Limestone lichens of three areas in the Brecon Beacons

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Contents

List of tables

Table of figures

1. Crynodeb Gweithredol

Cynhaliwyd arolwg o gennau calchfaen dau safle SoDdGA cyfredol ac un safle sy'n ymgeisio am statws SoDdGA. Gan ddefnyddio'r Mynegai Calchfaen, a gynlluniwyd i asesu statws cadwraethol safleoedd calchfaen, ni lwyddodd Ogof Ffynnon-Ddu – SoDdGA Pant Mawr na SoDdGA Blaen Nedd i gyrraedd y trothwy i'w hystyried ar gyfer statws SoDdGA. Fodd bynnag, llwyddodd yr ymgeisydd SoDdGA Mynydd Llangynidr i basio'r trothwy, gyda sgôr o 32.

Cafodd yr holl safleoedd eu difrodi gan chwarela ar wahanol adegau; mae wynebau sydd wedi'u hamlygu yn ddiweddar yn brin eu rhywogaethau o gymharu ag wynebau naturiol lle na fu unrhyw chwarela, ac nid ydynt yn cynnwys y rhan fwyaf o rywogaethau'r Mynegai. Fodd bynnag, mae gweithgareddau chwarela hanesyddol ar raddfa fechan weithiau wedi creu micro-gynefinoedd a oedd cyn hynny yn brin neu'n absennol ar safle.

Roedd y safleoedd yn gymharol brin eu rhywogaethau o gymharu â rhai safleoedd calchog tir isel, ond ystyrir mai adlewyrchiad yw hyn o ddaearyddiaeth a hinsawdd, nid arwydd o gyflwr gwael. Mae'r safleoedd ucheldirol hyn yn cynnal nifer o rywogaethau gogleddol a gorllewinol a/neu ucheldirol sy'n absennol o nifer o safleoedd iseldirol, gan gynnwys *Farnoldia jurana*, *Hymenelia heteromorpha* (dSoDdGA Mynydd Llangynidr, yr ail gofnod yng Nghymru), *Lempholemma cladodes*, *Peltigera leucophlebia* a *Solorina saccata*.

2. Executive summary

The limestone lichens of two existing SSSIs and one candidate SSSI were surveyed. Using the Limestone Index, designed to assess the conservation status of limestone sites, both Ogof Ffynnon-Ddu – Pant Mawr SSSI and Blaen Nedd SSSI failed to reach the threshold for consideration for SSSI selection. However, Mynydd Llangynidr cSSSI passed the threshold, with a score of 32.

All the sites have been damaged by quarrying at various times; recently exposed faces are species-poor compared to natural unquarried faces, and lack most of the Index species. However, small-scale quarrying from an early datehassometimes created microhabitats that previously were rare or absent at a site.

The sites were relatively species-poor compared to some lowland limestone sites, but this is considered to be a reflection of geography and climate, and not a sign of poor quality. These upland sites support a number of northern and western and/or upland species which are absent in many lowland sites, including *Farnoldia jurana*, *Hymenelia heteromorpha* (Mynydd Llangynidr cSSSI, second Welsh record), *Lempholemma cladodes*, *Peltigera leucophlebia* and *Solorina saccata*.

3. Introduction

Three areas in the Brecon Beacons were surveyed to assess the significance of the limestone lichens, including limestone on two existing SSSIs, and in five areas of a candidate SSSI, Mynydd Llangynidr. All the sites are on Carboniferous Limestone, at altitudes of between 360 and 605 m, and all are in the vice-county of Breconshire (V.C. 42).

4. Methods

Survey was carried out between June and September 2022, in dry weather.

Survey concentrated on species listed in the Limestone Index (Sanderson et al. 2018). This index 'applies to both rock and associated bare ground habitats in hard limestone landscapes .... The list (Table 5) comprises 104 species balanced to cover southern and northern non-montane (below 600m) limestone in Britain ... The index is designed to cover coherent outcrops of limestone in a distinct landscape relationship (spatial, geological or climatic) covering areas of between 100 to 1,000 ha [0.1 to 10 km^2]' (Sanderson et al. 2018). It is recommeneded by Sanderon et al. that a site acheiving a score of 30 or more on the Index should be considered for SSSI notification. Note that one or both of *Protoblastenia calva* and *P. lilacina* at a site counts as one on the Index.

Species not on the Index were recorded when they were easily recognised in the field, when they had potential conservation interest, or when material needed to be collected for examination in case it was an Index species. In practice, the lists for each site are reasonably complete for a single visit, with no species routinely ignored.

The lichen nomenclature used is conservative, following the recording spreadsheet in use by the British Lichen Society in 2022. Therefore some recent name changes have not been followed.

Numbered localities where notes or records were made are listed in Table 10. In Figures 1 to 7 these do not necessarily indicate the only areas visited, nor the distribution of interest. The locality numbers are used in the species lists in Tables 3–9.

5. Results

5.1. General

A total of 100 species was recorded during the survey. The two existing SSSIs failed to meet the criterion for possible SSSI selection on the basis of the Limestone Index (Ogof Ffynnon Ddu – Pant Mawr SSSI scored 21 and Blaen Nedd SSSI scored 24), but Mynydd Llangynidr cSSSI scored a total of 32, passing the threshold for consideration for SSSI status (Table 1).

A number of species found have conservation gradings in addition to their presence on the Limestone Index, most notably the Vulnerable *Hymenelia heteromorpha*, found on Mynydd Llangynidr (Table 2).

5.2. Ogof Ffynnon Ddu – Pant Mawr SSSI

Refer to Tables 3 & 11, Figures 1, 8–10.

Limestone in much of the the site mostly exists in the form of fractured low rocks on hillocks, the fragments scarcely constituting a scree on the sloping ground. In addition there are a few rather small boulders, and ground where fractured rock scarcely projects from the turf. These areas are so similar to each other, that is seems unlikely that much rock has been picked from the surface (except perhaps some for wall-building), and the exposures are in a natural state. Microhabitat diversity is generally low. The larger blocks are the most diverse, and the north-facing sides of blocks tend to have a richer flora than many surfaces, with species including *Polyblastia cupularis*, *Porina linearis*, *Protoblastenia calva* and *Verrucaria caerulea*. The loose fragments on slopes are very pale, with a bare appearance, but there is some *Farnoldia jurana* and others, and *Opegrapha dolomitica* is frequent hidden in cavities between the stones. Stony ground has a little *Cladonia furcata* and *C. pocillum*, but a terricolous flora is scarcely present. The virtual absence of *Collemataceae* (species tending to occur on moister rocks or in rain tracks) is noticeable, with only one thallus of *Collema fuscovirens* seen. A very little *Lempholemma cladodes* was present in some hollows on blocks, but the rocks at the site do not form the proper solution hollows that this genus favours. On ground with very low fractured rocks, bird perches encourage a conspicuous lichen covering including the dark brown *Verrucaria nigrescens* (not normally thought of as a bird-perch species), but nearby rocks with no obvious nutrient input are pale and bare. Small stones lying on or close to soil are often bare of lichens, but *Staurothele hymenogonia* was found once.

Some areas of pavement occur, but these seem to be no more species-rich than other rocks. A deep, disused quarry in the western part of the site had a few colonies of *Solorina saccata* and a very small amount of *Peltigera leucophlebia* on soil on ledges; suitable microhabitats for these species seem to be absent in the rest of the site.

Limestone Index: 21 (23 including earlier records of *Bryobilimbia hypnorum* and *Leptogium diffractum*).

5.3. Blaen Nedd SSSI

Refer to Tables 4 & 12, Figures 2, 11–14.

This is an extensive and attractive site with plenty of rock, but habitat diversity is relatively low, and quarrying has damaged most of the outcrops. In the NE part of the site there is a lime kiln, and some quarried faces here have faces of rather massive limestone with a bare appearance. Elsewhere, excavations are more shallow, often leaving a low quarried face at the margin. Areas of pavement are frequent, but much has been damaged by removal of the surface. There is a reasonable number of Limestone Index species, but many are in rather small quantity. A few lichens appear to be more frequent on natural surfaces such as taller and relatively undamaged clints, including *Clauzadea immersa*, *Dermatocarpon miniatum*, *Lepraria nivalis* (one record, the rain-sheltered microhabitat rare at the site), *Porina linearis*, *Protoblastenia calva*, *Verrucaria caerulea* and *Verrucaria dufourii* (one record). Terricolous species were poorly developed, comprising mostly small quantities of *Cladonia cervicornis*, *C. pocillum* and *C. rangiformis*. *Peltigera leucophlebia* occurred twice, in both cases in formerly disturbed areas. The few apparently natural outcrops other than pavement had a more natural appearance, but the lichen flora was not obviously richer than more disturbed areas; however, the fern *Cystopteris fragilis* was seen twice on natural faces, and not elsewhere at the site. In general *Caloplaca* species were not at all diverse. *Collemataceae* were also sparse and few in number, probably due to the dry nature of the site, with few flushed areas. Rain-sheltered rock was very sparse.

Limestone Index: 24.

5.4. Mynydd Llangynidr cSSSI

The cSSSI comprises five seperate areas. Species recorded here are shown in Tables 5 to 9.

Limestone Index (whole cSSSI): 32.

5.4.1. Cefn yr Ystrad

Refer to Tables 5 & 13, Figures 3, 15–18.

The south-western part of the site comprises irregular lines of low, pavement-like outcrops, and on the steepest part of the slope there are very locally low cliffs no more than 2 m high. All outcrops are in a natural condition except for one small, long-disused quarry face. Microhabitat diversity is rather low, comprising mainly the flattish tops of rocks (with *Lempholemma cladodes* in hollows), and steep sides, with *Polyblastia cupularis*, *Porina linearis*, *Verrucaria caerulea* and others. *Solorina saccata* is very rare on cliffs; one occurrence was on the old quarry face. *Lepraria nivalis* was confined here to one recess in cliffs.

On the higher ground leading to the top of the hill, there are some very low natural outcrops, rather scattered, and several areas of very shallow, long-disused workings. These workings are old enough and shallow enough to have a reasonable lichen flora, and the very low rock faces, and associated patches of stones, create microhabitat diversity that may not have

been there previously. *Peltigera leucophlebia* was associated with one working, and the Vulnerable *Hymenelia heteromorpha* was found in a stone patch at 583 m altitude.

North-west of the modern quarry of Cwar yr Ystrad, there is a line of low, clint-like outcrops in natural condition (Localities 150, 151), with rare *Lepraria nivalis*, *Solorina saccata* and others.

Special features: *Hymenelia heteromorpha*.

Limestone Index: 22.

5.4.2. Cwar Blaen Dyffryn

Refer to Tables 6 & 14, Figures 4, 19–24.

Most of the site comprises a recently disused quarry, with low lichen interest. However, the northern slope of the site has some much older, small-scale workings which now have some lichen interest, including *Solorina saccata*, and some unquarried exposures in a natural condition, which are relatively rich and a huge contrast to most of the site. Long-disused workings are at Localities 108 to 114, and natural exposures extend westwards from here as Localities 115 to 119. The cliff at SO097.149 also supports *Thalictrum minus*, and two shrubs of *Sorbus aria* agg. which are likely to be *S. porrigentiformis*, previously recorded from here.

Above the edges of the main quarry faces are a few small exposures in natural condition, which support a few Index species.

Special features: *Placynthium hungaricum*.

Limestone Index: 21.

5.4.3. Trefil old quarry

Refer to Tables 7 & 15, Figures 5, 25–27.

Most of the site comprises a sizeable disused quarry, with quarry faces of massively-bedded limestone, numerous mostly small boulders, and patches of stones. The quarry faces and boulders both have mainly a bare aspect, and lichen diversity is low. Upper surfaces of boulders are slightly richer, from poor drainage or from enrichment by bird-perching. The low lichen diversity is likely to be due to the nature of the relatively recently exposed rock surface, where weathering has not yet modified the surface layer to make it more suitable for lichens. A slow rate of colonisation by lichens is probably a less likely reason for low diversity (at least of common species). Terricolous lichens are very few, represented by local small colonies of *Cladonia rangiformis*, and very rare *Peltigera rufescens*.

West of the old quarry there are small patches of pavement-like rock which appear to be unquarried. These are a great contrast to the rocks in the quarry, as there is a high lichen cover, and a number of Limestone Index species not found in the quarry occur here:

Acrocordia conoidea, *Dermatocarpon miniatum*, *Rhizocarpon umbilicatum*, *Thelidium papulare* and *Verrucaria caerulea*.

Limestone Index: 12.

5.4.4. Dyffryn Crawnon

Refer to Tables 8 & 16, Figures 6, 28–31.

The site comprises numerous low crags and low exposures, mostly on a north-facing slope, and a few patches of low pavement with no grykes. Most of the exposures have been modified by shallow quarrying, but a few faces appear to be natural. The lichen flora seems to be rather uniform on many exposures. North faces have *Porina linearis*, *Opegrapha dolomitica*, *Lepraria nivalis* and others, but these are often very local. Surfaces with prolonged moisture were scarcely represented, but one low rock set into turf had *Psorothichia schaereri*. *Lempholemma cladodes* was rather frequent in solution hollows on horizontal blocks. *Solorina saccata* was recorded in a few location on soil associated with rocks. One occurrence seemed rather typical of this species; it grew on bare soil on the side of a soil cap on rocks. This microhabitat is rare. Other terricolous lichens were rare, with only a few scraps of *Cladonia rangiformis* and *Peltigera rufescens* on thin soil adjacent to rock.

There are significant low exposures of limestone at Locality 54 and eastwards, but these were outside the area suggested for survey and were not examined.

Special features: good population of *Lempholemma cladodes*.

Limestone Index: 18.

5.4.5. Cwm Claisfer

Refer to Tables 9 & 17, Figures 7, 32–35.

There is an exposure of low, NW-facing cliffs. The eastern end is unshaded, and has been quarried in the past, but west of approximately Locality 43 the exposures are apparently in a natural state, with weathered rock faces with ledges and cavities. Here the faces are often lightly shaded by ash and rowan, and there are a number of plants of *Sorbus minima*. The local light shade is not detrimental to the lichen flora. However, there are very low, close-cropped hawthorn throughout the site, as well as cropped Spruce seedlings, so a reduction in grazing would result in much of the low rock habitat becoming excessively shaded, as well as the base of the cliffs.

Hymenelia prevostii and *Porina linearis* are two species that are frequent on cliffs at the site, responding to the northerly aspect. Several colonies of *Solorina saccata* were seen; the habitat of this species here is rather restricted, mainly soily ledges on rock faces, or small vertical soil surfaces on rock. *Peltigera leucophlebia* was more frequent, growing on thin soil over rock surfaces, on both larger and very low outcrops. The thin soil here typically thickens rapidly away from the rock, so that available habitat is also rather limited in extent.

Limestone Index: 22.

6. Discussion

Most of the sites visited have been damaged by quarrying at various times. Older workings are often small-scale and very shallow, with stone presumably removed by hand (Figures 18,33), whereas the most recent produce deep pits (Figures 10, 24). Natural, unquarried outcrops are recognisable by the natural form and weathering, and the absence of grassy spoil mounds and platforms in front of the face (Figures 12, 22, 35). Natural exposures usually have a much richer lichen flora than quarried faces, and vascular plants are also richer. The bare appearance of quarried faces is probably not due merely to the slow rate of lichen colonisation. Recently exposed rock is probably unsuitable as a substratum for most lichens, and the surface layer needs to be modified by weathering to make it more suitable, a process which could take well in excess of 100 years, though no studies on this subject have been located.

Extensive quarrying also removes all or much of the local population of a species, so that recolonisation will be slow or may not occur. However, quarrying can create microhabitats that were previously rare at a particular site, such as patches of stones (Figure 18), or soil-covered ledges on which *Peltigera leucophlebia* and *Solorina saccata* can grow (Figures 10, 20). These two terricolous species do not need the old weathered faces required by many Index species. Recent quarries have often created larger areas of rock than existed previously, which may in the distant future be good lichen habitats. However, the few natural cliffs that have by chance escaped quarrying are much to be preferred on biodiversity, geomorphological and aesthetic grounds, and should be treasured.

The sites studied here are upland and inland. Compared to many lowland lichen sites they are relatively species poor, with, for instance, lower numbers of species of Caloplaca and Collemataceae than sites near to the coast. However, this should be seen as a reflection of geography rather than an indicator of poor quality. There are several species in the Brecon Beacons sites that are predominantly northern and western in distribution, which are absent or less well-represented in lowland Welsh sites, including *Farnoldia jurana* (northern and western in Britain, including Derbyshire and the Pennines, but some records near North Wales coast), *Hymenelia heteromorpha* (second Welsh record, found in Pennines and Scotland), *Lempholemma cladodes*, *Peltigera leucophlebia* and *Solorina saccata* (mainly northern and western, lost from many southern sites).

There is little doubt that some Index species will have been overlooked during survey, and that further visits to the sites would produce more records. Some of the Index species cannot be confirmed in the field and require collection, and these are likely to be under-recorded.

All the sites visited are grazed by sheep, and continued grazing is important to maintain the lichen interest. Most exposures are low, and development of scrub and woodland would result in most of the current lichen communities being replaced by common robust mosses on small exposures, and species-poor specialised lichen communities on cliffs.

7. References

Sanderson, N. A., Wilkins, T.C., Bosanquet, S.D.S and Genney, D.R. 2018 Guidelines for the Selection of Biological SSSIs. Part 2: Detailed Guidelines for Habitats and Species Groups. Chapter 13 Lichens and associated microfungi. Joint Nature Conservation Committee, Peterborough.

8. Data tables and photographs

Table 1. List of sites visited, with Limestone Index (LI) score.

SSSI	Subsites	grid ref. (centre)	approx. area km^2	number of species	LI
Ogof Ffynnon Ddu - Pant Mawr SSSI	Whole SSSI	SN867160	1	47	**21**
Blaen Nedd SSSI	Whole SSSI	SN917140	1.5	62	**24**
Mynydd Llangynidr cSSSI	Whole SSSI	SO080135	5.5		**32**
Mynydd Llangynidr cSSSI	Cefn yr Ystrad	SN917140	2.5	49	22
Mynydd Llangynidr cSSSI	Cwar Blaen Dyffryn	SO096148	0.5	52	21
Mynydd Llangynidr cSSSI	Trefil old quarry	SO116141	0.5	47	12
Mynydd Llangynidr cSSSI	Dyffryn Crawnon	SO121166	1.5	43	18
Mynydd Llangynidr cSSSI	Cwm Claisfer	SO148167	0.5	67	22

Table 2. Species recorded that have a conservation grading. RDB = Red Data Book, NR = Nationally Rare, NS = Nationally Scarce, VU = Vulnerable, NT = Near Threatened, DD = Data Deficient, LC = Least Concern. See Sanderson *et al.* (2018) for details.

Species recorded	RDB	RDB Wales	NR/NS	RDB/Notable
Farnoldia jurana	LC	LC	NS	Nb
Hymenelia heteromorpha	VU	LC	NR	RDB
Hymenelia prevostii	LC	LC	NS	Nb
Lecania cuprea	LC	LC	NS	Nb
Lempholemma cladodes	NT	VU	NR	NT
Lepraria nivalis	LC	LC	NS	Nb
Opegrapha dolomitica	LC	LC	NS	Nb
Placopyrenium canellum	LC	LC	NR	Nb
Placynthium hungaricum	DD	LC	NR	Nb
Polyblastia albida	LC	LC	NS	Nb
Polyblastia cupularis	LC	LC	NS	Nb
Staurothele caesia	LC	LC	NS	Nb
Staurothele hymenogonia	LC	VU	NS	Nb
Staurothele rupifraga	LC	LC	NS	Nb

Table 3. Limestone Index Species recorded in 2022 at Ogof Ffynnon-Ddu - Pant Mawr SSSI.

Species	Notes
Bilimbia lobulata	Very rare. 88 on moss on ledge on N-facing exposure.
Clauzadea immersa	Rare. 92 below slight overhang.
Clauzadea metzleri	Rare. 78 stone on stony slope.
Farnoldia jurana	Rather frequent on boulders and loose rocks. 69, 70 f, 72, 74, 75, 77, 81, 87 stones on ground, 90, 92.
Gyalecta jenensis	Occasional on shaded surfaces. 69, 74, 77, 81.
Hymenelia prevostii	Occasional. 69, 72, 74, 75, 87 stones on ground, 88.
Lecanora semipallida	Rare. 76.
Lempholemma cladodes	Very rare. 69 on top of boulder. Hormocystangia not seen.
Opegrapha dolomitica	Occasional on sheltered surfaces, often in cavities between stones in 'scree'. 69, 70, 72, 74, 77, 81, 83 frequent in cavities in scree, 86.
Peltigera leucophlebia	Rare. 93 small quantity on soil on ledge in old quarry.
Polyblastia albida	Rare. 77, 78 stone on stony slope.
Polyblastia cupularis	Rare. 69 north side of boulder, 77, 82 pavement, 84, 85 N side of clint, 86 poorly drained surface below small overhang, 88.
Porina linearis	Occasional on steep surfaces. 69, 72, 76, 84 N facing rock, 88, 90, 92.
Protoblastenia calva	Rare to occasional. 69, 84, 85.
Rhizocarpon umbilicatum	Occasional. 72, 85, 89.
Solorina saccata	Rare. 93 a few colonies on soil on ledges in old quarry.
Staurothele hymenogonia	Very rare. 87 stones on stony ground.
Staurothele rupifraga	Rare. 83.
Thelidium decipiens	Rare. 88.
Thelidium incavatum	Rare. 75, 78 stones on stony slope.
Verrucaria caerulea	Rare. 69 r N side of boulder, 72, 84, 88.
Species totals:	**Limestone Index: 21**

Table 4. Limestone Index Species recorded in 2022 at Blaen Nedd SSSI.

Species	Notes
Caloplaca marmorata	Very rare. 6 one small thallus.
Clauzadea immersa	Rare. 9 steep side of clint, 12, 14.
Dermatocarpon miniatum	Rare, in small quantities. 4 r, 10 on low pavement vr.
Farnoldia jurana	Fairly frequent. 2, 3, 4, 6, 9, 12, 16.
Gyalecta jenensis	Occasional on N faces and in shade. 12, 14, 16, 25 shaded clint.
Hymenelia prevostii	Rare on north-facing or shaded rocks. 1 r, 2, 16.
Lecanora semipallida	Frequent on level rocks with some enrichment. 2, 4, 5, 6, 9, 13.
Lempholemma cladodes	Very rare. 13 rain hollow in top of clint.
Lepraria nivalis	Very rare. 9 rain-sheltered side of clint.
Leptogium plicatile	Rare in rain tracks or in hollows. 1 r, 9 in hollow.
Opegrapha dolomitica	Rare. 1 overhanging north-facing quarried face.
Peltigera leucophlebia	Rare. 1 edge of turf on lip of low outcrop in small quantity, 24 thin soil over rock, probably flushed in winter.
Peltigera rufescens	Rare in short turf, small quantities. 4.
Petractis clausa	Rare. 14 low rock in turf.
Porina linearis	Rare. 12 side of clint.
Protoblastenia calva	Local. 11, 12.
Protoblastenia incrustans	Rare. 9 clint, 12.
Rhizocarpon umbilicatum	Occasional on low, gently sloping rocks. 2, 3 r, 4, 5, 6, 9 o, 12, 18, 21.
Romjularia lurida	Very rare. 1 o.
Staurothele caesia	Occasional. 9, 13, 15.
Thelidium decipiens	Occasional. 11, 15, 16, 22.
Thelidium papulare	Rare. 1.
Verrucaria caerulea	Local, occasional. 4, 9 ro, 11, 12, 15, 21, 25 shaded clint.
Verrucaria dufourii	Rare. 9 side of clint.
Species totals:	**Limestone Index: 24**

Table 5. Limestone Index Species recorded in 2022 at Mynydd Llangynidr cSSSI: a. Cefn yr Ystrad.

Species	Notes
Acrocordia conoidea	Occasional on steep faces. 128, 129, 131, 133.
Caloplaca marmorata	Rare, on recently exposed patches of rock. 128, 133 surface exposed by loss of mat of Syntrichia intermedia, 134 small stone lying on rock.
Clauzadea immersa	Very rare. 145 slightly rain-sheltered stone patch of stones below very small, long-disused quarried face; 150 side of clint.
Dermatocarpon miniatum	Occasional on moist ledges. 129, 131, 133, 134, 136, 137, 138, 140.
Farnoldia jurana	Rare. 139 small cliff, 142 possibly natural rocks immediately above small, long-disused quarried face; 145 patch of stones, 148 small natural outcrop.
Hymenelia heteromorpha	Very rare. 145 stone in stone patch in front of long-disused shallow workings.
Hymenelia prevostii	Frequent on steep faces. 128, 131, 133, 136, 137, 138, 142, 143, 150.
Lepraria nivalis	Very rare. 141 recess in low cliff, 150 crevice in clint.
Opegrapha dolomitica	Rare in small quantities. 135, 138, 141, 145 patch of stones, 150.
Opegrapha rupestris [LF]	Rare, on Baglittoa baldensis.
Peltigera leucophlebia	Very rare. 142 ledges above small, long-disused quarried face.
Peltigera rufescens	Very rare. 142 ledge above small, long-disused quarried face.
Petractis clausa	Rare. 129 beside rain-filled hollow.
Placopyrenium canellum	Rare, on Aspicilia calcarea. 139.
Polyblastia cupularis	Rare, mainly on steep faces. 133, 134, 135, 149 small stone patch, 150.
Porina linearis	Occasional on steep faces. 128, 133, 138, 139, 151.
Protoblastenia calva	Rare, mainly on steep faces. 134, 139, 149 stone in stone patch.
Rhizocarpon umbilicatum	Occasional. 128, 129, 133, 134, 136, 137, 139, 141, 142, 146, 148, 150.
Solorina saccata	Rare on rock faces. 135 small quantity on small and long-disused quarried face, 139 rare on small natural cliff, 151 soil on ledge on clint.
Thelidium incavatum	Rare. 140 small stone lying on rock.
Thelidium papulare	Rare, in small quantities. 133 side of clint, 137, 139.
Verrucaria caerulea	Occasional on steep faces. 133, 136, 137, 138, 145 patch of stones below very small, long-disused quarried face; 150.
Species totals:	**Limestone Index: 22**

Table 6. Limestone Index Species recorded in 2022 at Mynydd Llangynidr cSSSI: b. Cwar Blaen Dyffryn.

Species	Notes
Acarospora cervina	Very rare. One colony on steep north facing natural exposure.
Acrocordia conoidea	Local on unquarried exposures. 108, 115, 116, 118, 127.
Bilimbia lobulata	Very rare. 119 small colonies on natural cliff.
Caloplaca marmorata	Rare, recently-exposed rock on natural exposures. 122 low outcrop where Cladonia pocillum mat has been lost.
Clauzadea immersa	Very rare. 124 low natural outcrop.
Dermatocarpon miniatum	Local, rare on natural exposures. 116, 122.
Farnoldia jurana	Very rare. 124 on low natural outcrop.
Gyalecta jenensis	Locally frequent on natural exposures. 108, 110, 113.
Hymenelia prevostii	Occasional on natural exposures, 108, 115, 118, 119, 122, 123, 126.
Lempholemma cladodes	Local, rare. 111 hollow in boulder on quarry spoil, 114 hollows in two boulders, 126 low hollow in natural outcrop.
Lepraria nivalis	Local on natural north-facing cliffs or long-disused workings. 110, 112, 113, 115 lf, 118 abundant on natural cliff.
Opegrapha dolomitica	Local, rare. 110, 117, 127.
Peltigera leucophlebia	Rare. 115 mossy turf by natural outcrops.
Peltigera rufescens	Rare. 108 long-disused working, 121 vegetated spoil mound.
Polyblastia cupularis	Rare. 108 long-disused quarried face, 109 long-disused quarried face, 116 natural exposure.
Porina linearis	Rare to occasional on natural exposures or long-disused workings. 113 r, 115, 122, 127.
Protoblastenia lilacina	Local, rare to occasional. 108.
Rhizocarpon umbilicatum	Local, occasional. 115, 116, 122, 126, 127.
Solorina saccata	Local and occasional on natural exposures or long-disused workings. 108 moss on low steep face, 109 mossy ledge on north-facing rock, 119 ledge at base of natural cliff, 122 side of soil cap on rocks and crevice in face, 125 mossy rocks below small overhang and on moss at edge of soil cap on rock, 126 upper surface of low fractured natural outcrop.
Thelidium decipiens	Occasional. 109 steep north face, 113 cliff, 117, 124.
Thelidium papulare	Local, rare. 113 long-disused workings, 120 boulder from quarry activities.
Verrucaria caerulea	Local, rare on natural exposures. 119, 123, 124, 127.
Species totals:	**Limestone Index: 22**

Table 7. Limestone Index Species recorded in 2022 at Mynydd Llangynidr cSSSI: c. Trefil old quarry.

Species	Notes
Acrocordia conoidea	Very rare. 107 north side of unquarried pavement-like outcrop.
Caloplaca marmorata	Rare. 94 on boulder, 106 low unquarried outcrop, probably where moss has been lost.
Dermatocarpon miniatum	Very local on unquarried pavement-like outcrops. 104, 105, 106 occasional.
Gyalecta jenensis	Rare. 95, 99.
Peltigera rufescens	Very rare. 103 small quantity.
Polyblastia albida	Rare. 98 on boulder.
Porina linearis	Very rare. 94.
Protoblastenia lilacina	Occasional. 94.
Rhizocarpon umbilicatum	Very local on unquarried pavement-like outcrops. 104, 106.
Thelidium decipiens	94 ledge on exposure.
Thelidium papulare	Very rare on unquarried rocks. 105 low rocks, 106 unquarried pavement-like outcrop, rare.
Verrucaria caerulea	Very local on unquarried pavement-like outcrops. 104, 106, 107.
Species totals:	**Limestone Index: 12**

Table 8. Limestone Index Species recorded in 2022 at Mynydd Llangynidr cSSSI: d. Dyffryn Crawnon.

Species	Notes
Acrocordia conoidea	Rare. 63 steep north-facing surface in small quantity.
Dermatocarpon miniatum	Rare. 55 very locally frequent on low outcrops.
Farnoldia jurana	Rare. 59.
Gyalecta jenensis	Rare. 63 north-facing surface.
Hymenelia prevostii	Occasional. 57, 63.
Lecania cuprea	Rare. 60 small amount on stone below overhang.
Lecanora semipallida	Occasional on slightly enriched tops. 55, 58.
Lempholemma cladodes	Occasional in solution hollows on surfaces of level rocks, 57, 61, 65, 68.
Lepraria nivalis	Very local. 64 locally frequent on cliff in natural condition.
Opegrapha dolomitica	Rare and in small quantities on north-facing steep rocks. 64,
Peltigera rufescens	Occasional in turf adjacent to rocks, in small quantities. 59, 65.
Porina linearis	Occasional on steep north-facing surfaces. 63, 66, 67.
Protoblastenia calva	Occasional. 55, 57.
Psorotichia schaereri	Rare. 56 on low, seasonally moist rock.
Rhizocarpon umbilicatum	Frequent. 55.
Solorina saccata	Rare. 63 vegetated ledge on north-facing exposure, 67 soil on side of soil capping of exposure on north-facing slope.
Thelidium papulare	Rare. 60 stone below overhang.
Verrucaria caerulea	Occasional. 57, 58, 63, 64.
Species totals	**Limestone Index: 18**

Table 9. Limestone Index Species recorded in 2022 at Mynydd Llangynidr cSSSI: e. Cwm Claisfer.

Species	Notes
Acrocordia conoidea	Rather rare, mainly at west end of site. 27 r, 48, 52.
Caloplaca marmorata	Very rare. 36.
Clauzadea immersa	Rare. 29 f.
Farnoldia jurana	Rare. 35.
Gyalecta jenensis	Occasional. 29 o, 31, 42.
Hymenelia prevostii	Rare. 27 f.
Lecania cuprea	Rare. 31 r small overhang.
Lecanora semipallida	Occasional on nutrient-enriched tops of rocks. 32, 35, 40.
Lepraria nivalis	Occasional on steep cliffs. 34, 42, 48, 49,
Leproplaca xantholyta	Rare below overhangs. 52.
Opegrapha dolomitica	Rare. 29 r, 31 r.
Peltigera leucophlebia	Very local on thin soil associated with rocks. 37, 38 by very small and low outcrop in turf, 42 thin soil by top of low outcrop, 43 thin soil by top of rock.
Peltigera rufescens	Rare in small quantity on thin soil adjacent to rock. 27 r, 42.
Petractis clausa	Very rare. 39 low rock.
Porina linearis	Frequent on somewhat rain-sheltered faces. 29 f, 35, 36, 48.
Protoblastenia calva	Rather rare. 33.
Protoblastenia incrustans	Rare. 33, 39.
Rhizocarpon umbilicatum	Occasional on low, well-lit rocks. 27, 30, 32, 33, 35, 38.
Romjularia lurida	27 r.
Solorina saccata	Very local on soil on ledges and over rocks. 37, 44 thin soil at top of exposure, 45 soil in horizontal fissure in light shade of ash, 48.
Thelidium papulare	Rare or overlooked. 36.
Verrucaria caerulea	Rare. 45 rock face in light shade of tree, 47 r, 48.
Totals:	**Limestone Index: 22**

Table 10. Localities where records or notes were made.

Locality	GIS	accuracy (± m)	alt.	date	site
1	SN 92176 14655	3	386	2022 06 15	Blaen Nedd
2	SN 92168 14646	3	388	2022 06 15	Blaen Nedd
3	SN 92151 14628	3	395	2022 06 15	Blaen Nedd
4	SN 92151 14607	3	397	2022 06 15	Blaen Nedd
5	SN 92197 14587	3	389	2022 06 15	Blaen Nedd
6	SN 92090 14582	3	396	2022 06 15	Blaen Nedd
7	SN 92027 14536	3	382	2022 06 15	Blaen Nedd
8	SN 91988 14301	3	366	2022 06 15	Blaen Nedd
9	SN 92045 14297	3	373	2022 06 15	Blaen Nedd
10	SN 92303 14259	3	379	2022 06 15	Blaen Nedd
11	SN 92290 14117	3	377	2022 06 15	Blaen Nedd
12	SN 91742 13931	3	374	2022 06 16	Blaen Nedd
13	SN 91729 13948	3	375	2022 06 16	Blaen Nedd
14	SN 91756 13974	3	376	2022 06 16	Blaen Nedd
15	SN 91744 13979	3	377	2022 06 16	Blaen Nedd
16	SN 91720 14022	3	378	2022 06 16	Blaen Nedd
17	SN 91704 14022	4	378	2022 06 16	Blaen Nedd
18	SN 91712 14099	3	374	2022 06 16	Blaen Nedd
19	SN 91739 14122	3	376	2022 06 16	Blaen Nedd
20	SN 91888 14282	3	359	2022 06 16	Blaen Nedd
21	SN 91910 14315	3	373	2022 06 16	Blaen Nedd
22	SN 91904 14380	3	388	2022 06 16	Blaen Nedd
23	SN 91697 14389	3	379	2022 06 16	Blaen Nedd
24	SN 91695 14370	3	378	2022 06 16	Blaen Nedd
25	SN 91450 14442	3	383	2022 06 16	Blaen Nedd
26	SN 91451 14403	3	380	2022 06 16	Blaen Nedd
28	SO15255 17014	3	469	2022 07 04	Cwm Claisfer
29	SO15220 17008	5	463	2022 07 04	Cwm Claisfer
30	SO15187 16988	6	463	2022 07 04	Cwm Claisfer
31	SO15171 16982	3	463	2022 07 04	Cwm Claisfer
32	SO15139 16998	3	451	2022 07 05	Cwm Claisfer
33	SO15109 16959	4	461	2022 07 05	Cwm Claisfer
34	SO15090 16953	3	455	2022 07 05	Cwm Claisfer
35	SO15042 16921	4	458	2022 07 05	Cwm Claisfer
36	SO15014 16902	3	457	2022 07 05	Cwm Claisfer
37	SO14968 16871	3	458	2022 07 05	Cwm Claisfer
38	SO14971 16869	3	458	2022 07 05	Cwm Claisfer
39	SO14957 16825	3	464	2022 07 05	Cwm Claisfer
40	SO14952 16830	3	466	2022 07 05	Cwm Claisfer
41	SO14906 16808	3	457	2022 07 05	Cwm Claisfer
42	SO14876 16820	3	446	2022 07 05	Cwm Claisfer
43	SO14876 16828	3	449	2022 07 05	Cwm Claisfer

Locality	GIS	accuracy (± m)	alt.	date	site
44	SO14845 16803	3	443	2022 07 05	Cwm Claisfer
45	SO14826 16776	5	457	2022 07 05	Cwm Claisfer
46	SO14808 16758	5	448	2022 07 05	Cwm Claisfer
47	SO14771 16728	3	451	2022 07 05	Cwm Claisfer
48	SO14590 16527	3	455	2022 07 05	Cwm Claisfer
49	SO14535 16485	3	440	2022 07 05	Cwm Claisfer
50	SO14450 16379	3	448	2022 07 05	Cwm Claisfer
51	SO14436 16366	4	445	2022 07 05	Cwm Claisfer
52	SO14404 16347	6	443	2022 07 05	Cwm Claisfer
53	SO14387 16325	4	447	2022 07 05	Cwm Claisfer
54	SO12899 16015	3	463	2022 08 30	Dyffryn Crawnon
55	SO12045 16016	3	508	2022 08 30	Dyffryn Crawnon
56	SO12018 15998	3	510	2022 08 30	Dyffryn Crawnon
57	SO11993 15981	3	514	2022 08 30	Dyffryn Crawnon
58	SO11822 16111	3	524	2022 08 30	Dyffryn Crawnon
59	SO11687 16081	3	514	2022 08 30	Dyffryn Crawnon
60	SO11572 16141	3	517	2022 08 30	Dyffryn Crawnon
61	SO11636 16272	3	528	2022 08 30	Dyffryn Crawnon
62	SO11694 16506	3	512	2022 08 30	Dyffryn Crawnon
63	SO11719 16506	4	498	2022 08 30	Dyffryn Crawnon
64	SO11844 16536	3	499	2022 08 30	Dyffryn Crawnon
65	SO12208 16787	3	504	2022 08 30	Dyffryn Crawnon
66	SO12347 16912	4	490	2022 08 30	Dyffryn Crawnon
67	SO12372 16956	4	492	2022 08 30	Dyffryn Crawnon
68	SO12481 17001	3	494	2022 08 30	Dyffryn Crawnon
69	SN 88194 16332	3	510	2022 09 02	Ogof Ffynnon Ddu
70	SN 88186 16255	3	506	2022 09 02	Ogof Ffynnon Ddu
71	SN 88130 16270	3	514	2022 09 02	Ogof Ffynnon Ddu
72	SN 88090 16380	3	509	2022 09 02	Ogof Ffynnon Ddu
73	SN 87922 16391	3	513	2022 09 02	Ogof Ffynnon Ddu
74	SN 87854 16417	3	509	2022 09 02	Ogof Ffynnon Ddu
75	SN 87470 16364	3	509	2022 09 02	Ogof Ffynnon Ddu
76	SN 87246 16388	3	510	2022 09 02	Ogof Ffynnon Ddu
77	SN 87173 16418	3	520	2022 09 02	Ogof Ffynnon Ddu
78	SN 87101 16384	3	506	2022 09 02	Ogof Ffynnon Ddu
79	SN 87049 16292	3	497	2022 09 05	Ogof Ffynnon Ddu
80	SN 87015 16310	3	493	2022 09 05	Ogof Ffynnon Ddu
81	SN 87032 16262	3	494	2022 09 05	Ogof Ffynnon Ddu
82	SN 87010 16176	4	498	2022 09 05	Ogof Ffynnon Ddu
83	SN 86937 16188	3	496	2022 09 05	Ogof Ffynnon Ddu
84	SN 86881 16155	4	490	2022 09 05	Ogof Ffynnon Ddu
85	SN 86861 16164	3	490	2022 09 05	Ogof Ffynnon Ddu
86	SN 86861 16176	3	489	2022 09 05	Ogof Ffynnon Ddu

Locality	GIS	accuracy (± m)	alt.	date	site
87	SN 86718 16070	4	475	2022 09 05	Ogof Ffynnon Ddu
88	SN 86687 16075	3	475	2022 09 05	Ogof Ffynnon Ddu
89	SN 86675 16066	3	473	2022 09 05	Ogof Ffynnon Ddu
90	SN 86645 15965	3	468	2022 09 05	Ogof Ffynnon Ddu
91	SN 86618 15967	3	468	2022 09 05	Ogof Ffynnon Ddu
92	SN 86590 16020	3	464	2022 09 05	Ogof Ffynnon Ddu
93	SN 86372 16043	3	441	2022 09 05	Ogof Ffynnon Ddu
94	SO11684 14043	3	469	2022 09 21	Trefil old quarry
95	SO11686 14014	3	470	2022 09 21	Trefil old quarry
96	SO11702 13956	3	468	2022 09 21	Trefil old quarry
97	SO11681 13875	3	460	2022 09 21	Trefil old quarry
98	SO11775 13867	3	462	2022 09 21	Trefil old quarry
99	SO11811 13894	3	467	2022 09 21	Trefil old quarry
100	SO11796 13929	3	472	2022 09 21	Trefil old quarry
101	SO11777 13940	3	467	2022 09 21	Trefil old quarry
102	SO11752 14144	3	472	2022 09 21	Trefil old quarry
103	SO11718 14255	4	479	2022 09 21	Trefil old quarry
104	SO11601 14339	3	455	2022 09 21	Trefil old quarry
105	SO11585 14351	3	453	2022 09 21	Trefil old quarry
106	SO11594 14271	3	451	2022 09 21	Trefil old quarry
107	SO11529 13948	3	428	2022 09 21	Trefil old quarry
108	SO09934 15066	3	458	2022 09 22	Cwar Blaen Dyffryn
109	SO09937 15073	3	455	2022 09 22	Cwar Blaen Dyffryn
110	SO09909 15050	3	461	2022 09 22	Cwar Blaen Dyffryn
111	SO09883 15026	3	464	2022 09 22	Cwar Blaen Dyffryn
112	SO09871 15013	3	474	2022 09 22	Cwar Blaen Dyffryn
113	SO09860 15004	3	472	2022 09 22	Cwar Blaen Dyffryn
114	SO09848 15003	3	465	2022 09 22	Cwar Blaen Dyffryn
115	SO09834 14996	3	467	2022 09 22	Cwar Blaen Dyffryn
116	SO09818 14978	4	474	2022 09 22	Cwar Blaen Dyffryn
117	SO09807 14964	4	477	2022 09 22	Cwar Blaen Dyffryn
118	SO09783 14961	4	482	2022 09 22	Cwar Blaen Dyffryn
119	SO09736 14953	3	462	2022 09 22	Cwar Blaen Dyffryn
120	SO09702 14942	3	472	2022 09 22	Cwar Blaen Dyffryn
121	SO09454 14774	3	466	2022 09 22	Cwar Blaen Dyffryn
122	SO09265 14685	3	505	2022 09 22	Cwar Blaen Dyffryn
123	SO09303 14636	3	506	2022 09 22	Cwar Blaen Dyffryn
124	SO09348 14634	3	510	2022 09 22	Cwar Blaen Dyffryn
125	SO09369 14668	3	488	2022 09 22	Cwar Blaen Dyffryn
126	SO09502 14664	3	500	2022 09 22	Cwar Blaen Dyffryn
127	SO09839 14709	3	514	2022 09 22	Cwar Blaen Dyffryn
128	SO06871 12718	3	457	2022 09 23	Cefn yr Ystrad
129	SO06935 12743	3	463	2022 09 23	Cefn yr Ystrad

Locality	GIS	accuracy (± m)	alt.	date	site
130	SO06949 12755	3	462	2022 09 23	Cefn yr Ystrad
131	SO06972 12793	3	462	2022 09 23	Cefn yr Ystrad
132	SO06987 12826	3	461	2022 09 23	Cefn yr Ystrad
133	SO06961 12836	3	455	2022 09 23	Cefn yr Ystrad
134	SO06980 12882	4	449	2022 09 23	Cefn yr Ystrad
135	SO07021 12943	3	446	2022 09 23	Cefn yr Ystrad
136	SO07367 12947	3	491	2022 09 23	Cefn yr Ystrad
137	SO07413 12936	3	501	2022 09 23	Cefn yr Ystrad
138	SO07667 13244	3	535	2022 09 23	Cefn yr Ystrad
139	SO07755 13560	3	536	2022 09 23	Cefn yr Ystrad
140	SO07736 13540	3	536	2022 09 23	Cefn yr Ystrad
141	SO07722 13523	3	535	2022 09 23	Cefn yr Ystrad
142	SO07756 12984	3	549	2022 09 26	Cefn yr Ystrad
143	SO07914 13149	3	576	2022 09 26	Cefn yr Ystrad
144	SO08034 13101	3	581	2022 09 26	Cefn yr Ystrad
145	SO08043 13191	3	583	2022 09 26	Cefn yr Ystrad
146	SO08187 13241	3	591	2022 09 26	Cefn yr Ystrad
147	SO08227 13517	3	596	2022 09 26	Cefn yr Ystrad
148	SO08617 13835	3	607	2022 09 26	Cefn yr Ystrad
149	SO08834 13873	3	603	2022 09 26	Cefn yr Ystrad
150	SO08072 14340	3	528	2022 09 26	Cefn yr Ystrad
151	SO08018 14291	3	533	2022 09 26	Cefn yr Ystrad

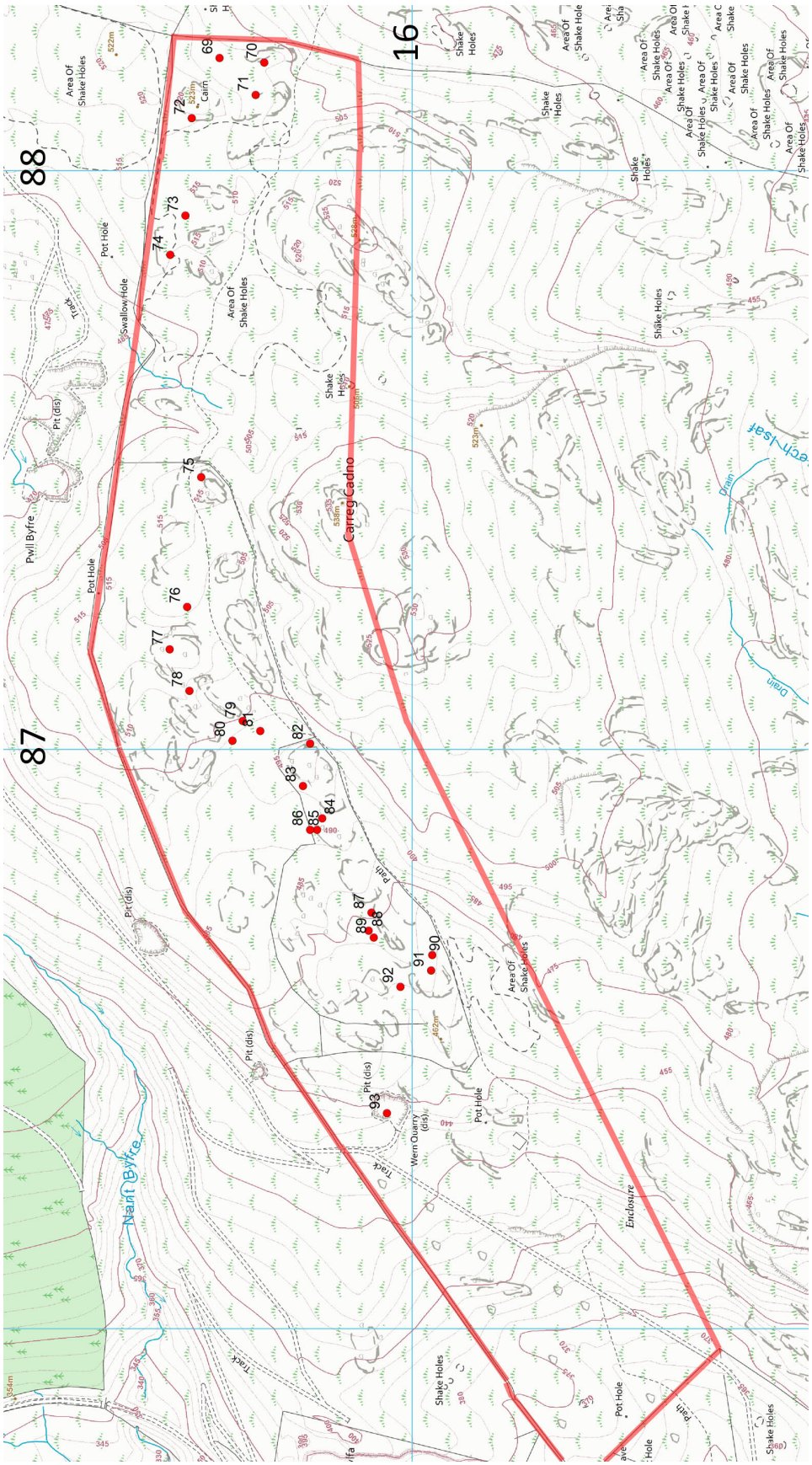

Figure 1. Ogof Ffynnon Ddu - Pant Mawr SSSI.

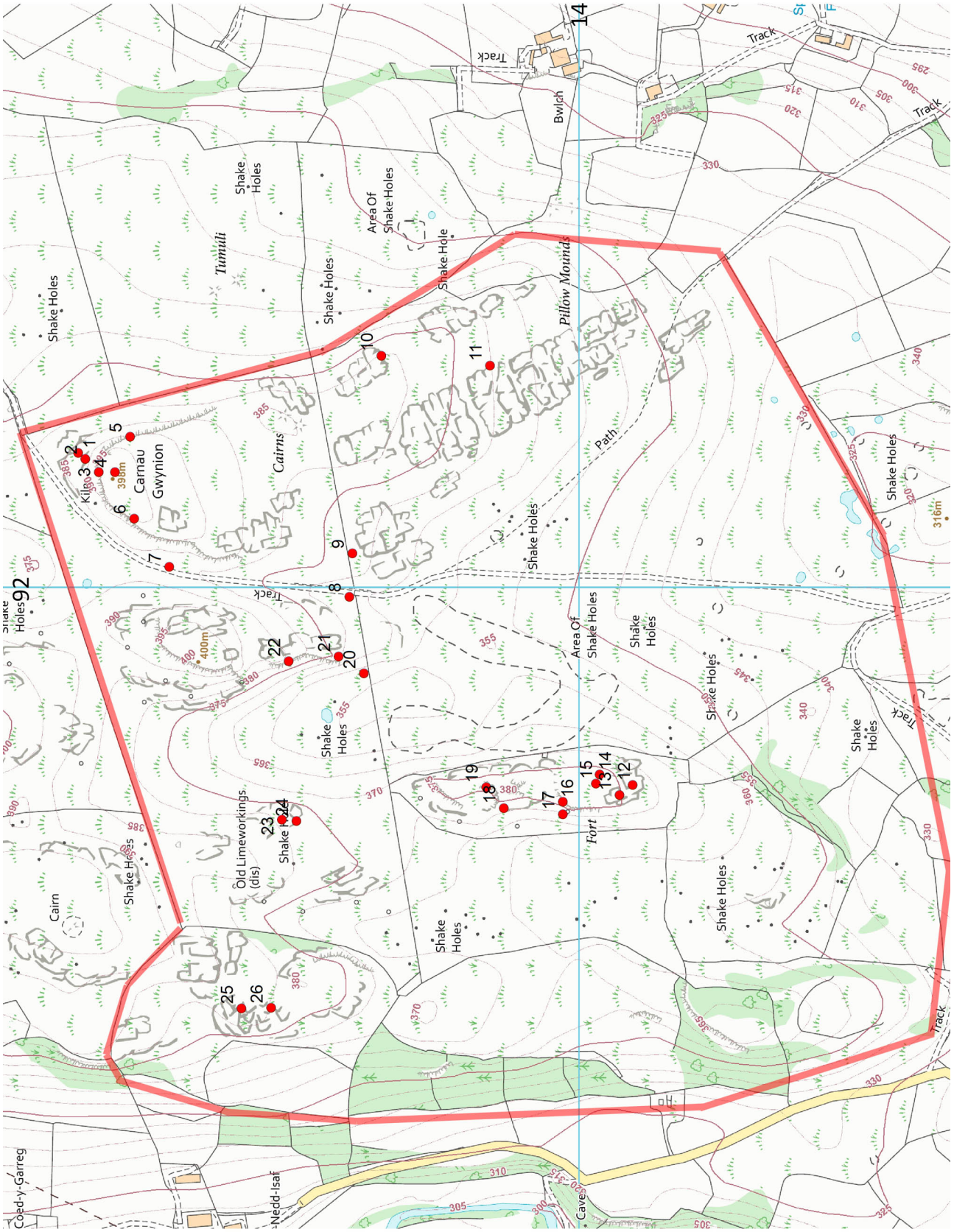

Figure 2. Blaen Nedd SSSI.

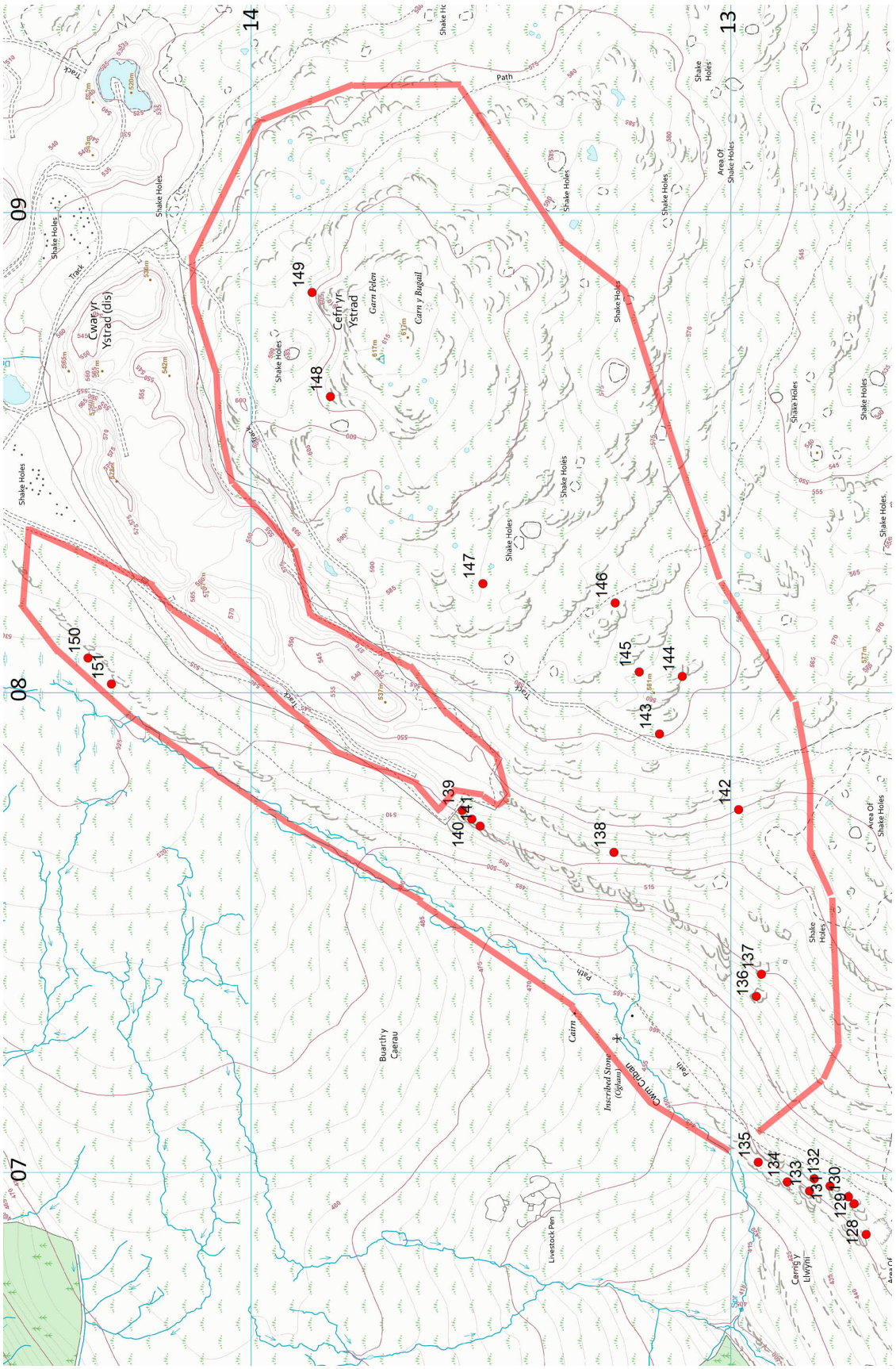

Figure 3. Cefn yr Ystrad (Mynydd Llangynidr cSSSI in part).

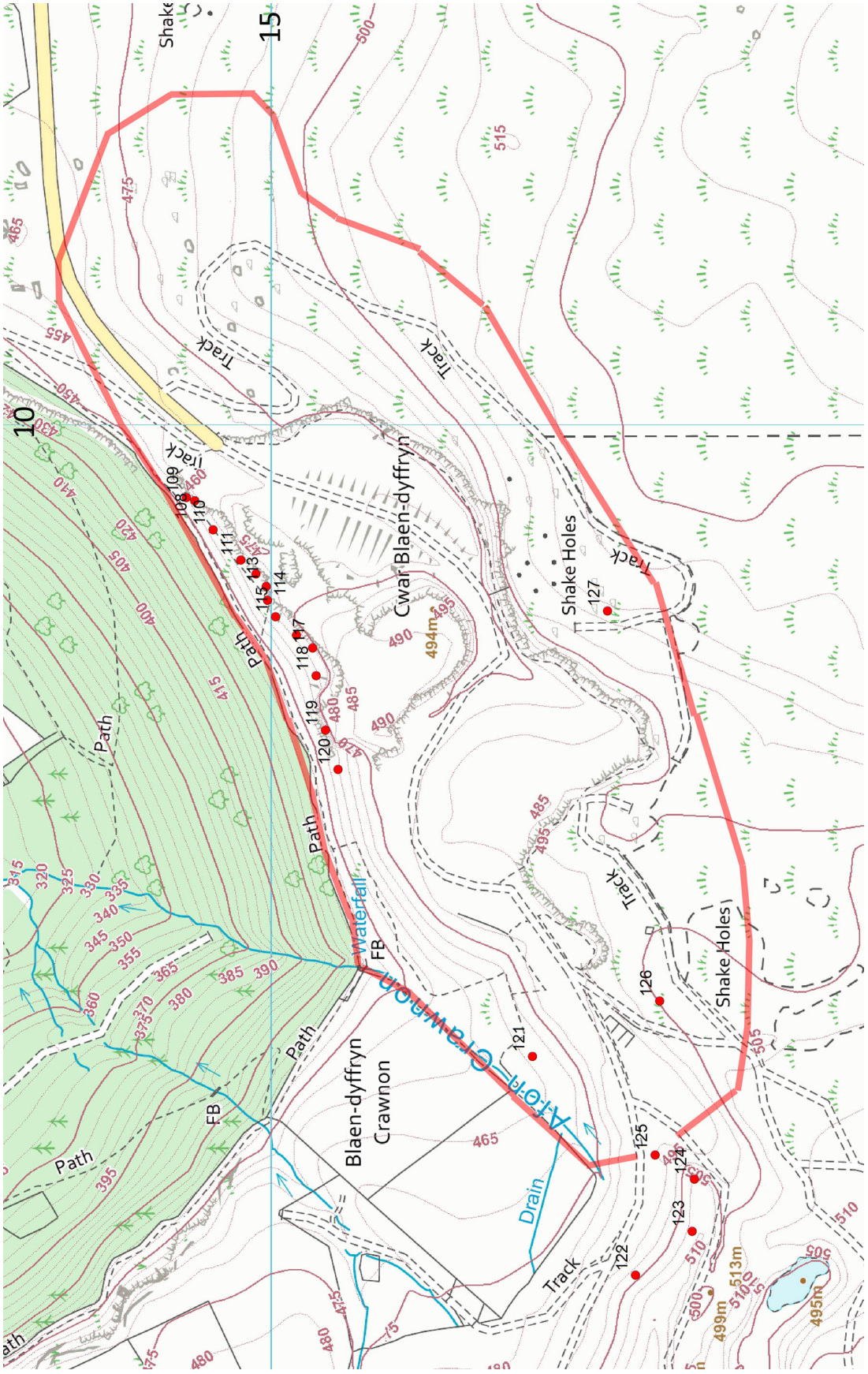

Figure 4. Cwar Blaen Dyffryn (Mynydd Llangynidr cSSSI in part).

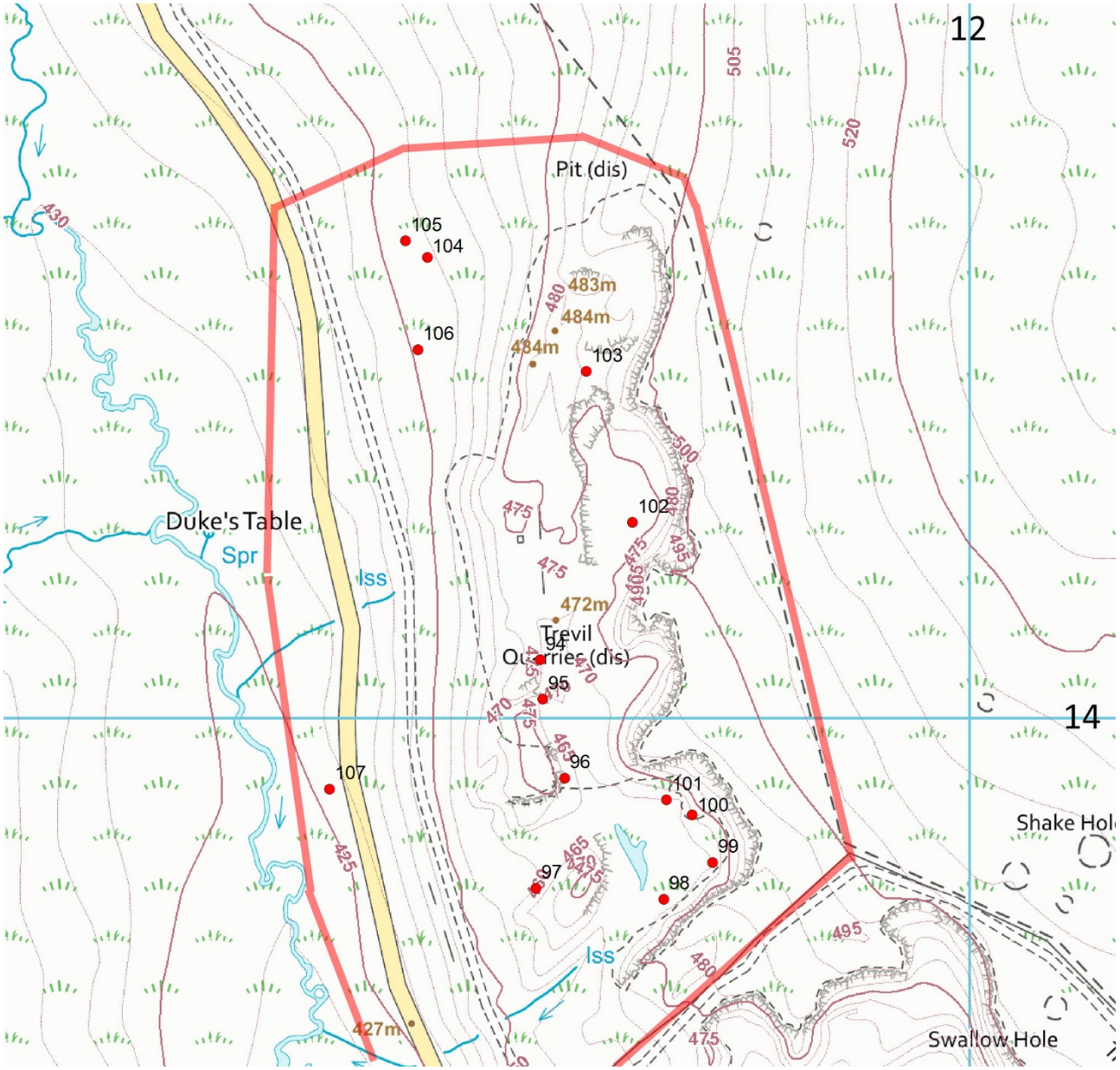

Figure 5. Trefil old quarry (Mynydd Llangynidr cSSSI in part).

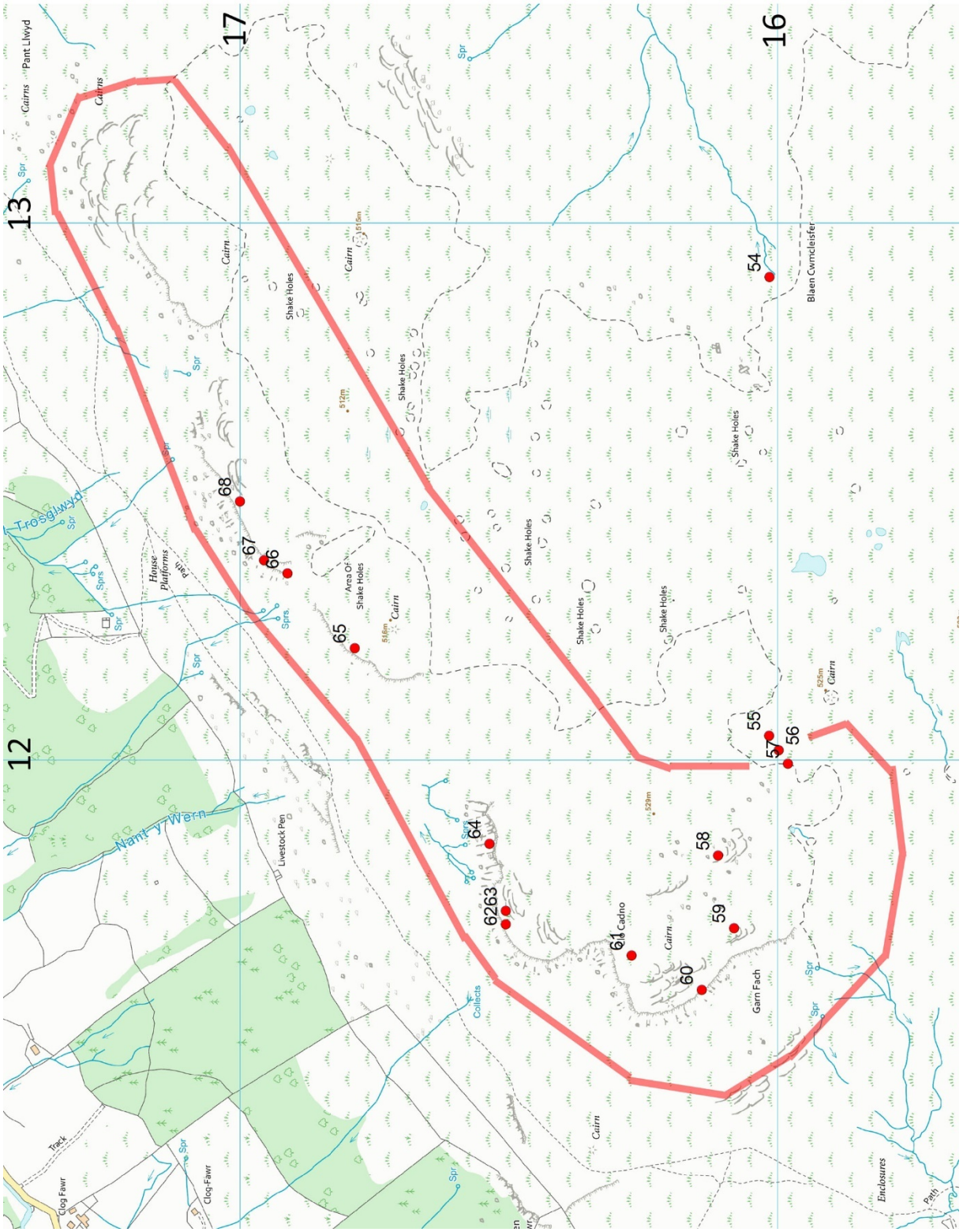

Figure 6. Dyffryn Crawnon (Mynydd Llangynidr cSSSI in part).

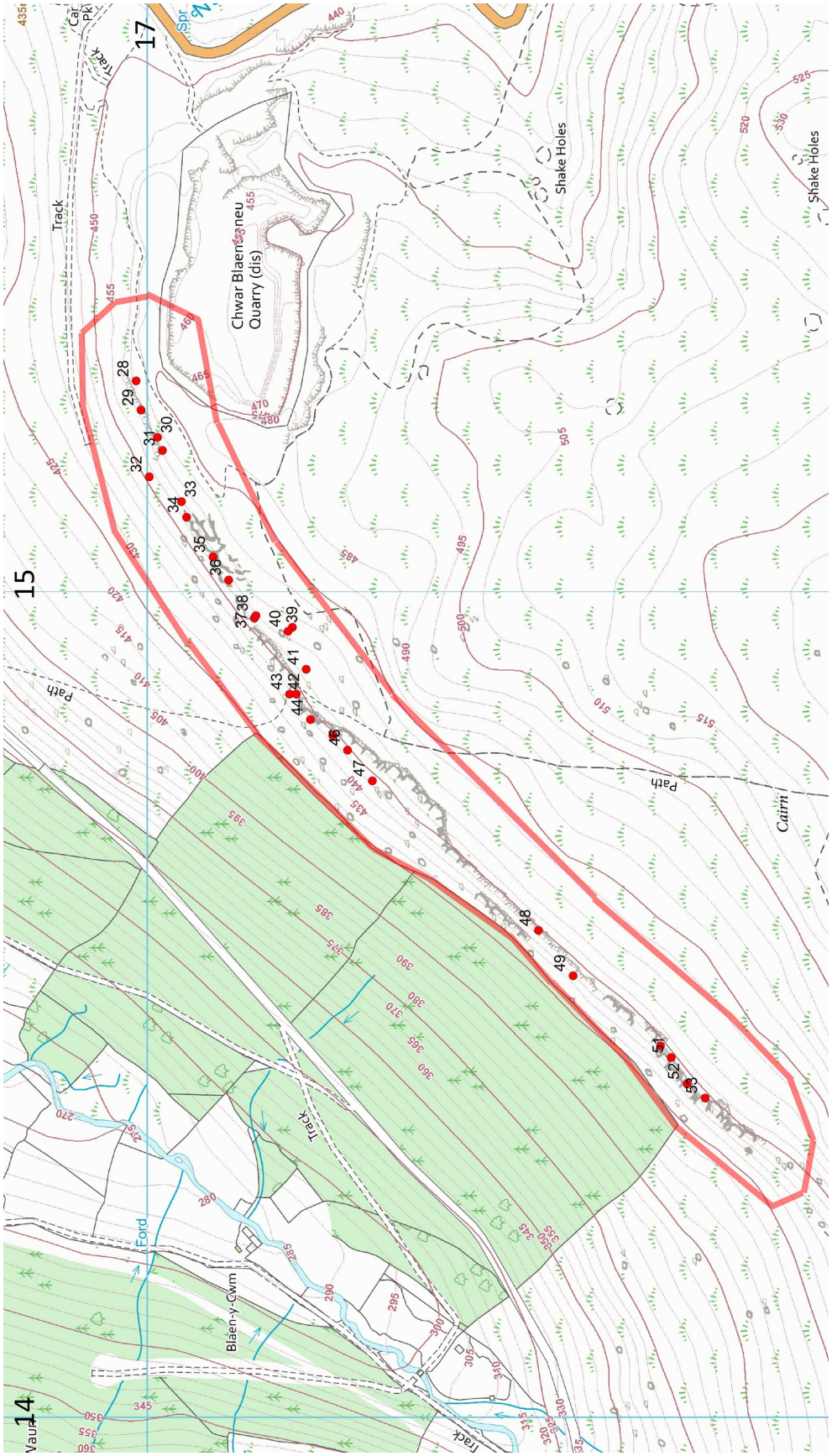

Figure 7. Cwm Claisfer (Mynydd Llangynidr cSSSI in part).

Figure 8. Typical limestone landscape at Ogof Ffynnn Ddu, of low hillocks with low, fractured rocks.

Figure 9. Ogof Ffynnon Ddu: larger blocks such as these are relatively lichen-rich, but are sparse at the site.

Figure 10. This recent quarry at Ogof Ffynnon Ddu is generally lichen-poor, but small quantities of *Peltigera leucophlebia* and *Solorina saccata* grow on soil on the ledges here.

Figure 11. Most faces at Blaen Nedd are quarried.

Figure 12. A rare unquarried face at Blaen Nedd.

Figure 13. An area of pavement at Blaen Nedd; most pavement at the site is much less well-developed.

Figure 14. Blaen Nedd: the well-drained sides of clints support a number of Index species, here with *Porina linearis* and *Verrucaria caerulea*.

Figure 15. Cefn yr Ystrad: pavement-like exposures at the SW end of the site; in the distance the scarp slope with small exposures, and recent quarries on the horizon.

Figure 16. Cefn yr Ystrad: low and apparently unquarried cliffs on the scarp slope.

Figure 17. Cefn yr Ystrad: there is a line of low exposures along the NW margin of the site, abutting peaty ground to the west.

Figure 18. Cefn yr Ystrad: very small-scale quarrying has created microhabitats otherwise rare at the site, such as this stone patch supporting *Hymenelia heteromorpha*, below a small worked face.

Figure 19. Cwar Blaen Dyffryn: north-facing slope with small-scale workings in foreground and a natural cliff (with trees) above centre of photograph.

Figure 20. Cwar Blaen Dyffryn: small-scale workings, now supporting *Solorina saccata* on low face.

Figure 21. Cwar Blaen Dyffryn: workings predating the main quarry; quarried faces with platform at base.

Figure 22. Cwar Blaen Dyffryn: natural, unquarried exposures at north edge of site.

Figure 23. Cwar Blaen Dyffryn: small natural exposures exist by the modern quarries; the quarry face just beyond.

Figure 24. Cwar Blaen Dyffryn: part of the recent quarry, a forbidding place for lichens.

Figure 25. Trefil: quarried faces and spoil, mostly with poor lichen colonisation.

Figure 26. Trefil: small natural exposures west of the quarry, with a more diverse lichen cover.

Figure 27. Trefil: small natural exposures on west side of site.

Figure 28. Dyffryn Crawnon: much of the site has only low outcrops scattered along the crest of the north slope.

Figure 29. Dyffryn Crawnon: these low cliffs are the tallest exposures at the site.

Figure 30. Dyffryn Crawnon: an unusually moist rock for the site, supporting *Psorotichia schaereri*.

Figure 31. Dyffryn Crawnon: low rock with several solution hollows supporting black colonies of *Lempholemma cladodes*.

Figure 32. Cwm Claisfer: long-disused quarried faces in eastern part of site, with grassy spoil mounds.

Figure 33. Cwm Claisfer: old, very shallow workings.

Figure 34. Cwm Claisfer: natural, unquarried cliff in western part of site, with *Solorina saccata* on a ledge.

Figure 35. Cwm Claisfer: natural, unquarried cliff in western part of site.

Full species lists have been excluded from the Accessible version of the report on the NRW website because it is not possible to format these data tables in a way that works well for machine readers. The full species tables are included in the version held by NRW Library and those on the distribution list.

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.

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

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