

Lichen survey of Coed Maes- mawr, Coed Esgairneuriau a Cheunant Caecenau SSSI



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Evidence Report No 622

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1. Crynodeb Gweithredol

Mae nifer o arbenigwyr cennau wedi ymweld â SoDdGA Coed Maes-mawr, Coed Esgairneuriau a Cheunant Caecenau yn y gorffennol, ac maen nhw wedi cofnodi fflora cen nodedig gan gynnwys 11 rhywogaeth Mynegai Coetiroedd Cefnforol Deheuol (**SOWI**) a 15 o rywogaethau Mynegai Coedwigoedd Glaw Ucheldirol (**URI**) (Sanderson *et al.* 2018) o fewn y SoDdGA (data o fanyleb contract CNC). Comisiynodd CNC arolwg pellach i gael gwell dealltwriaeth o doreithrwydd a dosbarthiad cennau ac i helpu i gyfarwyddo rheolaeth gan gynnwys clirio coed Llarwydd yn fuan.

Roedd y gymuned o hen dyfiant *Lobarion pulmonariae* o risgl tra-fasig yn bresennol ar goed masarn, criafol, ynn, helyg a chyll. Cofnodwyd rhywogaethau nodedig o *Graphidion* ar goed cyll, celyn ac ynn yn ogystal â phatshys o risgl llyfn ar goed derw a bedw. Roedd y gymuned o risgl asid cefnforol *Parmelietum laevigatae* yn bresennol ac wedi datblygu orau ar goed derw ac, yn fwy lleol roedd wedi datblygu'n dda ar hen goed bedw.

Gwyddwn fod safle astudiaeth 2021 (sy'n cynnwys rhai ardaloedd yn union y tu allan a gerllaw i'r SoDdGA) bellach yn cynnal y canlynol:

- **1 rhywogaeth ar y Rhestr Goch sydd Mewn Perygl (EN) yng Nghymru** *Graphina pauciloculata*.
- **3 rhywogaeth ar y Rhestr Goch sydd Dan Fygythiad (VU) yng Nghymru:** *Menegazzia terebrata*, *Sticta canariensis (dufourii)* a *Sticta fuliginosa*.
- **17 rhywogaeth ar y Rhestr Goch sydd Dan Beth Bygythiad (NT) yng Nghymru:** *Arthonia vinosa*, *Biatora chrysantha*, *Dimerella lutea*, *Hypotrachyna taylorensis*, *Micarea pycnidiophora*, *Mycobilimbia epixanthoides*, *Nephroma parile*, *Pachyphiale carneola*, *Pannaria conoplea*, *Parmeliella parvula*, *Parmeliella triptophylla*, *Parmelinopsis horrescens*, *Peltigera collina*, *Phyllopsora rosei*, *Sticta limbata*, *Sticta sylvatica* a *Thelotrema lepadinum*.
- 17 rhywogaeth **URI** (y trothwy ar gyfer statws SoDdGA yw 10 rhywogaeth)
- 27 rhywogaeth **SOWI** (y trothwy ar gyfer statws SoDdGA yw 20 rhywogaeth).

Roedd 7 rhywogaeth ychwanegol o *Lobarion* **SOWI** yn bresennol yn union y tu allan i safle astudiaeth 2021.

Mae'r *Micarea pycnidiophora* a gofnodwyd yn 2021 yn newydd i VC47 Sir Drefaldwyn ac mae'n ymddangos mai'r SoDdGA yw'r ail yn unig lle ceir *Biatora chrysantha* yn VC47. Roedd rhywogaethau ychwanegol o ddiddordeb a gofnodwyd yn 2021 yn cynnwys y microffwng '*Ophiobolus pannariae*' a *Filicupula suboperculata*. Mae'n ymddangos mai'r cyntaf oedd yr ail gofnod yn unig ar gyfer Cymru, ac mae'n debyg y bydd yn haeddu o leiaf statws o Dan Fygythiad (**?VU**) os bydd yn cael ei werthuso'n ffurfiol. Mae'n ymddangos bod *Filicupula suboperculata* yn newydd i Gymru; cafodd ei gofnodi'n tyfu ar lysiau'r afu *Frullania*. Ffwng bychan iawn yw hwn y byddaf yn ei gofnodi fel arfer mewn coetiroedd hynafol, ond efallai mai'r rheswm am hynny yw gan mai yno y byddaf yn chwilio amdano!

Mae lefelau trawiadol o adfywio coed/llwyni ar y safle hwn ond ar hyn o bryd mae'n cael ei danbori ac mae adfywio gormodol o amgylch hen goed/coed cyll yn fygythiad i'r fflora cen. Rhoddir argymhellion priodol o ran mesurau rheoli i gynnal/gwella'r fflora cen, gan gynnwys rhai argymhellion ar gyfer yr ardaloedd o goedwigoedd conwydd.

2. Executive Summary

Coed Maes-mawr, Coed Esgairneuriau a Cheunant Caecenau SSSI has been visited by several lichenologists in the past, and they have recorded a notable lichen flora including 11 Southern Oceanic Woodland Index (**SOWI**) species and 15 Upland Rainforest Index (**URI**) species (Sanderson *et al.* 2018) within the SSSI (data from the NRW contract specification). NRW commissioned further survey to get a better understanding of the abundance and distribution of lichens and help inform management including imminent Larch clearance.

The old growth *Lobarion pulmonariae* community of more base rich bark was present on sycamore, rowan, ash, willow and hazel. Notable *Graphidion* species were recorded on hazel, holly and ash as well as smooth bark patches on oak and birch. The oceanic acid bark *Parmelietum laevigatae* community was present and best developed on oak and more locally it as well developed on veteran birch.

The 2021 study site (which includes some areas just outwith and adjacent to the SSSI) is now known to support:

- **1 Red-Listed species Endangered EN in Wales** *Graphina pauciloculata*.
- **3 Red-Listed Vulnerable VU in Wales:** *Menegazzia terebrata*, *Sticta canariensis (dufourii)* and *Sticta fuliginosa*.
- **17 Red-Listed Near Threatened NT in Wales:** *Arthonia vinosa*, *Biatora chrysantha*, *Dimerella lutea*, *Hypotrachyna taylorensis*, *Micarea pycnidiophora*, *Mycobilimbia epixanthoides*, *Nephroma parile*, *Pachyphiale carneola*, *Pannaria conoplea*, *Parmeliella parvula*, *Parmeliella triptophylla*, *Parmelinopsis horrescens*, *Peltigera collina*, *Phyllopsora rosei*, *Sticta limbata*, *Sticta sylvatica* and *Thelotrema lepadinum*.
- 17 **URI** species (the threshold for SSSI status is 10 species).
- 27 **SOWI** species (the threshold for SSSI status is 20 species).

An additional 7 *Lobarion* **SOWI** species occur just outwith the 2021 study site.

The *Micarea pycnidiophora* recorded in 2021 is new to VC47 Montgomeryshire and the SSSI appears to only be the second site for *Biatora chrysantha* in VC47. Additional species of note recorded in 2021 include the microfungi ' *Ophiobolus pannariae* ' and *Filicupula suboperculata*. The former appears to be only the second record for Wales; and likely to merit at least Threatened status (**?VU**) if formally evaluated. *Filicupula suboperculata* appears to be new to Wales; it was recorded growing on the liverwort *Frullania*. This is a diminutive fungus I only record from ancient woodlands, but that might be because that's where I look for it!

The site has impressive levels of tree/shrub regeneration but is currently undergrazed and excessive regeneration around old trees/hazels is now posing a threat to the lichen flora. Appropriate management recommendations are given to maintain/enhance the lichen flora, including some recommendations for the conifer forestry areas.

3. Introduction

Coed Maes-mawr, Coed Esgairneuriau a Cheunant Caecenau SSSI has been visited by several lichenologists in the past, but there are very few detailed records of the distribution of notable lichens within the site. The NRW contract specification states that 11 Southern Oceanic Woodland Index (SOWI) species and 15 Upland Rainforest Index (URI) species (Sanderson *et al.* 2018) have been recorded in the SSSI, but notes that the wider Dyfi Forest (within 5km of the SSSI) holds 35 SOWI and 19 URI species; NRW consider it highly likely that more Old Forest lichens are present within the SSSI so commissioned three days survey. A better understanding of the abundance and distribution of lichens would help inform management including imminent Larch clearance.

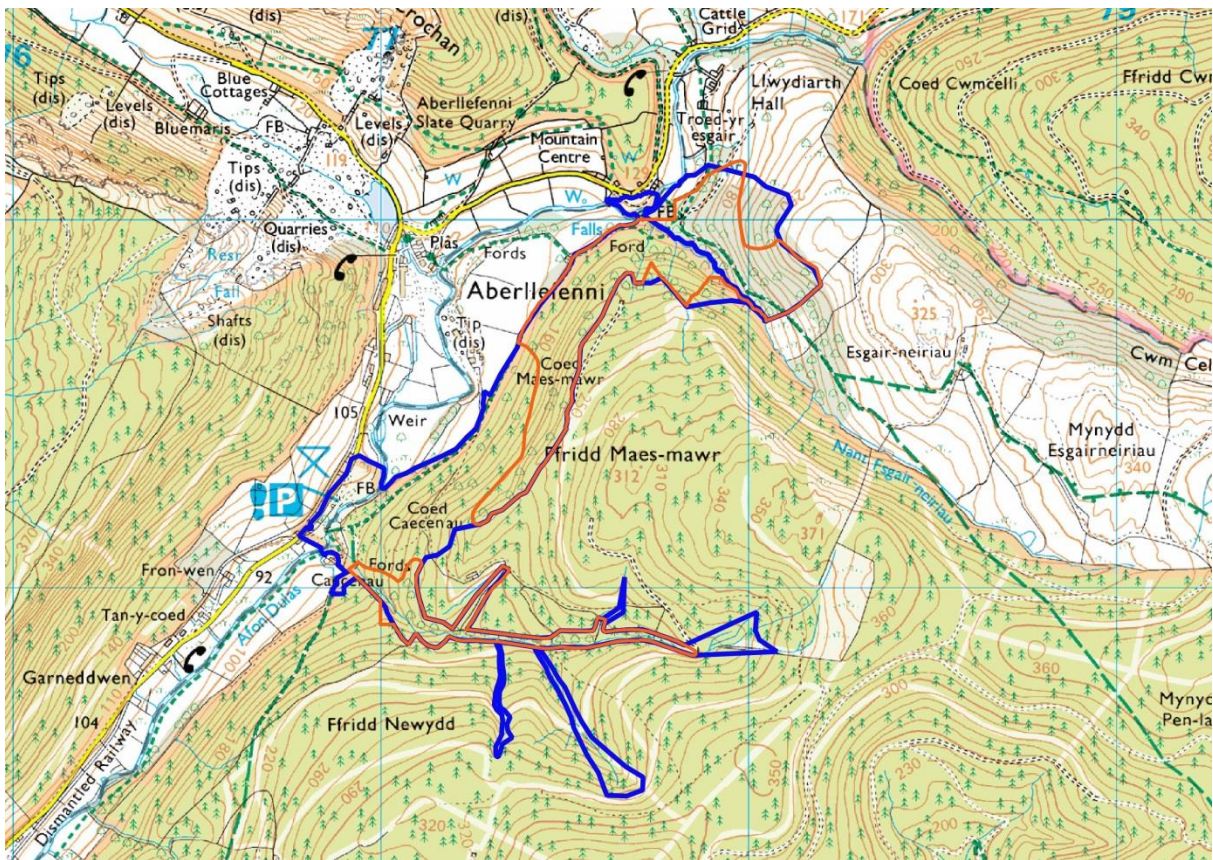


Figure 1: The survey area (outlined in blue) and the Coed Maes-mawr, Coed Esgairneuriau a Cheunant Caecenau SSSI (outlined in orange).

4. Aims and Objectives

The aims and objectives of the study were to:

- Record Nationally Scarce, Nationally Rare and 'old woodland indicator' index species (Sanderson *et al.* 2018) and species that are Red-listed either in the UK (Woods & Coppins 2102) and/or Wales (Woods, 2010).
- Discuss the notable species recorded.
- Generate maps of the best trees for lichens.
- Combine 2021 survey data with older records, to produce a site dossier that includes records of all notable lichens.
- Discuss findings.

5. Methods

5.1 Field survey

The fieldwork took the form of a walkover survey of the study site over 3.5 days between 28th November and 1st December 2021). Two of the half days were wet, the rest of the time was dry. The survey visited Coed Maes-mawr, Coed Esgairneuriau a Cheunant Caecenau SSSI, and intervening/adjacent ground (Figure 1). Some additional recording took place outwith these areas whilst traversing between different areas of the site (see Target Note Map in section 7.2).

Potential lichen habitats within the areas visited were searched for lichens, lichenicolous fungi and non-lichenized micro-fungi traditionally recorded by lichenologists. Survey effort concentrated on those microhabitats likely to support well-developed lichen communities and/or notable species.

Species lists were compiled and target notes recorded for features/species of particular interest such as Nationally Scarce/Rare, Red-Listed or otherwise notable species. Target notes were sometimes used to make a note on other features of interest. Locations were recorded using a handheld Garmin eTrex H Global Positioning System (GPS). Samples were collected of species not readily identifiable in the field using a x14 hand lens, for subsequent identification in the laboratory. As small a sample as possible was collected using hammer and chisel or knife, as appropriate.

Samples collected in the field were identified in the laboratory using the standard literature (Smith *et al.*, 2009 *et seq.*; and various keys in the published and unpublished literature), compound/binocular microscopes, and chemical analysis. Field records and identifications from laboratory work were collated. All records will be submitted to the British Lichen Society (BLS) and be subsequently available through the National Biodiversity Network (<http://data.nbn.org.uk/>).

5.2 Desk study

A list of all notable species recorded was compiled based of the results of the fieldwork plus the data available on NBN, Chambers(1999) and some additional unpublished spreadsheet and BLS recording sheets provided by NRW (see section 11.2).

6. Site account

6.1 Main lichen habitats and lichen communities

The main lichen interest in many areas was associated with old trees/shrubs including oak, birch, holly, sycamore, ash, willow, rowan and hazel.

The old growth *Lobarion pulmonariae* community of more base rich bark was widespread in the site but only locally well-developed. The most common *Lobarion* species was *Sticta fuliginosa* (on 12 trees - locally frequent, but rare in most of the site); the best populations of *S. fuliginosa* were upstream of Caecenau (where it was recorded as occasional in the valley woodland and on boundary trees/hazels). Other leafy *Lobarion* species were even more scarce and/or more local but included *Sticta limbata*, *Sticta sylvatica*, *Nephroma parile*, *Pannaria aff. conoplea* and *Peltigera collina*. *Lobaria pulmonaria* was seen just outwith the study site.

Of particular importance at the site was an oceanic form of the *Graphideetum scriptae* (*Graphidion*) community on smooth bark. In much of the site *Thelotrema lepadinum* was scarce but it was occasional (to locally frequent) in some stands (e.g. the oakwoods along the top edge of the site). It was recorded on hazel, oak, ash, birch and holly. *Graphina ruiziana* was generally scarce but widespread and locally frequent. It was recorded on hazel, oak, holly, birch, and rowan. *Graphina pauciloculata* was recorded on hazel in the valley woodland upstream of Caecenau and on birch, and holly in the Nant Esgair-neiriau valley.

The oceanic acid bark *Parmelietum laevigatae* community was widespread with crustose species frequent throughout (e.g. frequent *Megalania pulverea*, *Ochrolechia androgyna* and *Trapelia corticola*, with occasional *Micarea alabastrites*). Leafy forms of the community with *Hypotrachyna laevigata* were fairly frequent in suitable habitat (and this species was noted fertile once) and more locally there were records for *Sphaerophorus globosus*. The community included records for *Bryobilimbia sanguineoatra*, *Dimerella lutea*, *Hypotrachyna taylorensis* (on two oaks), *Micarea stipitata*, *Mycoblastus sanguinarius*, *Ochrolechia tartarea*, *Parmeliella parvula* and *Micarea pycnidiphora* (on one oak).

The deadwood niches associated with veteran trees were unexceptional. Species of deadwood included *Chaenotheca brunneola*, *Micarea adnata* and *Cladonia incrassata* but some of the more exacting/specialist *Caliciales* were not seen. However, deadwood niches are difficult to survey and more detailed, targeted survey of deadwood niches could find additional interest.

6.2 Notable lichens

A list of notable lichens is given in Appendix 11.2. The more notable species are summarised below. UK conservation value is listed in bold black text.

Other lichen interest recorded in 2021 but just outwith the study site (at TN104) included *Lobaria pulmonaria* (SOWI, **VU** in Wales).

Notable **URI** *Parmelietum* species on acid bark (e.g. oak, birch) include:

<i>Biatora chrysantha</i>	URI	NS	NT in Wales
<i>Bryobilimbia sanguineoatra</i>	URI	NS	
<i>Hypotrachyna taylorensis</i>	URI		NT in Wales
<i>Menegazzia terebrata</i> ¹	URI		VU in Wales
' <i>Ophiobolus pannariae</i> '		?NS	?VU in Wales
<i>Parmeliella parvula</i>	SOWI	URI	NT in Wales
<i>Parmelinopsis horrescens</i>	URI	NT NS	NT in Wales

Additional species on patches of more basic bark of old trees/shrubs (e.g. oak, sycamore, ash, willow, hazel) include:

<i>Arthonia vinosa</i>	SOWI		NT in Wales
<i>Dimerella lutea</i>			NT in Wales
<i>Nephroma parile</i>	SOWI		NT in Wales
<i>Pachyphiale carneola</i>	SOWI		NT in Wales
<i>Pannaria conoplea</i>	SOWI		NT in Wales
<i>Phyllopsora rosei</i> ¹	SOWI	NT NS	NT in Wales
<i>Sticta canariensis (dufourii)</i> ¹	SOWI		VU in Wales
<i>Sticta fuliginosa s. lat.</i>	SOWI		VU in Wales
<i>Sticta limbata</i>	SOWI		NT in Wales
<i>Sticta sylvatica</i>	SOWI		NT in Wales

Additional species on oak included:

<i>Micarea pycnidiophora</i>	SOWI	NS	NT in Wales
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Smooth patches of bark on trees/shrubs (e.g. oak, ash, holly, hazel) support:

<i>Arthothelium ruanum</i>		NS	
<i>Graphis ruiziana</i>	URI	NS	
<i>Graphina pauciloculata</i>		VU NR	EN in Wales
<i>Melaspilea amota/ochrothalamia</i>	tbc	NT NR or LC NS	DD/LC in Wales
<i>Thelotrema lepadinum</i>	SOWI		NT in Wales

The small branches and old twigs of old oak supported

<i>Usnea ceratina</i>	SOWI		Least Concern in Wales
<i>Usnea florida</i>	SOWI	NT	Least Concern in Wales

¹ Species not recorded 2021 but recorded previously at the site (see Table 4, section 11.2 for details).

7. Notes on the lichens

7.1 Notes on some the more notable lichens

Each of the more notable species is discussed briefly below. Target Note locations (TNs) are shown on the map in section 7.2. Full details of all target notes are given in Appendix 11.3.

Arthonia vinosa

SOWI

NT in Wales

Recorded on 1 oak (TN40). Under-browsing is posing a threat to this species (see TNs). This appears to be a new record for the Aberllefenni area.

Biatora chrysantha

URI NS

NT in Wales

This appears to be only the second site for this species in VC47 Montgomeryshire (Figure 4). Recorded on 3 old alders and an oak (TN47). Under-browsing is posing a threat to this species (see TNs). This appears to be a new record for the Aberllefenni area.

Bryobilimbia sanguineoatra

URI NS

Recorded on 6 oaks (TNs 41, 62, 81, 88, 96 and 101). Under-browsing is posing a threat to this species at some locations (see TNs). This appears to be a new record for the Aberllefenni area.

Dimerella lutea

NT in Wales

Recorded on 7 oaks (TNs 1, 41, 49, 72, 83, 87 and 100) and 1 ash (TN56). Under-browsing is posing a threat to this species at most locations (see TNs). Also recorded by Ray Woods in Caecenau Gorge, nr Corris in 1998. Recorded in 1999 by Steve Chambers in gorge at SH777100.

Graphina pauciloculata

SOWI VU NR

EN in Wales

Graphina pauciloculata was recorded growing on *Graphina ruiziana* on several hazels in the valley woodland upstream of Caecenau (TN24) and on *Graphina ruiziana* on birch, ash and young holly in the Nant Esgair-neiriau valley (TNs 55, 56, 57). It has also been previously recorded by Steve Chambers on hazel in the gorge at c. SH77697 10031 (grid ref. estimated from map).

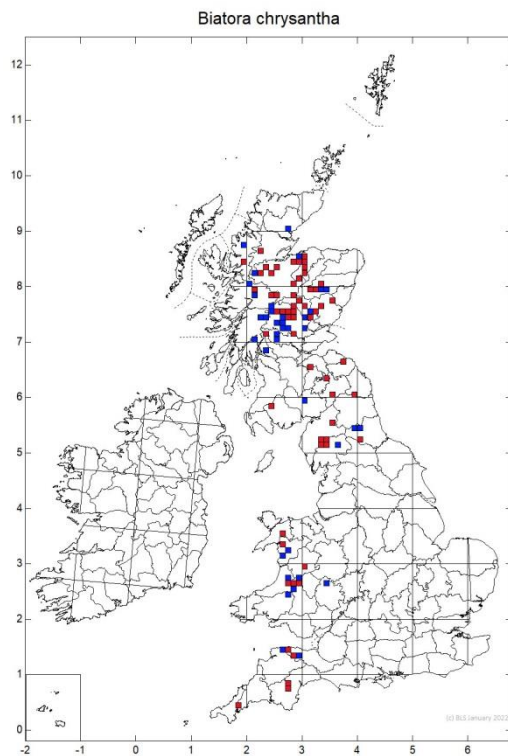
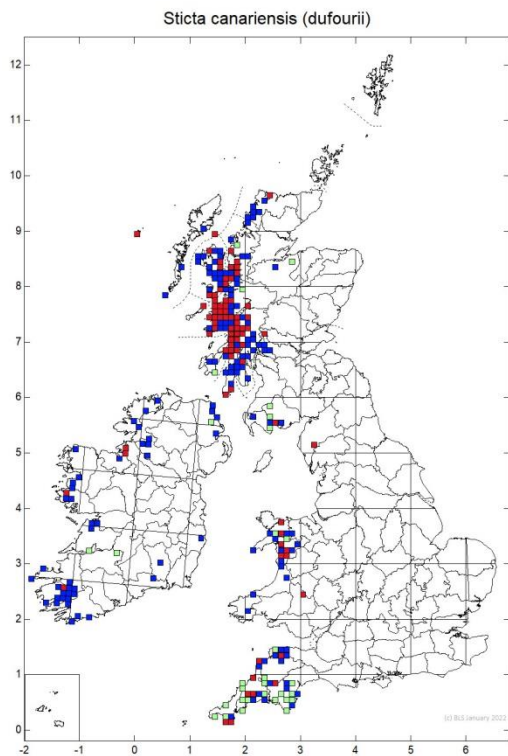
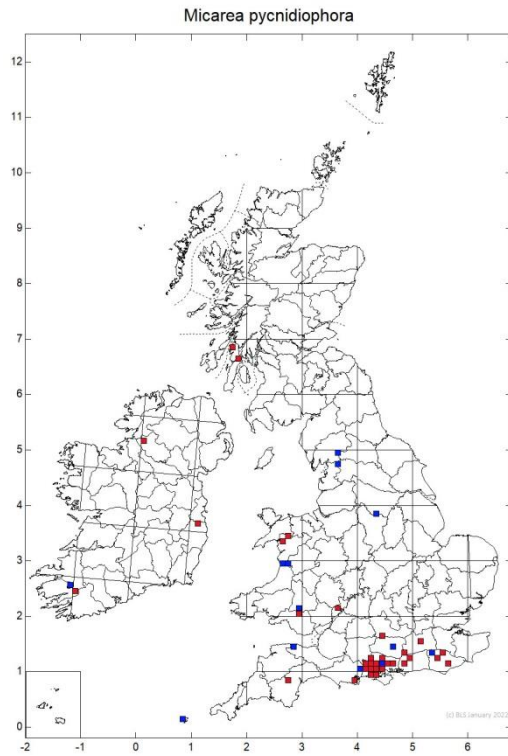
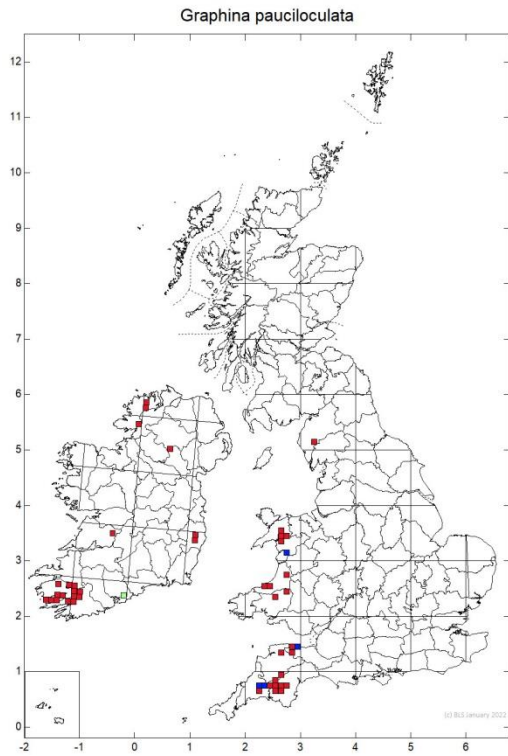
The species is listed as endemic to Great Britain and Ireland in Woods & Coppins (2012) but GBIF lists a single record in northern Spain. Its strongholds are in southwest Ireland and Devon. The populations of *Graphina ruiziana* (the apparent host for *G. pauciloculata*) at Coed Maes-mawr is healthy and it is colonising new trees/shrubs (as is the *G. pauciloculata*). On the basis of this 2021 visit *G. pauciloculata* will almost certainly occur on other trees/shrubs at the site. The SSSI could potentially be of some international importance for this species. Although both these *Graphina* species can persist on smooth bark patches on older trees (e.g. oak), the continued presence of some young stems of holly, birch and hazel is likely to be important for both lichens; however, at some locations too much regeneration is potentially posing a threat (see TNs). Unlike much of the epiphytic lichen interest in the Aberllefenni area *G. pauciloculata* can persist in open to very shaded conditions (Smith *et al.* 2009) so the threat to this particular species may be overstated in the TNs, but as a precaution this should maybe be investigated further/monitored.



Figure 2: Several hazels upstream of Caecenau with *Graphina ruiziana* and *Graphina pauciloculata* **EN** in Wales (TN24).



Figure 3: Young holly in the Nant Esgair-neiriau valley with *Graphina ruiziana* and *Graphina pauciloculata* **EN** in Wales (TN57).



Key to map date classes

- 2000+
- 1960 - 1999
- 1650 - 1959

Figure 4: Distribution maps of some of the most notable species.

Hypotrachyna taylorensis **URI** **NT** in Wales
On 3 oaks (TNs 88, 90, 102). Previously recorded by Ray Woods in Caecenau Gorge, near Corris in 1996, and in 1999 by Steve Chambers at c. SH7779 0994.

Menegazzia terebrata **URI** **VU** in Wales
Not recorded 2021. Recorded in 1999 by Steve Chambers on an oak in the gorge c. SH7762 1005.

Micarea pycnidiophora **SOWI** **NS** **NT** in Wales
New to VC47 Montgomeryshire. Recorded near the base of an oak (TN45). Under-browsing is posing a threat (see TNs).

Nephroma parile **SOWI** **NT** in Wales
Recorded along an old boundary on several hazels and rowans (TNs 2, 3, 4) as well as on nearby oak (TN5) a sycamore near the ruins at Foel-friog (TNs 9, 10). Under-browsing is posing a threat (see TNs).

'*Ophiobolus pannariae*' **NE** **?VU** in Wales
A lichenicolous fungus on *Parmeliella parvula* recorded on one oak along the river TN40 where it is potentially threatened by under-browsing. The species is probably attributable to the *Neolamya* (Brian Coppins pers. comm.). There appears to be only one previous record of it for Wales: SH42 Coed Ganllwyd by Francis Rose in 1975 (Brian Coppins pers. comm.) The host *Parmeliella parvula* is **NT** in Wales, so '*O. pannariae*' would probably qualify as Threatened if formally evaluated.

Pachyphiale carneola **SOWI** **NT** in Wales
Recorded on one oak (TN47). Under-browsing is posing a threat.

Pannaria conoplea **SOWI** **NT** in Wales
Pannaria aff. conoplea recorded in SSSI on oak at TN36 by Anna Griffith in 2021. *P. conoplea* recorded just outwith the site: 1) in 1999 by Steve Chambers at c. SH7758 1004; 2) by Joe Hope on ash at SH776099. A record on NBN in 'the gorge' at SH777100 might be within the 2021 study site but this could possibly be an error in data entry and refer to Steve's record at SH7758 1004 - this requires further investigation.

Parmeliella parvula **SOWI, URI** **NT** in Wales
Recorded on 6 oaks (TN 5, 6, 40, 41, 48, 86) and an old birch (TN8). Threatened by Under-browsing at all localities.

Parmelinopsis horrescens **URI** **NT NS** **NT** in Wales
Not recorded 2021. Recorded by Ray Woods in Caecenau Gorge, near Corris in 1996. Recorded in 1999 by Steve Chambers in gorge at SH777100. Recorded by Joe Hope on birch at Nant Esgair (SH7789009918), also at two locations just north of the site at Llwydiarth (on tree at SH7784310181 and on alder at SH7780410276). The NBN also lists the species at SH774095 (at Coed Maes-Mawr, in 1997, recorder unknown).



Figure 5: Young sycamore and collapsed sycamore with *Sticta limbata* Red-Listed **NT** in Wales near the ruins at TN9.

7.2 Target Note locations

The locations of the target notes including notable species discussed in section 7.1 are shown in Figures 6-8. Full details are given in the Appendices. Some areas were examined only briefly due to time constraints and some areas remain unexplored. In addition to new locations for recorded species, further survey work could find additional species new to the site.

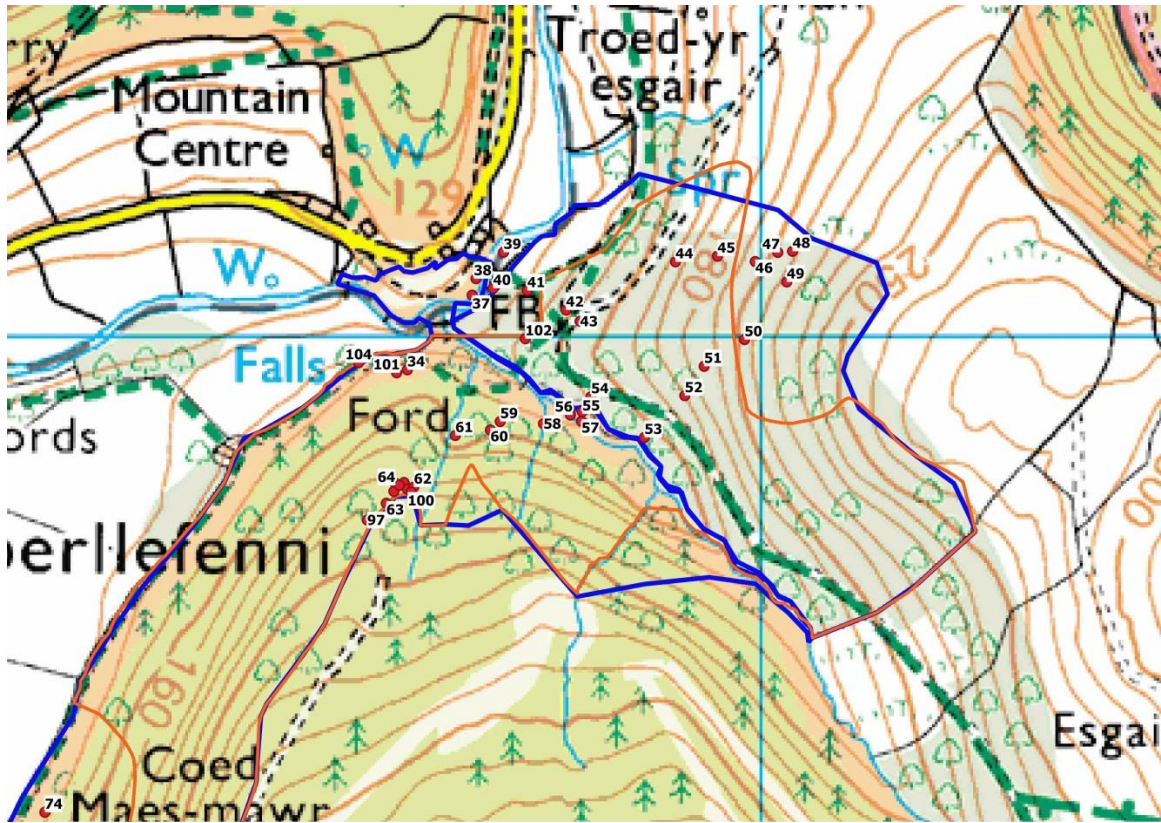


Figure 66: Target note locations (north section).

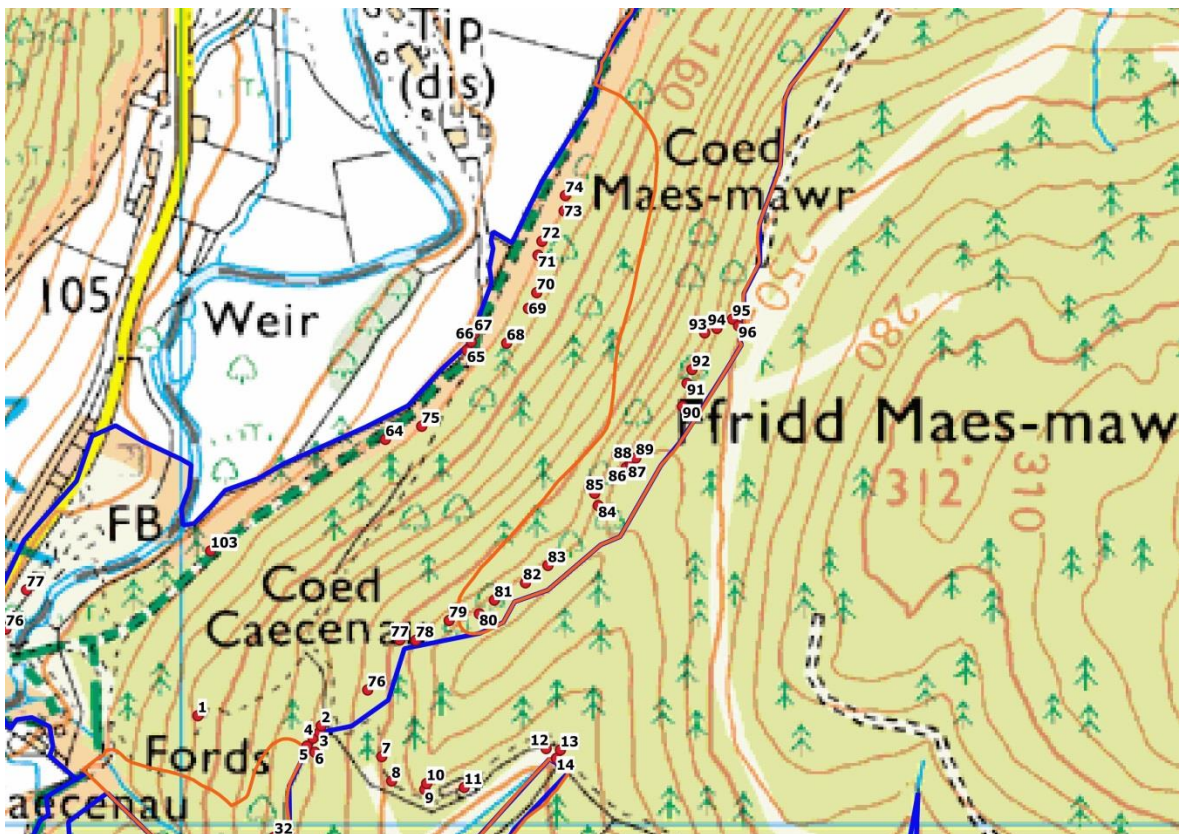


Figure 7: Target note locations (mid-section).

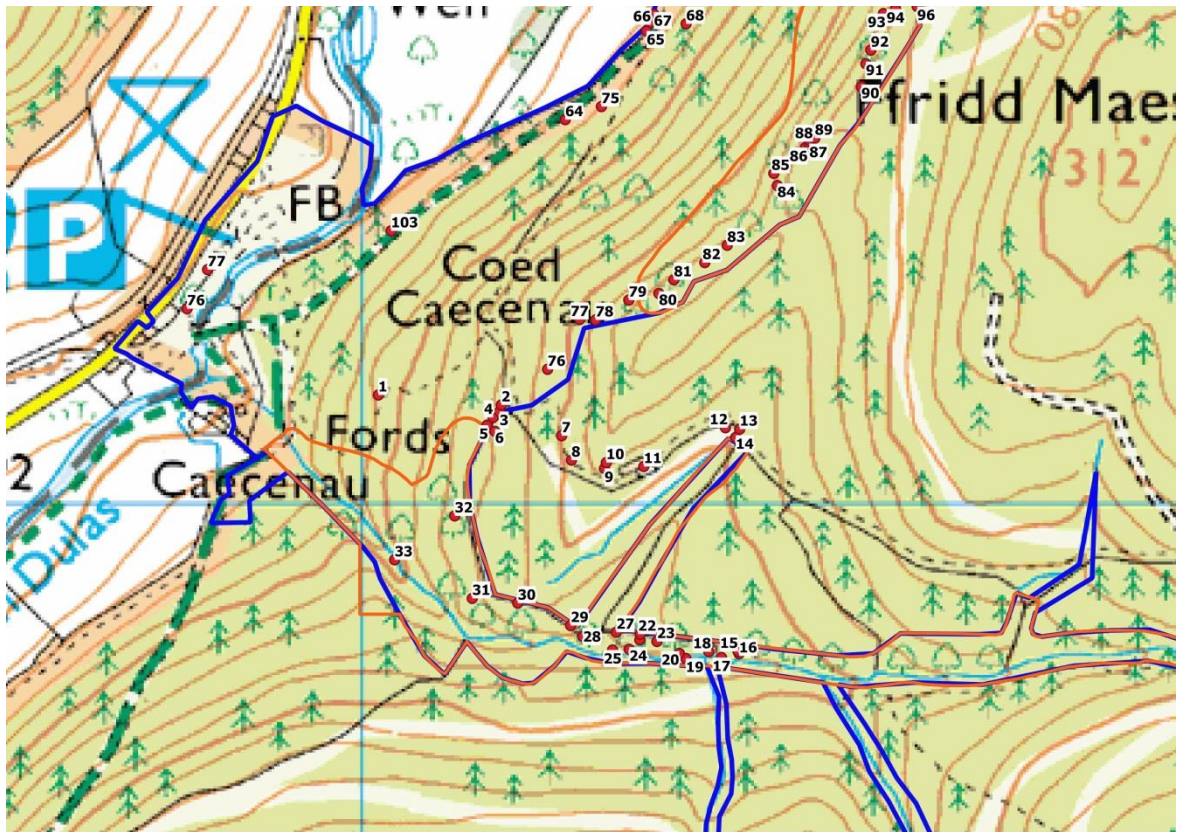


Figure 8: Target note locations (south section).

8. Evaluation

Woodland habitats for lichens can be assessed on the basis of assemblages of notable species as well as the presence of particularly notable species (e.g. Red-Listed species). Various indices have been developed to assess woodlands (e.g. Coppins & Coppins 2002 who developed the indices of Francis Rose). The woodland habitats for lichens have been assessed using three indices that are applicable in Wales: the Upland Rainforest Index (**URI**), the Southern Oceanic Woodland Index (**SOWI**) and the Pinhead index (Sanderson *et al.*, 2018).

8.1 Upland Rainforest Index (URI) score

Seventeen URI species have been recorded (Table 1). An additional notable species recorded in this community in 2021 is *Biatora chrysantha* (regarded as ‘Bonus’ species for oceanic woods by Coppins & Coppins, 2002). The threshold for SSSI quality is 10 in this area of Britain (Sanderson *et al.* 2018).

Table 1: Upland Rainforest Index (URI) species.

Species
<i>Bryobilimbia sanguineoatra</i>
<i>Cetrelia olivetorum s. lat.</i>
<i>Graphis ruiziana</i>
<i>Hypotrachyna laevigata</i>
<i>Hypotrachyna taylorensis</i>
<i>Lepraria membranacea</i>
<i>Loxospora elatina</i>
<i>Megalaria pulverea</i>
<i>Menegazzia terebrata</i> (see note below)
<i>Micarea stipitate</i>
<i>Mycoblastus caesius</i>
<i>Mycoblastus sanguinarius f. sanguinarius</i>
<i>Ochrolechia tartarea</i>
<i>Parmeliella parvula</i>
<i>Parmelinopsis horrescens</i> (see note below)
<i>Sphaerophorus globosus</i>
<i>Trapelia corticola</i>

Notes on Table 1: *Menegazzia terebrata* was not recorded in 2021. Recorded in 1999 by Steve Chambers on oak in gorge at c.SH77623 10053. *Parmelinopsis horrescens* was not recorded in 2021. Recorded by Ray Woods in Caecenau Gorge, near Corris in 1996. Recorded in 1999 by Steve Chambers in gorge at SH777100. Recorded by Joe Hope on birch at Nant Esgair (SH7789009918), also at two locations just north of the site at Llwydiarth (on tee at SH7784310181 and on alder at SH7780410276). The NBN also lists the species at SH774095 (at Coed Maes-Mawr, in 1997, recorder unknown).

8.2 Southern Oceanic Woodland Index (SOWI) score

Twenty-seven SOWI species are now known from the site (Table 2). The threshold for SSSI quality is 20 in this area of Britain (Sanderson *et al.* 2018). Additional notable species recorded in 2021 that indicate high quality habitats and were regarded as ‘Bonus’ species for oceanic woods by Coppins & Coppins (2002) include *Biatora chrysantha* and *Graphina pauciloculata*. The SOWI species *Lobaria pulmonaria* was recorded just outwith the survey area (at TN 104). Additional SOWI species are known along interconnecting woods along the Afon Dulas (see section 9.8).

Table 2: Southern Oceanic Woodland Index (SOWI) species.

Species
<i>Anisomeridium ranunculosporum</i>
<i>Arthonia vinosa</i>
<i>Cetrelia olivetorum s. lat.</i>
<i>Chaenotheca brunneola</i>
<i>Cladonia caespiticia</i> (see note below)
<i>Lecanora jamesii</i>
<i>Leptogium teretiusculum</i>
<i>Loxospora elatina</i>
<i>Micarea alabastrites</i>
<i>Micarea cinerea f. cinerea</i>
<i>Micarea pycnidiophora</i>
<i>Nephroma parile</i>
<i>Pachyphiale carneola</i>
<i>Pannaria conoplea</i> (see note below)
<i>Parmeliella parvula</i>
<i>Parmeliella triptophylla</i> (see note below)
<i>Peltigera collina</i>
<i>Peltigera horizontalis</i>
<i>Pertusaria multipuncta</i>
<i>Phyllopsora rosei</i> (see note below)
<i>Sticta canariensis (dufourii)</i> (see note below)
<i>Sticta fuliginosa s. lat.</i>
<i>Sticta limbata</i>
<i>Sticta sylvatica</i>
<i>Thelotrema lepadinum</i>
<i>Usnea ceratina</i>
<i>Usnea florida</i>

Notes on Table 2: *Cladonia caespiticia* was not recorded in 2021. Recorded by Ray Woods in Caecenau Gorge, near Corris in 1996. *Pannaria. aff. conoplea* was recorded in SSSI on oak at TN36 by Anna Griffith in 2021. *P. conoplea* was recorded by Steve Chambers and Joe Hope just outwith the site and possibly within site (see section 7.1). *Parmeliella triptophylla* was not recorded in 2021.

Recorded in 1999 by Steve Chambers in gorge at SH777100. Also recorded by Joe Hope on ash and oak at Foel Friog along the Afon Dulas (SH775100, 776100, 772098, 773099). *Phyllopsora rosei* was not recorded in 2021. Recorded in in gorge at SH777100 in 1991 by Ray Woods and in 1999 by Steve Chambers. Joe Hope recorded aff. *Phyllopsora rosei* on oak at SH7791409881. *Sticta canariensis dufourii* was not recorded in 2021. Recorded by Ray Woodson an ash in Caecenau Gorge, near Corris in 1996 SH770089. This section with *S. dufourii* not visited 2021. The NBN also lists the species at SH774095 (at Coed Maes-mawr, in 1997, recorder unknown).

8.3 Pinhead Index

The Pinhead community (*Calicetum hyperelli* and *C. abietinum*) is a specialist community of bark and lignum niches sheltered from direct rainfall with the fruiting bodies (the ‘pinhead’) raised on a tiny stalks (the ‘pins’). Typical niches are areas of lignum in the rain shadow of upper limbs, on the underside of decorticated limbs, on the rain-sheltered side of leaning dead standing tree trunks, sheltered crevices in very rough gnarly bark, and hollows in veteran trees. The Pinhead Index is used to assess the quality of these specialist lichen niches at a site. Only one ‘pinhead’ species was recorded in 2021 (Table 3). The threshold for SSSI quality is 10 pinhead species (Sanderson *et al.* 2018).

Table 3: Pinhead lichens.

Species
<i>Chaenotheca brunneola</i>

8.4 Overall evaluation

The **URI** and **SOWI** scores clearly indicate the site is of high conservation value for lichens. The large number of notable species also supports the high conservation importance of the site. The latter includes 17 species that are Near Threatened **NT** in Wales, 3 species that are Vulnerable **VU** in Wales and 1 species that is Endangered **EN** in Wales. Additional species of note include ‘*Ophiobolus pannariae*’; this species is lichenicolous on the Welsh Red-Listed **NT** *Parmeliella parvula*, and likely to merit Threatened status (**?VU**) if formally evaluated. The fungus *Filicupula suboperculata* was also recorded growing on *Frullania*. This is a diminutive fungus and was only recorded new to Wales in 2021 (there are no records shown on the NBN or the BLS database, but it was noted twice in Meirionnydd in 2021 by George Greiff and Sam Bosanquet). I only record it from *Frullania* in ancient woodlands, but that might be because that’s where I look for it!

9. Discussion

9.1 History and historical threats

The broadleaved woodlands visited in 2021 are shown as broadleaved woodlands on the 1888 Six-inch map (survey date 1887) but the plantations dominated by Larch in 2021 (with scattered oaks) are shown as mixed broadleaved/planted conifers in 1887.

The mixed/conifer broadleaved woodland and the oak dominated plantations on the in the Nant Esgair-neiriau valley were clearly more intensively managed for oak. The Nant Esgair-neiriau valley was intensively managed right up to the watercourse and few old broadleaves of species other than oak remain (some old birch, rarely ash e.g. TN55, 56). Some pasture trees do however survive along the Afon Dulas (e.g. TN 40).

Other less easily accessible areas appear to have been managed for oak but not so intensively - there has probably been more mixed management as upland pasture woodland. The higher level oak area abuts onto/overlaps with an area marked on the OS map as Ffridd Maes-mawr (though most of the Ffridd Maes-mawr on the 1887 map just shows open ground with no obvious sign of mapped trees). In addition to frequent oaks, the occasional old/veteran birch is an important component of the wood here (e.g. TNs 8, 95). *Thelotrema lepadinum* is generally more frequent in these less intensively managed areas (on oak, birch, rowan and holly). *T. lepadinum* was usually scarce/rare in the areas that have been more intensively managed as oak plantations.

Trees and hazels along old boundaries are particularly important for *Lobarion* lichens.

The valley woodland upstream of Caecenau is a hotspot for the lichen flora and unlike the Nant Esgair-neiriau valley, supports significant stands of broadleaves other than oak. The valley woodland and associated boundary trees/hazels support the *Lobarion* community and the hazel stands here are particularly important for *Graphina pauciloculata* (Red-Listed **EN** in Wales). Riparian ash and sycamore also support the *Lobarion* including the Red-listed **VU** *S. canariensis (dufourii)* recorded by Ray Woods in 1996.

Some of the areas have been impacted by commercial conifer forestry. It is unknown how many old trees were lost due to underplanting/felling/removal but there are remnants which hint at lost lichen interest (e.g. veteran birch TN8 in clearfell areas, and old oaks TN70, 72 and veteran holly 75 in the larch plantation).

9.2 Recent and current threats

Much of the site has frequent to abundant regeneration establishing and/or established young poles/young trees (including broadleaved planting in some areas). Some diversification of the oak-dominated areas with holly, rowan and birch is welcome, and broadleaved regeneration in the clear-felled conifers is welcome.

The establishment of a more diverse range of trees should diversify the lichen interest over time but there are serious concerns that the regeneration is too dense and in many areas it poses a threat to the existing lichen interest (section 9.4). The scarcity of seed sources for other species (e.g. hazel, ash, sycamore, alder, and willow) in some areas will limit diversification without intervention (section 9.4). Appropriate densities of ash, hazel and willow regeneration will increase the available habitat for *Lobarion* lichens. Young willow is establishing in some areas (e.g. along the forest track) but encouraging it in other areas is recommended (e.g. along riparian areas of the Nant Esgair-neiriau where it would be a suitable phorophyte for colonisation by *Lobarion* species).

9.3 Pollution

No obvious signs of widespread pollution were noted for example there was no evidence of nitrogen enrichment on oak trunks. Nitrogen sensitive spp. remain dominant on branches with *Usnea subfloridana*, *Evernia prunastri*, *Parmelia* spp. and *Hypogymnia* spp. all frequent to abundant.

The *Parmelietum laevigatae* is a community of acidic bark and community is very vulnerable to ammonia pollution. *Hypotrachyna laevigata* was occasional throughout the site and locally frequent to locally abundant. Some algal growth was seen on birch (Figure 9) but this was the exception and not a general feature.

The *Lobarion* community is very sensitive to SO₂ and ammonia pollution and the scarcity in the site might partly relate to past acid rain effects. However, it is likely that past woodland management has played a major role. Forms of woodland management such as tree felling/coppicing will have removed the *Lobarion* lichen habitat directly and led to declines. This idea is supported by the continued presence of the *Lobarion* on less disturbed areas (e.g. ravine woodland), riparian trees and boundary trees. Monitoring the *Lobarion* along the Afon Dulas (section 9.8) would probably be the best way to monitor the effects of pollution on lichens in the area (these would be the most at threat from fertiliser applications which should be discouraged near the site and should follow best practice guidelines in the valley).



Figure 9: Algal growth on a birch at the edge of the conifer forestry at TN20.

9.4 Grazing, regeneration, infill and woodland structure

High epiphytic lichen interest is strongly associated with woodland features that arise through browsing - and maintenance of high lichen interest in woodlands is dependent on grazing. With heavy browsing a rich lichen flora can persist for long periods and in the absence of other factors (such as intensive woodland management and pollution) decline in the lichen flora is gradual, occurring over relatively long timescales (being largely driven by cumulative loss of veterans over time due to natural death). In contrast, without sufficient browsing the lichen flora can decline very quickly (within 5-20 years if browsing is very low/excluded); this is largely due to increased shade on lower trunks (e.g. due to tree regeneration, ivy).

Halo thinning around old trees/shrubs is recommended but it is difficult to see how this would be practical at such a large scale without some increased browsing to control seedlings and regrowth from cut stumps. Initially focussing on some key areas would seem sensible.

The most urgent area to deal with is probably the Coed Maes-mawr oakwood area along the top of the site. This would benefit from halo thinning of the holly, birch and rowan regeneration and removal of non-native regeneration (e.g. TN81, 93, Figures 10, 11). Holly thickets establishing around old trees are a particularly serious shade threat to lichens, but dense stands of young birch and rowan can also be a serious problem. Care should be taken to retain a good scatter of young trees/shrubs (*Graphina ruiziana* and *Thelotrema lepadinum* are colonising the young trees).

The Nant Esgair-neiriau valley also has issues with regeneration of holly thickets and birch (see TNs). Halo thinning on the west and southwest facing slopes would be

relatively easy to address as much of the regeneration is at the seedling/young sapling stage (and the west facing slopes are relatively accessible). The halo thinning should extend to the lower slopes and the riparian section of the Afon Dulas where there are old pasture trees (e.g. TNs 40, 41, Figure 12).

The north-east facing slopes of the Nant Esgair-neiriau valley have dense established thickets of pole stage birch infilled between mature oaks (e.g. TNs 58, 59, 60) - but this will be a bigger job. The lower trunks of many of the oaks on these slopes have an impoverished flora dominated by common bryophytes. Some serious halo thinning around large old oaks is recommended here but it will be important to retain some young maturing birch and holly (*Graphina ruiziana* is colonising the young birch so this is likely to be important to retain birch for this species and potential habitat for *Graphina pauciloculata*). Ideally some pre-commencement survey for *G. ruiziana*/*G. pauciloculata* would be undertaken prior to thinning operations to avoid those poles/young trees supporting these species.

Some diversification of the riparian section of the Nant Esgair-neiriau valley is desirable but this is unlikely to happen without intervention (seed sources of ash, willow and hazel are rare so planting of some sycamore, willow and hazel would be good, perhaps with some protection of any suppressed basal shoots on existing seed trees (e.g. the ash with *Graphina pauciloculata* at TN56).

If *Chalara* resistant strains of ash evolve, planting of ash in suitable areas of the site would be good.



Figure 10: Holly thickets and non-native conifer regeneration establishing around oak and old birch trees in the higher level oakwoods. Halo thinning around old birch and oak in this area is urgently required.



Figure 11: Photos to show general view downslope of oakwood with dense thicket understorey. Dense regeneration, especially dense young holly thickets as seen here but also rowan and birch, will pose a serious threat to the existing lichen flora. Ideally halo thin around oaks and old/veteran birch in the whole oakwood area and increase browsing. But ensure to leave a number of scattered poles of rowan and birch throughout as the lichen flora of these is developing nicely and is likely to improve if shading/thicket development is controlled.



Figure 12: Old pasture oak along the river at TN40 with the notable lichen flora threatened by under-browsing (but note this is not that obvious in the photo). The lichen flora includes species Red-Listed **NT** in Wales: *Arthonia vinosa*, *Parmeliella parvula* and 'Ophiobolus pannariae' (?VU, see section 7.1).

9.5 Future veterans

Halo thinning around existing veterans with appropriate browsing levels to control excessive regeneration/regrowth should be the priority, but the development of potential future lichen habitat is also important. Encouraging the development of future veteran habitat with diverse range of microhabitat conditions/lichen niches is the key.

Halting infill of gladed areas and restructuring some areas (e.g. in the Nant Esgair-neiriau valley) will increase diversity by maintaining/creating glades/gladed conditions. Appropriate browsing levels should allow some low level (or patchy) establishment of regeneration but maintain diversity by preventing infill of all glades with dense regeneration, and preventing long term succession to even-structured, dense canopy high forest.

In addition to halo thinning around the veterans, halo thinning saplings/poles around selected young maturing/mature trees could be undertaken to promote the development of 'future veterans' with a diverse range of lichen niches.

Trees selected for management as 'future veterans' should not be limited to oak. Veteran birch is an important for the *Parmelietum* but often quite scarce and/or local in many of the oak-dominated stands. The development of future veteran birch, rowan, hazel and holly should be promoted.

The trees should be selected on the basis of current form. For example specimens with more interesting form such as low split trunks, multi-stemmed trunks, leaning trunks, large low limbs, will provide more niches than trees with tall straight trunks with no lower limbs. Appropriate browsing levels would be essential to maintain niches in suitable condition for lichen colonisation as the trees age and minimise/avoid the need for future halo thinning.

9.6 Conifer forestry

The clearfells are dominated by dense thicket regeneration that will establish into dense high forest (which would be unsuitable for colonisation by old growth lichens). Ideally significant networks of these areas would be heavily thinned to encourage development of a more patchy structure; areas with a more open woodland structure would over time become more suitable for colonisation by old growth lichens.

The priority for thinning/restructuring operations should be areas adjacent to the existing broadleaved woodland, trees along watercourses, old trees along tracks/near ruins, and along boundary features with trees/hazels. These are key linear features that currently support old growth lichens (*Parmelietum* and *Lobarion* lichens) and are imminently threatened by the shade from adjacent dense thicket regeneration (numerous examples in TNs, e.g. TNs2, 3, 4, 5, 6, 8, 11, 12, 13, 14, also Figures 13,14,15,16,17).

Forest operations including PAWS restoration, track upgrades, and putting in new tracks should avoid damage to existing broadleaves. Examples of appropriate management considerations include:

- Larch areas with abundant regeneration including dense holly regeneration, often forming thickets (Figure 18). These will pose a serious threat to the development of a lichen flora after Larch felling. Dense thicket broadleaved regeneration (especially holly) poses a far greater threat to lichens than Larch. Thinning/control is recommended especially around any oaks within the larch areas (see section 11.1).
- Some watercourses through the remaining conifer blocks have remnant broadleaves (e.g. at TN 18, Figure 19). Ideally a wide riparian strip should be cleared of conifers to increase light levels. When conifers are felled some established young broadleaves will be useful to limit sudden exposure post conifer felling, but follow up control of regeneration is likely to be necessary to control shaded levels from thickets.
- The lichen interest in and near to conifer areas does include obviously large old trees (e.g. Figure 13) but also in some areas relatively spindly trees/hazels that could easily be dismissed as scrub. The relatively well-lit small hazels, willows and rowans along the edge of forest tracks supported important *Lobarion* and *Graphidion* species (e.g. Figure 14, also see section 11.1). Additional survey work is essential before any felling of broadleaves along the edge of the lower forest track.



Figure 13: Dense thicket regeneration on clearfells adjacent to old birch with the Welsh Red-listed **NT** *Parmeliella parvula* and *Hypotrachyna laevigata*.



Figure 14: Small hazels, willows and rowans along the forestry track support the *Lobarion* including *Peltigera horizontalis*, *Sticta limbata* (Welsh Red-Listed **NT**) and *Sticta fuliginosa* (Welsh Red-listed **VU**). For examples see TNs 65, 66, 67, and 103.



Figure 15: Veteran ash at the Foel Friog ruins (TN11). The tree supports a *Lobarion* community including *Peltigera horizontalis*, *Peltigera praetextata*, *Leptogium teretiusculum*, *Sticta sylvatica* (Welsh Red-listed **NT**) and *S. fuliginosa* (Welsh Red-listed **VU**). The community here (and along nearby old boundary features e.g. TNs 12, 13, 14) is threatened by dense tree regeneration



Figure 16: Multi-stemmed sycamore along the boundary with clear-felled conifers. The tree supports a *Lobarion* community including *Peltigera horizontalis*, *Peltigera praetextata*, *Sticta sylvatica* (Welsh Red-listed **NT**) and *S. fuliginosa* (Welsh Red-listed **VU**). The community is threatened by dense tree regeneration/thicket regeneration on clearfells.



Figure 17: A line of boundary hazels with *Sticta* sp. (Welsh Red-listed **NT/VU**). The community is seriously threatened by dense tree regeneration/including *Prunus spinosa*, holly and thicket regeneration on adjacent clearfells. Halo thinning around all old hazels and old trees along this whole boundary is recommended.



Figure 18: Larch areas with abundant regeneration including dense holly regeneration, often forming thickets. These will pose a serious threat to the development of a lichen flora after Larch felling. Dense thicket broadleaved regeneration (especially holly) poses a far greater threat to lichens than Larch. Thinning/control is recommended (see section 11.1).



Figure 19: remnant broadleaves along watercourses through the forestry (at TN18). These should be a priority for PAWS restoration. The fallen tree (probably oak) in the foreground supports *Micarea adnata* NS and *Micarea incrassata* NS.

9.7 Habitat networks and woodland restoration at the landscape scale

Colonisation sources for many of the notable lichens (e.g. *Lobarion* species and some of the *Parmeliatum* species such as *Hypotrachyna taylorensis*) are very local so optimising nearby site conditions to maximise chances for colonisation is recommended. Thinning operations will be key to this and increasing within-site connectivity between areas of high lichen interest will be important. Connecting corridors should be monitored/maintained in suitable habitat condition to facilitate colonisation.

Given the poor establishment /colonisation capabilities of 'old growth' lichens (the main species of interest recorded during the survey) steps should be taken to increase connectivity with other ancient woods at the landscape scale, but great care should be taken to ensure this is done with particular consideration of the specific niche requirements of lichens. As discussed above, dense thicket regeneration over large expanses will produce unsuitable habitat for lichen colonisation, (and so effectively act as a barrier to wider colonisation) and regeneration close to existing veteran trees can be disastrous for the lichen flora on those trees. Management to maintain/improve current conditions for old growth lichens (as the only colonisation sources we have) is the priority, with suitably sensitive restoration over suitable timescales to increase connectivity at the landscape scale over the longer term (Acton, In prep.). Restoration that compromises the existing interest or establishes unsuitable habitat for colonisation is incompatible with the maintenance/recovery of high quality lichen interest. With suitable restoration the lichen flora could improve over time and be more resilient to future pressures such as climate change.

9.8 Afon Dulas *Lobarion* communities

In 1999 Steve Chambers and Any Law visited pasture/riparian woodland outwith the 2021 survey area. Their report (Chambers, 1999) considered the "quality and development of the *Lobarion* species [in an area west of the gorge/waterfalls downstream of TN 39] is very high, particularly ... *Lobaria* [*Ricasolia*] *virens* and ... as good as it gets nowadays [in this region]". Steve recorded 'dust-bin lid' sized plants of *Ricasolia virens*. The *Lobarion* species Steve recorded in the area are listed in Table 4. Most of these have not been recorded in the 2021 survey area and so the importance of this section outwith the SSSI for lichens cannot be overstated.

With appropriate management of the pasture/riparian woodland and the SSSI, these lichen species will hopefully eventually colonise the SSSI. This will involve ensuring trees in the SSSI (especially those along the river and further upslope e.g. in vicinity of TNs 34, 101) are in favourable condition to act as suitable receptor sites.

Note that most of Steve's grid references are estimated from paper maps. Joe Hope revisited a number of these locations in 2020 and has recorded full GPS grid references (spreadsheet data held by NRW).

Table 4: *Lobarion* species along the Afon Dulas recorded by Steve Chambers. Species in bold text have *not* been recorded in the 2021 study site.

Species	Conservation Status (UK)	Welsh Red List	SOWI etc.
<i>Leptogium lichenoides</i>	LC	LC	SOWI
<i>Lobaria pulmonaria</i>	LC Sc L IR	VU	SOWI
<i>Mycobilimbia epixanthoides</i>	LC	NT	SOWI
<i>Nephroma laevigatum</i>	LC Sc L IR	NT	SOWI
<i>Pannaria conoplea</i>	LC Sc L IR	NT	SOWI
<i>Parmeliella parvula</i>	LC Sc L* IR	NT	SOWI, URI
<i>Parmeliella triptophylla</i>	LC Sc L IR	NT	SOWI
<i>Ricasolia amplissima</i>	LC Sc L IR	VU	SOWI
<i>Ricasolia virens</i>	LC Sc L IR	EN	SOWI
<i>Sticta fuliginosa s. lat.</i>	LC Sc L IR	NT	SOWI
<i>Sticta sylvatica</i>	LC Sc L IR	NT	SOWI

9.9 Further survey work

Recommended survey/monitoring work is listed below:

- Survey of car park trees prior to any tree felling/surgery.
- Survey of any native broadleaves trees along the forest tracks before felling any e.g. for forest road upgrades/new access tracks (see Appendix 11.1).
- Assess the regeneration levels and the need for any halo thinning etc. in key *Lobarion* areas along the Afon Dulas (the riparian pasture trees visited during this survey required some halo thinning so the worry is that the key *Lobarion* areas further downstream could be at risk).
- After any initial halo thinning and controlling regeneration as recommended in this report, regeneration levels should be monitored to guide follow up thinnings/control. For example: in higher level oakwoods at Coed Maes-mawr and in the adjacent Larch areas downslope; the valley woodland upstream of Caecenau, pasture trees along the Afon Dulas, oakwoods in the Nant Esgair-neiriau valley.
- Targeted search for *Pannaria conoplea* to confirm presence in the SSSI.
- Targeted search for *Sticta canariensis (dufourii)* to confirm presence.
- A survey of additional areas of the study site not visited in 2021. For example the NBN lists some notable species by an ‘unknown’ recorder in 1997 at Coed Maes-mawr (SH774095). They include *Parmelinopsis horrescens*, *Parmeliella parvula*, *Peltigera collina*, *Hypotrachyna taylorensis* and *Sticta canariensis (dufourii)*.

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11. Appendices

The Appendices of data tables and location photographs have been removed from this version of the report because it is not possible to make them comply with Accessibility legislation. Full PDFs of the report are stored by the Natural Resources Wales Library and the National Library of Wales.



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