Cyfoeth Naturiol Cymru
Natural Resources Wales

Lichen survey of parts of Gwydyr Forest, Glyn Lledr, Gwynedd

A multi-stemmed sycamore clothed in *Lobaria pulmonaria* at Llannerch Elsi

Dave Lamacraft

Evidence Report Number 701

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Cafodd Dave Lamacraft ei gontractio gan Cyfoeth Naturiol Cymru (CNC) i gynnal arolygon cennau mewn ardaloedd PAWS, RAWS ac ASNW yng nghoedwigoedd Ystad Goetir Llywodraeth Cymru o amgylch Glyn Lledr a Llanerch Elsi yn Nyffryn Lledr. Cofnodwyd coed oedd yn cynnal rhywogaethau cen SOWI /URI/RDB gyda GPS a chofnodwyd toreithrwydd o gennau gan ddefnyddio graddfa DAFOR.

Gwnaed 550 cofnod o 152 tacson o gennau a ffyngau sy'n byw ar gennau. Mae 61 o'r rhain yn nodedig gan gynnwys:

- 34 tacson SOWI;
- 15 tacson URI (yn cynnwys *Mycoblastus sanguinarioides* fel tacson cryptig o fewn *Mycoblastus sanguinarius* a gafodd ei ganfod yn ddiweddar ym Mhrydain Fawr);
- Un tacson NT (GB), *Ramonia chrysophaea* (hefyd yn newydd i VC49);
- Cofnodwyd un tacson CR (Cymru), *Lobarina scrobiculata*, ar waelod mwsoglyd criafolen fach iawn ar ochr llwybr;
- Un tacson EN (Cymru), *Ricasolia virens*;
- 5+ tacson VU (Cymru), *Leptogium burgessii* (ail safle VC49), *Lobaria pulmonaria*, *Pyrenula occidentalis* (hefyd yn newydd i VC49), *Ricasolia amplissima*, a dau o'r grŵp *Sticta fuliginosa* s lat;
- 13 dosbarth NT (Cymru), pob un yn gysylltiedig â chymuned Lobarion o risgl llai asidig (a gynrychiolir hefyd yn dda gan y SOWI);
- Mae cofnodion diddorol eraill yn cynnwys ail gofnod VC49 o *Schismatomma umbrinum* a *Catinaria* '*isidioides*', sy'n newydd i VC49 (tacson sy'n agos at *Catinaria atropurpurea* ond gyda thalws sy'n atgoffa rhywun o *Bacidia biatorina*, sydd angen dilyniannu DNA, ac sydd ar hyn o bryd yn cael yr enw answyddogol 'isidioides').

Ym mhobman mae'r gymuned Lobarion o risgl llai asidig yn cael ei chynrychioli'n dda e.e. 51 o goed gyda Lobaria pulmonaria, er bod rhywfaint o ddiddordeb asid nodedig hefyd gyda tartarea *Ochrolechia* er enghraifft, a phoblogaethau da o *Shaerophorus globosus*. Ceir cynrychiolaeth gyfyngedig o'r gymuned fesig aeddfed ar rai coed derw hynod gyda *Varicellaria hemisphaerica*, a diddordeb rhisgl llyfn gwasgaredig gan gynnwys *Pyrenula occidentalis*, record newydd ar gyfer VC49. Mae'r diddordeb hwn wedi goroesi er gwaethaf coniffereiddio'r ardal. Nid oes fawr o amheuaeth fod yr ardal wedi cynnal diddordeb cen eithriadol cyn y cyfnod coniffereiddio. Mae'r rhan fwyaf o'r problemau rheoli cynefin yn ymwneud â rheoli coniffereiddio a phlanhigfeydd. Y prif broblemau yw:

- Cysgod, o ganlyniad i'r conwydd a'r ffawydd;
- Cysgod, o ganlyniad i ddatblygiad isdyfiant yn absenoldeb pori neu fath arall o reolaeth;
- Pa mor agored i niwed yw coed pwysig ar ochr ffordd goedwig;

- Llwyrgwympo ardaloedd o PAWS.

Gallai'r safle pwysig hwn sydd eisoes yn gyfoethog ddod yn gyfoethocach fyth drwy reolaeth ffafriol, er bod angen i'r rheolaeth hon fynd y tu hwnt i'r dull presennol o adfer PAWS sydd i'w weld yn seiliedig ar lwyrgwympo. Dyma argymhellion penodol Glyn Lledr, sy'n mynd i'r afael â'r materion uchod:

- Cylch-deneuo a chael gwared o gonwydd mewn modd sensitif;
- Rheoli isdyfiant;
- Rheoli Rhywogaethau estron goresgynnol;
- Rheoli eiddew;
- Diogelu coed ar ochrau ffyrdd coedwig;
- Rheoli Clefyd Coed Ynn;
- Rheoli ffawydd ym Mhont Gethin.

2. Executive summary

Dave Lamacraft was contracted by Natural Resources Wales (NRW) to undertake lichen surveys of the areas of PAWS, RAWS, and ASNW in the Welsh Government Woodland Estate forestry around Glyn Lledr and Llanerch Elsi in the Lledr Valley. Trees supporting SOWI / URI / RDB lichen species were recorded with a GPS and lichen abundances were recorded using the DAFOR scale.

550 records were made of 152 taxa of lichens and lichenicolous fungi. 61 of these are notable, including:

- 34 SOWI taxa;
- 15 URI taxa (with inclusion of *Mycoblastus sanguinarioides* as a cryptic taxon within *Mycoblastus sanguinarius* recently recognised in GB);
- One NT (GB) taxon, *Ramonia chrysophaea* (also new to VC49);
- One CR (Wales) taxon, *Lobarina scrobiculata*, recorded on the mossy base of a very small stunted trackside rowan;
- One EN (Wales) taxon, *Ricasolia virens*;
- 5+ VU (Wales) taxa, *Leptogium burgessii* (2nd VC49 site), *Lobaria pulmonaria*, *Pyrenula occidentalis* (also new to VC49), *Ricasolia amplissima*, and two of the *Sticta fuliginosa* s lat group;
- 13 NT (Wales) taxa, all associated with the *Lobarion* community of less acidic bark (also well represented by the SOWI);
- Other interesting records include the second VC49 record of *Schismatomma umbrinum* and *Catinaria 'isidioides'*, new to VC49 (a taxon close to *Catinaria atropurpurea* but with a thallus reminiscent of *Bacidia biatorina*, in need of DNA sequencing, and currently given the unofficial name 'isidioides').

Throughout, the *Lobarion* community of less acidic bark is well represented e.g. 51 trees with *Lobaria pulmonaria*, although there is some notable acid interest too with e.g. *Ochrolechia tartarea* and good populations of *Sphaerophorus globosus*. There is limited representation of the mature mesic community on some veteran oak with *Varicellaria hemisphaerica*, and scattered smooth bark interest including *Pyrenula occidentalis*, a new record for VC49. This interest has survived despite the coniferisation of the area. There is little doubt that the area supported outstanding lichen interest pre-coniferisation. Most of the habitat management issues relate to the coniferisation and plantation management. The main issues are:

- Shade, as a result of the conifers and beech;
- Shade, as a result of understory development in absence of grazing or other management;

- Vulnerability of important forest road side trees;
- Clear-felling areas of PAWS.

This already rich and important site could become even better with favourable management, although this management needs to go beyond the current approach to PAWS restoration which appears to be based around clearfelling. Specific recommendations at Glyn Lledr, addressing the issues above, are:

- Halo thinning and sensitive conifer removal;
- Understory control;
- INNS control;
- Ivy control;
- Protection of trees on the sides of forest roads;
- Ash Dieback management;
- Beech control in Pont Gethin.

3. Introduction

Dave Lamacraft was contracted by Natural Resources Wales (NRW) to undertake lichen surveys of five areas in the Glyn Lledr part of Gwydyr Forest, Gwynedd.

3.1. Scope of the project

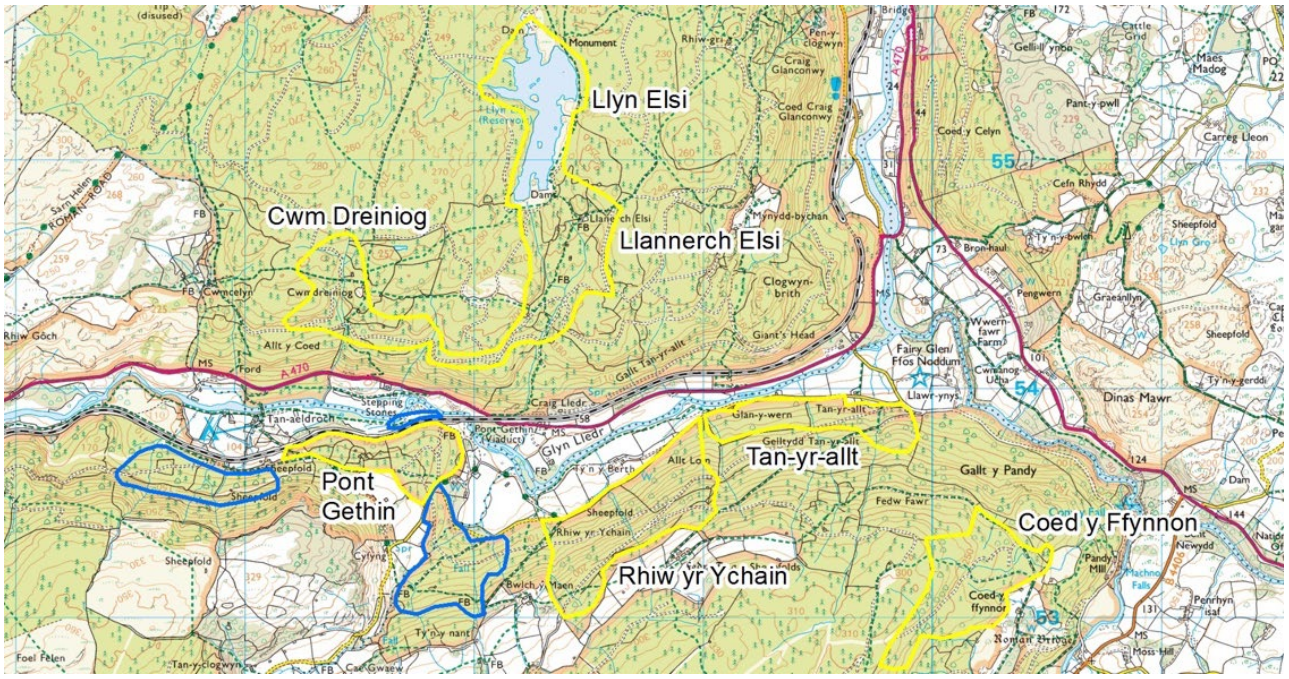
This contract involves lichen survey of the areas of PAWS, RAWS, and ASNW in the Welsh Government Woodland Estate forestry around Glyn Lledr and Llanerch Elsi in the Lledr Valley identified on the map (Figure 1). Trees supporting SOWI / URI / RDB lichen species will need to be GPSed and DAFORed, some illustrative photos taken, an epiphyte list made for each area, woodland management recommendations made to guide Nature Network Funded projects next financial year, and a spreadsheet of records prepared to send to Cofnod and the British Lichen Society.

3.1.1. Specification

From the contract specification:

- Survey the lichens of the areas indicated in Figure 1 focusing particularly on notable (SOWI / URI / RDB) species;
- Record the notable lichen flora on as many separate trees as possible (GPSed to 10-figure Grid Reference accuracy), and produce a map of the distribution of important trees;
- Identify areas of woodland that would be particularly suitable for PAWS restoration that would expand on currently restricted lichen-rich areas;
- Combine 2023 survey data with older records, where available, to produce a site dossier in the form of a report;
- Produce a spreadsheet of records suitable for importing into GIS.
- GPS readings must be British National Grid, not Lat-Long.

Figure 1. Survey locations (provided by NRW).



4. Method

The areas were surveyed in March 2023. A 10x Lichen Candelaris hand lens was used to search for and identify lichens in the field. Recording was made using an iPhone SE, which was also used for taking photos along with an Olympus Tough TG-6 for macro photos. GPS readings were made using a Garmin GPSMAP 64s.

Every effort was made to identify lichens in the field, limiting the need for collection for later confirmation in the laboratory. The chemicals commonly used by lichenologists in the field, potassium hydroxide (KOH), and sodium hypochlorite (NaClO), in this case Milton Sterilising Fluid, were used for chemical tests to aid in field identification. Some specimens were collected for later microscopic confirmation with a Meiji 20-40x stereo microscope and a Leica compound microscope.

Records of notable species were mapped using QGIS and input into the standard British Lichen Society recording spreadsheet. The concept of individual equivalents (Bergamini et al 2019) has been applied here as a means to assess population size.

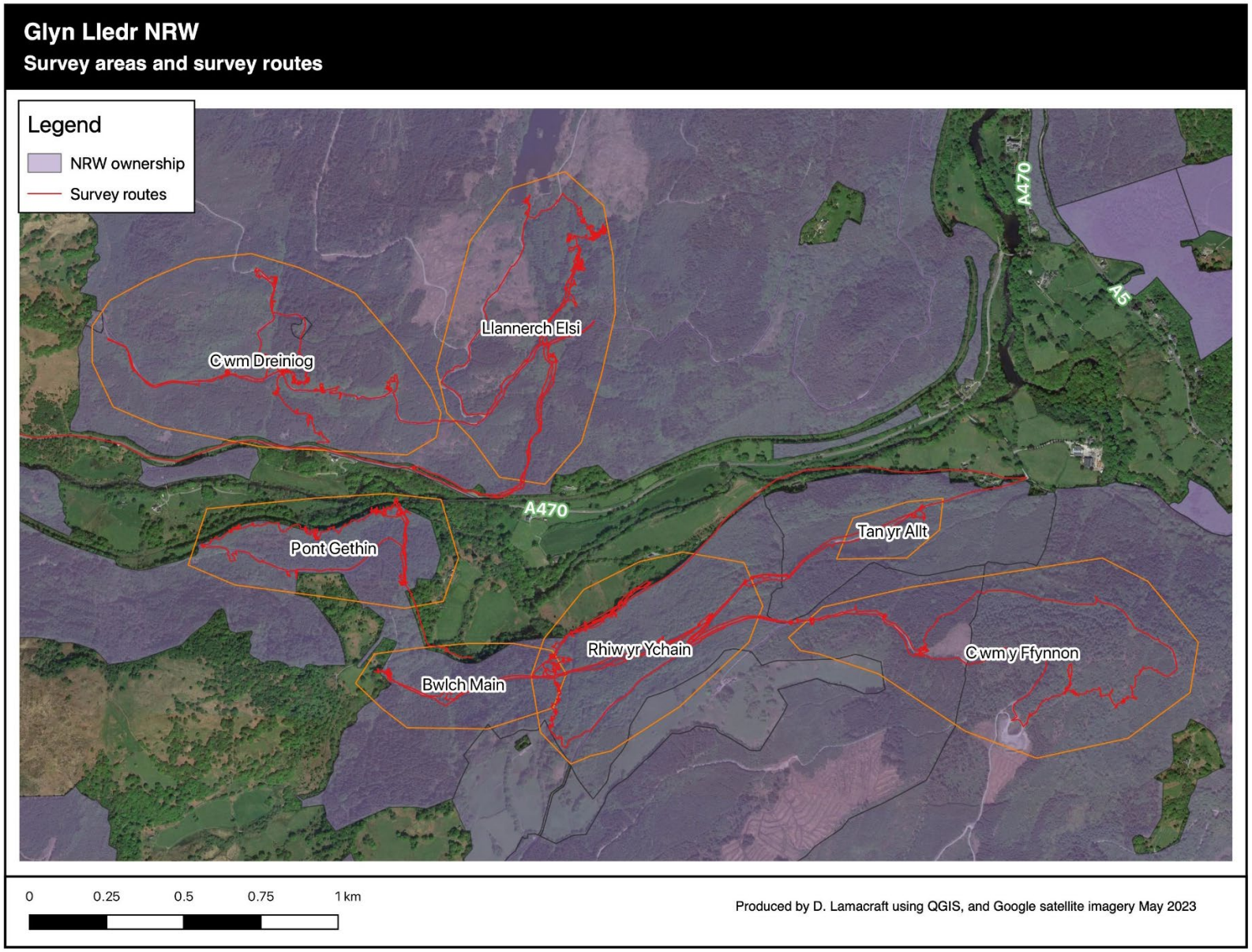
Synonyms

Recent name changes for species recorded are listed below. The current names – following the BLS (https://britishlichensociety.org.uk/resources/lichen-taxon-database) – are used.

New name	Recent synonym
Alyxoria culmigena	*Opegrapha culmigena*
Alyxoria ochrocheila	*Opegrapha a ochrocheila*
Arthonia atra	*Opegrapha atra*
Aquacidia viridifarinosa	*Bacidia viridifarinosa*
Bacidina squamellosa	*Bacidia squamellosa*
Coenogonium pineti	*Dimerella pineti*
Coenogonium luteum	*Dimerella lutea*
Coniocarpon cinnabarinum	*Arthonia cinnabarina*
Coniocarpon cuspidans	*Arthonia elegans*
Diarthonis spadicea	*Arthonia spadicea*
Enterographa zonata	*Opegrapha zonata*
Gyrographa gyrocarpa	*Opegrapha gyrocarpa*
Lepra albescens	*Pertusaria albescens var. albescens*
Lepra amara	*Pertusaria amara*
Lepra multipuncta	*Pertusaria multipuncta*
Lepraria finkii	*Lepraria lobificans*
Lobarina scrobiculata	*Lobaria scrobiculata*
Mycobilimbia sphaeroides	*Mycobilimbia pilularis*
Naetrocymbe punctiformis	*Arthopyrenia punctiformis*
Pectenia plumbea s. str.	*Degelia plumbea s. lat.*
Ricasolia amplissima	*Lobaria amplissima*
Ricasolia virens	*Lobaria virens*
Scytinium lichenoides	*Leptogium lichenoides*
Scytinium teretiusculum	*Leptogium teretiusculum*
Sticta ciliata	*Sticta fuliginosa*
Sticta fuliginoides	*Sticta fuliginosa*
Varicellaria hemisphaerica	*Pertusaria hemisphaerica*

Zwackhia sorediifera	*Zwackhia sorediifera*

Figure 2. Survey routes



5. Results

All target areas were surveyed (Figure 2).

550 records were made of 152 taxa of lichens and lichenicolous fungi (see Appendix 1). 61 of these are notable (Table 1). Locations of SOWI and URI taxa are shown in Figures 3 and 4, and a heatmap of all notable taxa in Figure 5. Target notes are in Appendix 3 and species distribution maps in Appendix 4. These included:

- 34 SOWI taxa;
- 15 URI taxa (with inclusion of *Mycoblastus sanguinarioides* as a cryptic taxon within *Mycoblastus sanguinarius* recently recognised in GB);
- One NT (GB) taxon, *Ramonia chrysophaea* (also new to VC49), see Target Note GLL34;
- One CR (Wales) taxon, *Lobarina scrobiculata*, recorded on the mossy base of a very small stunted trackside rowan, see Target Note GLL53;
- One EN (Wales) taxon, *Ricasolia virens*;
- 5+ VU (Wales) taxa, *Leptogium burgessii* (2nd VC49 site), *Lobaria pulmonaria*, *Pyrenula occidentalis* (also new to VC49), *Ricasolia amplissima*, and two of the *Sticta fuliginosa* s lat group;
- 13 NT (Wales) taxa, all associated with the *Lobarion* community of less acidic bark (also well represented by the SOWI);
- Other interesting records include the 2nd VC49 record of *Schismatomma umbrinum* and *Catinaria 'isidioides'*, new to VC49 (a taxon close to *Catinaria atropurpurea* but with a thallus reminiscent of *Bacidia biatorina*, in need of DNA sequencing, and currently given the unofficial name 'isidioides').

Throughout, the *Lobarion* community of less acidic bark is well represented e.g. 51 trees with *Lobaria pulmonaria* along with the other three '*Lobaria*' taxa *Lobarina scrobiculata, Ricasolia amplissima* and *Ricasolia virens* and other taxa rare in Wales e.g. *Pectenia plumbea* s str, *Leptogium burgessii* etc

There is some notable acid interest too with e.g. *Ochrolechia tartarea* and good populations of *Sphaerophorus globosus*, and *Mycoblastus sanguinarioides*, a recent segregate from *Mycoblastus sanguinarius* seperable microscopically by the presence of crystals in the hymenium which may be the first VC49 record of this taxon.

There is limited representation of the mature mesic community on some veteran oak with *Varicellaria hemisphaerica*, and scattered smooth bark interest inc. *Pyrenula occidentalis*, a new record for VC49.

The results for each survey area are presented below.

Table 1. Red List lichens recorded during the survey. Note that *Catinaria 'isidioides'* is an undescribed taxon, and *Sticta ciliata*, *S. fuliginoides* and *S. fuliginos s.str.* have not yet been fully evaluated.

Taxon name	Status
Agonimia allobata	NT (Wales), NT, NS, SOWI
Anisomeridium ranunculosporum	SOWI
Arthonia vinosa	NT (Wales), SOWI
Arthothelium ruanum	NS
Bacidia biatorina	NT (Wales), SOWI
Bacidina squamellosa	DD (Wales), NS
Catinaria atropurpurea	NT (Wales), SOWI
Catinaria ' isidioides'	New VC
Chaenotheca brunneola	SOWI
Cladonia caespiticia	SOWI
Collema subflaccidum	SOWI
Eopyrenula grandicula	NS, IR
Hypotrachyna laevigata	URI
Japewiella tavaresiana	URI
Lecanora alboflavida	NS, SOWI, URI
Lecanora argentata	NS
Lecanora jamesii	SOWI
Lepra multipuncta	SOWI
Lepraria membranacea	URI
Leptogium burgessii	VU (Wales)
Lobaria pulmonaria	VU (Wales), IR, SOWI
Lobarina scrobiculata	CR (Wales), IR, SOWI
Loxospora elatina	SOWI, URI
Megalaria pulverea	URI
Micarea adnata	NS
Micarea alabastrites	IR, SOWI, URI
Micarea cinerea f. cinerea	SOWI
Micarea stipitata	IR, URI
Mycobilimbia epixanthoides	NT (Wales), SOWI
Mycobilimbia sphaeroides	NT (Wales), SOWI
Mycoblastus caesius	URI
Mycoblastus sanguinarioides	URI
Mycoporum antecellens	SOWI
Nephroma laevigatum	NT (Wales), SOWI
Ochrolechia tartarea	URI
Pachyphiale carneola	NT (Wales), SOWI
Parmeliella parvula	NT (Wales), SOWI, URI
Parmeliella triptophylla	NT (Wales), IR, SOWI
Pectenia plumbea s. lat.	VU (Wales)
Peltigera horizontalis	SOWI
Pyrenula occidentalis	VU (Wales), IR
Ramonia chrysophaea	NT (GB), NT (Wales), New VC
Ricasolia amplissima	VU (Wales), IR, SOWI
Ricasolia virens	EN (Wales), IR, SOWI
Ropalospora viridis	NS, URI
Schismatomma umbrinum	NS
Scytinium lichenoides	SOWI
Scytinium teretiusculum	SOWI
Sphaerophorus globosus	URI

Stenocybe septata	SOWI
Sticta ciliata	NT (Wales)
Sticta fuliginoides	VU (Wales), IR
Sticta fuliginosa s. lat.	VU (Wales), IR, SOWI
Sticta fuliginosa s. str.	VU (Wales), IR
Sticta limbata	NT (Wales), IR, SOWI
Sticta sylvatica	NT (Wales), IR, SOWI
Strigula taylorii	NS
Thelotrema lepadinum	NT (Wales), SOWI
Trapelia corticola	URI
Usnea esperantiana	NT (GB), DD (Wales), NR
Usnea florida	NT? (GB), SOWI

Key: EN: Endangered; VU: Vulnerable; NT: Near Threatened; NR/NS: Nationally Rare/Nationally Scarce; IR: International Responsibility species; SOWI: Southern Oceanic Woodland Index; URI: Upland Rainforest Index

Figure 3. Locations of SOWI taxa

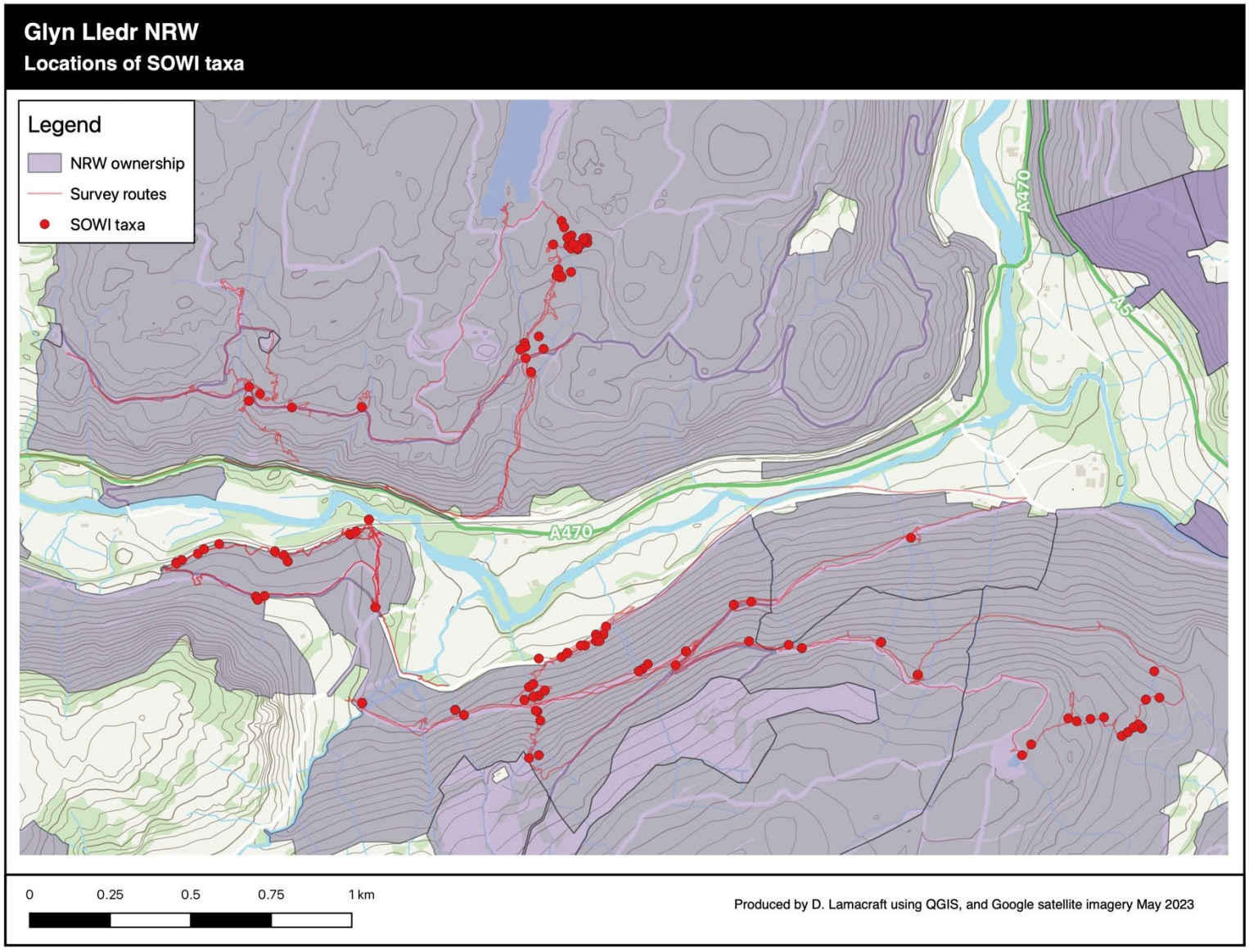


Figure 4. Locations of URI taxa

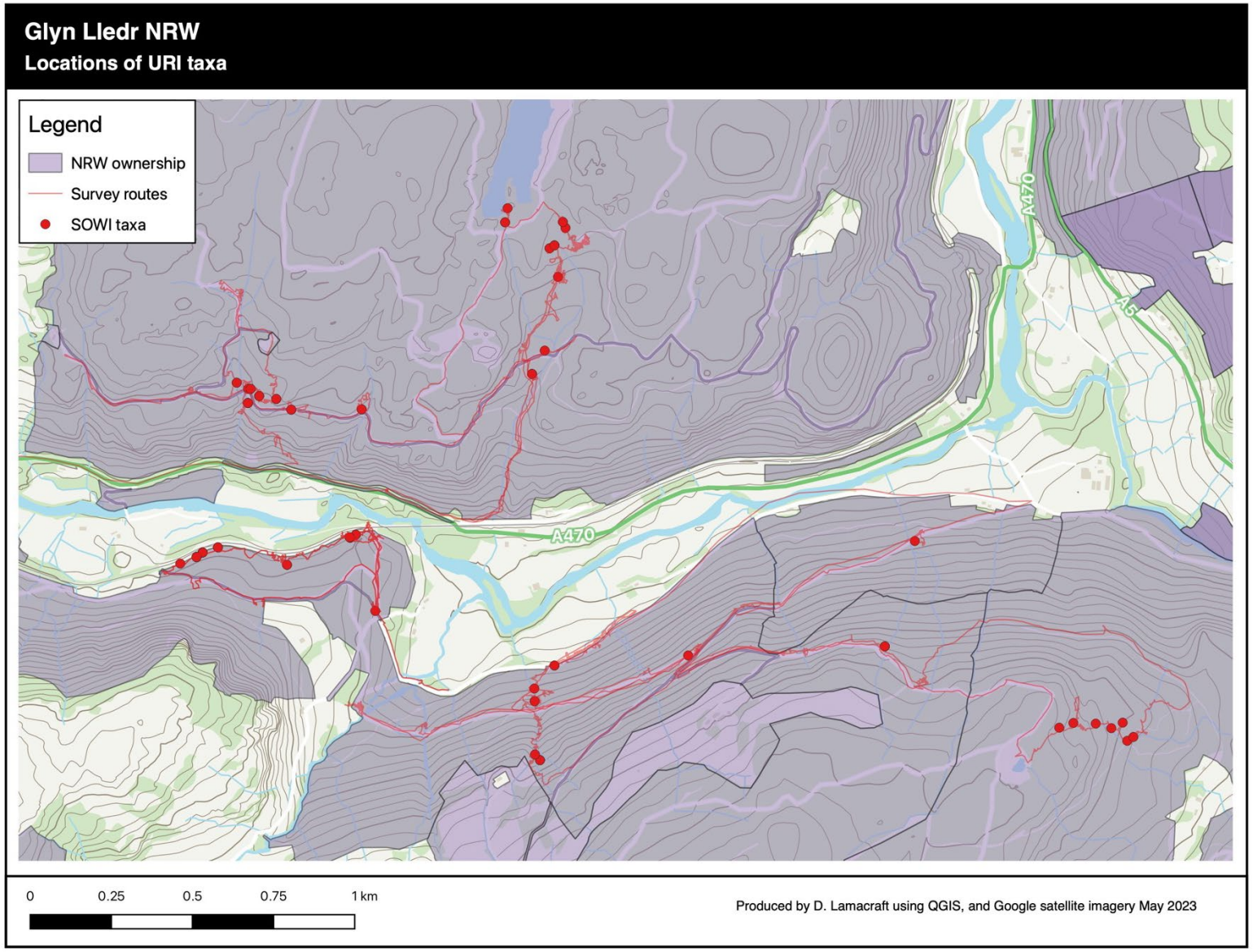
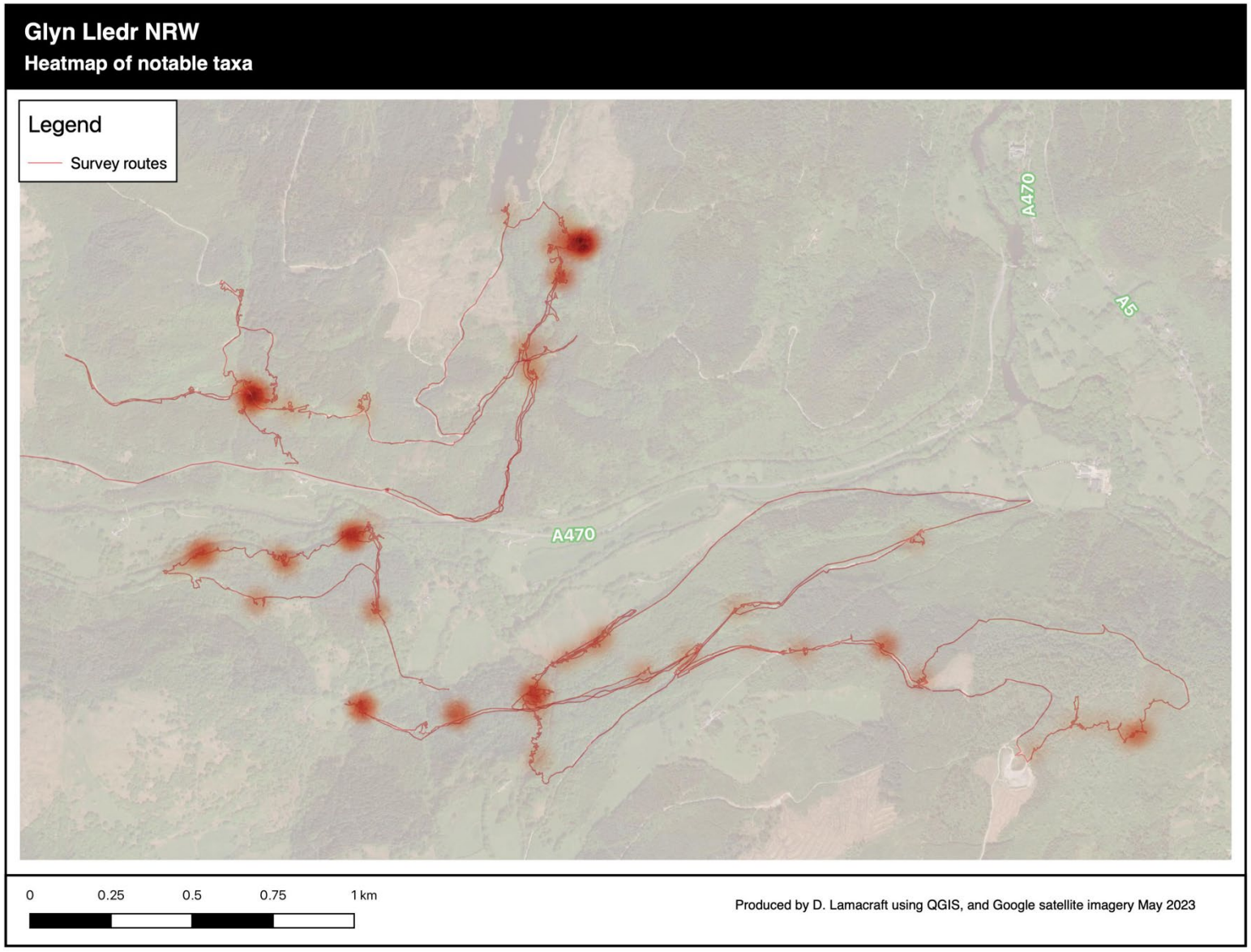


Figure 5. Heatmap of notable taxa



5.1. Pont Gethin

The surveyed area at Pont Gethin (Figure 2) was mostly remnant native broad-leaved woodland that has survived the conifer and beech planting. The majority of the conifer has recently been clearfelled. The lichen interest is mostly on old ash and oak, and on younger willow, hazel and rowan around the edges of the site associated with old boundaries and tracks.

120 records of 72 taxa of lichens and lichenicolous fungi were made (Appendix 1) of which 32 are notable (Table 2). Target notes are in Appendix 3 and distribution maps in Appendix 4.

These included:

- 17 SOWI taxa;
- 9 URI taxa;
- 3 VU (Wales) taxa, all of the *Sticta fuliginosa* s lat group;
- 6 NT (Wales) taxa, all associated with the *Lobarion* community of less acidic bark (also well represented by the SOWI);
- Other interesting records include the 2nd VC49 record of *Schismatomma umbrinum*.

Table 2. Notable taxa recorded at Pont Gethin. Individual equivalents are the number of trees or rocks on whuch the taxon occurs (Bergamini *et al* 2019).

Taxon name	Status	Substrate	Individual equivalents
Anisomeridium ranunculosporum	SOWI	Birch, oak, willow	4
Arthothelium ruanum	NS	Hazel, willow	3
Catinaria atropurpurea	NT (Wales), SOWI	Oak, willow	2
Collema subflaccidum	SOWI	Hazel	1
Eopyrenula grandicula	NS, IR	Hazel, willow	2
Hypotrachyna laevigata	URI	Birch, oak	4
Lecanora alboflavida	NS, SOWI, URI	Oak	1
Lepraria membranacea	URI	Birch	1
Loxospora elatina	SOWI, URI	Oak	1
Megalaria pulverea	URI	Birch, oak, willow	5
Micarea adnata	NS	Birch	1
Micarea alabastrites	IR, SOWI, URI	Birch, oak	5
Micarea cinerea f. cinerea	SOWI	Birch	1
Micarea stipitata	IR, URI	Birch	2
Mycobilimbia epixanthoides	NT (Wales), SOWI	Ash	1
Mycoblastus caesius	URI	Birch, oak	3
Pachyphiale carneola	NT (Wales), SOWI	Oak, willow	2
Peltigera horizontalis	SOWI	Rowan	1
Ropalospora viridis	NS, URI	Birch	1
Schismatomma umbrinum	NS	Rock outcrop	1
Scytinium lichenoides	SOWI	Ash, willow	2
Scytinium teretiusculum	SOWI	Ash	1
Sphaerophorus globosus	URI	Birch, oak	4
Stenocybe septata	SOWI	Holly	1
Sticta fuliginoides	VU (Wales), IR*	Willow	1
Sticta fuliginosa s. lat.	VU (Wales), IR, SOWI	Ash, willow, rowan	5
Sticta fuliginosa s. str.	VU (Wales), IR*	Rowan	1
Sticta limbata	NT (Wales), IR, SOWI	Ash, rowan	2
Sticta sylvatica	NT (Wales), IR, SOWI	Ash	2
Thelotrema lepadinum	NT (Wales), SOWI	Oak	1
Trapelia corticola	URI	Birch, oak	4
Usnea florida	NT? (GB), SOWI	Twig (oak?)	1

Key: EN: Endangered; VU: Vulnerable; NT: Near Threatened; NR/NS: Nationally Rare/Nationally Scarce; IR: International Responsibility species; SOWI: Southern Oceanic Woodland Index; URI: Upland Rainforest Index

5.2. Rhiw yr Ychain

The surveyed area Rhiw yr Ychain (Figure 2) was mostly remnant native broad-leaved woodland that has survived the conifer and beech planting. The lichen interest is mostly on ash (both on very large old trees and much younger ones), along with oak, willow, hazel and rowan. It is mostly concentrated in stream gullies and alongside the tracks/roads.

93 records of 52 taxa of lichens and lichenicolous fungi were made (Appendix 1) of which 25 are notable (Table 3). Target notes are in Appendix 3 and distribution maps in Appendix 4.

These include:

- 18 SOWI taxa;
- 5 URI taxa;
- One NT (GB) taxon, *Ramonia chrysophaea*, new to VC49;
- 3+ VU (Wales) taxa, *Lobaria pulmonaria*, *Ricasolia amplissima*, and two of the *Sticta fuliginosa* s lat group;
- 10 NT (Wales) taxa, all associated with the *Lobarion* community of less acidic bark (also well represented by the SOWI).

The *Lobarion* community of less acidic bark is well represented in this survey area e.g. *Ricasolia amplissima* (albeit just outside the NRW ownership), 26 trees with *Lobaria pulmonaria, Pectenia plumbea* s str etc.

Table 3. Notable taxa recorded at Rhiw yr Ychain. Individual equivalents are the number of trees or rocks on whuch the taxon occurs (Bergamini *et al* 2019).

Taxon name	Status	Substrate	Individual equivalents
Anisomeridium ranunculosporum	SOWI	Ash, holly	2
Arthothelium ruanum	NS	Hazel	1
Hypotrachyna laevigata	URI	Birch	2
Lecanora jamesii	SOWI	Willow	1
Lobaria pulmonaria	VU (Wales), IR, SOWI	Ash, sycamore, willow	26
Loxospora elatina	SOWI, URI	Beech	1
Megalaria pulverea	URI	Birch, hazel, willow	4
Micarea stipitata	IR, URI	Oak (lignum)	1
Mycobilimbia epixanthoides	NT (Wales), SOWI	Ash	1
Mycobilimbia sphaeroides	NT (Wales), SOWI	Ash	1
Nephroma laevigatum	NT (Wales), SOWI	Ash, hazel, willow	4
Pachyphiale carneola	NT (Wales), SOWI	Ash	1
Parmeliella parvula	NT (Wales), SOWI, URI	Hazel	1
Parmeliella triptophylla	NT (Wales), SOWI	Ash	2
Pectenia plumbea s. lat.	VU (Wales)	Ash	1
Peltigera horizontalis	SOWI	Ash, hazel	4
Ramonia chrysophaea	NT (GB), NT (Wales), New VC	Oak	1
Ricasolia amplissima	VU (Wales), IR, SOWI	Ash	1
Scytinium lichenoides	SOWI	Ash, ivy	3
Sticta ciliata	NT (Wales)	Willow	1
Sticta fuliginosa s. lat.	VU (Wales), IR, SOWI	Hazel, willow	4
Sticta fuliginosa s. str.	VU (Wales), IR	Ash, hazel, willow	4
Sticta limbata	NT (Wales), IR, SOWI	Ash, willow	4
Sticta sylvatica	NT (Wales), IR, SOWI	Ash	2
Thelotrema lepadinum	NT (Wales), SOWI	Hazel	1
Usnea florida	NT? (GB), SOWI	?	1

Key: EN: Endangered; VU: Vulnerable; NT: Near Threatened; NR/NS: Nationally Rare/Nationally Scarce; IR: International Responsibility species; SOWI: Southern Oceanic Woodland Index; URI: Upland Rainforest Index.

5.3. Tan yr Allt

The surveyed area at Tan yr Allt (Figure 2) was limited as it was largely beech plantation. The survey focussed mostly a remnant hazel-dominated area. The lichen interest is mostly on ash (both on very large old trees and much younger ones), along with oak, willow, hazel and rowan. It is mostly concentrated in stream gullies and alongside the tracks/roads.

18 records of 17 taxa of lichens and lichenicolous fungi were made (Appendix 1) of which 3 are notable (Table 4). Target notes are in Appendix 3 and distribution maps in Appendix 4.

These include:

- 1 URI taxon
- Two NS taxa

The interest is mostly associated with smooth bark.

Table 4. Notable taxa recorded at Tan yr Allt. Individual equivalents are the number of trees or rocks on whuch the taxon occurs (Bergamini *et al* 2019).

Taxon name	Status	Substrate	Individual equivalents
Arthothelium ruanum	NS	Hazel	1
Eopyrenula grandicula	NS, IR	Hazel	1
Megalaria pulverea	URI	Willow	1

Key: EN: Endangered; VU: Vulnerable; NT: Near Threatened; NR/NS: Nationally Rare/Nationally Scarce; IR: International Responsibility species; SOWI: Southern Oceanic Woodland Index; URI: Upland Rainforest Index

5.4. Cwm Dreiniog

The surveyed area Cwm Dreiniog (Figure 2) was mostly remnant native broad-leaved woodland that has survived the conifer planting. The lichen interest is mostly associated with old oak around a recent clearfell, and alongside forest roads including on steep rocky areas and along streams.

99 records of 60 taxa of lichens and lichenicolous fungi were made (Appendix 1) of which 19 are notable (Table 5). Target notes are in Appendix 3 and distribution maps in Appendix 4.

These include:

- 9 SOWI taxa;
- 8 URI taxa;
- One CR (Wales) taxon, *Lobarina scrobiculata*, recorded on the mossy base of a very small stunted trackside rowan;
- One NT (Wales) taxon, *Thelotrema lepadinum*;
- *Catinaria 'isidioides'*, new to VC49; a taxon close to *Catinaria atropurpurea* but with a thallus reminiscent of *Bacidia biatorina*, in need of DNA sequencing, and currently given the unofficial name 'isidioides'.

The lichen interest is mostly associated with the *Parmelion* community of acidic substrates e.g. with the only occurrence of *Ochrolechia tartarea* in the survey and good populaitons of *Sphaerophorus globosus*. The occurrence of *Lobarina scrobiculata* is a very notable exception. There is limited representation of the mature mesic community on some veteran oak with *Varicellaria hemisphaerica*.

Table 5. Notable taxa recorded at Cwm Dreiniog. Individual equivalents are the number of trees or rocks on whuch the taxon occurs (Bergamini *et al* 2019).

Taxon name	Status	Substrate	Individual equivalents
Anisomeridium ranunculosporum	SOWI	Oak	2
Arthothelium ruanum	NS	Rowan	1
Catinaria 'isidioides'	New VC	Oak	1
Chaenotheca brunneola	SOWI	Oak	1
Cladonia caespiticia	SOWI	Rock	1
Hypotrachyna laevigata	URI	Oak, willow	2
Lecanora argentata	NS	Oak	1
Lepraria membranacea	URI	Birch, oak, rock	3
Lobarina scrobiculata	CR (Wales), IR, SOWI	Rowan	1
Loxospora elatina	SOWI, URI	Oak	1
Megalaria pulverea	URI	Birch, oak, willow	8
Micarea stipitata	IR, URI	Oak	1
Mycoporum antecellens	SOWI	Birch, holly	2
Ochrolechia tartarea	URI	Oak	1
Lepra multipuncta	SOWI	Birch, rowan	2
Sphaerophorus globosus	URI	Birch, oak, rowan, rock	10
Thelotrema lepadinum	NT (Wales), SOWI	Rowan	1
Trapelia corticola	URI	Oak	3
Usnea florida	NT? (GB), SOWI	twigs	1

Key: EN: Endangered; VU: Vulnerable; NT: Near Threatened; NR/NS: Nationally Rare/Nationally Scarce; IR: International Responsibility species; SOWI: Southern Oceanic Woodland Index; URI: Upland Rainforest Index

5.5. Llannerch Elsi

The surveyed area at Llannerch Elsi (Figure 2) was mostly remnant native broad-leaved woodland that has survived the conifer planting. The lichen interest is mostly on ash and sycamore, along with oak, willow, hazel and rowan. The most significant interest by far is associated with the old farmstead of Llannerch Elsi, around the old farmhouse itself but also extending southwards where it is mostly on old boundary trees.

92 records of 50 taxa of lichens and lichenicolous fungi were made (Appendix 1) of which 22 are notable (Table 6). Target notes are in Appendix 3 and distribution maps in Appendix 4.

These include:

- 14 SOWI taxa;
- 7 URI taxa;
- One EN (Wales) taxon, *Ricasolia virens*;
- 3+ VU (Wales) taxa, *Lobaria pulmonaria*, *Ricasolia amplissima*, and two of the *Sticta fuliginosa* s lat group;
- 6 NT (Wales) taxa, all associated with the *Lobarion* community of less acidic bark (also well represented by the SOWI);

The *Lobarion* community of less acidic bark is well represented in this survey area e.g. *Ricasolia amplissima* (5 trees), *Ricasolia virens*, 22 trees with *Lobaria pulmonaria* etc. The interest is mostly around the old farmstead of Llannerch Elsi and its old field boundaries, which extend southward where huge ancient boundary sycamores have survived the coniferisation. There is some notable acid interest too, with *Mycoblastus sanguinarioides*, a recent segregate from *Mycoblastus sanguinarius* separable microscopically by the presence of crystals in the hymenium. This may be the first VC49 record of this taxon.

Table 6. Notable taxa recorded at Llannerch Elsi. Individual equivalents are the number of trees or rocks on whuch the taxon occurs (Bergamini *et al* 2019).

Taxon name	Status	Substrate	Individual equivalents
Arthonia vinosa	NT (Wales), SOWI	Oak	1
Bacidia biatorina	NT (Wales), SOWI	Oak	1
Cladonia caespiticia	SOWI	Oak	1
Hypotrachyna laevigata	URI	Oak	3
Lobaria pulmonaria	VU (Wales), IR, SOWI	Ash, hazel, ivy, oak, sycamore, rowan	22
Megalaria pulverea	URI	Birch, oak, willow	4
Mycoblastus sanguinarioides	URI	Oak	1
Pachyphiale carneola	NT (Wales), SOWI	Hazel, oak	2
Parmeliella parvula	NT (Wales), SOWI, URI	Willow	2
Peltigera horizontalis	SOWI	Sycamore	3
Lepra multipuncta	SOWI	Rowan	2
Ricasolia amplissima	VU (Wales), IR, SOWI	Ash, sycamore	5
Ricasolia virens	EN (Wales), IR, SOWI	Ash	1
Ropalospora viridis	NS, URI	Birch	1
Sphaerophorus globosus	URI	Birch, oak	3
Sticta fuliginosa s. lat.	VU (Wales), IR, SOWI	Hazel, willow	2
Sticta fuliginosa s. str.	VU (Wales), IR	Hazel, rowan, willow	3
Sticta limbata	NT (Wales), IR, SOWI	Ash, willow	3
Strigula taylorii	NS	Sycamore	1
Thelotrema lepadinum	NT (Wales), SOWI	Hazel	1
Trapelia corticola	URI	Oak	1
Usnea florida	NT? (GB), SOWI	Oak	1

Key: EN: Endangered; VU: Vulnerable; NT: Near Threatened; NR/NS: Nationally Rare/Nationally Scarce; IR: International Responsibility species; SOWI: Southern Oceanic Woodland Index; URI: Upland Rainforest Index

5.6. Coed y Ffynnon

The surveyed area at Coed y Ffynnon (Figure 2) was mostly remnant native broad-leaved woodland that has survived the conifer planting. The lichen interest is mostly on willow, but also ash, oak, willow, hazel and rowan and an old dead confier that appears to be a pine. The most important areas are associated with an old farm/barn, the tracksides and a large area of developing interest on willow and ash in wet woodland around SH802532 which would benefit from gradual removal of surrounding conifers.

91 records of 51 taxa of lichens and lichenicolous fungi were made (Appendix 1) of which 18 are notable (Table 7). Target notes are in Appendix 3 and distribution maps in Appendix 4.

These include:

- 9 SOWI taxa;
- 6 URI taxa;
- 1+ VU (Wales) taxa, *Lobaria pulmonaria* and two of the *Sticta fuliginosa* s lat group;
- 3 NT (Wales) taxa, all associated with the *Lobarion* community of less acidic bark (also well represented by the SOWI) and with twig communities (*Usnea esperantiana*, 2nd VC49 record);
- 1st post-2000 record of *Calicium glaucellum* in VC49 and *Nesolechia oxyspora* new to VC49.

The *Lobarion* community of less acidic bark is well represented in this survey area especially *Sticta* species and *Nephroma laevigatum* which colonising well through a large area of wet willow and ash woodland.

Table 7. Notable taxa recorded at Coed y Ffynnon. Individual equivalents are the number of trees or rocks on whuch the taxon occurs (Bergamini et al 2019).

Taxon name	Status	Substrate	Individual equivalents
Chaenotheca brunneola	SOWI	Pine	1
Hypotrachyna laevigata	URI	Birch, oak	2
Japewiella tavaresiana	URI	Willow	1
Lecanora argentata	NS	Willow	1
Lepra multipuncta	SOWI	Rowan	1
Lobaria pulmonaria	VU (Wales), IR, SOWI	Willow	2
Megalaria pulverea	URI	Ash, birch, willow	4
Mycoblastus caesius	URI	Oak, pine	1
Mycoporum antecellens	SOWI	Rowan	1
Nephroma laevigatum	NT (Wales), SOWI	Ash, willow	6
Peltigera horizontalis	SOWI	Ash	1
Ropalospora viridis	NS, URI	Birch	1
Sphaerophorus globosus	URI	Birch, oak	2
Sticta fuliginosa s. lat.	VU (Wales), IR, SOWI	Ash, willow	16
Sticta fuliginosa s. str.	VU (Wales), IR	Willow	3
Sticta limbata	NT (Wales), IR, SOWI	Ash, willow	3
Usnea esperantiana	NT (GB), DD (Wales), NR	Oak	1
Usnea florida	NT? (GB), SOWI	Oak, larch	2

Key: EN: Endangered; VU: Vulnerable; NT: Near Threatened; NR/NS: Nationally Rare/Nationally Scarce; IR: International Responsibility species; SOWI: Southern Oceanic Woodland Index; URI: Upland Rainforest Index

5.7. Bwlch y Maen

The surveyed area at Bwlch y Maen (Figure 2) was mostly remnant native broad-leaved woodland that has survived the conifer planting. The lichen interest is mostly on willow, but also ash, oak, willow, hazel and rowan. The most important areas are associated with an old farm/barn, the tracksides and a large area of developing willow and ash woodland.

26 records of 18 taxa of lichens and lichenicolous fungi were made (Appendix 1) of which 15 are notable (Table 8). Target notes are in Appendix 3 and distribution maps in Appendix 4.

These include:

- 11 SOWI taxa;
- One EN (Wales) taxon, *Ricasolia virens*;
- 5 VU (Wales) taxa, *Leptogium burgessii* (2nd VC49 site), *Lobaria pulmonaria*, *Pectenia plumbea* s, str., *Pyrenula occidentalis* (new to VC49), *Sticta fuliginosa* s lat;
- 7 NT (Wales) taxa, all associated with the *Lobarion* community of less acidic bark (also well represented by the SOWI).

The *Lobarion* community of less acidic bark is very well represented in this survey area with records of species rare in Wales and not recorded elsewhere in the survey area e.g. *Leptogium burgessii* and *Pyrenula occidentalis*.

Table 8. Notable taxa recorded at Bwlch y Maen. Individual equivalents are the number of trees or rocks on whuch the taxon occurs (Bergamini et al 2019).

Taxon name	Status	Substrate	Individual equivalents
Agonimia allobata	NT (Wales), NT, NS, SOWI	Ash	1
Bacidina squamellosa	DD (Wales), NS	Willow	1
Catinaria atropurpurea	NT (Wales), SOWI	Willow	1
Leptogium burgessii	VU (Wales)	Willow	3
Lobaria pulmonaria	VU (Wales), IR, SOWI	Ash	1
Mycobilimbia epixanthoides	NT (Wales), SOWI	Ash	
Nephroma laevigatum	NT (Wales), SOWI	Ash, hazel, willow	3
Pachyphiale carneola	NT (Wales), SOWI	Oak, willow	2
Parmeliella triptophylla	NT (Wales), SOWI	Ash, oak, willow	3
Pectenia plumbea s. lat.	VU (Wales)	Willow	1
Pyrenula occidentalis	VU (Wales), IR, new VC	Hazel	1
Ricasolia virens	EN (Wales), IR, SOWI	Ash, hazel	2
Sticta fuliginosa s. lat.	VU (Wales), IR, SOWI	Hazel, willow	2
Sticta sylvatica	NT (Wales), IR, SOWI	Willow	1
Thelotrema lepadinum	NT (Wales), SOWI	Oak, willow	2

Key: EN: Endangered; VU: Vulnerable; NT: Near Threatened; NR/NS: Nationally Rare/Nationally Scarce; IR: International Responsibility species; SOWI: Southern Oceanic Woodland Index; URI: Upland Rainforest Index

6. Discussion

6.1. Importance of the lichen flora

The areas surveyed here are of significant lichen interest, supporting a rich assemblage of oceanic/temperate rainforest taxa including a number of rare and threatened taxa and new taxa for VC49.

Applying the SSSI qualifying criteria, the site as a whole scores 34 on the Southern Oceanic Woodland Index (SOWI) and 15 on the Upland Rainforest Index (URI) (including *Mycoblastus sanguinarioides* scoring in the absence of *Mycoblastus sanguinarius*) based on records from this survey alone. If additional records are included (Bosanquet & Green 2021) these scores increase to 37 for the SOWI (with the addition of *Leptogium cyanescens*, *Pannaria conoplea* and *Peltigera collina*) and 17 on the URI (with the addition of *Graphis ruiziana* and *Hypotrachyna sinuosa*). These scores exceed the thresholds for qualification, which are 30 SOWI and 15 URI for this part of Wales, in the East Gwynedd Area of Search.

In addition the area supports a host of threatened taxa e.g. *Lobarina scrobiculata* CR (Wales), *Ricasolia virens* EN (Wales), *Leptogium burgessii* VU (Wales) (2nd VC49 site), *Lobaria pulmonaria* VU (Wales), *Pectenia plumbea* s, str. VU (Wales), *Ricasolia amplissima* VU (Wales), *Sticta fuliginosa* s lat. VU (Wales).

The area is particularly rich in taxa associated with the *Lobarion* community of base-rich (or less acidic) bark, well represented by both the SOWI and the threatened taxa listed above. Populations include a remarkable 51 trees with *Lobaria pulmonaria* along with 42 with *Sticta fuliginosa* s. lat., 13 with *Nephroma laevigatum*, 12 with *Sticta limbata* and 6 with *Ricasolia amplissima*. In some areas e.g. Llannerch Elsi not only are there numerous trees supporting interest but there is really high abundance of these taxa on the trees (see Figure 7)

The interest is found throughout all survey areas but the richest areas are Bwlch y Maen (Bosanquet & Green 2021) and Llannech Elsi, along with the western end of Rhiw yr Ychain, bordering Bwlch y Maen, where the most important features are blocks of native woodland that have escaped coniferisation, old field boundary trees within the conifer blocks, stream gullies and track sides with native trees present (again, remnants pre-dating coniferisation), and scattered native broadleaves amongst beech plantation.

6.2. Habitat management issues

This interest has survived despite the coniferisation of the area. There is little doubt that the area supported outstanding lichen interest pre-coniferisation. Most of the habitat management issues relate to the coniferisation and plantation management. The main issues are:

Shade; as a result of the conifers and beech

It is notable that most of the lichen interest persists in the best lit areas of native woodland e.g. along tracksides, steep rocky areas or in larger areas of open native woodland. Furthermore, where interest is found within the plantations e.g. at Llannerch Elsi and Rhiw yr Ychain it is often high in the canopy with the lower trunks of trees showing signs of heavy shade impacts i.e. dominated by common mosses with no lichen cover, something that is

unusual to see in most lichen-rich woodlands where the lower trunks support rich assemblages of lichens.

Shade; as a result of understory development in absence of grazing or other management

More of a limited issue than the above but still locally significant e.g. Bwlch y Maen.

Vulnerability of important forest road side trees

With much interest on small willows and hazels – inconsequential-looking trees alongside forest roads – there is the risk of accidental damage during forest operations. A good example is GLL112, where three small willows support an incredibly rich *Lobarion* community including *Leptogium burgessii* (VU Wales), see Figure 8.

Clear-felling areas of PAWS

There should continue to be a strong presumption against clearfelling PAWS sites, as per NRW guidance and policy favouring CCF and LISS, as it is not favourable for the restoration of native oceanic woodland and its lichen interest. Clearfelling results in instantly altered microclimatic conditions that clearly put trees under great stress, with death of trees in some cases, and older mature and veteran trees seeming most at risk (see Figures 9, 10). The lichen interest also suffers a similar fate, both directly e.g. suffering from sudden exposure to direct sunlight and loss of humidity, and indirectly e.g. from drying and flaking bark.

6.3. Habitat management recommendations

This already rich and important site could become even better with favourable management, although this management needs to go beyond the current approach to PAWS restoration which still often employs clearfelling; this is discussed in a report to NRW on the lichen interest of Coed y Brenin (Lamacraft 2021). These plantations are really important for their oceanic lichen interest, a link back to the pre-plantation environment (and beyond), but also are clearly now important for timber production. There would seem to be great potential to manage for both timber and biodiversity (lichens specifically): it does not have to be binary choice.

Specific recommendaitons at Glyn Lledr, addressing the issues above, are:

Halo thinning

Halo-thinning existing areas of interest e.g. the Llannerch Elsi area between the footpath/forest road junction at SH7831154380 and the old farmstead of Llannerch Elsi at SH7848654766. Here the conifers could be pushed back around areas of interest (see GLL56 to GLL79 and Figures 6, 11). This could be done with a mixture of removal and thinning and with a phased approach. The most appropriate treatment for each area will need to be decided depending on the circumstances of each site e.g. how close existing conifers are to existing interest, density of conifers etc. The aim will be to improve light levels without creating any sudden change in microclimate and over time to convert the area in Figure 6 to developing old-growth oceanic woodland (ideally combined with Nofence grazing). **Clearfelling stands of conifers around these areas of interest should be avoided at all costs, as this will likely destroy the lichen interest**.

Other areas that would benefit from a similar apprioach of halo-thinning are:

Rhiw yr Ychain (including the beech plantation) e.g. around GLL44 and nearby trees

Around GLL89 in Coed y Ffynnon. In all cases extreme care will need to be taken to avoid damage to existing interest.

An area of old oak, around SH8014553265 in Coed y Ffynnon

The wet woodland of Coed y Ffynnon with developing Lobarion interest (SH802532)

Understory control

The availability of Nofence GPS collars for stock management must open up the potential to graze blocks of woodland within the forest e.g. Llannerch Elsi (see above), Pont Gethin and the Bwlch y Maen area. This need not be restricted solely to the areas of 100% broadleaved e.g. the corridor of of interest along the path to Llannerch Elsi could be grazed together with some thinning of conifers to create an open structured mix of conifer and broadleaved trees, with the conifers removed gradually removed over time, or even left if they are having little negative impact and their regeneration is controlled (conifers - and beech – can and do support notable species that contribute to the SSSI assemblages). There are some instances where understory in impacting on interest:

- GLL68 (Llannerch Elsi), an ash with *Lobaria pulmonaria* that needs holly clearing from its base
- GLL69 (Llannerch Elsi), a rowan with *Lobaria pulmonaria* that needs conifer clearing from its base
- GLL70 (Llannerch Elsi), an oak with *Lobaria pulmonaria* that needs conifer clearing from its base

INNS control

There are localised occurrences of *Rhododendron ponticum* in the area (Figures 12, 13) although the only incidence in lichen rich areas was near GLL102 SH8022053233 in Coed y Ffynnon. In general terms *Rhododendron* and other INNS should be eradicated with ongoing control where needed.

Ivy control

In some areas ivy is either a threat to existing interest or to niche availability and should be controlled by cutting e.g. GLL3, area around GLL10 and in the good *Lobaria pulmonaria* area in Rhiw yr Ychain (Figure 14).

Protection of trees on the sides of forest roads

Contractors and NRW staff should be made aware of the importance of roadside trees, especially small willow, rowan, hazel that may otherwise look unimportant. Data on the trees with known interest should be made available to whoever needs access to such informaiton, and be included in information provided to contractors with stipulations that damage must

be avoided. The premise should perhaps be that any roadside native tree could have significant interest.

Ash Dieback management

A couple of ash have been marked presumably in relation to Ash Dieback:

- GLL3 (Pont Gethin), marked with blue spray; leave the smaller trunk standing, or monolithed if it cannot be left, and monolith the main trunk if possible.

- GLL40 (Rhiw yr Ychain), marked with pink spray; monolith at height, above the first small fork, and take care to avoid damage to lichen interest.

Beech control in Pont Gethin

Some areas have stands of beech plantation. This regionally non-native species will happily regenerate beneath a closed canopy and can pose a threat to both regeneration of native tree species and to lichen interest due to the dense shade that it casts. The northern flank of the Pont Gethin survey area has high lichen interest, but also abundant beech regeneration (Figure 15) from mature planted beech. It is suggested that the beech regeneration is controlled (eradicated) and the mature beech are felled to remove this threat and the area allowed to continue to develop as old growth native woodland.

6.4. Survey recommendations

The outcomes of this and other recent surveys of commercial plantations in North Wales e.g. Coed y Brenin and Dyfi Forest have shown just how important these plantations can be for rare and threatened oceanic lichens. This survey had focussed on some of the areas that appeared to have greatest potential, but other areas exist and there are many roadside willows that have not been surveyed: further survey will no doubt find more interest. Although already surveyed (Bosanquet & Green 2021), the Bwlch y Maen area is probably worth further survey effort given it is such a rich area.

Figure 6. Suggested management area at Llannerch Elsi

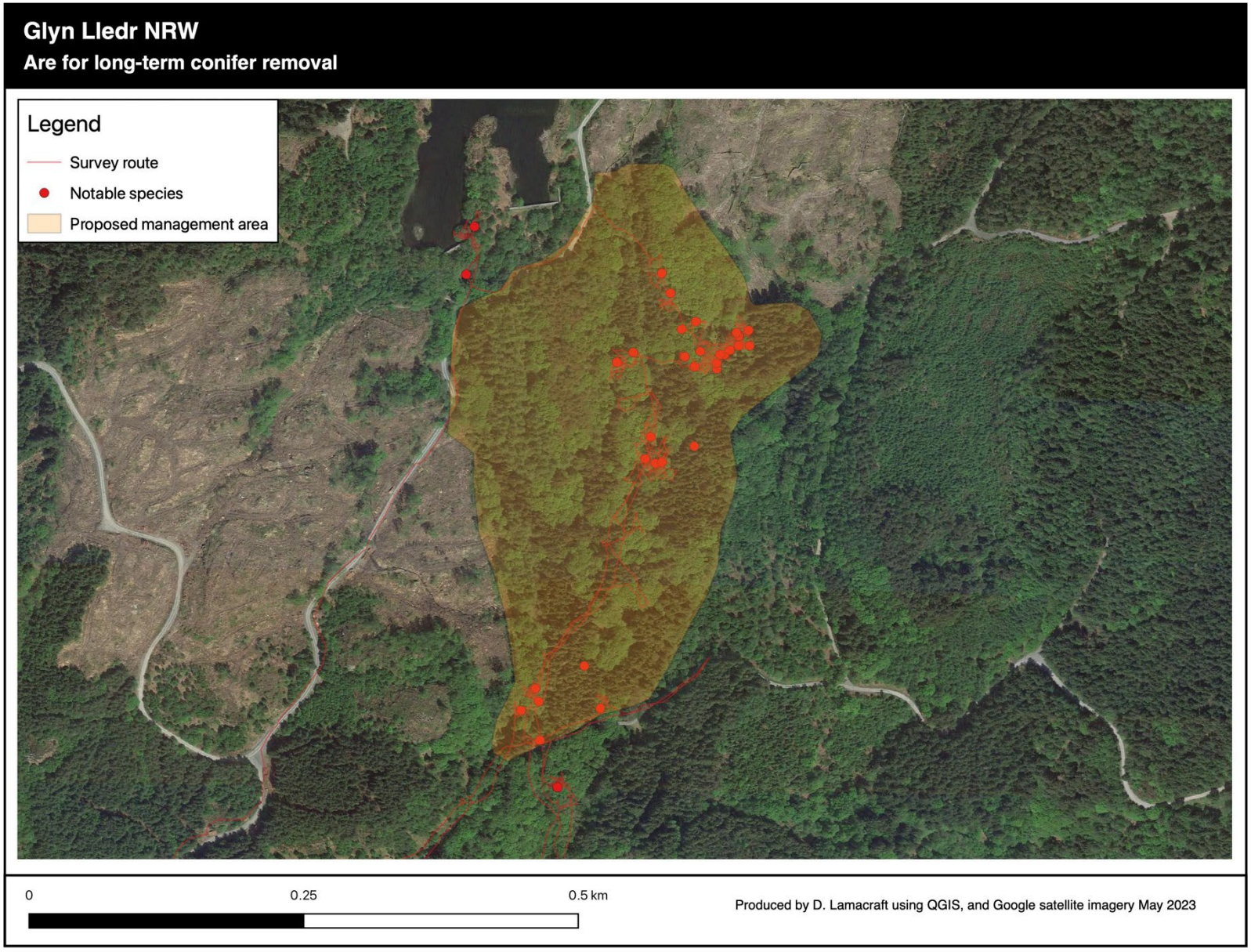


Figure 7. An abundance of *Lobaria pulmonaria* on a sycamore at Llannerch Elsi (GLL77)

Figure 8. Small willows on the side of the forest road in Bwlch y Maen (GLL112), these all support *Leptogium burgessii* and the one on the left a very rich Lobarion community, probably the richest single tree recorded in Glyn Lledr.

Figure 9. Clearfelled PAWS at Cwm Dreiniog, this results in a drastic change in microclimate which puts sudden stress on surviving trees, risking tree death, and renders conditions unsuitable for any surviving lichen interest.

Figure 10. Clearfelled PAWS at Coed y Ffynnon, as above this results in a drastic change in microclimate which puts sudden stress on surviving trees, a number of which appear to be dying, and renders conditions unsuitable for any surviving lichen interest.

Figure 11. Large Sycamores supporting Lobarion lichens hemmed in by conifers, these conifers should be cleared in a phased manner starting with halo thinning the sycamores to reduce impacts on these trees combined with a thin of conifers beyond

Figure 12. A *Rhododendron* bush in clearfelled PAWS at Coed y Ffynnon

Figure 13. *Rhododendron* in developing area of interest at Coed y Ffynnon (GLL101)

Figure 14. The western end of Rhiw yr Ychain, with frequent *Lobaria pulmonaria* but many trees with ivy cover which should be cut to remove the threat and to create more suitable habitat

Figure 15. Beech regeneration surrounding old oaks with lichen interest at Pont Gethin (GLL7)

7. References

Bergamini A, Bisang I, Hodgetts N, Lockhart N, van Rooy J, Hallingbäck T. 2019. Recommendations for the use of critical terms when applying IUCN red-listing criteria to bryophytes. *Lindbergia*, 2019(1), 1-6

Bosanquet SDS, Green H. 2021. *Lichen surveys of Glyn Lledr – Bwlch y Maen*. NRW Internal Report, Natural Resources Wales, Bangor.

Dobson, F. S. 2018. *Lichens: An Illustrated Guide to the British and Irish Species*. Richmond Publishing.

Lamacraft, DM. 2021. *Survey and monitoring of epiphytic lichens around PAWS sites in Coed y Brenin*. Unpublished report to NRW.

Sanderson, NA, Wilkins, TC, Bosanquet, SDS, Genney, DR. 2018. *Guidelines for the Selection of Biological SSSIs. Part 2: Detailed Guidelines for Habitats and Species Groups. Chapter 13 Lichens and associated microfungi*. JNCC, Peterborough.

Smith, CW, Aptroot, A, Coppins, BJ, Fletcher, A, Gilbert, OL, James, PW, Wolseley, PA. (eds.) 2009. *The Lichens of Great Britain and Ireland*. London: British Lichen Society.

Woods, RG. 2010. *A Lichen Red List for Wales*. Salisbury: Plantlife.

Appendix 1: Species list.

Appendices of site species lists and individual tree photographs have been removed from this version of the report because it would be impossible to make them comply with Accessibility Legislation. The full report PDF is held by the Natural Resources Wales Library as well as the national Deposit Libraries and can be obtained on request.

Data Archive Appendix

Data outputs associated with this project are archived on server–based storage at Natural Resources Wales.

The data archive contains:

[A] The final report in Microsoft Word and Adobe PDF formats.

[A] A spreadsheet of records in Microsoft Excel format.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue https://libcat.naturalresources.wales (English Version) and https://catllyfr.cyfoethnaturiol.cymru (Welsh Version) by searching 'Dataset Titles'.

Further copies of this report are available from library@cyfoethnaturiolcymru.gov.uk