appears to have declined to only two small fronds on an earth bank alongside a track with *Anemone nemorosa*, *Carex digitata*, *Fissidens taxifolius*, *Fraxinus excelsior* (seedlings), *Galium odoratum*, *Hedera hibernica*, *Luzula foersteri* and *Trichostomum brachydontium*.

Rhodobryum roseum
Gloucestershire: REa

R. roseum has undergone a massive decline in Gloucestershire since the early part of the twentieth century and has not been recorded in the county since 1988 (Hearn 1989). There is an undated record of fruiting plants from beside the River Wye near Symonds Yat (**NMW**), as well as other records from the same area (**NMW**) (Armitage 1914, (Knight 1914) but recent searches have failed to find it.

Riccardia multifida
Gloucestershire: DD

R. multifida was reported from The Slaughter (**NMW**) (Hearn 1989) where it is still abundant on a damp cliff face along the abandoned railway line.

Saccogyna viticulosa
Gloucestershire: REb revised here to VU D2

S. viticulosa has been recorded twice in Gloucestershire, both times from the Wye Valley; near Tidenham in 1912 (**CHM**) (Knight 1920) and at Chepstow in 1949 (BRC). During this survey, two populations were found on conglomerate boulders; one on a stream bank, with *Blechnum spicant*, *Hookeria lucens*, *Scapania gracilis* and *Scapania undulata*, the other under a *Quercus* woodland canopy with species such as *Campylopus fragilis*, *Dicranum fuscescens*, *Hypnum jutlandicum* and *Polytrichastrum formosum*.

Schistidium rivulare
Gloucestershire: DD

S. rivulare was reported from the River Wye below Coldwell Rocks (Knight 1914), these were among the most south-easterly populations in Britain (Blockeel *et al*. 2014) but are now considered extinct.

Sciuro-hypnum plumosum
Gloucestershire: NT

S. plumosum has been reported twice from the River Wye near The Slaughter by Knight (1914) and in 1965 (**NMW**), it was also recorded from the Herefordshire part of the Wye by Armitage (1914). It has not been sought since the latter record but there is no reason to expect that it will have been lost from the site.

Scleropodium tourettii
Gloucestershire: VU D2

S. touretii is extensive on earth in crevices in the bedrock of Yat Rock in an area much used by the public with *Hedera hibernica*, *Homalothecium sericeum*, *Melica uniflora* and *Poa annua*. It appears to tolerate, or event benefit from, the human activity keeping the area open. It is of note that Armitage (1914) did not report *S. tourettii* from Yat Rock and it is possible that it was not present at the time.

Trichocolea tomentella
Gloucestershire: VU D2

T. tomentella was reported from Symonds Yat in 1903 (**NMW**) (Armitage 1914, Knight 1920) without further detail. It still occurs further downstream along the Wye Valley near The Hudnalls but most of the habitat which would have been suitable in the Symonds Yat area has been destroyed by forestry operations. Although it may still occur, it is unlikely to be found without specific searches.

Gains and losses

The area is extremely unusual because Eleanor Armitage published an account of the bryophytes that she recorded from the area in 1914, providing a baseline from which a reasonable comparison can be made. The following is a summary of her account including only the species treated as occurring both in Herefordshire and West Gloucestershire or specifically listed as occurring in West Gloucestershire. Taxa in bold have not been seen in the area since 1990.

1. **The Great Quarry** (Doward) and other open rocky ground and exposed rocks, both limestone and conglomerate. *Musci*: - ***Aloina aloides*** f., ***Bryum pallens*** o, *Calliergonella cuspidata* (c. fr.) o, *Campylium protensum* (c. fr.) o, *Ctenidium molluscum* f, *Cynodontium bruntonii* (c. fr. congl.) o, *Didymodon luridum* o, ***Ditrichum gracile*** f, *Encalypta vulgaris* o, ***Entodon concinnus*** r, *Entosthodon muhlenbergii/pulchellus* r, *Fissidens dubius* (c. fr.) f, *F. taxifolius* a, ***Grimmia montana*** vr., ***G. orbicularis*** vr., *G. trichophylla* (congl., c.fr.) o, *Homalothecium lutescens* (c. fr.) f., *H. sericeum* a, ***Microbryum rectum*** r., *Neckera crispa* vr., *Orthotrichum anomalum* vr., ***O. cupulatum*** r., ***Pleurochaete squarrosa*** vr, ***Pleurozium schreberi*** r, *Pseudoscleropodium purum* (c. fr.) a., ***Racomitrium fasciculare*** (congl.) r., ***R. heterostichum*** (congl.) o, *Rhytidiadelphus squarrosus* f, *Schistidium crassipilum* a, *Syntrichia montana* (c. fr.) f, *Tortella nitida* o, *Tortula muralis* f., ***T. subulata*** o, *Trichostomum brachydontium* o, *T. crispulum* (c. fr.) a, *Weissia controversa* a. *Hepaticae*: - ***Frullania tamarisci*** (rocks) r, *Lunularia cruciata* (rocky banks) r.

3. A. **Cliff-tops** Summit of the Yat Rock. *Musci*: - *Bryum argenteum*, *Didymodon sinuosus*, *Encalypta vulgaris*, *Entosthodon muhlenbergii/pulchellus*, *Fissidens dubius*, *Homalothecium sericeum*, *Orthotrichum anomalum*, ***O. cupulatum***, ***Pleurochaete squarrosa***, *Syntrichia montana*, *Tortella nitida*, *Tortula muralis*. *Hepaticae*: - *Porella platyphylla*.

3.B. **Steep shady limestone rocks** (Symonds Yat). Musci: - *Amblystegium confervoides* vr, *Anomodon longifolius* vr, *Anomodon viticulosus* (c. fr.) a, *Campyliadelphus chrysophyllus* r, *Conardia compacta* vr, *Eucladium verticillatum* (c. fr.) o, *Fissidens pusillus* (c. fr.) r, ***Gymnostomum aeruginosum*** r, *Gymnostomum calcareum* (fruits rare) f, *Gyroweissia tenuis* v, *Orthothecium intricatum* r, ***Platydictya jungermannioides*** vr, *Rhynchostegiella tenella* (c. fr.) a, *Scorpiurium circinnatum* r, *Seligeria campylopoda* r, *Thamnobryum alopecurum* (c. fr.) f, ***Zygodon stirtonii*** r, *Neckera crispa* (c. fr.) f, *Zygodon viridissimus* vr. Hepaticae: - *Cololejeunea calcarea* r, *Cololejeunea rossettiana* r, *Frullania dilatata* f, *Frullania tamarisci* o, *Lejeunea cavifolia* o, *Marchesinia mackaii* o, *Metzgeria conjugata* f, *Metzgeria pubescens* o, *Porella arboris-vitae* f, *P. platyphylla* o, ***Scapania aspera*** r

4. **Upper Woods** (partly on limestone, with some coal-measure sands). Musci: - *Atrichum undulatum* a, ***Aulacomnium androgynum*** r, ***Bryum rubens*** vr, ***Calliergonella lindbergii*** o, *Campylopus flexuosus* o, *C. pyriformis* (c. fr.) f, *Dicranella heteromalla* (sandstone) f, *D. schreberi* (c. fr.) r, *Dicranoweissia cirrata* vr, *Dicranum majus* r, *D. scoparium* o, *Entosthodon obtusus* r, *Fissidens bryoides* o, ***F. exilis*** r, *F. incurvus* r, *F. viridulus* o, *Hylocomium splendens* o, *Hypnum andoi* f, *H. cupressiforme* a, *H. cupressiforme* var. *resupinatum* o, *Isothecium myosuroides* f, ***Leptodontium flexifolium*** r, *Leucobryum juniperoideum* o, *Plagiomnium undulatum* f, ***Pleuridium subulatum*** o, *Pogonatum aloides* f, *Pohlia nutans* r, *Polytrichastrum formosum* o, *Polytrichum juniperinum* o, ***Rhytidiadelphus loreus*** r, *R. squarrosus* (fr. rare) o, *Tetraphis pellucida* (c.fr.) on stumps, ***Weissia rutilans*** vr.

5. **Lower Woods** on limestone with detached rocks. Musci: - *Amblystegium serpens* a, *Brachytheciastrum velutinum* f, *Brachythecium glareosum* (fruit rare) f, *B. rutabulum* a, *Campylophyllum calcareum* c.fr.) f, *Cirriphyllium crassinervium* (c.fr.) f, *C. piliferum* (fruit very rare) f, *Dicranella rufescens* r, *Didymodon insulanus* o, *Eurhynchium striatum* (cfr.) a, *Homalia trichomanoides* o, *Kindbergia praelonga* a, ***Leucodon sciuroides*** f, ***Loeskeobryum brevirostre*** o, *Mnium hornum* a, *M. stellare* o, *Orthotrichum affine* o, *O. diaphanum* f, *O. lyellii* o, *Oxyrrhynchium hians* (fr. rare) a, *O. pumilum* r, *O. schleicheri* (c.fr.) o, *Plagiomnium rostratum* (c.fr.) o, *Plagiothecium denticulatum* a, *P. nemorale* (c.fr.) r, *Plasteurhynchium striatulum* (fr. rare) o, ***Pogonatum nanum*** r, *Polytrichum juniperinum* o, *Pseudotaxiphyllum elegans* r, ***Rhodobryum roseum*** vr, *Rhynchostegium confertum* f, *Rhytidiadelphus triquetrus* (fruit rare) a, *Sciuro-hypnum populeum* f, *Taxiphyllum wissgrillii* (on rock) o, ***Thuidium assimile*** r, ***T. recognitum*** r, *T. tamariscinum* (c.fr) a, *Tortella tortuosa* (c.fr.) f, *Tortula marginata* (c.fr.) r, *Trichostomum tenuirostre* vr. Hepaticae: - *Aneura pinguis* (earth in wood) vr, *Calypogeia arguta* o, *C. fissa* (sandstone) r, *Cephalozia bicuspidata* o, *C. lunulifolia* r, *Diplophyllum albicans* (c.fr.) o, *Fossombronia pusilla* (damp spot) vr, *Frullania dilatata* trees) o, *F. tamarisci* (trees) r, *Leiocolea badensis* r, *L. turbinata* a, *Lophocolea bidentata* (logs) o, *L. heterophylla* (logs) r, *Metzgeria furcata* (on trees) f, ***Nardia scalaris*** (sandstone) r, *Pellia endiviifolia* (damp spots) o, *P. epiphylla* (c.fr. damp soil) r, *Plagiochila asplenioides* a, *Radula complanata* (trees) o, *Reboulia hemisphaerica* (steep slope) r, ***Scapania nemorea*** (sandstone) r, *Solenostoma gracillimum* r, *Trichocolea tomentella* r.

It appears that much of the open ground in the area has been lost either to development or to increased tree cover resulting from the decline in traditional use of the woodland. This would explain the disappearance of species such as *Aloina aloides*, *Ditrichum gracile*, *Entodon concinnus*, *Microbryum rectum* and *Pleurochaete squarrosa*. Apart from *Pleurozium schreberi* and *Tortula subulata*, both of which probably still occur somewhere in the area, the other species are mainly characteristic of bare rock which have declined throughout much of Gloucestershire and may well have been lost from the area. The summit of Yat Rock has been enclosed with a wall and some of the bare ground has been covered with gravel. The only remaining semi-natural habitat is the bare rock, a few square metres of very thin

grassland and the earth in crevices in the rock. It is actually quite impressive that species such as *Encalypta vulgaris* and *Entosthodon pulchellus* survive on the rock, particularly given the intense human pressure on the site. Other species which survive include *Tortula muralis* and most notably *Scleropodium tourettii*, the latter not recorded by Armitage and possibly a relatively recent colonist. It is possible that ongoing work to clear trees back from cliff edges (A. Swanson pers. comm.) could be beneficial to these species.

Entosthodon obtusus, *Leptodontium flexifolium* and *Weissia rutilans* are now rare plants in Gloucestershire (Lansdown 2014), probably having undergone a real decline, although it is also likely that they are under-recorded. Other species likely still to occur but to have been overlooked by the current survey include *Loeskeobryum brevirostre*, *Pogonatum nanum*, *Rhodobryum roseum* and *Thuidium recognitum* all of which are now rare, or have become extinct in Gloucestershire (Lansdown 2014). It seems likely that some of the species recorded by Armitage (1914) have been lost from the area, including *Grimmia orbicularis*, *Loeskeobryum brevirostre*, *Orthotrichum cupulatum*, *Pleurochaete squarrosa*, *Pogonatum nanum*, *Ptychomitrium polyphyllum*, *Racomitrium heterostichum*, *Rhodobryum roseum*, *Thuidium recognitum*, *Trichocolea tomentella* and *Weissia rutilans*. In contrast, nearly fifty taxa now known to occur in the area were not recorded by Armitage (1914), however it cannot automatically be assumed that they have subsequently colonised the area and many may simply have been overlooked. Some such as *Conocephalum salebrosum*, *Hygroamblystegium tenax* and *Plagiochila britannica* have only been recognised, or the identification has been clarified since 1914. Some, particularly epiphytes including such as *Cryphaea heteromalla*, *Orthotrichum pulchellum*, *O. stramineum* and *O. tenellum*, declined badly during the industrial revolution and have only relatively recently re-colonised.

The nature of the habitats along the Wye Valley has changed dramatically. It is certain that in the 18th century, the floor of the valley would have largely been open, with charcoal burning and the railway line running throughout its length in Gloucestershire. Loss of the railway line has certainly changed the extent of open ground at lower levels along the valley and any remaining grassland is very improved, showing low species diversity. Equally, it is likely that the decline in active exploitation of parts of the forest has led to closure of formerly open areas (Peterken 2007). Much of the grassland at higher levels is also improved and species-poor (such as around the car park near Yat Rock) although the sparse vegetation among the bedrock exposures on Yat Rock itself is still species-rich, supporting the only known populations of *Entosthodon pulchellus* and *Scleropodium tourettii* in the area. The most notable change is that open area on cliff-tops, which would have supported species such as *Entosthodon muhlenbergii* and *Pleurochaete squarrosa* are now very scarce.

This survey has demonstrated that this area remains locally and nationally important for bryophytes and retains most of the notable species which were recorded here in the early part of the 20th century. Most of the species which have gone from this area have also been lost from other sites in the county and beyond, although there is a small number of species which have probably been lost due to the increased cover of scrubby woodland resulting from abandonment of some of the traditional activities formerly carried out in the area, such as charcoal burning. There is a need to monitor some of the species which occur, particularly *Anomodon longifolius*, but also *Conardia compacta*, *Entosthodon pulchellus* and *Orthothecium intricatum* which are of national conservation concern and are at the south-eastern extreme of their UK range, therefore possibility indicative of populations trends overall in the UK. Equally, monitoring species classed here as LC(NR) for which Gloucestershire supports nationally important populations could provide a measure of national trends. There is also a need for specific survey for certain taxa such as *Bryum canariense*, *B. pallescens*, *Platydictya jungermannioides*, *Seligeria campylopoda*, *Fissidens crispus* and *Reboulia hemisphaerica*.

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