

Fungi

There are thought to be at least 12,000 species of fungi in Britain (including lichenised fungi), with new species being added each year.¹ However, fungi are among the least widely understood parts of our biodiversity, and there is much more to learn about fungi ecology, diversity and conservation.² Most of the world's ecosystems would collapse without fungi; they are often the primary decomposers and form positive mycorrhizal associations with nearly all plants. Fungi are a food source for many species and enable other species to feed on decomposing matter by breaking it down.

Fungi are widely grown or foraged from the wild as a foodstuff and are also valuable in the production of foods such as bread, cheese and even chocolate. Many important pharmaceutical drugs are derived from fungi, including penicillin, cyclosporin and statins.²

In contrast, fungi are the most significant pathogens for plants and, as such, include *Magnaporthe oryzae*, the world's most important fungal rice disease, *Ophiostoma novo-ulmi*, Dutch elm disease, and *Hymenoscyphus fraxineus*, the Ash dieback fungus.³

There are significant gaps in our knowledge and understanding of fungi. They are difficult to record, as fruiting bodies, the main source of records, may not appear in the same place, or appear every year, and sometimes only exist for a matter of days. Other species can only be identified by microscopy, culturing or even DNA typing. To compound this, there is a recognised skills shortage in taxonomy, particularly for fungi.⁴ Until recently there were only three fungi species on the global IUCN Red List, compared to almost 20,000 plants. There is a Global Fungal Red List Initiative aiming to address this imbalance, and there are now over 200 Red listed fungi, with hundreds more undergoing assessment.⁵

Wales is considered to have an 'extraordinary' diversity of fungi,⁴ and there are 27 species of fungi on the Wales Section 7 list, and 58 proposed Important Fungus Areas (IFAs).¹ Greater Gwent has two IFAs: Cwm Clydach, for populations of rare species and outstanding woodland habitat (300 recorded species); and Garn Ddyrys (Bloreng), for outstanding grassland habitat (50 species). Mynydd Llangattock, just outside the study area, is also an IFA. Fungi recording (and some foraging) is carried out by the Gwent Fungus Group.

Note that the project was unable to obtain permission to use some NBN fungi records, so there may be additional records for fungi.

Beech Deadwood Fungi

Protection: none

Conservation Status: various, see below

Data Availability: Poor (45 records)

Context: Deadwood Fungi are a key component of woodland ecosystems, and the deadwood fungi of Beech woodlands in Britain are considered internationally important.⁶ High diversity of deadwood fungi is more likely in older woodlands, as well as parklands and wood pasture, with long continuity of uneven age structure.⁷ This section uses the list of SSSI indicator species for Beech Deadwood Fungi assemblages.⁶ Although the list consists of 30 species of ascomycetes (sac fungi), gilled fungi, poroid fungi and others, only 10 of these have been found within the study area. Very few Beech Deadwood Fungi have been found in Wales as a whole, and it is thought that the assemblage is, like native Beech, on the edge of its range in Gwent and therefore impoverished compared with south-eastern Britain. Nevertheless, the presence of two species of the rare genus *Hericium* strongly suggests that some Gwent sites are significant for Beech Deadwood Fungi.

Scientific Name	Common Name	Number of records	Latest record	Red List Status ⁸
<i>Camarops polysperma</i>	Thick Tarcrust	3	1998	NT
<i>Ceriporiopsis gilvescens</i>	Pink Porecrust	2	2012	
<i>Corioloopsis gallica</i>	Brownflesh Bracket	1	1982	
<i>Eutypa spinosa</i>	Spiral Tarcrust	22	2010	
<i>Ganoderma pfeifferi</i>	Beeswax Bracket	4	2017	
<i>Hericium cirrhatum</i>	Tiered Tooth	9	2019	VU*
<i>Hericium coralloides</i>	Coral Tooth	1	1973	NT
<i>Inonotus cuticularis</i>	Clustered Bracket	1	2006	

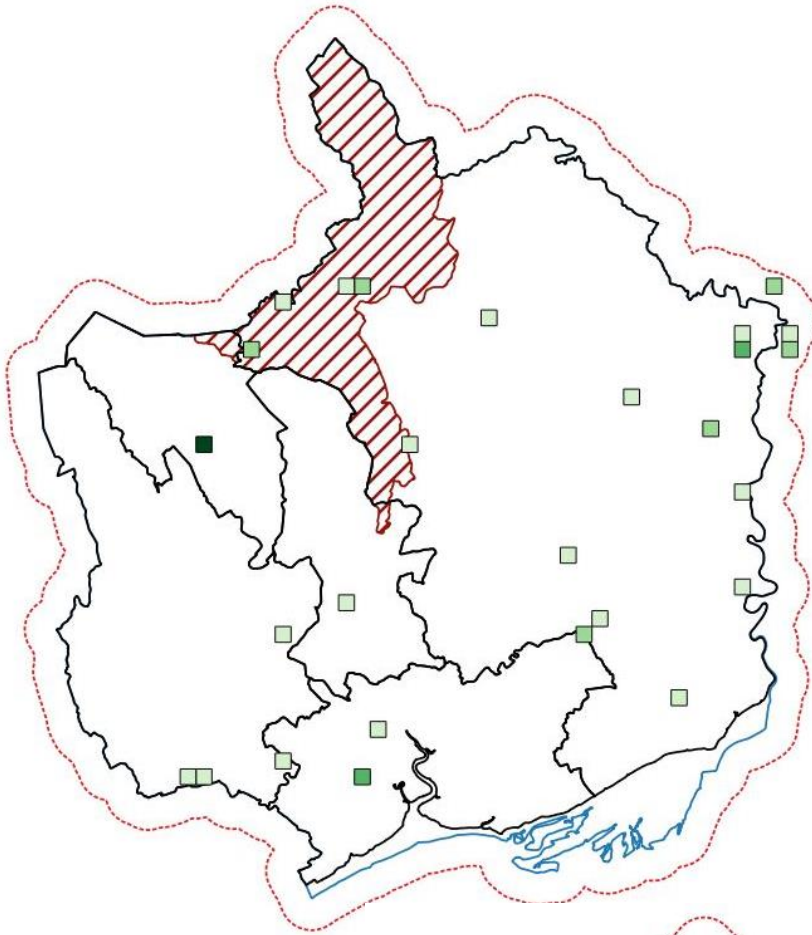
<i>Phleogena faginea</i>	Fenugreek Stalkball	1	2019	
<i>Volvariella bombycina</i>	Silky Rosegill	1	1999	

*Not listed on the 2006 Red Data list, but cited as Vulnerable on the 1992 list, as stated in Ainsworth 2004⁷

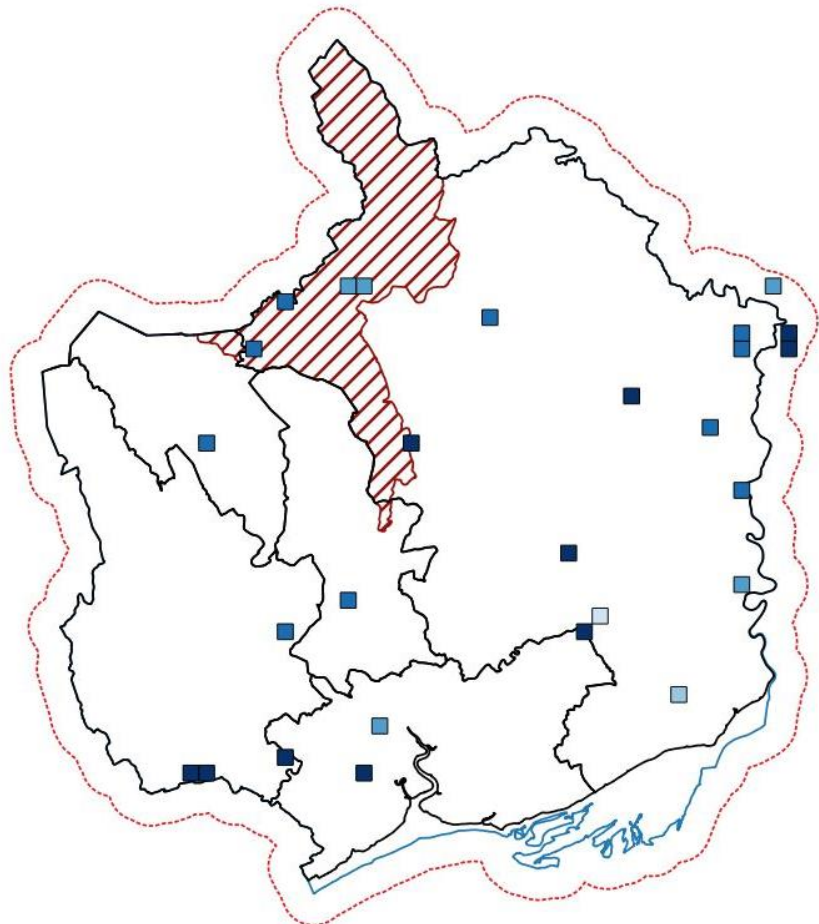
Outlook: It is difficult to predict what is happening to Beech Deadwood Fungi, due to lack of data. Until recently, deadwood was often removed from managed forests due to a misconception that this would improve tree health, or simply for ‘tidiness’.¹⁰ Now, the UK Forestry Standard includes guidelines to retain and manage veteran trees and leave a proportion of standing and fallen deadwood.¹¹ However, it will naturally take a long time to restock a variety of ages and types of deadwood. Currently, 82% of Welsh native woodlands are thought to be in an unfavourable condition for deadwood volume.¹² The same is true of most parklands in Gwent, with tidy landowners removing dead or dying landscape trees, often as a ready source of firewood. Without a change in guidance for private land managers the outlook for Beech fungi in parkland is not promising.

Greater Gwent range: Records of these rare fungi are very thinly scattered across Greater Gwent. This is perhaps due to lack of survey and awareness of the appearance of most species, rather than genuine absence. Silent Valley and Cwm Clydach stand out as sites with two of these species, and Silent Valley has the most records, but neither site has records within the last decade. In fact, out of 27 squares within the study area, only 10 have records within the last 10 years. Other sites with multiple records include Tredegar Park, Beaulieu Wood and Priory Grove, St Marys Vale and Wentwood, but these are only for one species. Local mycologists suggest that there are other sites likely to support Beech Deadwood Fungi, such as the Reddings Enclosure, which are not highlighted by current records.

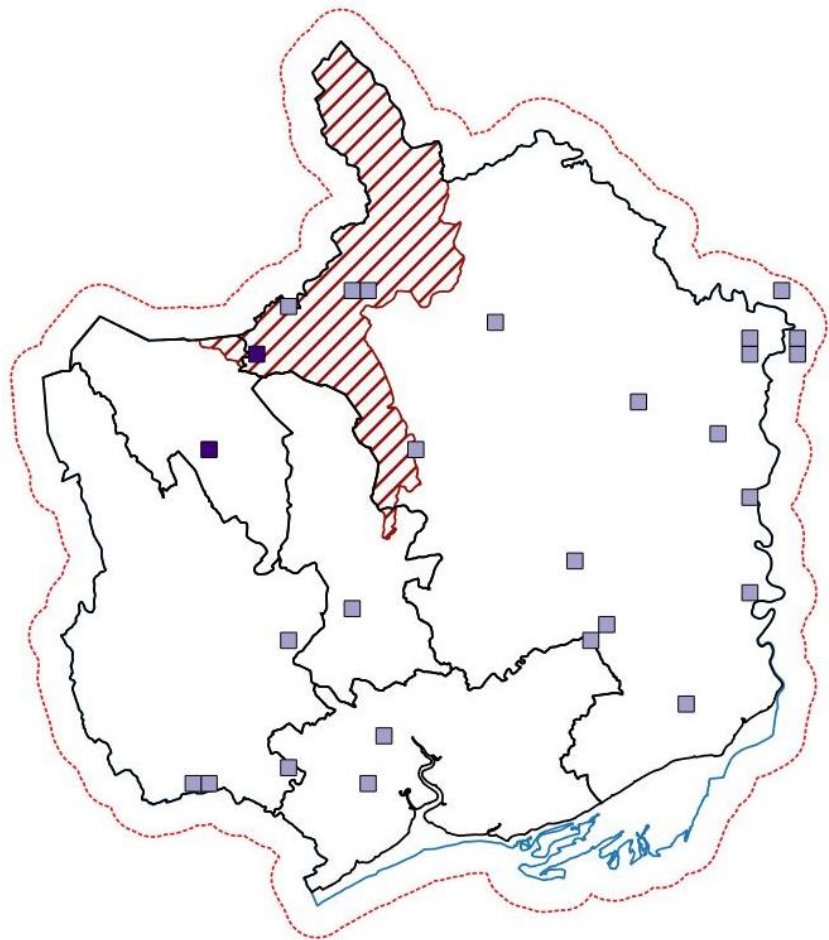
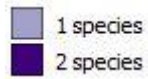
Density of Beech Deadwood Fungi Records (max 5/km²)



Beech Deadwood Fungi by decade

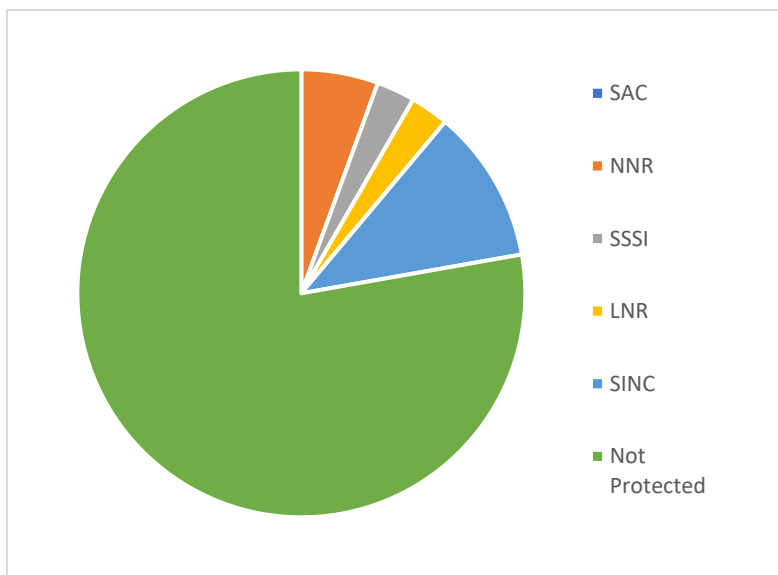


Diversity of Beech Deadwood Fungi Records



Protection: Only 22% of records come from protected sites, which is unexpected as these fungi would be indicative of older woodlands. All Ancient Semi-Natural Woodlands (ASNW) in Greater Gwent are designated at least as SINC, so it might be that records are falling outside of protected sites due to centring of grid references, particularly for older records with less accurate locations. Records from protected sites include Cwn Clydach NNR, Silent Valley SSSI/LNR, and SINC at Cefn Onn, Ruperra Woodlands, Bargain Wood, and Caerwent.

Beech Deadwood Fungi records on protected sites



Oak Deadwood Fungi

Protection: none

Conservation Status: various, see below

Data Availability: Moderate (211 records)

Context: Deadwood fungi are a key component of woodland ecosystems, and the deadwood fungi of Oak woodlands in Britain are considered internationally important.⁶ High diversity of deadwood fungi is more likely in older woodlands, as well as parklands and woodpasture, with long continuity of uneven age structure.⁷ This section uses the list of SSSI indicator species for Oak Deadwood Fungi assemblages.⁶ The list consists of 16 species; 12 of which have been found within the study area.

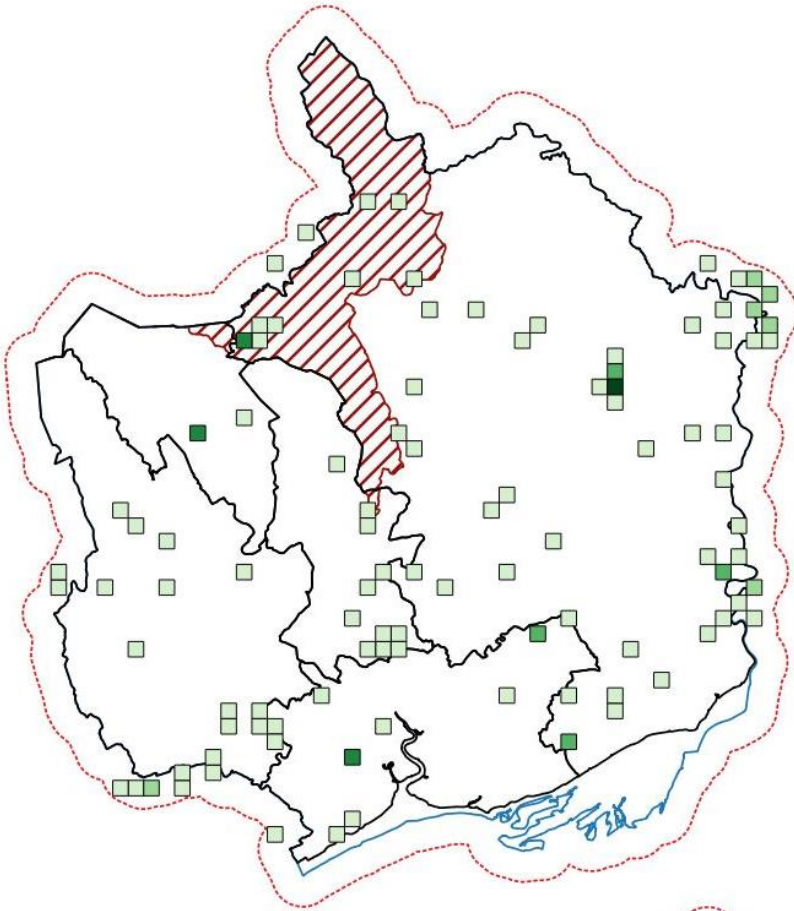
Scientific Name	Common Name	Number of records	Latest record	Red List Status ⁸
<i>Daedalea quercina</i>	Oak Mazegill	22	2017	
<i>Fistulina hepatica</i>	Beef-Steak Fungus	23	2017	
<i>Ganoderma lucidum</i>	Lacquered Bracket	4	2010	
<i>Ganoderma resinaceum</i>	A bracket fungus	5	2017	
<i>Grifola frondosa</i>	Hen of the Woods	7	2016	
<i>Gymnopus fusipes</i>	Spindle Toughshank	10	1973	
<i>Hymenochaete rubiginosa</i>	Oak Curtain Crust	27	2019	
<i>Laetiporus sulphureus</i>	Chicken of the Woods	56	2019	
<i>Mycena inclinata</i>	Clustered Bonnet	16	2019	
<i>Piptoporus quercinus</i>	Oak Polypore	6	2009	EN,

				Section 7
<i>Podoscypha multizonata</i>	Zoned Rosette	3	2019	
<i>Pseudoinotus dryadeus</i>	Oak Bracket	12	2017	

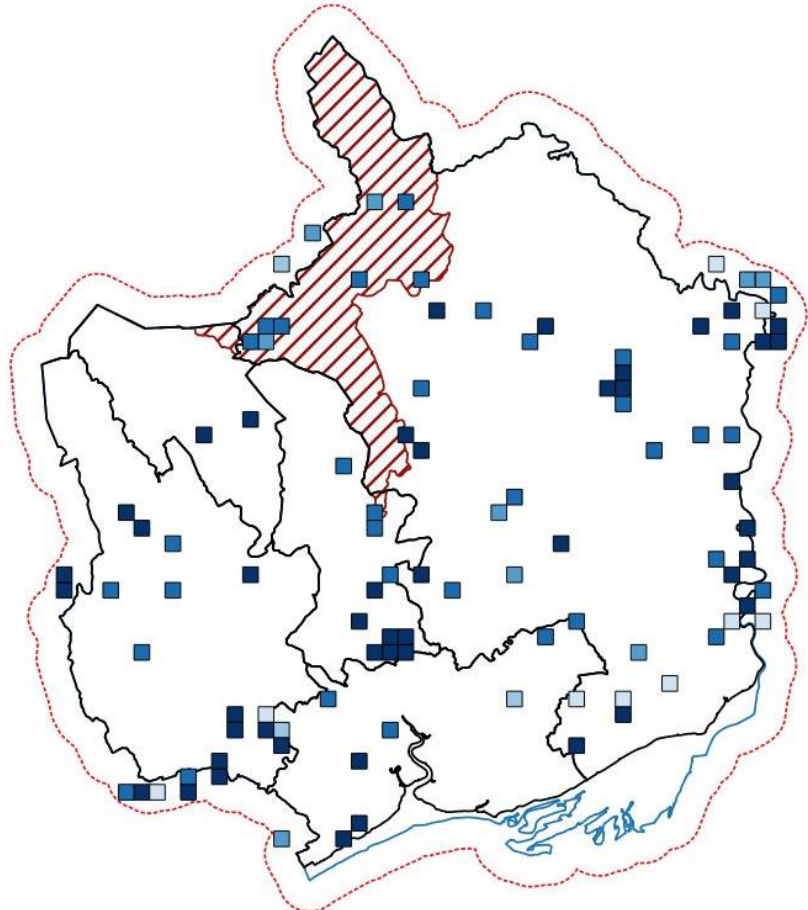
Outlook: It is difficult to predict what is happening to Oak Deadwood Fungi because of a lack of data. Until recently, deadwood was often removed from managed forests due to a misconception that this would improve tree health, or simply for ‘tidiness’.¹⁰ Now, the UK Forestry Standard includes guidelines to retain and manage veteran trees and leave a proportion of standing and fallen deadwood.¹¹ However, it will naturally take a long time to restock a variety of ages and types of deadwood. Currently, 82% of Welsh native woodlands are thought to be in an unfavourable condition for deadwood volume.¹² The same is true of most parklands in Gwent, with tidy landowners removing dead or dying landscape trees. However, there are far more ancient Oaks than Beeches in the landscape of Gwent, and the outlook for Oak saprotrophic fungi is probably better than for Beech saprotrophs in the county.

Greater Gwent range: Records of these rare fungi are widely scattered across Greater Gwent, with recent records for most sites. The most diverse sites are at Dingestow, Tredegar Park, Cwm Clydach, Pontypool Park, Magor Marsh and Lady Park Wood, as well as two English sites. Fungi records are ‘valid’ for a period of 50 years,⁶ so even sites with older records, such as Pontypool Park and Lady Park Wood should be considered significant. Dingestow could be considered for SSSI status, as eight species is the threshold for designation.⁶

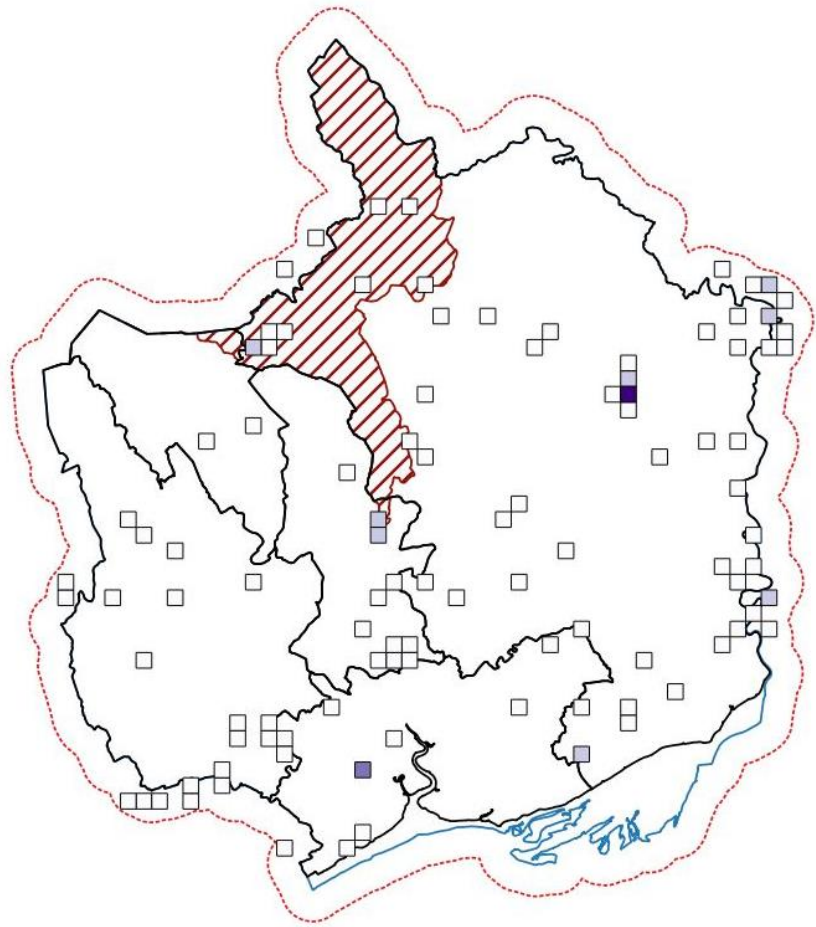
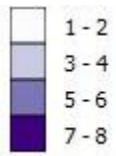
Density of Oak Deadwood Fungi Records (max 12/km²)



Oak Deadwood Fungi records by decade

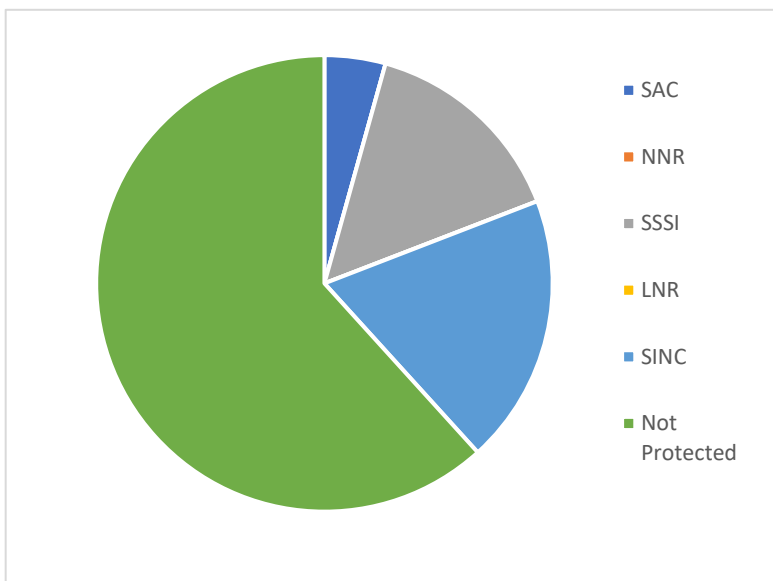


*Species richness of Oak
Deadwood Fungi*



Protection: Just over a third (38%) of records are from protected sites. SAC records are from the Wye Valley Woodlands and SSSI records are from Cwm Clydach (falling outside the NNR), Cwm Merddog (Silent Valley), Strawberry Cottage Wood and the Gwent Levels. SINC records are from a number of sites, especially old estates and parkland, such as Piercefield Park, Llantarnam, and Pontypool Park, and Ancient Semi Natural Woodlands, such as Bargain Wood and Park Wood. It is likely that more sites fall within small woodland fragments, especially in Monmouthshire, and centring of records causes them to fall outside of the protected area.

Oak Deadwood Fungi records from protected sites



Grassland Waxcap Fungi

Protection: none

Conservation Status: various, see below

Data Availability: Good (3,242 records for 46 species)

Context: Diverse grassland fungi grow in ancient pastures, forming varied associations with grasses, plants and mosses. There are five main groups of fungi that are found mostly in grasslands: Clubs & Corals; Crazed-Caps; Earthtongues; Pinkgills; and Waxcaps.



Crimson Waxcap (*Hygrocybe punicea*)

Andy Karran

Many are very colourful, with red, orange, yellow, green and even pink and purple species. Some grassland fungi are common and widespread, such as Parrot Waxcap and Blackening Waxcap, but some are extremely rare, including Pink Coral, Violet Coral and Grey Waxcap. Waxcaps are probably the most recorded group of grassland fungi.

Grassland fungi are lost during ploughing or if fertility gets too high, and it takes decades for a really diverse assemblage of grassland fungi to develop: at Dingestow Court, rare grassland fungi are still absent from a lawn that was ploughed 70 years ago, despite their presence on another otherwise identical lawn. Ancient grassland is widespread in Gwent, and some sites are of international significance. Rich assemblages of grassland fungi are scattered across the area, and it is likely that there are still some to be discovered. Detecting grassland fungi is complicated by their relatively short fruiting season and variability of fruiting between different years. Analysis of eDNA is allowing detection of grassland fungi in soil samples at any time of year, potentially revolutionising the study of these species.

Note that waxcap taxonomy has been subject to many changes as more is discovered about these species and their relationships to one another. The scientific names below follow Boertmann (2010) as described in the current SSSI guidelines⁶.

Scientific Name	Common Name	Study Area records	SSSI indicators ⁶	High diversity indicators ⁶	Red Data List ¹
<i>Hygrocybe acutoconica</i>	Persistent Waxcap	88	✓		
<i>Hygrocybe aurantiosplendens</i>	Orange Waxcap	30	✓	✓	*
<i>Hygrocybe calciphila</i>	Limestone Waxcap	16	✓		
<i>Hygrocybe calyptriformis</i>	Pink Meadow Cap	92	✓	✓	VU
<i>Hygrocybe cantharellus</i>	Goblet Waxcap	15	✓		

<i>Hygrocybe ceracea</i>	Butter Waxcap	128	✓		
<i>Hygrocybe chlorophana</i>	Golden Waxcap	390	✓		
<i>Hygrocybe citrinovirens</i>	Citrine Waxcap	38	✓	✓	
<i>Hygrocybe coccinea</i>	Scarlet Hood	212	✓		
<i>Hygrocybe coccineocrenata</i>	Bog Waxcap	2			
<i>Hygrocybe colemanniana</i>	Toasted Waxcap	60	✓	✓	
<i>Hygrocybe conica</i>	Blackening Waxcap	268	✓		
<i>Hygrocybe flavipes</i>	Yellow Foot Waxcap	63	✓	✓	
<i>Hygrocybe fornicate</i>	Earthy Waxcap	29	✓		
<i>Hygrocybe glutinipes</i>	Glutinous Waxcap	120	✓		
<i>Hygrocybe helobia</i>	Garlic Waxcap	7	✓		
<i>Hygrocybe ingrata</i>	Dingy Waxcap	7	✓	✓	
<i>Hygrocybe insipida</i>	Spangle Waxcap	189	✓		
<i>Hygrocybe intermedia</i>	Fibrous Waxcap	71	✓	✓	
<i>Hygrocybe lacmus</i>	Grey Waxcap	10	✓	✓	*
<i>Hygrocybe laeta</i>	Heath Waxcap	1	✓		
<i>Hygrocybe miniata</i>	Vermillion Waxcap	38	✓		
<i>Hygrocybe mucronella</i>	Bitter Waxcap	41	✓		
<i>Hygrocybe nitrata</i>	Nitrous Waxcap	20	✓	✓	
<i>Hygrocybe pratensis</i>	Meadow/Pale Waxcap	356	✓		
<i>Hygrocybe punicea</i>	Crimson Waxcap	107	✓	✓	
<i>Hygrocybe quieta</i>	Oily Waxcap	139	✓		

<i>Hygrocybe radiata</i>	Slender Waxcap	3	✓		*
<i>Hygrocybe reidii</i>	Honey Waxcap	104	✓		
<i>Hygrocybe russocoriacea</i>	Cedarwood Waxcap	76	✓		
<i>Hygrocybe spadicea</i>	Date-Coloured waxcap	3	✓	✓	VU ⁺
<i>Hygrocybe splendidissima</i>	Splendid Waxcap	24	✓	✓	
<i>Hygrocybe substragulata</i>		2	✓		
<i>Hygrocybe virginea</i>	Snowy Waxcap	455	✓		
<i>Hygrocybe vitellina</i>		4	✓		

* European Species of Conservation Concern

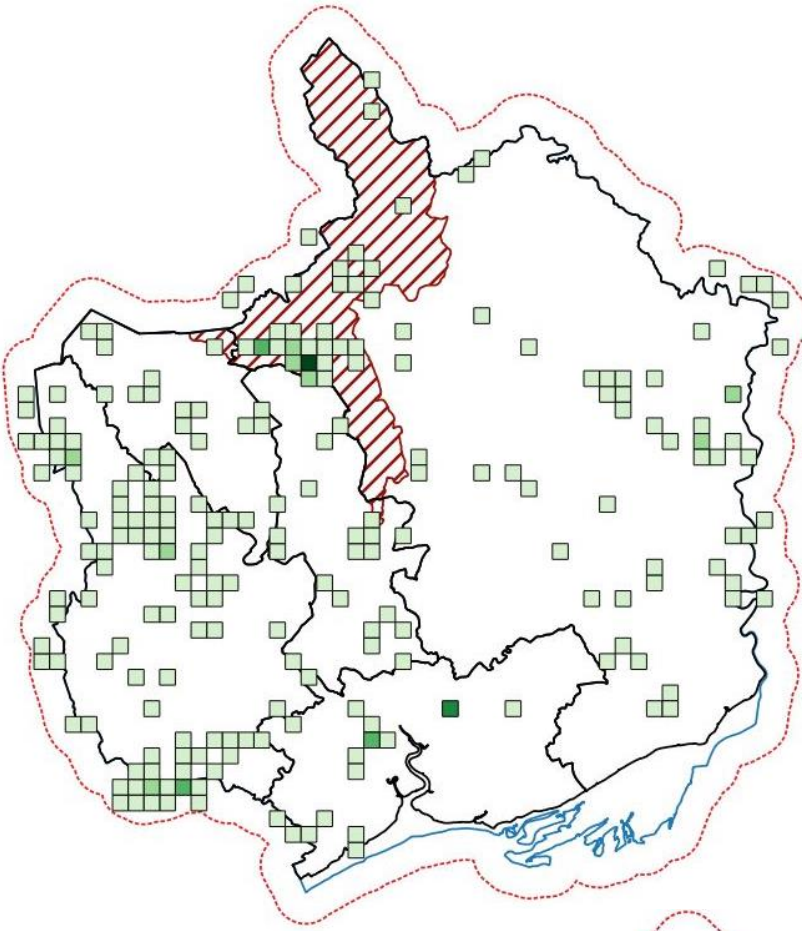
⁺ Wales Section 7 Priority Species

Outlook: Grassland fungi are very easy to destroy through ploughing, but Gwent is blessed with many ancient grasslands that are unlikely to be ploughed, especially in the western valleys, the north-east and the Trellech plateau. Understanding and appreciation of grassland fungi continues to improve, aided significantly by a book published by two Gwent mycologists.¹³ Management to protect grassland fungi is specifically covered by a Glastir farm prescription, and is being discussed for the Sustainable Farm Scheme. Known rich grassland fungi sites are mapped to prevent grant-funded tree planting, but woodland creation is still a very significant threat to these species, especially because permanent pasture is largely protected from ploughing but not from planting. The impacts from agricultural nitrogen pollution on grassland fungi remain unknown. Churchyards and cemeteries are often very important for the survival of grassland fungi, providing mowing takes place regularly and grass is removed to prevent nutrient build-up.

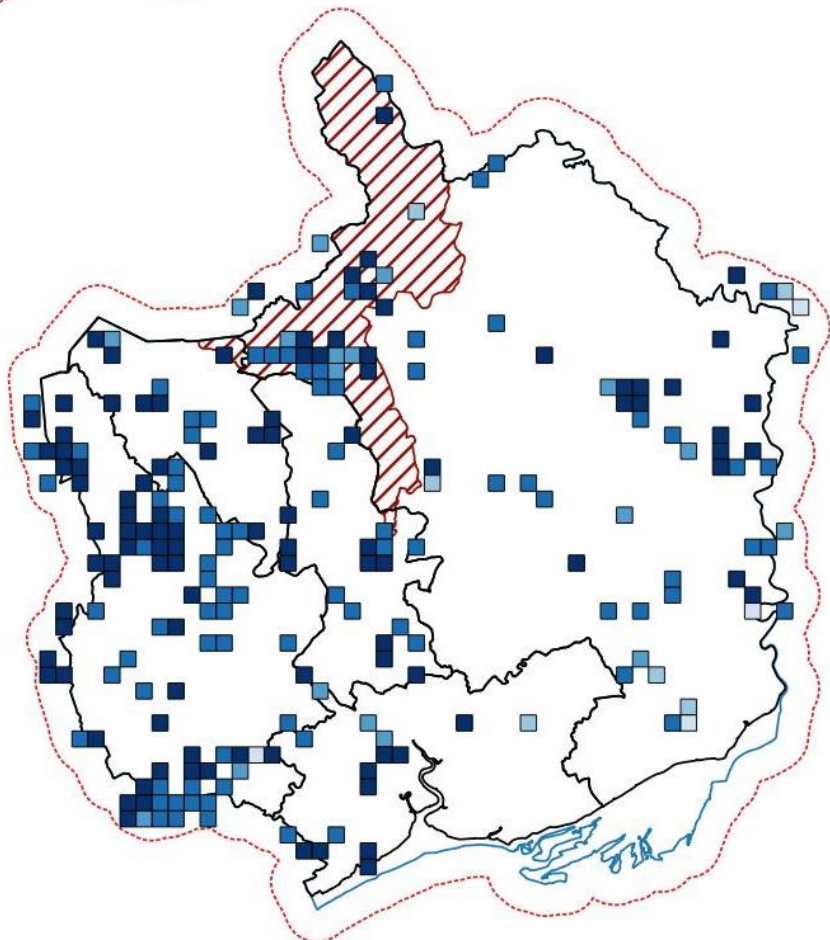
Greater Gwent range: Grassland fungi occur in farmland, hillsides, cemeteries, churchyards and lawns, and therefore have a very wide range in Gwent, although there are no records from the Gwent Levels. The county holds one of the most diverse grassland fungus sites in Britain. This internationally important site covers the grassland and heathland mosaics between the Bloreng and Cwm Clydach, including Gilwern Hill, and has 30 recorded waxcap species. Only two sites in the UK are known to hold more species than this.¹⁴

Other hotspots include Christchurch Cemetery LNR, Glasllwch Cemetery, Cefn Onn SINC, Aberbargoed Grasslands SAC/SSSI, Fochriw Tips and Cefn Gelligaer SINC, Pontypool Park SINC, Dingestow Court, Pentwyn Farm SSSI, New Grove Meadows SINC, Mountain Ranch and Mynydd Llangattwg SAC/SSSI. Sites supporting 19 or more SSSI species should be considered for notification. Sites with 12–19 SSSI species should be prioritised for further survey.

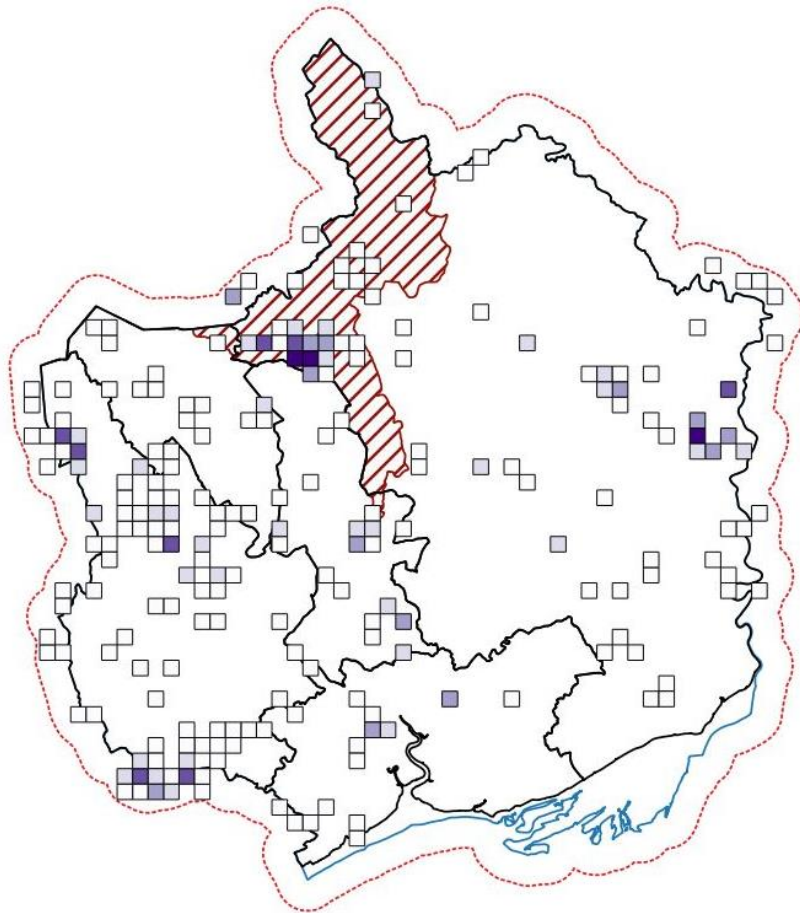
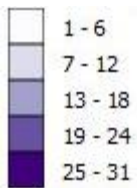
*Density of Waxcap Fungi
Records (max 301
records/km²)*



Waxcap records by date

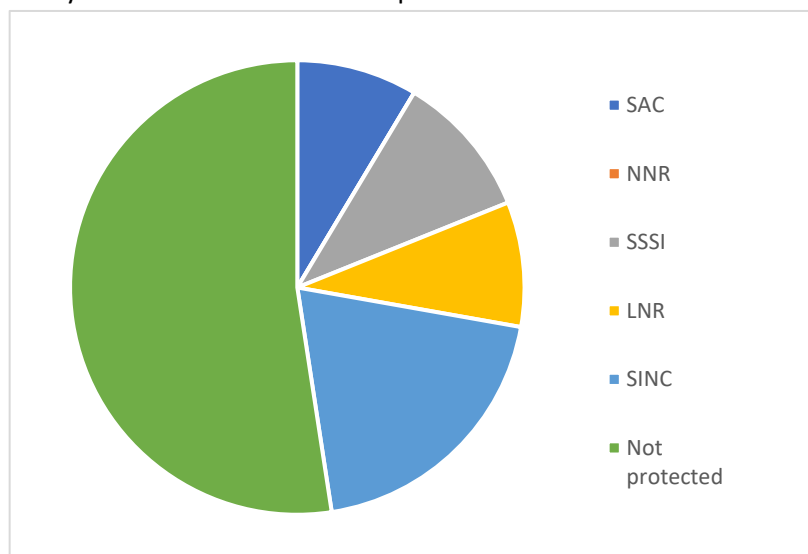


Species richness of waxcap fungi



Protection: Just under half (48%) of waxcap fungi records are from protected sites. SAC records are from Aberbargoed Grasslands, and the Usk Bat SAC (and the Cwm Clydach NNR, which falls within the Usk Bat SAC). Important SSSIs include the Bloreng and Pentwyn Farm. LNR records are almost entirely from Christchurch cemetery. SINC records are scattered throughout the area, and include Coed-y-Moeth and Cwmsyfiog Hillside, Cwmsyfiog SINC and Caerphilly Common, as well as those SINCs mentioned previously. Much of the internationally important complex in the Bloreng, Gilwern Hill, Cwm Clydach area is designated SSSI and has grassland fungi specifically addressed during management decisions, although many records fall outside of the protected areas.

Waxcap fungi records from protected sites



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Lichens and Bryophytes

Lichens and Bryophytes are often overlooked and under-recorded when compared to other species groups. There are around 1,800 lichen species and 1,000 bryophyte species found in the UK, with 119 species and 3 communities or assemblages listed on the Section 7 List in Wales. Of those Section 7 species, just 11 have been recorded in Greater Gwent, most with 5 or fewer records. The exception is Spreading-Leaved Beardless Moss (*Weissia squarrosa*), which has 29 recent records in central Monmouthshire.

Greater Gwent has a long history of recording bryophytes and relatively good coverage. The area has a high species richness, with one 1km² supporting over 150 species.¹ This is in part due to the wide variety of substrates provided by the area's geological diversity and the consequent variety of habitats, from woodlands and meadows to wetland and heath. In this section are highlighted some of the rarest mosses recorded in Greater Gwent, such as Flood Moss (*Myrinia pulvinata*) and Irish Earth-Moss *Ephemerum hibernicum*, as well as significant moss communities on arable land and limestone soils.

For lichens, Wales as a whole is extremely species rich: at one time it supported 71% of the British lichen flora, despite accounting for only 11% of Britain's area.² Greater Gwent seems less well recorded, especially when compared with neighbouring Gloucestershire or the Brecon Beacons National Park. The British Lichen Society holds no records at all for some 10km squares in Greater Gwent.³ This lack of lichen recording and, in particular, lichen recorders, is recognised as a national problem for Wales, and there is now a dedicated Lichen Apprenticeship Scheme, CENNAD,⁴ which aims to train more lichen experts.

Like many other species, both bryophytes and lichens are threatened by habitat loss. Ash dieback is predicted to have a significant negative impact on both: 58 bryophytes and 546 lichens are associated with ash, and many of these species are already Nationally Rare or Scarce.⁵ Both bryophytes and lichens are sensitive to pollution and can be useful indicators of air quality, as shown by analysis of epiphytic mosses and nitrogen-sensitive lichens in this section.

Arable Bryophytes

Protection: none

Conservation Status: none

Data Availability: Good (112 records, for 30 species)

Context: Historically almost every farm in Gwent had some arable land for cereals or forage, and specialist mosses, liverworts and hornworts of arable land would have been very widespread. Intensification of arable farming during the twentieth century led to significant declines in the distribution and abundance of arable bryophytes. In particular, those that produce sporophytes in late winter or spring have been disproportionately affected by a switch to autumn cultivation rather than overwintering of stubbles. A nationwide survey of arable bryophytes⁶ showed that Gwent was a national hotspot for bryophyte-rich arable fields, and the highest species tally for any arable field in Britain came from a field near Dingestow.



Sam Bosanquet

Arable bryophytes protect bare soil from erosion by binding the soil surface and can form a very high cover in cereal stubble fields. Autumn cultivation prevents the development of an arable bryophyte carpet, while slurry spreading and soil compaction are believed to reduce bryophyte abundance and diversity. Maize fields are particularly poor for arable bryophytes.

Although more than 70 bryophyte species have been recorded in arable fields in Gwent, only 30 of these are considered to be typical of the habitat as they occur in arable far more frequently than in other situations. Nine of these arable specialists are listed in the most recent Red Data List⁷ and/or are Nationally Scarce (recorded in fewer than 100 hectads in Britain since 1970).

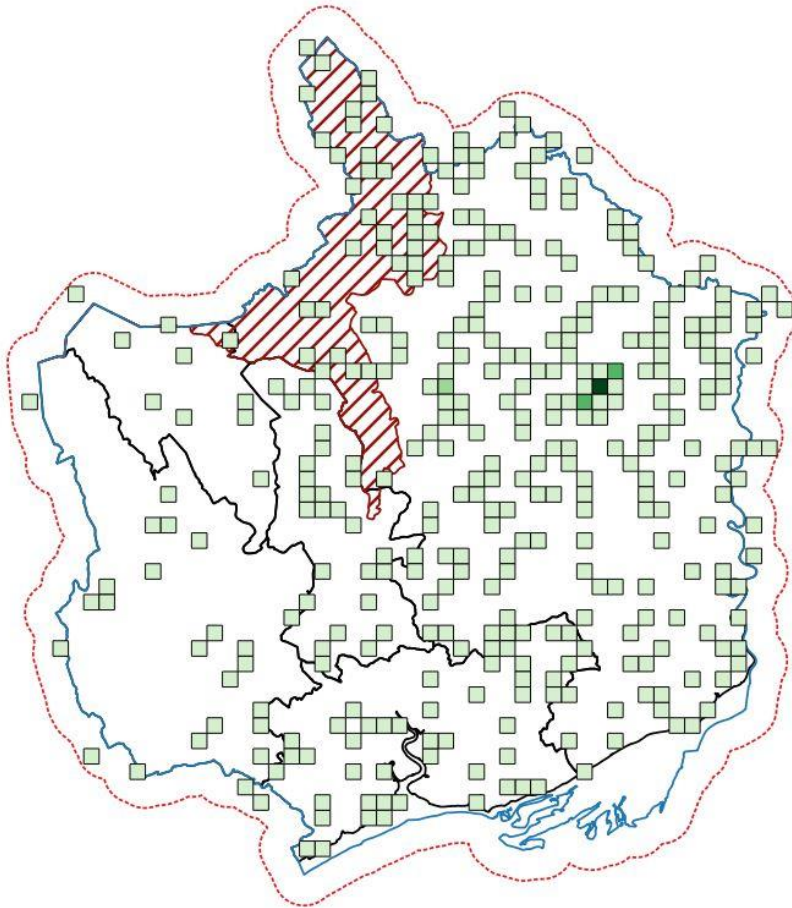
Scientific name	Common name	Greater Gwent records	Greater Gwent sites	UK status
<i>Acaulon muticum</i>	Rounded Pygmy-Moss	13	10 (but only 3 are arable)	RDB Vulnerable
<i>Anthoceros agrestis</i>	Field Hornwort	24	16	Nationally Scarce, RDB Vulnerable
<i>Didymodon tomaculosus</i>	Sausage Beard-Moss	2	1	Nationally Scarce
<i>Entosthodon fascicularis</i>	Hasselquist's Hyssop	19	13	RDB Near Threatened
<i>Fossombronia caespitiformis</i>	Husnot's Frillwort	2	2 (only 1 arable)	Nationally Scarce
<i>Microbryum floerkeanum</i>	Floerke's Phascum	2	2 (only 1 arable)	RDB Near Threatened
<i>Phaeoceros carolinianus</i>	Carolina Hornwort	22	11	Nationally Scarce, RDB Endangered
<i>Weissia rutilans</i>	Pointed-Leaved Stubble-Moss	6	3 (none arable)	Nationally Scarce
<i>Weissia squarrosa</i>	Spreading-Leaved Beardless-moss	22	5 (only 3 arable)	Nationally Scarce, RDB Near Threatened

Outlook: The nationwide arable bryophyte survey¹ identified pressures on arable bryophytes including loss of small-scale arable on livestock farms, declining frequency of spring cultivation and overwintered stubbles, over-use of fertilisers, and loss of soil structure. These pressures are all apparent in Gwent, especially in the low-lying Usk Valley and Raglan area, where silage, maize and oilseed rape cultivation have increased since the early 2000s. Bryophyte-rich stubbles are still encountered frequently in north-east Gwent, especially when wet winters make cultivation difficult, and this may be enough to allow the local survival of our arable bryophyte flora.

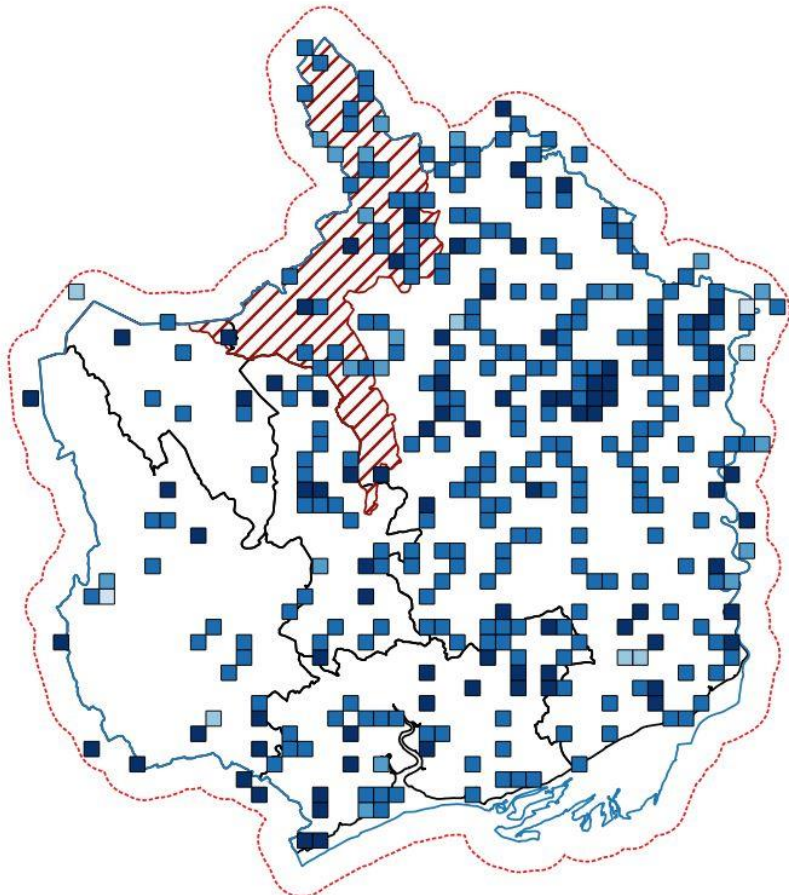
Prospects for arable bryophytes remain uncertain. Despite their role in reducing soil erosion in overwintered stubble fields, they are not widely appreciated by farmers or policy makers. Arable bryophytes are not specifically mentioned in consultation drafts for the Welsh Sustainable Farming Scheme, although they may benefit from options designed to conserve farmland birds.

Greater Gwent range: Arable bryophytes are found across Greater Gwent, but the majority are in the eastern half of the county. Greater Gwent is on the western edge of the core arable area of Britain, and relatively frequent wet autumns make overwintered stubbles disproportionately more frequent here than further east in Britain. Maps show Dingestow to be a particular hotspot for arable bryophytes. This is due in part to detailed recording, but it also reflects the abundance of low intensity arable in that area in the early 2000s. The low frequency of arable bryophytes in north-western Gwent reflects a relative lack of arable there, although several of the commoner arable bryophytes are able to survive on other periodically disturbed ground, such as in cemeteries.

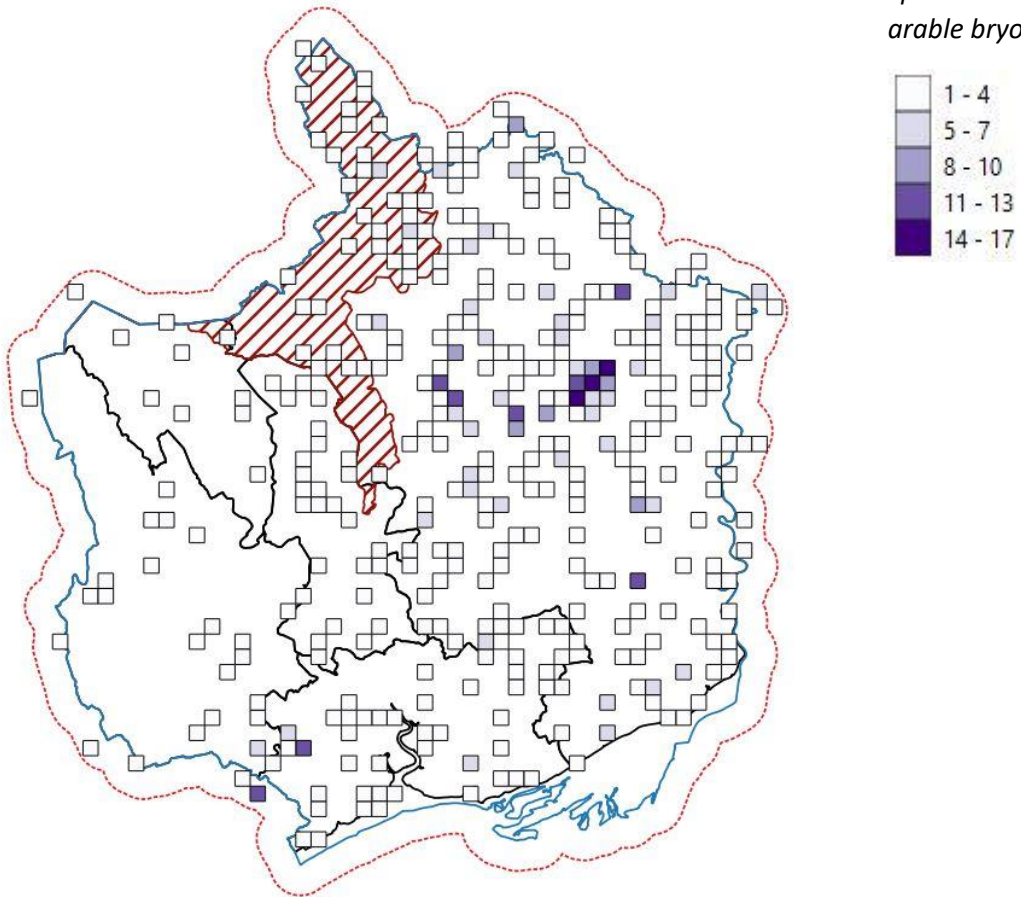
Density of records.
Maximum set to 115/km²



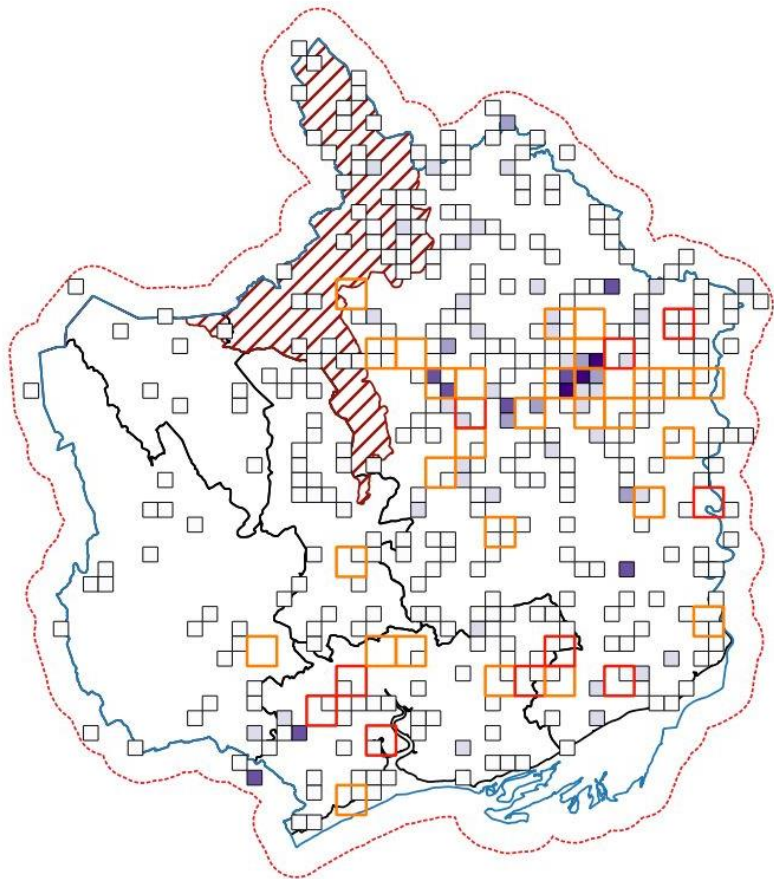
Species records by decade



Species richness of
arable bryophytes/km²



Species richness with Important
Arable Plant Areas (IAPAs)¹⁴

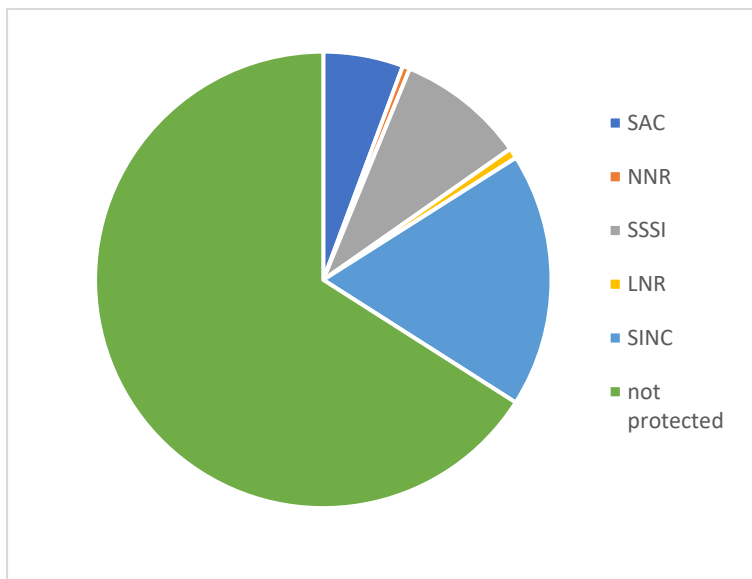


Habitats patterns: There is relatively poor coincidence with Plantlife’s Important Arable Plant Areas (IAPAs).¹⁵ This is partly because of the lack of specialist bryophyte surveys in some of these areas, but it is also because the drier fields favoured by many arable vascular plants are unsuitable for most of the uncommon arable bryophytes. Damp, clay and clay loam soils usually support the richest arable bryophyte assemblages.

Population trends: The majority of arable bryophyte records from Gwent come from the 2001 to 2004 ‘Survey of the bryophytes of arable land’.⁶ Prior to 2000 there was very little bryophyte recording at all in Gwent, especially not on arable land, and recording has been more broadly focused since 2004. Changes in arable land management, especially increases in slurry usage and the cultivation of maize and oilseed rape, make it highly likely that arable bryophytes are continuing to decline in Gwent, but there is a lack of very recent survey data.

Protection: Although there are some arable fields within designated sites, including the Gwent Levels SSSIs and those bordering the River Usk (Lower Usk) SSSI, only a tiny minority support rich arable bryophyte assemblages and none are recognised as an SSSI feature. No SINCs have been selected for arable bryophytes, although sites with Red listed species such as *Anthoceros agrestis* and *Phaeoceros carolinianus* qualify for selection. The Dingestow Court has a potentially qualifying Arable Bryophyte Assemblage feature but awaits notification.

Arable bryophyte records from protected sites



Irish Earth-Moss *Ephemerum hibernicum* (Holyoak & V.S.Bryan)

Protection: none

Conservation Status: none

Data Availability: Poor (1 record)

Context: Irish Earth-Moss (*Ephemerum hibernicum*) is a specialist moss of seasonally flooded, lime-rich areas. It was described as new to science from Irish turloughs in 2005 and is otherwise known from five European countries.⁸ Wentwood Reservoir is one of just two known British sites, the other being a turlough in Carmarthenshire. As such, this is one of Gwent's rarest species, both in British and global terms.

E. hibernicum habitat



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Ephemerum hibernicum is thought to have long-lived spores, which germinate when water levels are low, and rapidly produce new spore capsules. This lifestyle suits its naturally fluctuating turlough habitat as well as conditions at Wentwood Reservoir, where the water level varies depending on supply and demand. It is one of a suite of notable bryophytes that grow on lake and reservoir margins that includes the Nationally Scarce *Riccia cavernosa* at Llandegfedd Reservoir, Pant-yr-eos and Wentwood, *Ephemerum sessile* at Llandegfedd and Wentwood, and *Weissia rostellata* at Wentwood.

The only time *Ephemerum hibernicum* has been found in Gwent was in November 2003, when it was frequent at the north end of Wentwood Reservoir. The site has not been searched for bryophytes subsequently, and the status of the population is unknown.

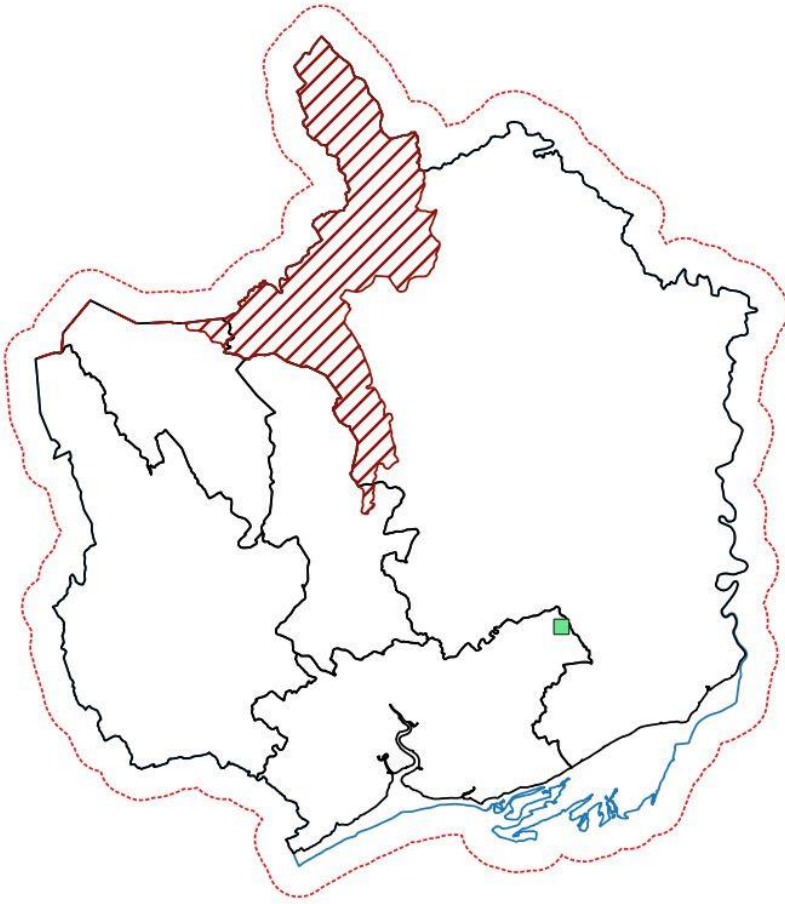
Outlook: The UK population of *Ephemerum hibernicum* is currently restricted to two sites. The Carmarthenshire colony is in a National Nature Reserve and is considered secure, but the Gwent colony is on a water-supply reservoir and is vulnerable to changes in water-level management. Elsewhere in Britain, lake margin bryophytes have been lost through the maintenance of high water levels, because this does not allow the bryophytes to germinate, and through invasion of non-native plants especially New Zealand Pygmyweed (*Crassula helmsii*).

Greater Gwent range: The restriction of *Ephemerum hibernicum* in Gwent to Wentwood Reservoir is likely to be genuine, because relatively lime-rich lakes with seasonally fluctuating water levels are rare in the area. The Nedern turlough was searched recently and there is no suitable habitat for *E. hibernicum* there. Llandegfedd Reservoir and Pant-yr-eos Reservoir might offer suitable conditions, but *E. hibernicum* was not recorded at either during surveys in the early 2000s.

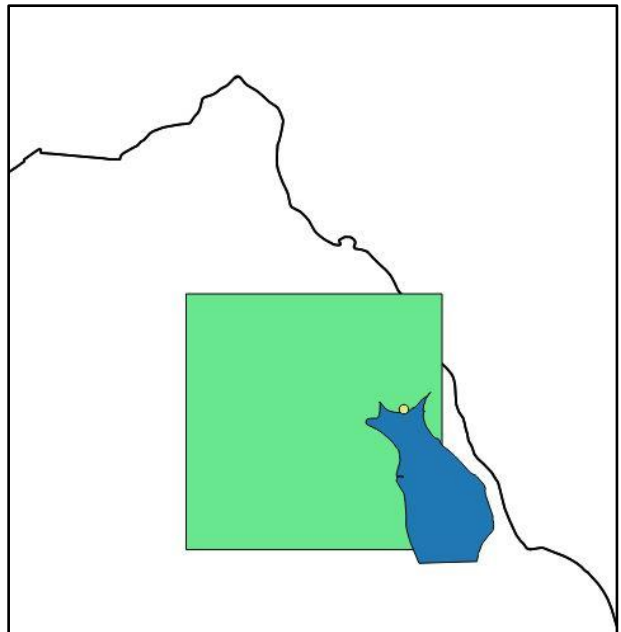
Population trends: The current state of the population is unknown and requires survey.

Protection: Wentwood Reservoir is not designated, but surrounding grassland is a SINC for its acid grassland diversity.

E. hibernicum record in
Greater Gwent



*Inset showing location of record, at northern
end of Wentwood Reservoir.*



Epiphytic Bryophytes

Protection: none

Conservation Status: see below

Data Availability: Good (881 records)

Context: Epiphytes are plants that grow on other plants: in this case bryophytes (mosses and liverworts) that grow on trees. They are a natural part of healthy ecosystems and help absorb water and particulates as well as sheltering invertebrates.



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During the nineteenth and twentieth centuries, industrial pollution, especially sulphur dioxide, made most tree bark in Gwent so acidic that very few mosses grew on it. Reductions in sulphur dioxide – thanks to a combination of legislation, improved technology and outsourcing of polluting industries to other countries – have allowed an astonishing resurgence of epiphytic mosses and liverworts in Gwent and much of the rest of Britain. Trees in Newport and western Gwent, where epiphytes were completely absent in the late twentieth century, now support a diverse range of mosses: for example, 24 species on ash trees in a park in Bettws; 21 on maple in Crindau; and 18 on ash and maple at Dyffryn.

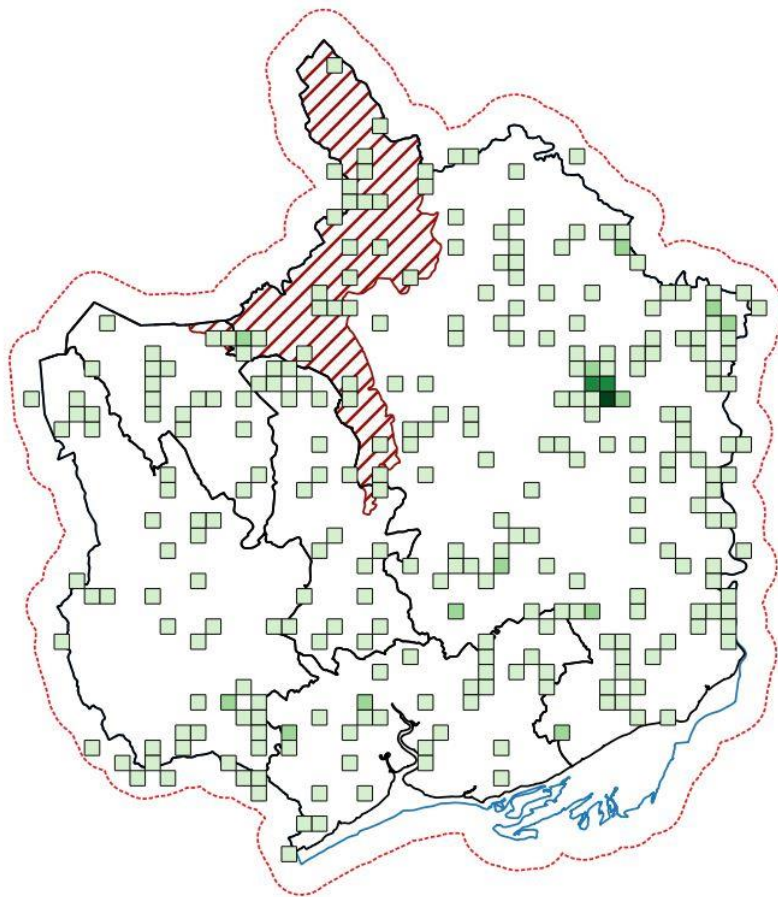
Many of our commonest epiphytic bryophytes, such as Dilated Scalewort (*Frullania dilatata*) and Lateral Cryphaea (*Cryphaea heteromalla*) are now found across Gwent. Twelve species of epiphytic bryophyte that were unknown in Gwent before 2000 have been recorded recently in the county, highlighting the spread of some of these species. Some are now very widespread, such as Frizzled Pincushion (*Ulotia phyllantha*).

Scientific name	Common name	GG records
<i>Cololejeunea minutissima</i>	Minute Pouncewort	123
<i>Colura calyptrifolia</i>	Fingered Cowlwort	17
<i>Neckera pumila</i>	Dwarf Neckera	32
<i>Orthotrichum pallens</i>	Pale Bristle-Moss	4
<i>Orthotrichum pumilim</i>	Dwarf Bristle-Moss	2
<i>Orthotrichum schimperi</i>	Schimper's Bristle-Moss	1
<i>Orthotrichum striatum</i>	Smooth Bristle-Moss	124
<i>Pylaisia polyantha</i>	Many-flowered Leskea	30
<i>Syntrichia papillosa</i>	Marble Screw-Moss	102
<i>Syntrichia virescens</i>	Lesser Screw-Moss	12

<i>Ulota calvescens</i>	Balding Pincushion	1
<i>Ulota phyllantha</i>	Frizzled Pincushion	380

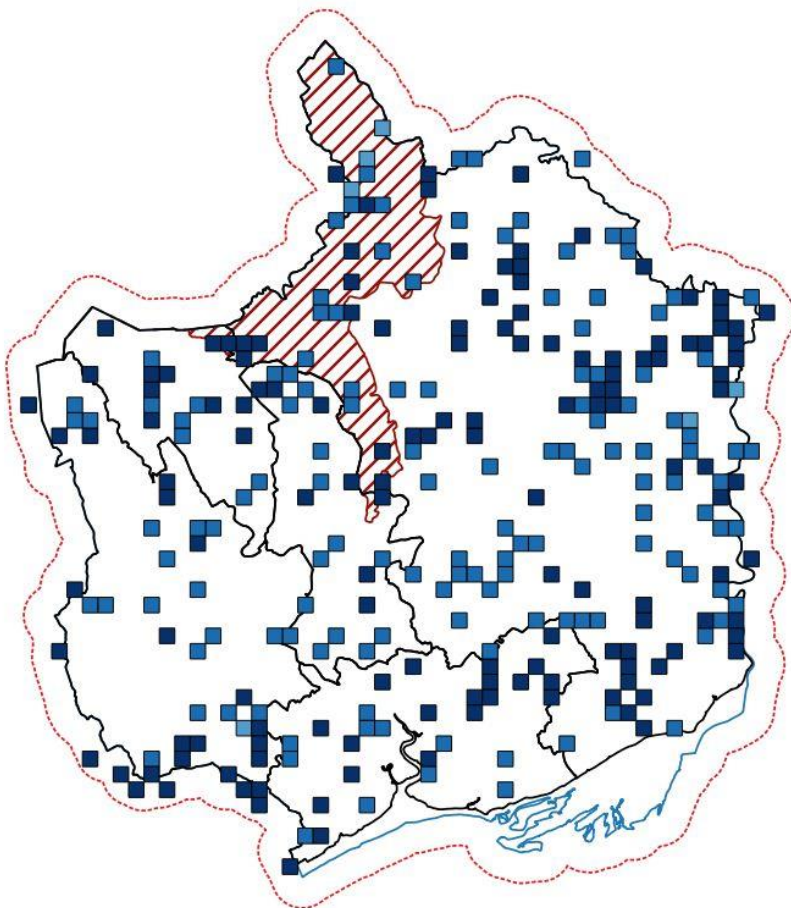
Outlook: Sulphur dioxide continues to decline in Britain, and two current major air pollutants – nitrogen oxides (NOx) and particulates – actually seem to favour many epiphytic mosses and liverworts. Gwent populations of these bryophytes are expected to continue to increase, at least in urban areas; this is in stark contrast to many nitrogen-sensitive epiphytic lichens (see N-sensitive Lichens section).

Greater Gwent range: Epiphytic bryophytes are now found across Gwent, whereas in the first bryophyte *Atlas* they were largely restricted to the north-east of the county, away from industrial pollution. Even the rarer species that were absent from the area until 2000 are now widely distributed, although there is an obvious recording hotspot at Dingestow.

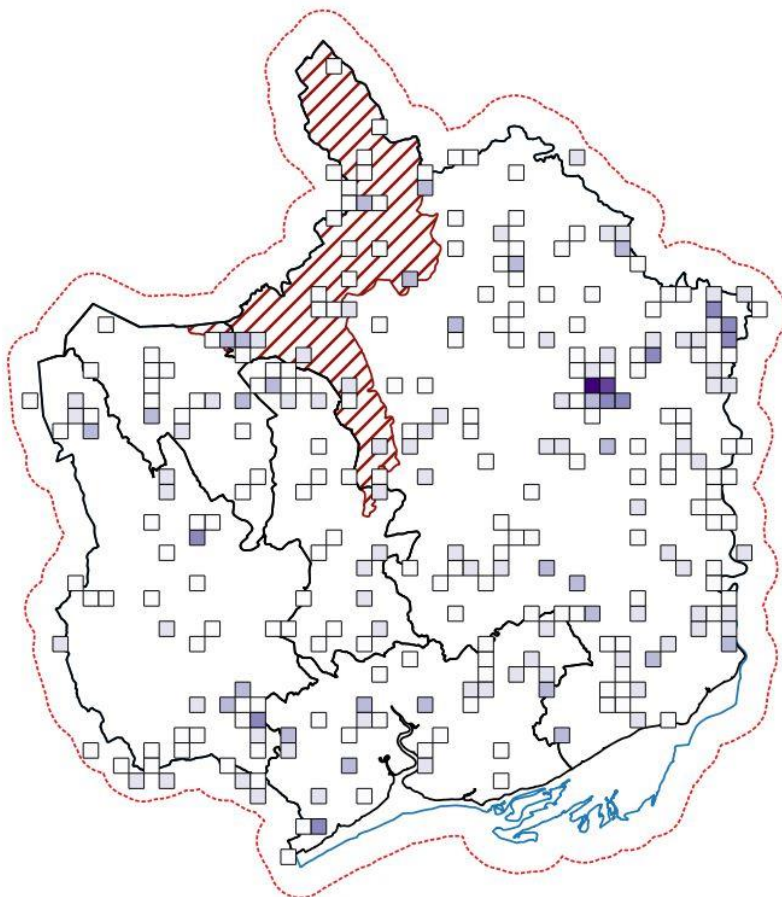
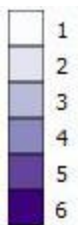


*Distribution of
Epiphytic moss records
across Greater Gwent
(maximum 26/km²)*

Epiphytic moss records by date



Diversity of Epiphytic moss records



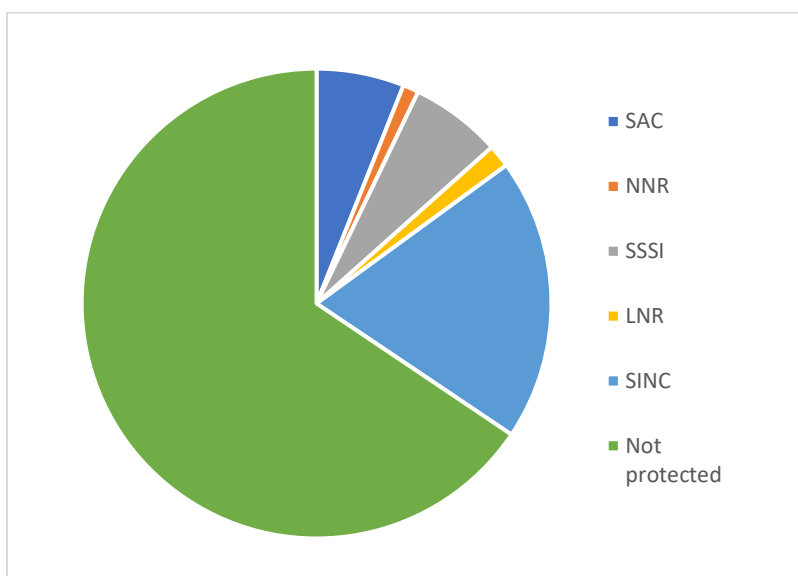
Habitats patterns: There is no obvious pattern in occurrence of epiphytic bryophytes in Gwent now, and differences tend to reflect host tree species more than habitat. Ash, maple or willow can hold 20 or more epiphytic mosses in woodland, field boundary or urban habitats, whereas birch or oak typically support fewer species regardless of habitat.

Population trends: There is a significant upward trend in occurrence of the mapped rarer epiphytic bryophytes (unsurprisingly because they were unknown in the area, with the exception of a 1967 record of *Pylaisia polyantha*, until 2000) and commoner epiphytic species. This reflects a substantial increase across Britain, particularly in polluted areas,⁸ resulting from the combined effects of sulphur dioxide reduction and climate change. Some of the epiphytic mosses and liverworts, such as *Cololejeunea minutissima*, are frost-sensitive and were restricted to the west coast of Britain during the twentieth century but have spread rapidly north-eastwards over the last 20 years. However, without reductions in sulphur dioxide pollution, these climate change range expansions would not have been possible, because polluted, acidic bark cannot support *Cololejeunea minutissima* regardless of the climate.

Some epiphytic mosses that were once very rare in Britain as a whole have recently colonised southern Britain, probably because of drifting spores from continental Europe.⁹ Gwent is the only area of Britain where the former Red List species *Orthotrichum pallens*, *O. pumilum* and *O. schimperi* have been found, although this is probably a reflection of detailed recording here. Several other epiphytic mosses are expected to colonise Gwent over the next few years.

Protection: Just over 34% of records come from protected sites. This is really a reflection of how much land is protected across the region, rather than an association with any particular habitat or site. Technically some of the rarer epiphytes could be used for SINC selection, for example, the Environment (Wales) Act Section 7 mosses *Orthotrichum pallens* and *O. pumilum*. The great thing about this story is that the mosses have gone from being absent to everywhere to being found not only protected sites but also in Newport city centre and the Valleys, showing that air quality was the limiting factor rather than any particular habitat requirement.

Epiphytic Moss records from protected sites



Flood Moss *Myrinia pulvinata* (Wahlenb.) Schimp

Protection: none

Conservation Status: none

Data Availability: Poor (7 records)

Context: Large rivers that flood regularly are home to many specialist plants and invertebrates that have evolved to survive periodic inundation and burial with silt. Flood Moss (*Myrinia pulvinata*) is one of the most ecologically demanding of these specialist species, and is restricted to tree trunks well above mean water levels in a zone that is flooded regularly but perhaps not annually. It is known from fewer than 50 British sites and is restricted in Gwent to the River Usk.

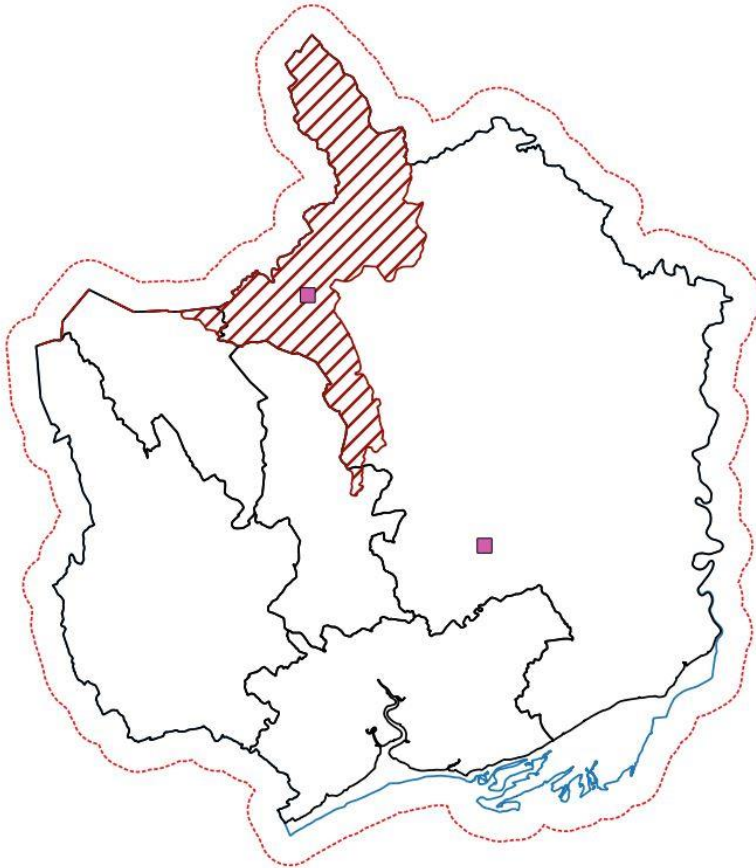


There are records from two reaches of the river, at Govilon and Llantrisant, dating from 2000 and 2006 respectively. The species has declined elsewhere in Britain,⁸ although it might be somewhat overlooked. Riverbank management, flood scheme construction and diseases affecting crack willow and alder are all threats to this rare moss.

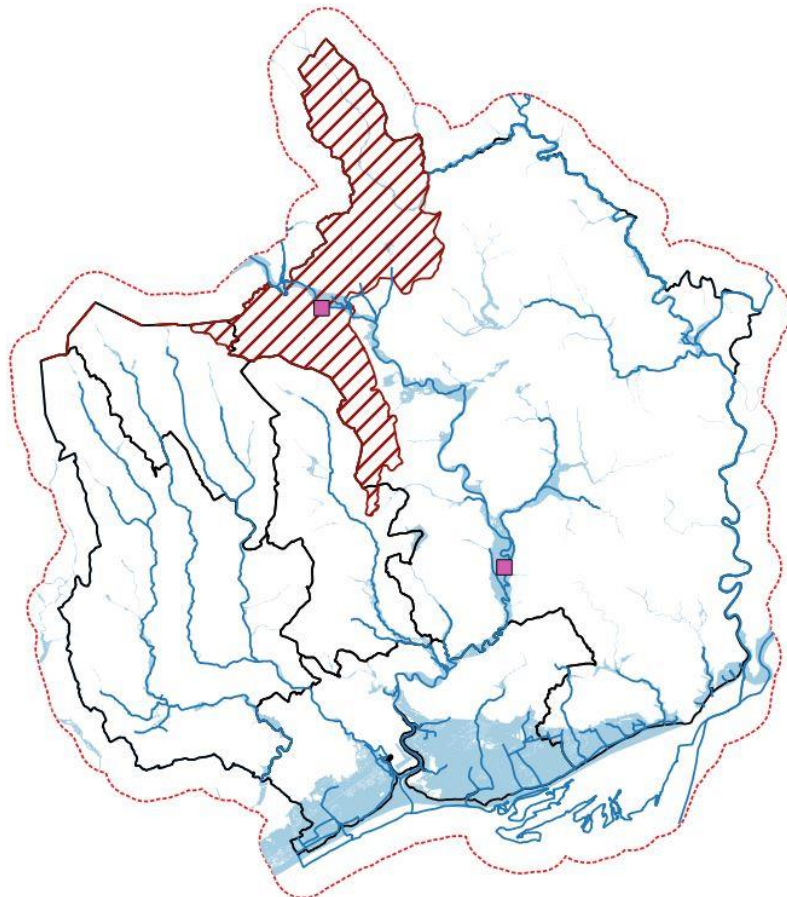
Outlook: The UK population of *Myrinia pulvinata* is declining,⁸ and ongoing construction of 'hard' flood defences is a threat to some of its remaining colonies. Both Gwent sites are in relatively broad floodplains with few dwellings that seem unlikely to be priorities for new flood defences. Nevertheless, this moss is known from just one tree at Govilon and two at Llantrisant, so there is a significant risk that a colony could be lost unintentionally to tree felling.

Greater Gwent range: The restriction of *Myrinia pulvinata* in Gwent to the River Usk is probably genuine, because the river has a broad flood plain and carries a high silt load. *Myrinia* grows on the Wye upstream of Hay-on-Wye but has never been found on the Gwent reach of the Wye. The Zone 3 flood map suggests suitable habitat may also occur near Llanfihangel Gobion and The Bryn, and targeted searching of these areas is needed.

Distribution of Flood Moss records across Greater Gwent



Flood Moss records with main rivers¹⁵ and Flood Zone 3¹⁶



Habitats Patterns: *Myrinia pulvinata* is, unsurprisingly, restricted in Gwent by its very exacting habitat requirements.

Population trends: The Llantrisant population was discovered in 2001 and revisited in 2003 and 2006; it appeared stable over that period. The Govilon colony has not been revisited since it was discovered in 2000.

Protection: Both colonies of *Myrinia pulvinata* are within the River Usk SSSIs, but they are not recognised as a qualifying feature of the SSSIs.

Limestone Bryophytes

Protection: none

Conservation Status: none

Data Availability: Moderate (264 records)

Context: Carboniferous limestone is relatively limited in extent in Britain, but has two significant outcrops in Gwent. One is in the lower Wye Valley at Lady Park Wood and near Chepstow, and the other runs from Cwm Clydach and Gilwern Hill southwards along the Bloreng ridge to the Machen area. This hard, lime-rich rock supports numerous uncommon mosses and liverworts, and Gwent is one of the most important areas in Wales for limestone bryophytes, with 12 Nationally Rare and Scarce species present.

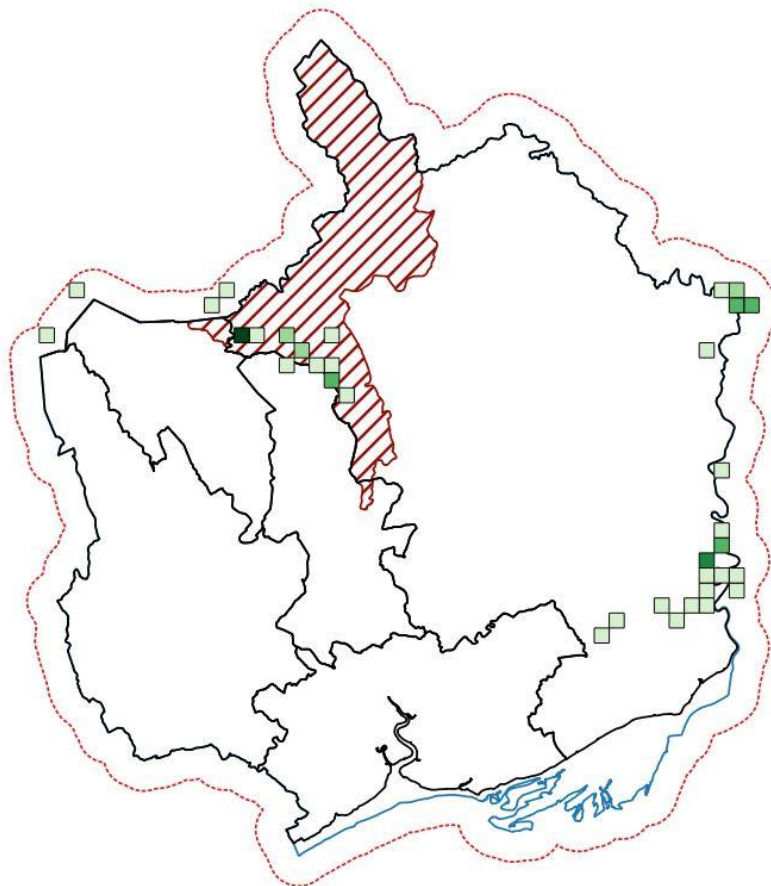


The Rare and Scarce limestone bryophytes are restricted to natural outcrops of limestone rather than quarries, and quarrying has undoubtedly reduced their populations in Gwent. However, there was very little bryophyte recording in the area until 2000, so it is impossible to confirm historic losses. Since 2000, most populations appear to be stable, with the notable exception of Long-Leaved Tail-Moss (*Anomodon longifolius*), but threats include changes in shading and rampant growth of ivy and brambles enhanced by nitrogen (N) pollution.

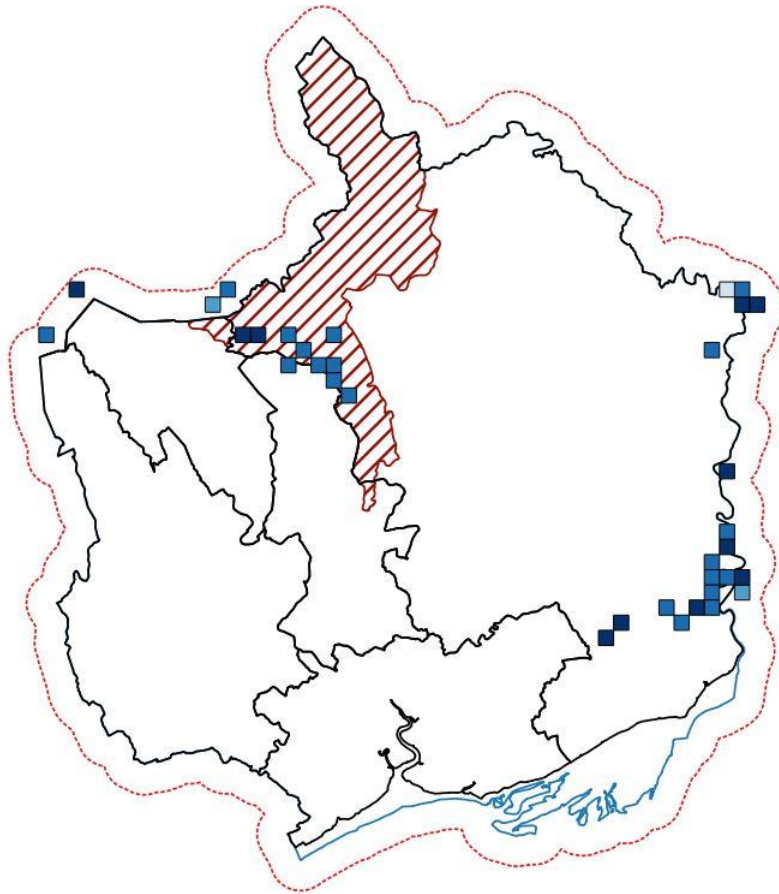
Scientific name	Common name	GG records
<i>Amblystegium confervoides</i>	Tiny Feather-Moss	14
<i>Anomodon longifolius</i>	Long-Leaved Tail-Moss	14
<i>Campylophyllum calcareum</i>	Chalk Feather-Moss	24
<i>Cololejeunea rossettiana</i>	Rossetti's Pouncewort	18
<i>Entosthodon muehlenbergii</i>	Muehlenberg's Thread-Moss	2
<i>Lejeunea mandonii</i>	Atlantic Pouncewort	2
<i>Seligeria acutifolia</i>	Sharp Rock-Bristle	25
<i>Seligeria campylopoda</i>	Bentfoot Rock-Bristle	47
<i>Seligeria donniana</i>	Donn's Rock-Bristle	21
<i>Seligeria patula</i>	Spreading Rock-Bristle	5
<i>Seligeria pusilla</i>	Dwarf Rock-Bristle	41
<i>Thuidium recognitum</i>	Lesser Tamarisk-Moss	3

Outlook: The UK range of the Rare and Scarce limestone bryophytes is stable, and there is little likely threat of new quarrying threatening populations because so many sites are designated SSSI. Climate change is also unlikely to be a significant threat because many of the limestone bryophytes are found much further south in Europe than Britain. Competition from plants such as ivy and bramble, enhanced by nitrogen pollution and potentially by the opening of woodland canopies due to ash dieback, are the principal threats. Most of these species have very small, localised populations within any particular site, and stochastic events, such as treefall or accidental damage, are possible. Since 2000, one of the three Gwent colonies of *Anomodon longifolius* has been lost to treefall at Lady Park Wood and another has been swamped by brambles following woodland management near Moun-ton, leaving just a single population in the whole of Wales.

Greater Gwent range: The Nationally Rare and Scarce limestone bryophytes are concentrated in three areas of Gwent: the outcrops between Cwm Clydach and the Blorenge; the Lady Park Wood area; and the Blackcliff-Wyndcliff limestone. There are further limestone outcrops in eastern Torfaen and the Machen area, but these have been extensively quarried and notable bryophytes have not been found despite much surveying.

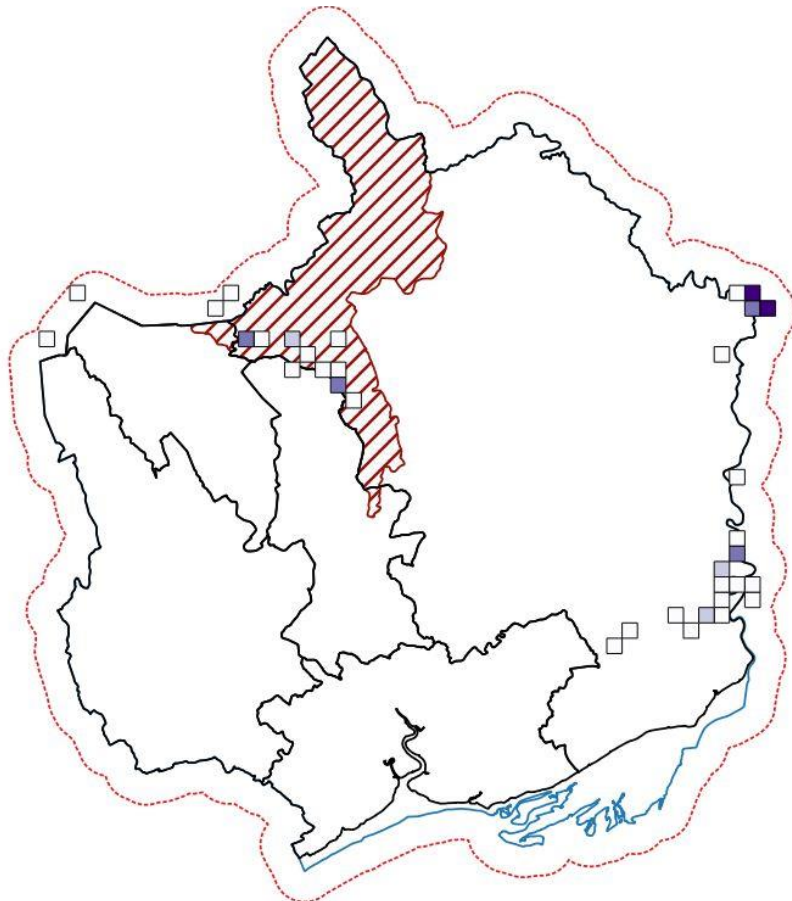
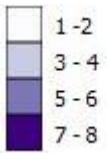


Distribution of Rare and Scarce limestone bryophyte records (maximum 31/km²)



Rare and Scarce limestone bryophyte records by date

Diversity of Rare and Scarce limestone bryophytes

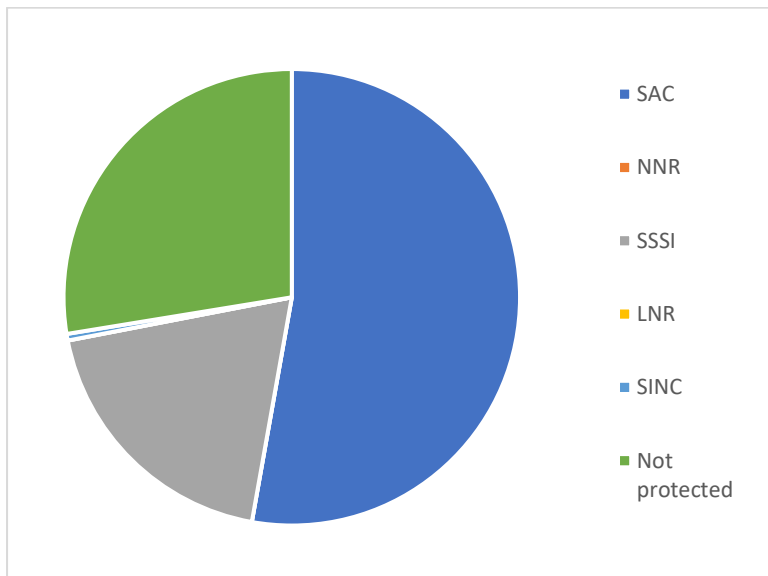


Habitats Patterns: The distribution of Rare and Scarce limestone bryophytes follows natural exposures of Carboniferous limestone in Gwent. Disused quarries hold commoner lime-loving bryophytes, sometimes in abundance, as do outcrops of Silurian limestone in the Usk area, but the rare species are absent. The main natural limestone exposures have all been surveyed in detail, often on multiple visits by experts, but so too have many former quarries, so recording bias is not the cause of the concentration of records of rarer species in these natural sites.

Population trends: There are insufficient historic records to allow population trends to be established, although *Anomodon longifolius* has declined at Lady Park Wood and gone from the Mounton and Wyndcliff areas.

Protection: Just over 72% of records of these Rare and Scarce bryophytes come from protected sites. Lady Park Wood, Blackcliff-Wyndcliff, Piercefield and Cwm Clydach are all SAC, whilst parts of Gilwern Hill and the Blorenge are SSSI. Some important areas of limestone between Gilwern Hill and the Blorenge deserve notification as SSSI for their bryophytes, as do several localities for *Seligeria campylopoda* and *Thuidium recognitum* (and *Anomodon longifolius*, if it has not been lost) in south-east Gwent. The most important sites for limestone bryophytes in Gwent can be ranked using the diversity of Nationally Rare and Scarce species they hold. The top six sites in order of importance are: Lady Park Wood, the Blorenge, Cwm Clydach, Blackcliff-Wyndcliff, Gilwern Hill, Mounton woods, and Piercefield.

Rare and Scarce limestone bryophyte records from protected sites



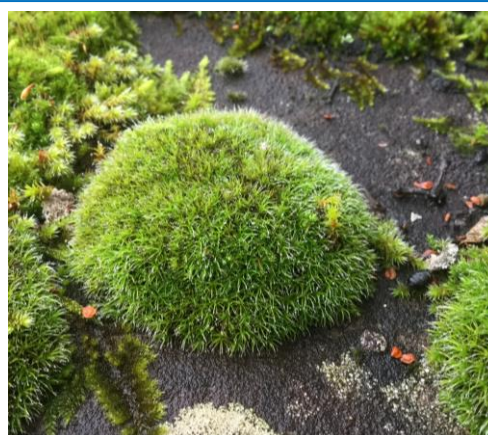
Stone Roof Tile Mosses

Protection: none

Conservation Status: none

Data Availability: Good (55 records represent coverage of most likely sites for these species)

Context: Sandstone tiled roofs in the southern Welsh Marches support a suite of nationally rare and scarce mosses that are also found, albeit rarely, on droughted rock exposures. When locally sourced stone tiles were a widespread form of roofing, these mosses would have been common in Gwent. They are now restricted to fewer than 20 church and barn roofs



Sam Bosanquet

in the area and are known to have been lost from two churches due to re-roofing and cleaning since 2000. Most colonies hold just a handful of patches of the rare mosses, probably because of pre-2000 cleaning, and the majority of churches and chapels in Gwent have unsuitable slate or artificial tile roofs.

Although 22 moss species have been recorded on stone roof tiles in Gwent, the majority are relatively common in Wales. Four exceptions are highlighted by Plantlife¹⁰ as being important in a British context. Both *Grimmia laevigata* and *Grimmia ovalis* are listed as Near Threatened in the most recent Red Data List⁷, and all four species are Nationally Scarce (found in fewer than 100 hectads across Britain).

Scientific name	Common name	Greater Gwent records	Greater Gwent sites	UK status ⁷
<i>Grimmia decipiens</i>	Great Grimmia	10	2	Nationally Scarce
<i>Grimmia laevigata</i>	Hoary Grimmia	11	7 (lost from 2)	Near Threatened, Nationally Scarce
<i>Grimmia ovalis</i>	Flat-rock Grimmia	27	16 (lost from 2)	Near Threatened, Nationally Scarce
<i>Hedwigia ciliata</i> *	Fringed Hoar-Moss	7	4	Nationally Scarce

*includes both var. *ciliata* and var. *leucophaea*

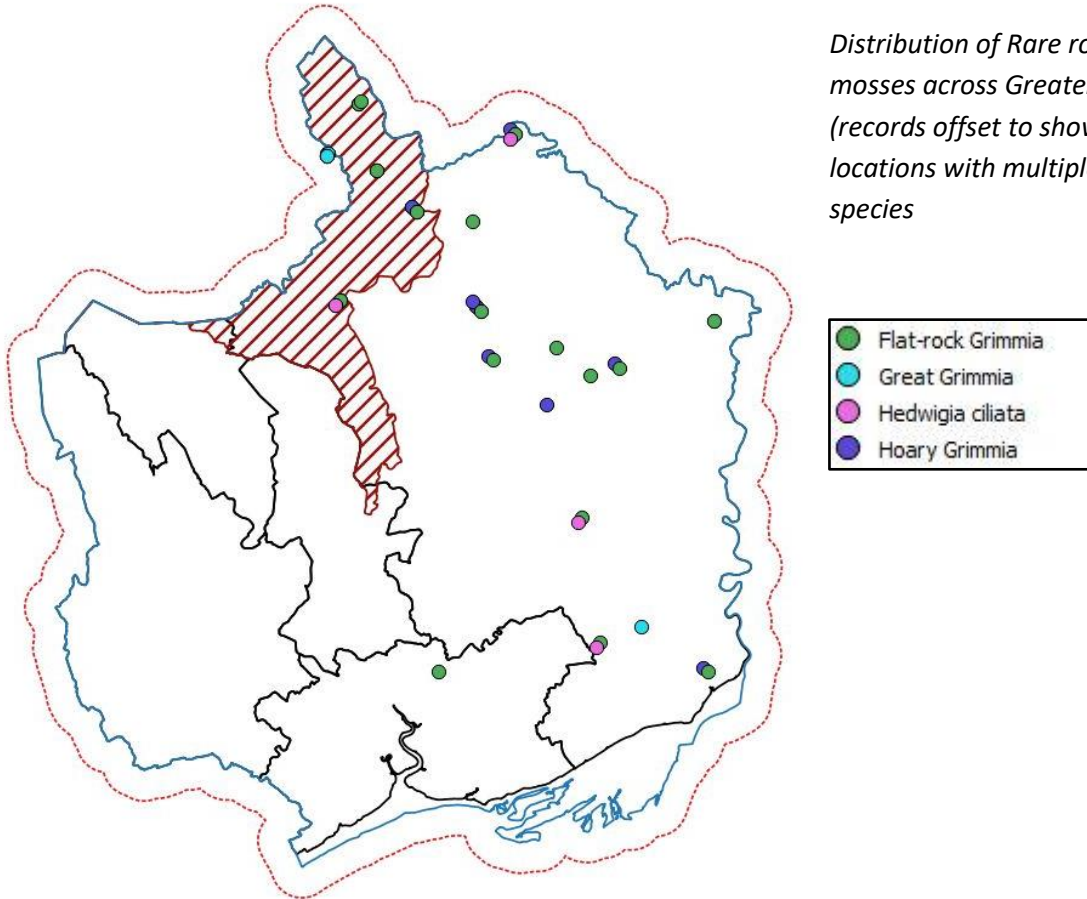
Outlook: The UK populations of all four roof tile mosses are believed to be declining on natural rock due to eutrophication,⁸ and one of the two Gwent colonies of *Grimmia decipiens* had declined from seven patches in 1999 to one alga-choked patch in 2018 due to ammonia pollution. Cleaning and re-roofing of sandstone tiled roofs have caused declines in Gwent and undoubtedly elsewhere in Britain. At least two church roofs that supported these rare mosses have been repaired and cleaned since the

colonies were discovered; other recently re-roofed churches had the rare mosses restricted to porches, and many visited between 1999 and 2002 had clean tiled roofs entirely lacking mosses. Given the rarity of stone-tiled buildings in Gwent, and the rarity of these mosses on those buildings, the loss of one roof is a significant reduction in the overall resource.

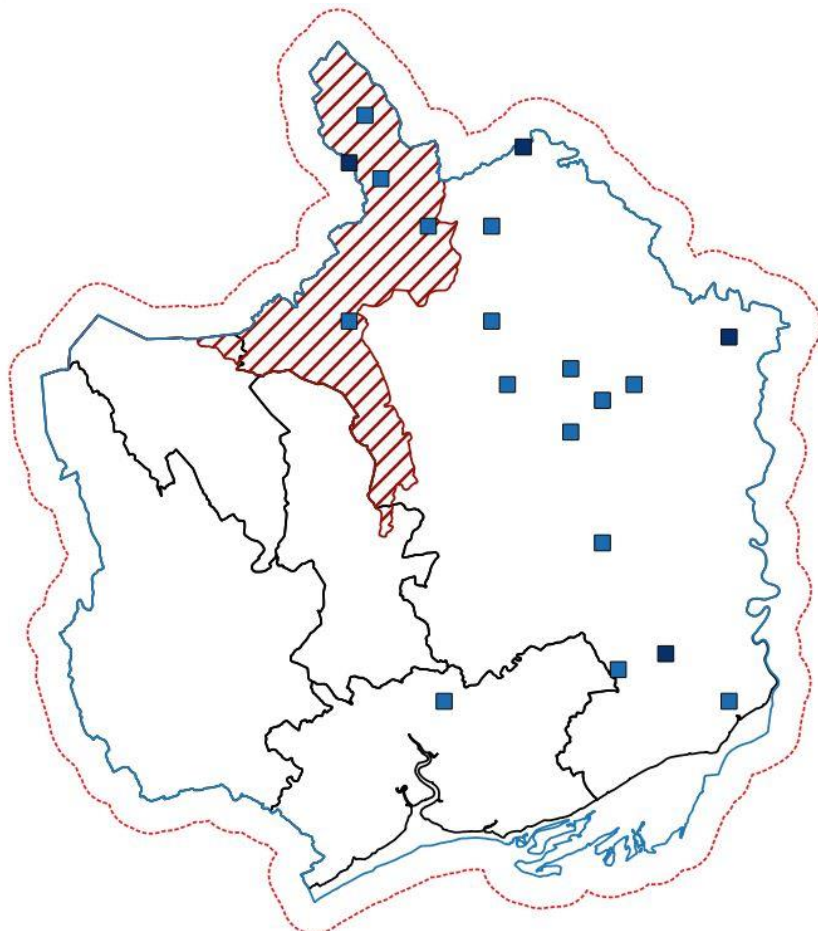
Greater Gwent range: The four Nationally Scarce roof tile mosses have been recorded from 18 sites in Gwent. The majority of sites are churches in the north-east between Raglan, Dixton and Llangua, but there are also five sites in the BBNP, and five in southern Gwent between Caerleon and Rogiet. Greater Gwent is on the south-western edge of the core British range of these mosses, which extends into Herefordshire and south Powys; none of these species has been found in Glamorgan and the lack of records from western Gwent is considered genuine because of the rarity of sandstone roof tiles.

Fifteen sites are churches, two are stone-tiled barns, and one colony of *Grimmia decipiens* is on a bridge. The only historic record was made in 1925 and related to a hotel in Tintern, which has since been re-roofed and lost its colony of *Grimmia ovalis*. Targeted recording of church roofs between 1999 and 2002 revealed the majority of the current known sites, and only seven sites have been visited in the last decade.

Distribution of Rare roof tile mosses across Greater Gwent (records offset to show locations with multiple species)



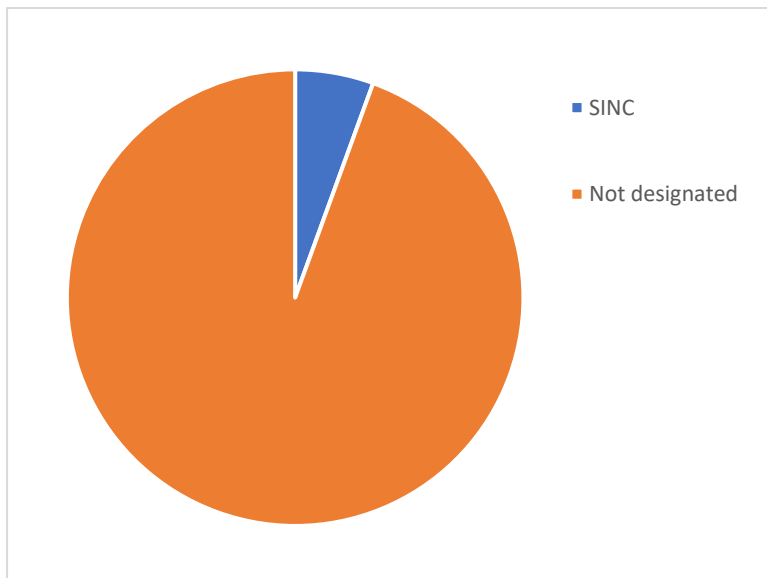
Roof tile moss records by date



Population trends: The lack of historic data makes it impossible to be certain that these species have declined, but a decline can be inferred with reasonable confidence given the number of cleaned or re-roofed churches in eastern Gwent compared with the number now supporting roof tile mosses. At least two church roofs (Llanvapley and Raglan) that supported these rare mosses have been repaired and cleaned since the colonies were discovered, and their survival is uncertain; other recently re-roofed churches (Caerleon, Llangattock Lingoed and Rogiet) had the rare mosses restricted to porches, whilst several (for example, Llandenny) had clean tiled roofs entirely lacking mosses.

Protection: None of the stone roof tile mosses grows in a statutorily protected site (SSSI) in Gwent, and only one site is a SINC (for neutral grassland rather than mosses). The *Guidelines for Selection of Wildlife Sites in South Wales*¹¹ state that any site supporting a Red Data Book species or species from three or fewer sites should be designated. Colonies of the Near Threatened *Grimmia laevigata* and *Grimmia ovalis* might thereby become SINC. Many churches were involved in GWT's Living Churchyards Project or the Caring for God's Acre and Beautiful Burial Ground schemes, but it is not known whether any specifically considered roof tile mosses.

Stone roof tile moss records from protected sites.



N-Sensitive Lichens

Protection: none

Conservation Status: none

Data Availability: Moderate (459 records)

Context: Epiphytic lichens are abundant on trees in unpolluted forests throughout the world and would be abundant in Gwent without air pollution. Historic sulphur dioxide pollution from industry decimated acid-sensitive lichens across the county, whilst agricultural ammonia pollution combined with industrial NO_x are now damaging N-sensitive lichens. Epiphytic lichens grow in bushy, three-dimensional carpets on tree branches and play vital roles in heathy ecosystems by intercepting rainfall, cycling nutrients, and providing shelter for invertebrates.¹² Most people now think of trees having bare bark, which shows how unfamiliar we are with healthy, functioning ecosystems.



Sam Bosanquet

Scientific name	Common name	Number of GG records
<i>Bryoria fuscescens</i>		0
<i>Evernia prunastri</i>	Oak Moss	67
<i>Graphis elegans</i>		14
<i>Graphis scripta</i>	Script Lichen	30
<i>Hypogymnia physodes</i>	Dark Crottle	190
<i>Hypogymnia tubulosa</i>		21
<i>Ochrolechia androgyna</i>		18
<i>Parmelia saxatilis</i>		111
<i>Parmelia sulcata</i>	Netted Shield Moss	75
<i>Pseudevernia furfuracea</i>		1
<i>Sphaerophorus globosus</i>		2
<i>Usnea articulata</i>		3
<i>Usnea cornuta</i>		1
<i>Usnea dasopoga</i>		1
<i>Usnea esperantiana</i>		1
<i>Usnea florida</i>	Witches Whisker	4

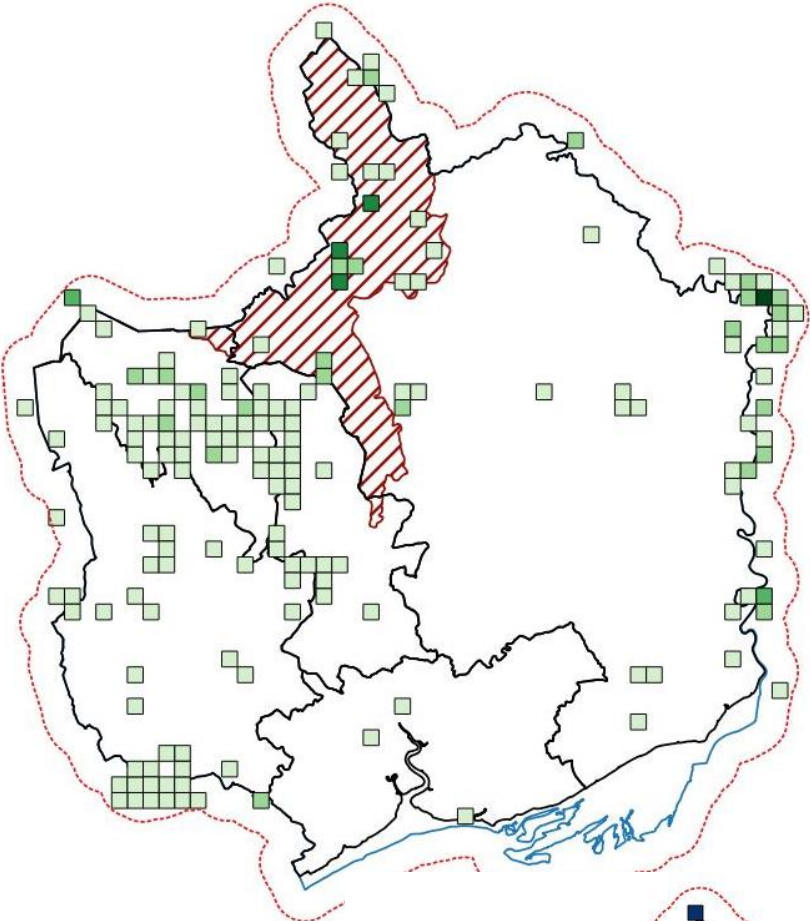
<i>Usnea subfloridana</i>		30
<i>Usnea wasmuthii</i>		1

Outlook: According to Rowe et al.¹³ over 60% of the UK currently receives ammonia concentrations above the critical level set to protect lichens and bryophytes ($1 \mu\text{g}/\text{m}^3$); this represents 87.9% of England, 56.3% of Wales, 17.9% of Scotland and 90.8% of Northern Ireland. The situation in Gwent is worse than that in Wales as a whole: 372 1km squares in Gwent have ammonia concentrations $<1 \mu\text{g}/\text{m}^3$, whereas 1262 are $>1 \mu\text{g}/\text{m}^3$. Of the 1634 squares in the area, 77.2% have ammonia concentrations that are too high to support N-sensitive lichens.

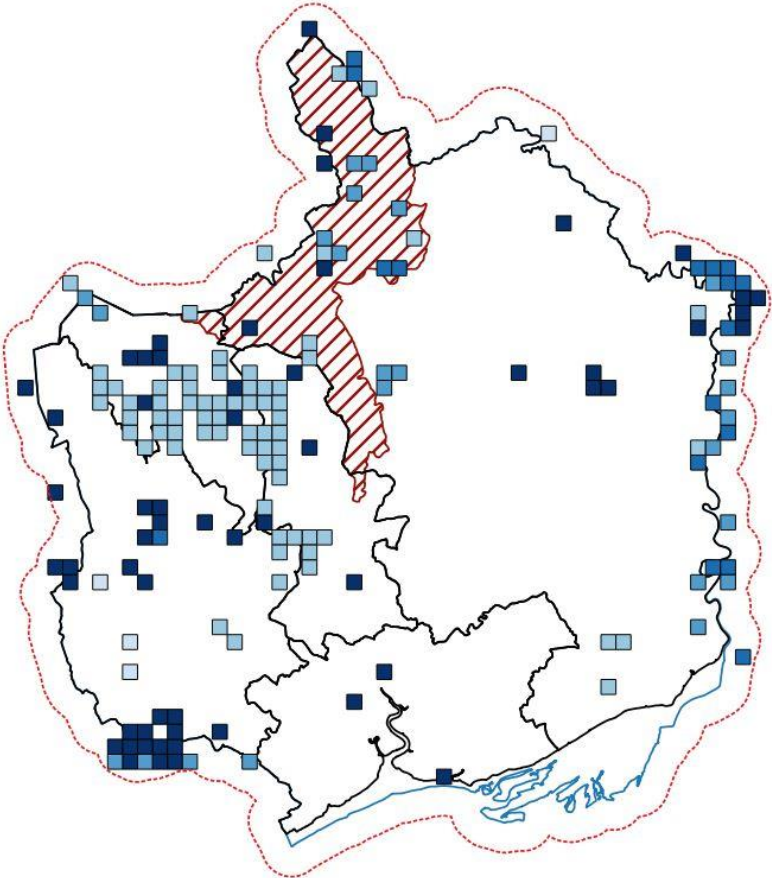
The current trend is towards increased intensive agriculture in lowland Gwent, but most lowland parts of the county are already too N-polluted to support N-sensitive lichens. Hope comes from the western valleys, where ammonia-producing intensive agriculture remains rare and ammonia concentrations are still low. N-sensitive lichens such as *Usnea dasopoga* and *Pseudevernia furfuracea* have recently been recorded in Torfaen, and many areas of Gwent that were once so polluted by industry that epiphytes were almost lost are now bastions of the area's epiphytic lichens.

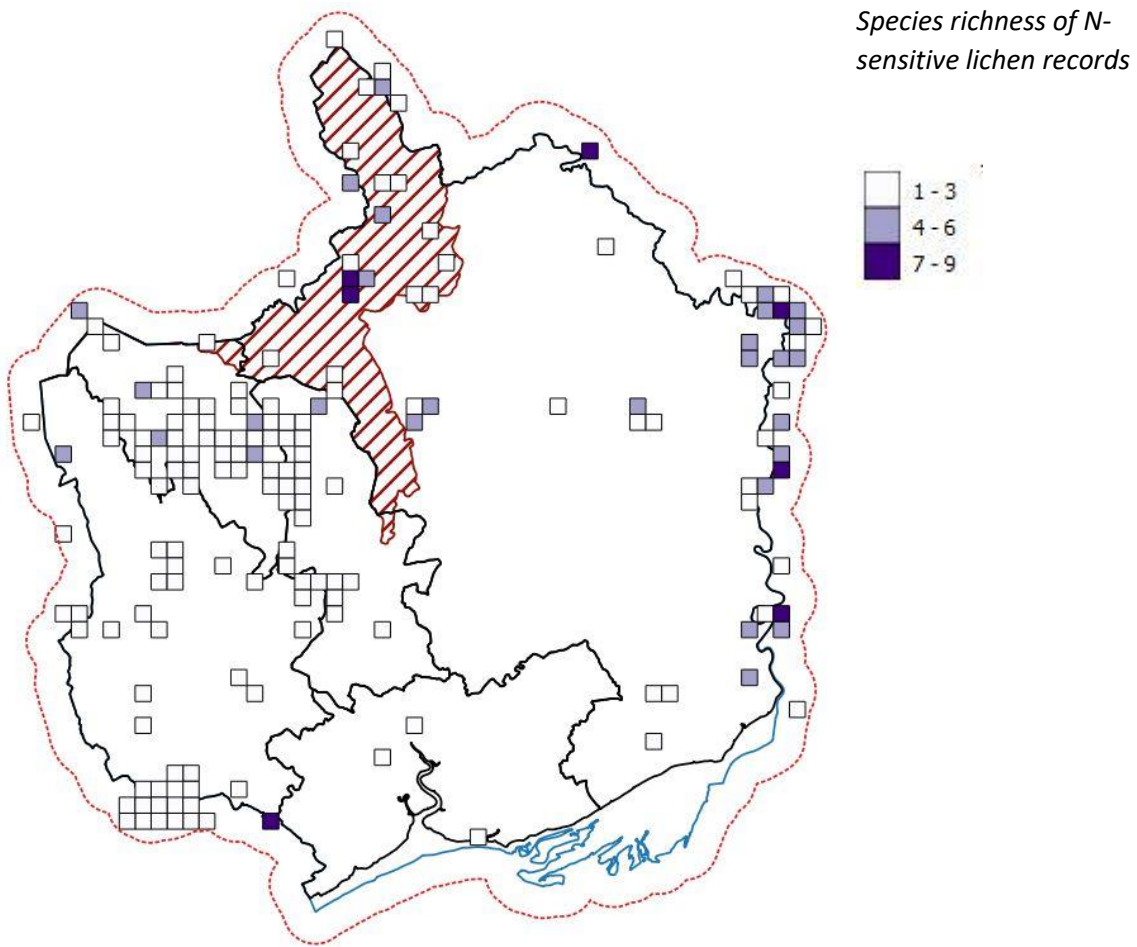
Greater Gwent range: N-sensitive lichens would once have occurred across Gwent, but most of the eastern and southern parts of the area are too N-polluted for them to survive other than where topography and tree cover provide shelter from ammonia. In contrast, the Wye Valley, Black Mountains and the western valleys of Gwent support widespread populations of these epiphytic lichens, although many grid squares have no recent records.

Distribution of N-sensitive lichens records across Greater Gwent (max density 24/km²)



N-sensitive lichen records by date



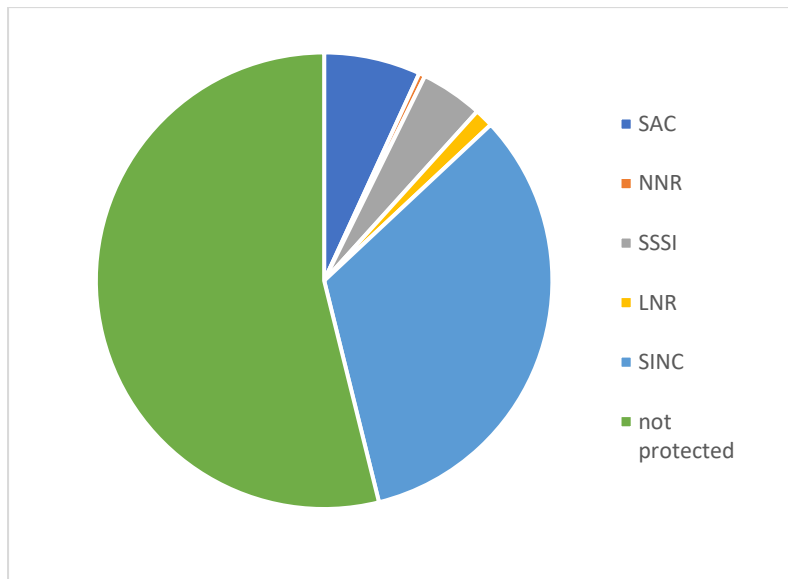


Habitats patterns: N-sensitive epiphytic lichens should be present in most woodland types, but are especially typical of oak and birch woodland. However, air pollution overrides any habitat patterns: there are suitable woodlands throughout lowland eastern Gwent, but pollution has made much of this unsuitable for these species. The paucity of recent lichen recording affects the distribution maps. However, recent observations suggest that some N-sensitive species, such as *Evernia prunastri* and *Usnea subfloridana*, are still scattered in eastern Gwent, where ammonia levels are low; while N-sensitive lichens are widespread and often abundant in the Black Mountains and western valleys (Sam Bosanquet, pers. comm.).

Population trends: There is insufficient data to determine trends at the population level, but observations at Dingestow Court suggest ongoing declines of N-sensitive lichens on parkland oak branches there (Sam Bosanquet, pers. comm.).

Protection: Just over 46% of records come from protected sites: mostly from the large upland SINCs in the Valleys, with some from woodland SACs such as Cardiff Beech Woods and Sugar Loaf Woodlands. Epiphytic lichens are key ecosystem components within the woodland habitats for which Sugarloaf Woodlands SAC and some nearby SSSI are notified, so this technically confers some legal protection on them, but there are complexities in demonstrating damage through off-site air pollution.

N-sensitive epiphytic lichens records from protected sites



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