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Ditrichum plumbicola survey of Mwyngloddiau Fforest Gwydir/ Gwydyr Forest Mines SAC

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Evidence Report No 585

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Mae arolwg o hen fwyngloddiau plwm wedi diweddaru gwybodaeth am statws *Ditrichum plumbicola* yn ACA Mwyngloddiau Fforest Gwydir.

Mae bron i bob uned ACA lle cafwyd hyd i D. plumbicola o'r blaen yn parhau i'w gefnogi, ond mae maint ac arwynebedd cytrefi unigol yn amrywio'n sylweddol. Mae rhai cytrefi dan fygythiad coed pin, coed sbriws a choed eraill a gwnaed argymhellion ar gyfer gwaith rheoli uned-benodol er mwyn mynd i'r afael â hyn.

2. Executive Summary

A survey of former lead mines brings up to date knowledge of the status of *Ditrichum plumbicola* in Mwyngloddiau Fforest Gwydir/ Gwydyr Forest Mines SAC.

Nearly all SAC units where *D. plumbicola* had been found previously continue to support it, although size and extent of individual colonies varies greatly. Certain colonies are threatened by the proximity of pine, spruce and other trees and recommendations for unit-specific management have been made to address this.

3. Introduction

Ditrichum plumbicola (Lead-moss) (Photo 1) is a Nationally Scarce specialist of lead-rich toxic spoil in disused lead mines across Britain and Ireland. Outside of Britain and Ireland, *D. plumbicola* is known only from SW Germany and Belgium. Mwyngloddiau Fforest Gwydir/ Gwydyr Forest Mines SAC (and Mwyngloddiau a Chreigiau Gwydyr SSSI, which underpins it) supports the largest known concentration of colonies of *D. plumbicola* in the world.

The SAC has 44 units of varying size scattered across the Gwydyr Forest. Its disused lead and zinc workings support the Annex I habitat *6130 Calaminarian grasslands of the Violetalia calaminariae* that is a primary reason for selection of this SAC. The Calaminarian grassland of the Gwydyr Forest is of foremost importance for the local frequency of *D. plumbicola.*

The population of *D. plumbicola* in Gwydyr Forest Mines SAC was first surveyed in 2001, again in 2006 as part of a Wales-wide assessment of the species and most recently in 2011 as part of monitoring of the Calaminarian grassland. This report documents monitoring undertaken in 2021 to update the status of *D. plumbicola* and to identify where any habitat management or other action is urgently needed to conserve it.

Photo 1. *Ditrichum plumbicola,* Gwydyr Forest Mines SAC

4. Approach

4.1. Review of Historical Dataset

Localities where *D. plumbicola* has previously been recorded in the SAC were provided on an Ordnance Survey 1:25,000 scale map by Natural Resources Wales (NRW) as part of the project's Technical Specification, highlighting units where survey effort should be targeted.

In addition, all records of *D. plumbicola* held in the British Bryological Society's database for the area were obtained and overlaid on freely available aerial imagery using Quantum GIS software (QGIS Development Team, 2021) to prepare field maps and effectively target field survey effort.

4.2. Field Survey

Fieldwork was undertaken during ideal weather conditions (dry and mild but following relatively recent rain) between 11th and 15th October inclusive by Sharon Pilkington CEnv MCIEEM, a professional botanist specialising in bryophytes. On the 12th and 13th October, she was joined by Philippa Thompson, a local amateur bryologist with an interest in furthering her knowledge of the rarities of her home area.

27 SAC units and one other site (A) where colonies of *D. plumbicola* had previously been found and/or where Calaminarian grassland was known or thought to be present were surveyed (Table 1). Prior to the survey, scoping work by NRW had identified units 2, 34 and 42 as bat sites only, units 5, 7, 8, 16, 19, 20, 22 and 23 as overgrown/inaccessible and units 6, 21 and 24 as having no suitable habitat for *D. plumbicola* or lacking information. None of these units was surveyed. Three other units – 28, 30 and 36 – had historical records of *D. plumbicola* but were not surveyed as permission for access was not forthcoming.

Although historical records were helpful in locating *D. plumbicola* habitats in some of the units, the most effective survey approach was a careful search for the kind of sheltered, fine-grained toxic spoil microhabitat preferred by *D. plumbicola* and, once found, to undertake a hands-and-knees search for the moss.

When a patch of *D. plumbicola* was detected, its location was recorded as a 10-figure grid reference by means of a high-sensitivity GPS/GLONASS receiver[1]. An estimate of patch/colony area and frequency (DAFOR) was made in the Calaminarian grassland in each unit. Any obvious threats to all or part of each unit's population of *D. plumbicola* were also noted.

[1] Garmin model GPSMAP 64S. This receiver connects to both GPS and GLONASS satellite networks to give a typical positioning accuracy of 3m, even in obscured terrain.

Colonies were arbitrarily ranked as small (<10cm^2), medium (10-50cm^2) or large (>50cm^2), depending on their actual/estimated area (which often included multiple small patches at one spatially distinct locality). Colonies were treated as spatially distinct entities if they, or their component patches, grew 5m or more from neighbouring colonies.

4.3. Limitations

Other than the three SAC units where permission was not forthcoming for fieldwork, there were no constraints to completing a full survey.

Table 1 Surveyed SAC units

Unit	Name	Historical *D. plumbicola* site?
1	New Pandora Leadworks	Yes
3	Ty Gwyn 2	Yes
4	Geirionydd	Yes
9	Cefn Maenllwyd	Yes
10	Glyn Farm	Yes
11	Penllan	Yes
12	Pen y Gwaith	Yes
13	Hafna Lead Mine 1	Yes
14	Hafna Lead Mine 2	Yes
15	Hafna Lead Mine 3	No
17	Hafna Lead Mine 5	No
18	Snowdonia National Park	No
25	Craig y Fuches-Las 2	No
26	Craig y Fuches-Las 3	No
27	Cyffty Mine	Yes
29	Sarnau 1	Yes
31	Sarnau 2	Yes
32	Craig y Fuches-Las 4	No
33	Forest Enterprise 1	Yes
35	Forest Enterprise 3	Yes
37	Coed Mawr Pool Mine	Yes
38	Castle Terrace 1	Yes
39	Castle Terrace 2	Yes
40	Aberllyn Lead Mine 1	Yes
41	Aberllyn Lead Mine 2	Yes
43	Plas Muriau 1	Yes
44	Plas Muriau 2	Yes
A	A (not part of SAC but important)	No

5. Results

D. plumbicola was found in 18 SAC units (Table 2) and also at the mouth of a shaft that does not lie within the SAC or SSSI at SH7827759233. Appendix I lists all of the localities where *D. plumbicola* was found, with summaries of estimated colony size. Summary descriptions of populations within each SAC unit are given in Section 3.1 in numerical order. Records of other bryophytes and higher plants of conservation importance found incidentally in the course of the fieldwork (not necessarily within SAC units) are listed in Appendix II.

Table 2 Confirmed populations of *D. plumbicola* by SAC unit

Unit	Name	Population notes	Frequency in Calaminarian grassland	Threats identified[2]
1	New Pandora Leadworks	Large and extensive	Locally frequent	No
3	Ty Gwyn 2	Small and scattered	Rare	No
4	Geirionydd	Very small	Rare	No
9	Cefn Maenllwyd	Small and scattered	Rare	No
10	Glyn Farm	Very small	Rare	No
11	Penllan	Small and scattered	Rare	No
12	Pen y Gwaith	Medium – only in one place	Rare	Yes
14	Hafna Lead Mine 2	One large colony, the other smaller	Rare	Yes
27	Cyffty Mine	Large and extensive	Locally frequent	Yes
29	Sarnau 1	Large	Frequent	No
31	Sarnau 2	Medium, scattered	Rare	Yes
33	Forest Enterprise 1	Large but local	Rare	Yes
35	Forest Enterprise 3	Large	Locally frequent	Yes
37	Coed Mawr Pool Mine	Locally substantial	Rare	Yes
38	Castle Terrace 1	Large but local	Rare	Yes
39	Castle Terrace 2	Large	Locally frequent	Yes
40	Aberllyn Lead Mine 1	Large	Abundant	Yes
43	Plas Muriau 1	Small	Rare	Yes

No *D. plumbicola* was found in units 13, 41 and 44, where it was previously known. Unit 13 is becoming overgrown and no suitable microhabitat for *D.*

[2] Excluding ongoing natural succession and naturally decreasing soil toxicity

plumbicola was found on the spoil tips. The spoil tips in units 41 and 44 lie in shade below tall trees in woodland and although they previously supported *D. plumbicola* they are no longer suitable.

Although fine-grained spoil is present in units 15, 17 and 18, *D. plumbicola* was not found, a finding consistent with previous surveys of these units. In units 15 and 18, there are substantial areas of suitable-looking spoil although it has been well colonised by other bryophytes, higher plants and lichens and may not be toxic enough to support *D. plumbicola*. In unit 17, the spoil appears to have been regraded and is quite friable and exposed to the elements, with advanced vegetation succession underway.

Names of bryophytes used in this report follow Blockeel *et al.* (2021) and Stace (2019) for higher plants.

5.1. Populations by SAC unit

5.1.1. Unit 1 New Pandora Leadworks

Unit 1 supports one of the largest populations of *D. plumbicola* in the SAC, with colonies concentrated in the extensive areas of relatively bare fine spoil close to the ruins of a crushing mill and the stream banks (Figure 1). The remainder of the SAC has little suitable habitat for *D. plumbicola*.

5.1.2. Unit 3 Ty Gwyn 2

D. plumbicola occurs on spoil close to the tops of shafts and elsewhere at this site but it is an exposed site and most of the colonies are less than 10cm^2 in size (Figure 1). However, none of them is threatened.

5.1.3. Unit 4 Geirionydd

This former mine lies on a very steep, north-facing slope above Llyn Geirionydd and has extensive, stony spoil tips with negligible fine-grained substrate. Only one small colony of *D. plumbicola* was found, high on a tip (Appendix I) but it was not considered to be threatened. Near the bottom fence of the mine, many stems of *D. lineare*, a Nationally Scarce moss (Pescott, 2016), grow on a clay bank at SH76196112.

5.1.4. Unit 9 Cefn Maenllwyd

Four widely separate colonies of *D. plumbicola* were found in unit 9 (Figure 2), none of which was larger than 20cm^2. The mine remains primarily consist of extensive areas of stony spoil with little good habitat for this moss; however, no threats were noted to any of the colonies.

Figure 1. Distribution of *D. plumbicola* in SAC units 1 and 3

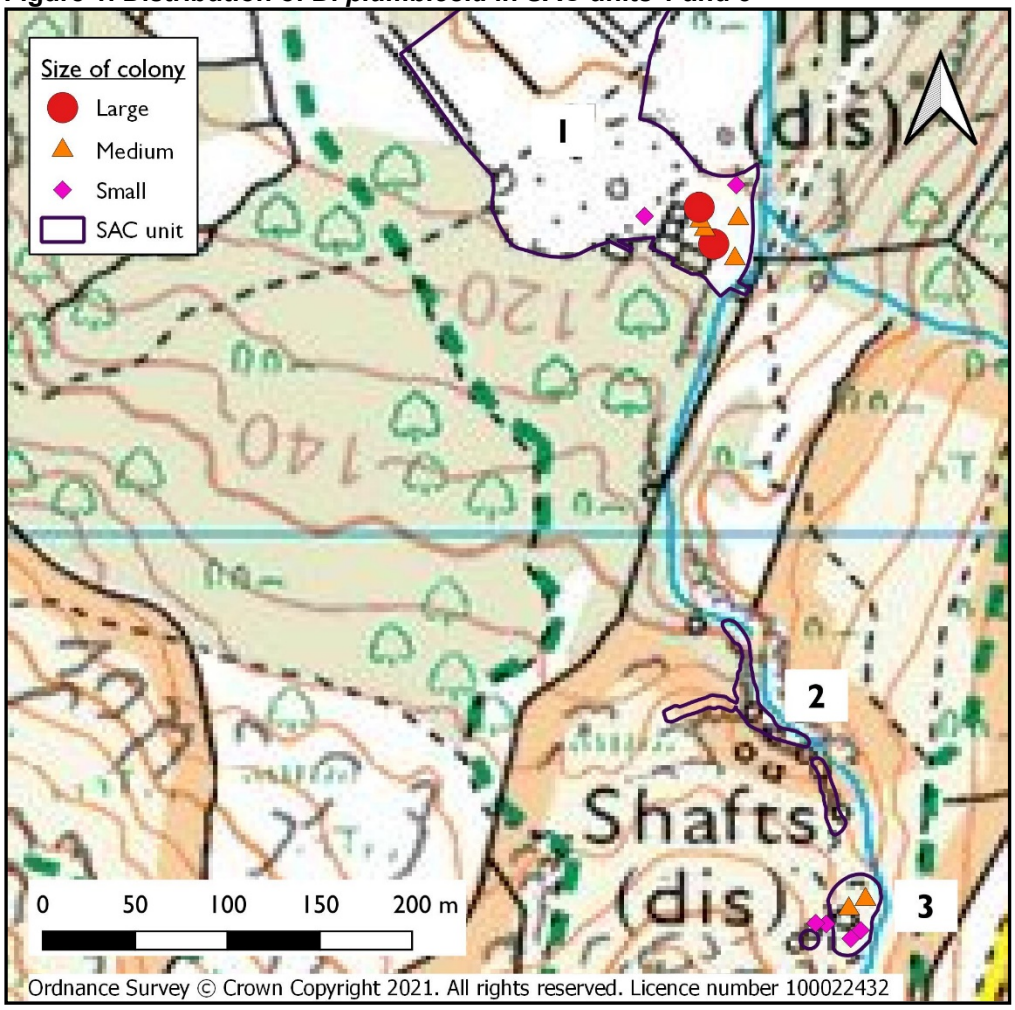
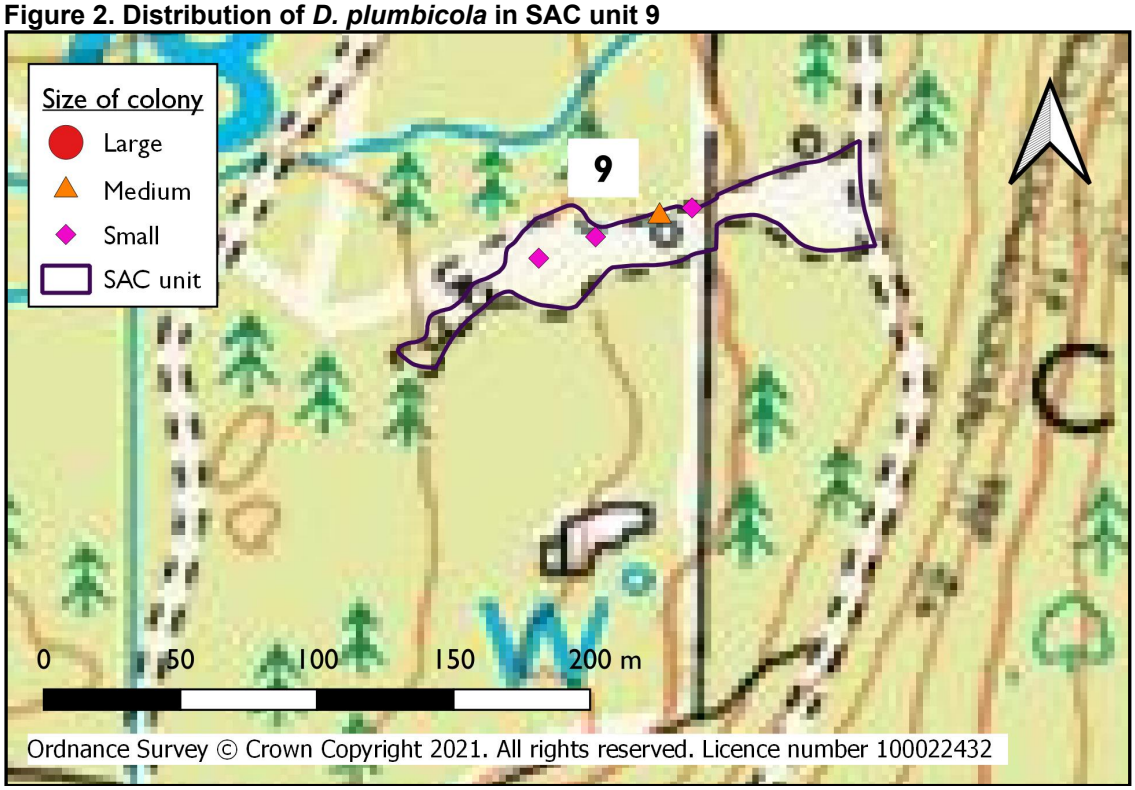


Figure 2. Distribution of *D. plumbicola* in SAC unit 9



5.1.5. Unit 10 Glyn Farm

This site (Figure 3) has extensive areas of spoil and well-developed Calaminarian grassland which has been colonised by scattered *Agrostis vinealis* (Brown Bent), *Festuca ovina* (Sheep's-fescue), *Noccaea subcaerulescens* (Alpine Penny-cress) and *Cladonia* species. The unit is quite exposed and lacks much fine-grained substrate. Only one small colony of *D. plumbicola* was found.

5.1.6. Unit 11 Penllan

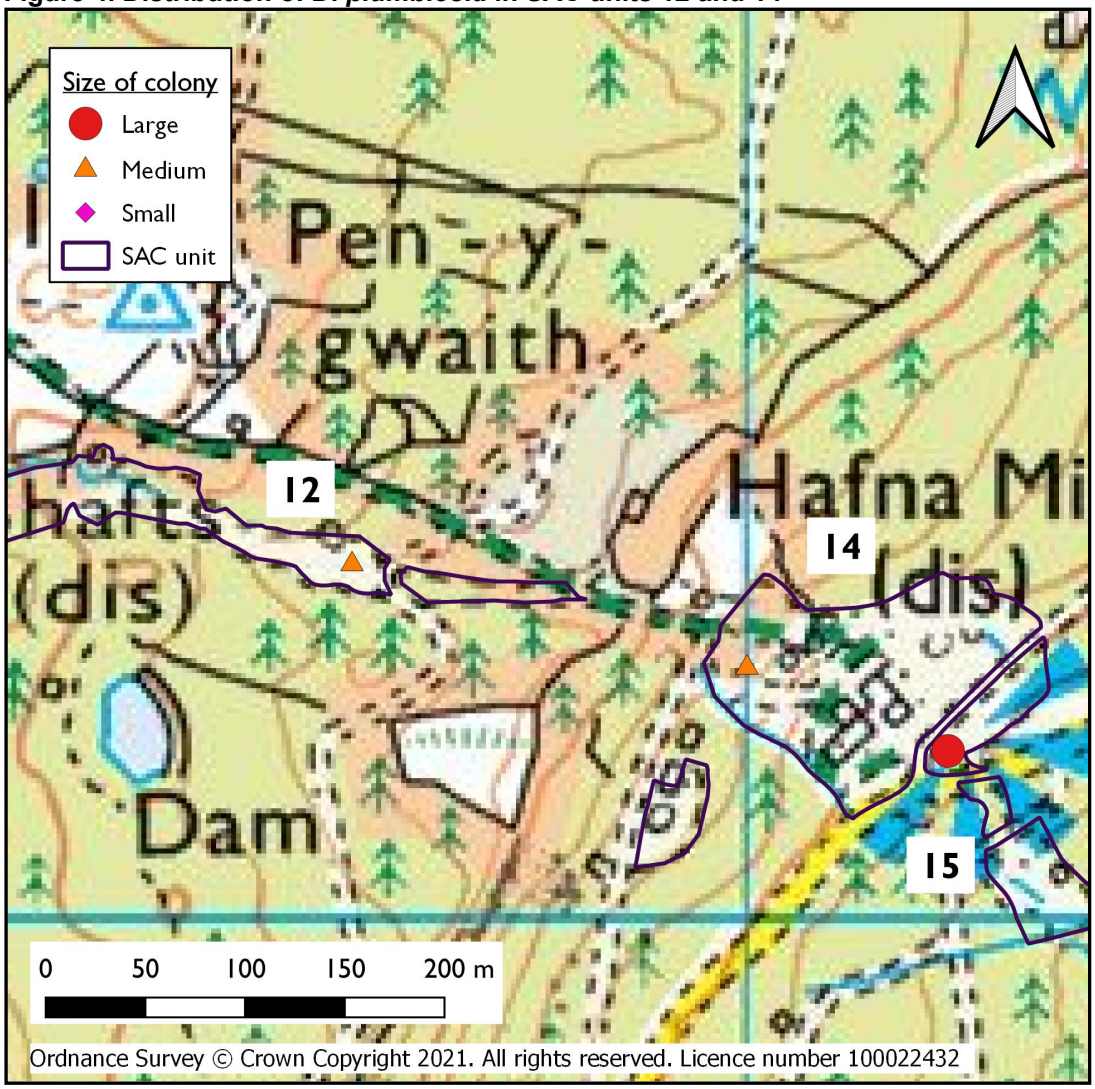
Although most of the spoil in this unit is too stony or too vegetated for *D. plumbicola*, small colonies grow on small patches of fine substrate sheltered by *Calluna vulgaris* (Heather) or other vegetation, mainly close to shaft heads (Figure 3). None of the patches is imminently threatened.

Figure 3. Distribution of *D. plumbicola* in SAC units 10 and 11

5.1.7. Unit 12 Pen y Gwaith

See Figure 4. The upper edge of a prominent, east-facing spoil bank supports scattered patches of *D. plumbicola* along several metres. It grows just below mature/degenerate *Calluna* on top of the heap, but is not present lower down, possibly because the spoil is quite loose and eroding. All of the colonies are below pines and other conifers growing on top of the spoil heap and at risk from needle drop.

Figure 4. Distribution of *D. plumbicola* in SAC units 12 and 14



5.1.8. Unit 14 Hafna Lead Mine 2

Unit 14 includes the impressive Hafna Mine but most of the ground around the ruined structures is unsuitable for *D. plumbicola*. A notable exception to this is a south-facing bank of sparse Calaminarian grassland between the road and a track leading to the car park. Quite an extensive population of *D. plumbicola* grows on this bank (Figure 4) scattered over several metres. The other colony found in this unit is close to the top of the mine, on a steep and unstable south-facing spoil tip in woodland. Vegetation succession is advanced, and it

has only a few square metres of good remaining habitat for *D. plumbicola*. Needles and leaves shed by nearby trees are direct threats to the colony.

At SH78066014, mine masonry supports numerous spore-producing individuals of *Asplenium septentrionale* (Forked Spleenwort).

5.1.9. Unit 27 Cyffty Mine

Of all of the SAC units surveyed, Cyffty Mine had the largest population of *D. plumbicola*, which was widespread on sloping and level fine spoil in the south-western part of the mine (Figure 5; Photo 2). Overall, nearly 1000cm^2 of *D. plumbicola* was estimated here. A small outlying colony also occurs on levelled spoil just outside the mine fence (and possibly the SAC boundary) at SH7717158797. A fenced path keeps visitors to the mine away from the spoil heaps and developing heath where the main concentrations of *D. plumbicola* are and the only threat is the proximity of pine trees to a few patches of plants.

Figure 5. Distribution of *D. plumbicola* in SAC unit 27

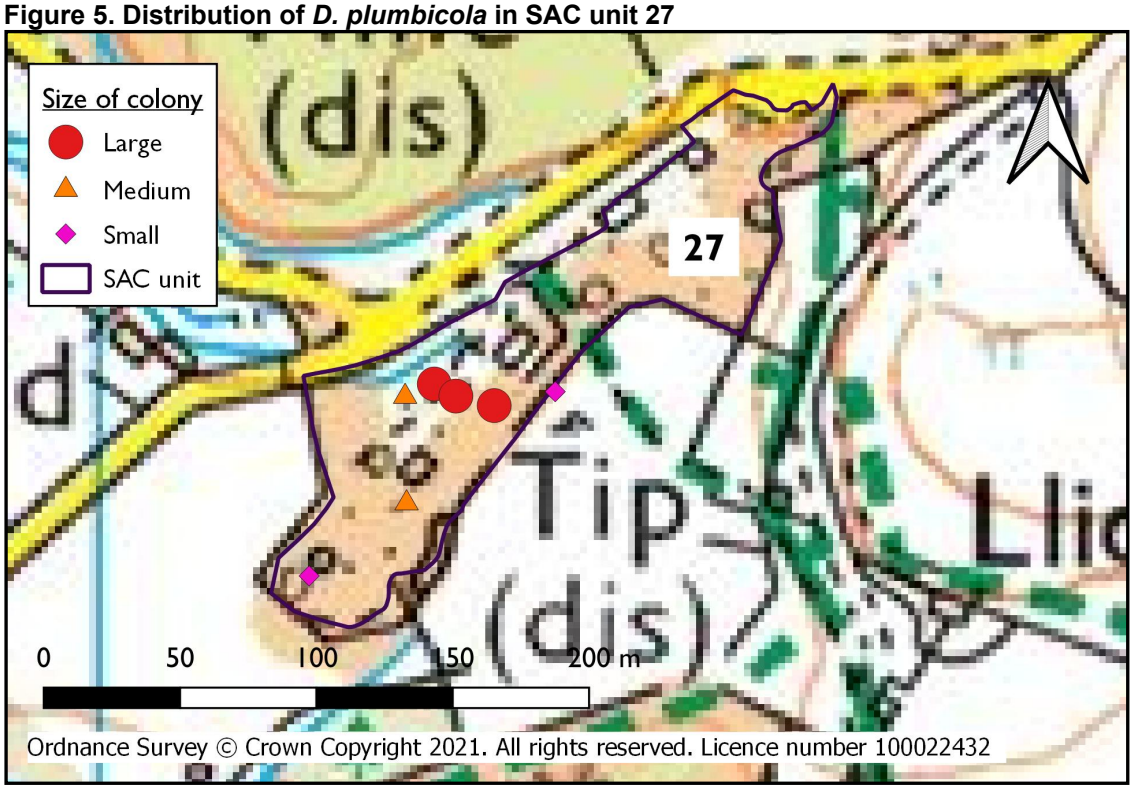


Photo 2: SE-facing spoil slopes in Unit 27 support an extensive colony of *D. plumbicola* (SH7712758800)

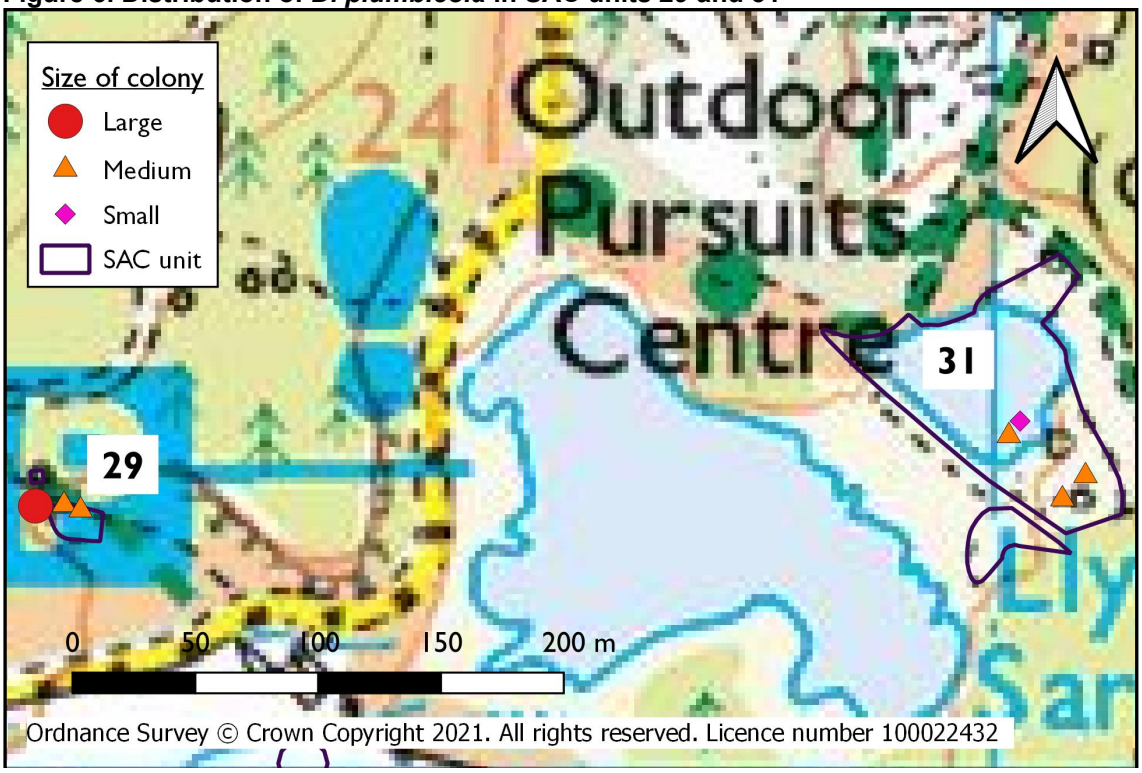
5.1.10. Unit 29 Sarnau 1

This very small unit supports a surprisingly large population of *D. plumbicola*, although some of it may lie just outside the SAC boundary (Figure 6). The population occurs on gently sloping and sheltered mine spoil in in and around a lightly used foot path.

5.1.11. Unit 31 Sarnau 2

D. plumbicola is found in several places in the unit, on an extensive area of fine spoil that is beginning to succeed to acid grassland and heath (Figure 6). None of the colonies was particularly large and much of the site is too exposed to be suitable for it. All of the colonies were found where there was some shelter offered by the ground micro-topography or by grasses and/or dwarf ericaceous shrubs. At the south-western end of the SAC, numerous tall pine trees fringe the spoil mounds and the small patches in this area are vulnerable to needle drop.

Figure 6. Distribution of *D. plumbicola* in SAC units 29 and 31



5.1.12. Unit 33 Forest Enterprise 1

Although there is a relatively substantial population of *D. plumbicola* in unit 33, it is very localised because of vegetation succession and a lack of fine-grained substrate on many of the tips. The entire population is within 20m of a small, ruined building (Figure 7; Photos 3 & 4) and is scattered about in sparse heathland developing over nearby spoil. Birch and conifer saplings have also colonised this heath and without control will be an increasing threat to the colonies of *D. plumbicola*.

Photo 3: *D. plumbicola* habitat by southern end of ruined building (SH7861759306)

Photo 4: *D. plumbicola* is scattered east of the building in the shelter of *Calluna* (SH7862659315)

5.1.13. Unit 35 Forest Enterprise 3

This unit (Figure 7) has an extensive area of bare, fine-grained spoil at its northern end (Photo 5) which supports a substantial population of *D. plumbicola* both inside and outside the enclosure fence. Further south, there are many more patches (Photo 6) covering an area of approximately 7m x 2m of east-facing sloping, damp spoil among rocks outside the fence. The only threat is needle-drop from a few conifers to a few patches of shoots in the north of the unit.

Figure 7. Distribution of *D. plumbicola* in SAC units 33 and 35

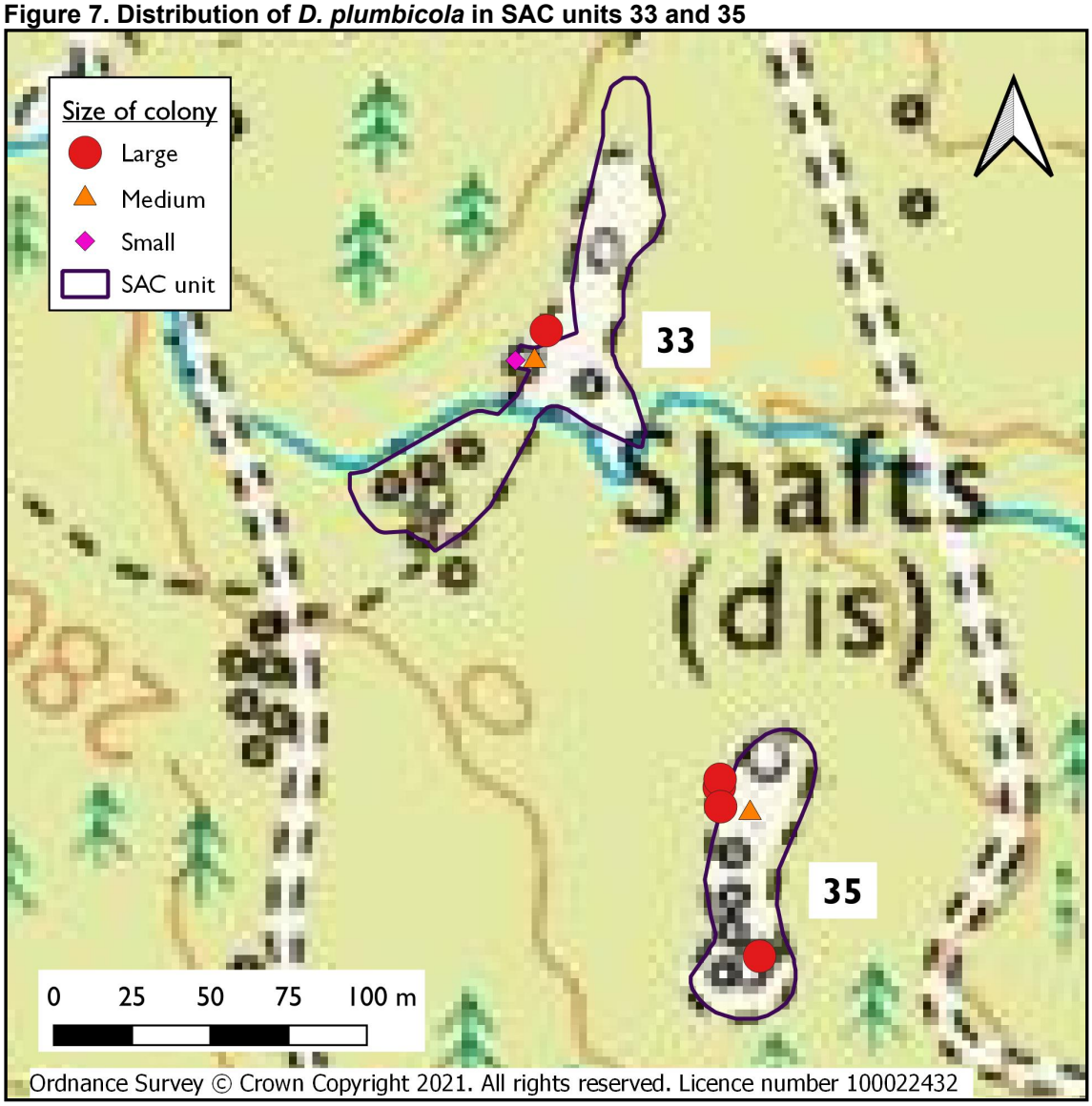


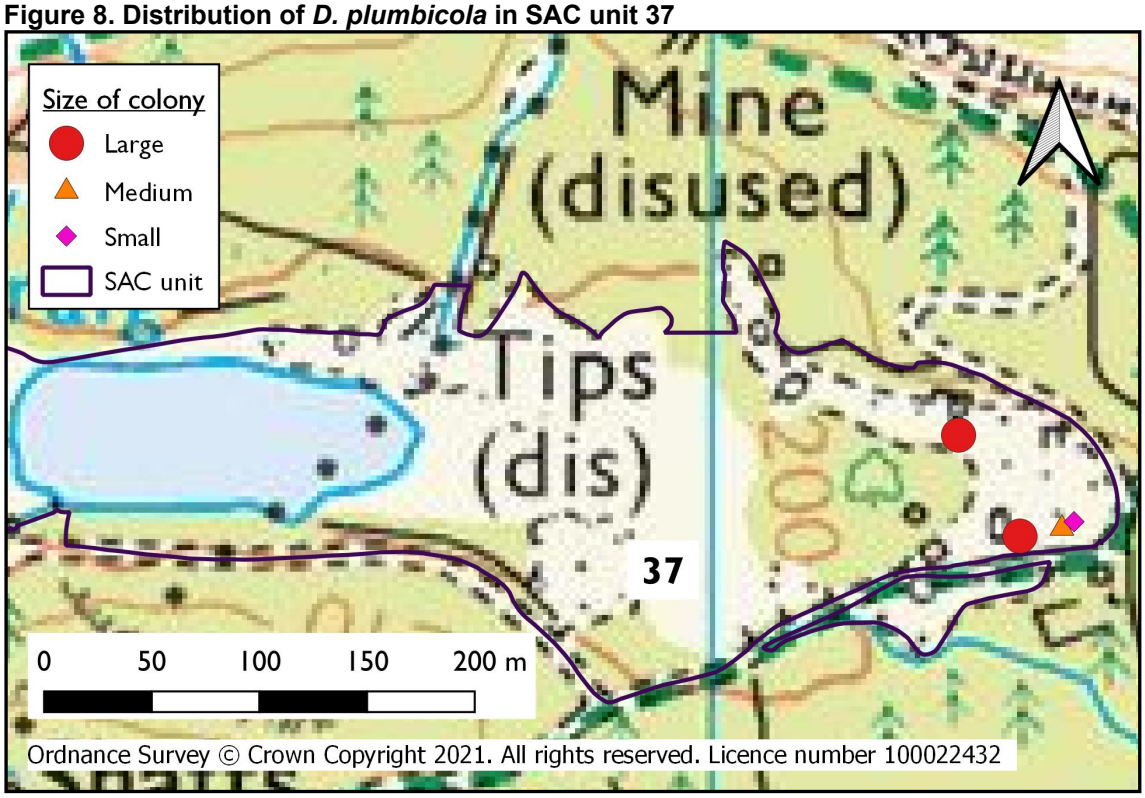
Photo 5: Northern end of Unit 35 - an extensive area of spoil supports abundant *D. plumbicola* on both sides of the fence

Photo 6: Southern end of unit 35. *D. plumbicola* is abundant over approximately 7 x 2m (SH7869559115)

5.1.14. Unit 37 Coed Mawr Pool Mine

For such a large unit, the population of *D. plumbicola* is very small. Nearly all of the spoil is stony and natural succession is advanced, with high cover of *Racomitrium lanuginosum* and *Cladonia* lichens. Little suitable habitat for *D. plumbicola* therefore remains; the colonies are mainly found close to a forestry track at the eastern side of the mine (Figure 8). Around 60 metres north-west, another colony of small patches on a spoil heap close to tall pine trees is at risk from needle drop.

Figure 8. Distribution of *D. plumbicola* in SAC unit 37



5.1.15. Unit 38 Castle Terrace 1

The southern end of this mine (Figure 9) includes some open, fine-grained spoil where there are scattered colonies of *D. plumbicola*. It is succumbing to succession however and supports a sparse grassy dry heath. This does afford shelter to the tiny colonies of *D. plumbicola* found at its edge, although the pine and spruce saplings that have also colonised the spoil present an increasing threat to them.

5.1.16. Unit 39 Castle Terrace 2

This is a small unit (Figure 9) but, for its size, it has a relatively large area of good quality habitat for *D. plumbicola*, which is present here in two discrete colonies. The smaller of these occurs over several metres along the bottom of a small spoil tip (Photo 7) and is threatened by needle drop from nearby conifers. Ten metres from the tip in grassland is a small rectangular patch of

bare, damp sediment (Photo 8) which supports a much more substantial colony, estimated to be around 900cm^2 in total.

Photo 7: Part of a colony scattered along the base of a small spoil heap (SH7904857615)

Photo 8: This small area of nearly bare spoil at SH7904157621 holds c900cm^2 of *D. plumbicola*

5.1.17. Unit 40 Aberllyn Lead Mine 1

Unit 40 is the smallest of the surveyed units (Figure 9) and comprises a single fenced-off shaft (Photo 9) and a few square metres of bare spoil around it. The spoil supports numerous small patches of *D. plumbicola*, both inside and outside the fence. However, this population is vulnerable to shading and leaf drop from conifers nearby and from large bushes of *Ulex europaeus* (Gorse) growing at the mouth of the shaft.

Figure 9. Distribution of *D. plumbicola* in SAC units 38 - 40

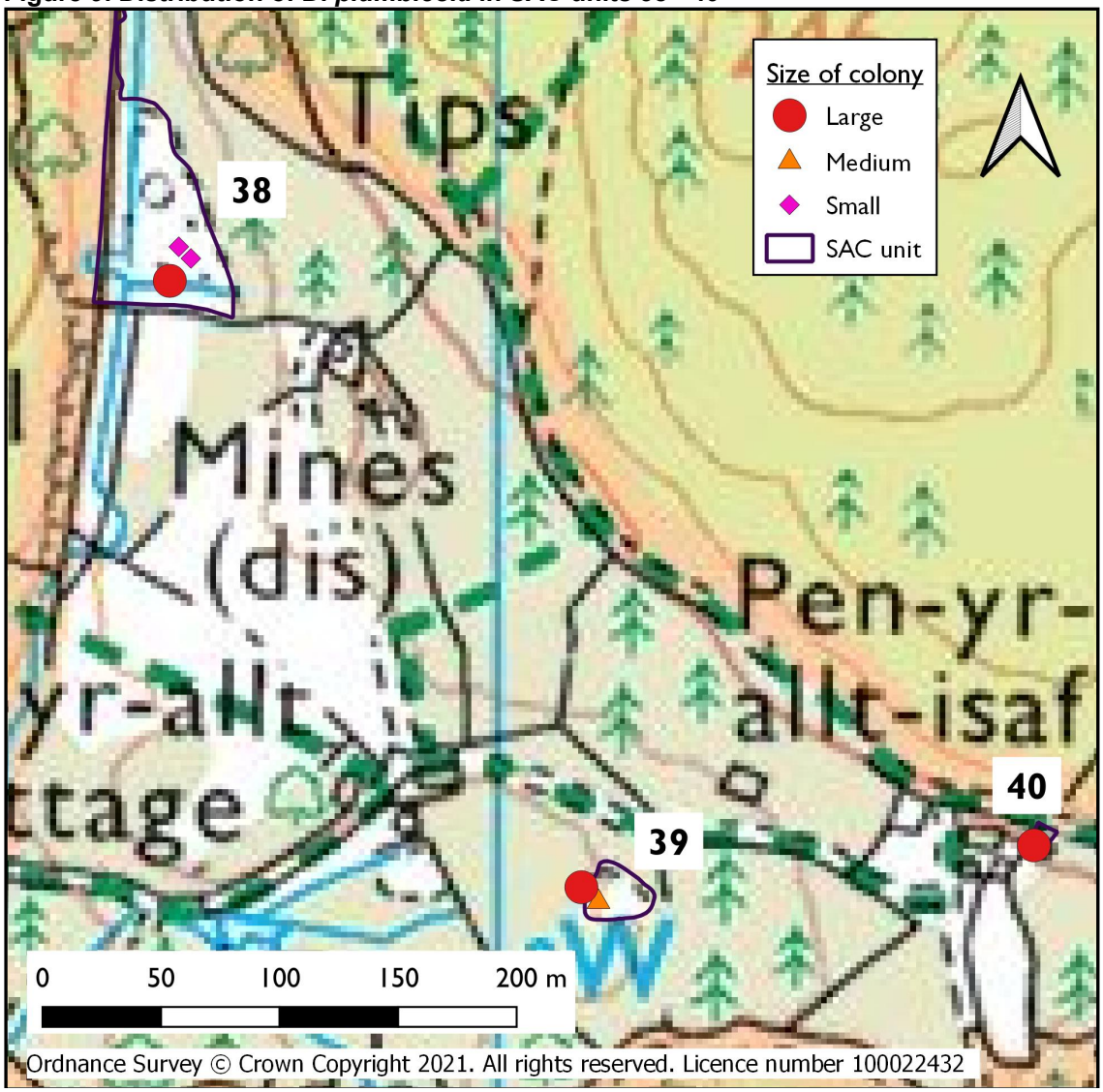


Photo 9: Fenced-off shaft in Unit 40. Most *D. plumbicola* is on the spoil just outside the fence to the right (SH7923257638)

5.1.18. Unit 43 Plas Muriau 1

Little remains of this mine, apart from a few patches of gently sloping spoil crossed by a lightly used foot path. Vegetation succession is advanced and grasses and large common mosses cover much of the spoil. A tiny residual population of *D. plumbicola* grows as several minute patches just above the path. Young birch and spruce trees have colonised the spoil upslope of the population and are likely to become a significant threat as they grow.

6. Conclusions

Gwydyr Forest Mines SAC retains a strong population of *Ditrichum plumbicola*, spread across at least 18 different units. Certain of the units are of exceptional importance for this species, retaining large areas of Calaminarian grassland that is fine-grained and toxic enough to support large and extensive populations. Unit 1 (New Pandora Leadworks), unit 27 (Cyffty Mine), Unit 35 (Forest Enterprise 3) and Unit 39 (Castle Terrace 2) are particularly important sites.

However, the majority of the units support much smaller and/or more localised populations. Some of these are mines where the processes of spoil amelioration and natural succession are advanced and where little good habitat remains e.g., unit 9 (Cefn Maenllwyd), unit 11 (Penllan), unit 33 (Forest Enterprise 1), unit 37 (Coed Mawr Pool Mine), unit 38 (Castle Terrace 1) and unit 43 (Plas Muriau 1).

Of the units where *D. plumbicola* has previously been found, only two – unit 13 (Hafna Lead Mine 1) and unit 44 (Plas Muriau 2) no longer support it, due to loss of open habitat.

Speculative surveys of units where *D. plumbicola* has not been found previously but where Calaminarian grassland might be present failed to find any additional colonies, primarily because the mine remains lacked suitable habitat. However, a single small population was found in a previously unknown locality by a shaft that is not within the SAC or SSSI. It is considered likely that additional colonies will be present in the area, both within and outside the SSSI/SAC.

Other than natural processes, the single main threat to extant colonies of *D. plumbicola* is the proximity of pine, spruce and birch trees, many of which grow as adventive saplings on spoil tips. Leaf/needle drop can smother tiny populations of *D. plumbicola* and amplify the processes of natural succession, whilst shade cast by trees may have a negative impact on colonies.

7. Management Recommendations

Tree and shrub control is needed to protect colonies of *D. plumbicola* in 11 of the SAC units. This work is largely of a small-scale nature and is detailed in Table 3. Because many of the colonies in these sites are tiny and could easily be dislodged by a misplaced boot, it is recommended that works should be supervised by a bryologist.

Table 3. Management recommendations

Unit	Name	Action needed	Gridref of *D. plumbicola*
12	Pen y Gwaith	Fell young pine/spruce trees growing on top of spoil heap above *D. plumbicola*. (Photo 10)	SH7780760178
14	Hafna Lead Mine 2	Fell two pine trees close to the top of the very steep unstable spoil heap where *D. plumbicola* is found. This colony is very vulnerable to dislodging.	SH7800560127
27	Cyffty Mine	Fell pine tree casting needles onto colonies of *D. plumbicola*	SH7711758756
31	Sarnau 2	Fell tall pines at eastern edge of unit casting needles onto spoil. Fell pines overhanging sloping spoil where *D. plumbicola* is found.	SH7803359112 SH7804259121
33	Forest Enterprise 1	Fell saplings growing on heathy spoil east and north of small stone building (Photo 11)	All unit 33 GRs in Appendix I
35	Forest Enterprise 3	Cut back/fell spruce tree very close to colony of *D. plumbicola* just outside enclosure fence.	SH7869159161
37	Coed Mawr Pool Mine	Cut down pine tree(s) immediately to south of *D. plumbicola* colony on slope of spoil tip.	SH7811958454
38	Castle Terrace 1	Cut down pine and spruce saplings growing on heathy spoil on top and sides of tip close to *D. plumbicola* colonies.	All unit 38 GRs in Appendix I
39	Castle Terrace 2	Cut down pine and spruce saplings growing on and below the spoil heap which support *D. plumbicola*.	SH7904857615
40	Aberllyn Lead Mine 1	Clear gorse around mouth of shaft and cut back a spruce adjacent to the fence	SH7923257638
43	Plas Muriau 1	Cut down young birch trees growing 4-5m upslope of *D. plumbicola* (Photo 12)	SH8054357309

In places where the population of *D. plumbicola* is vulnerable to extinction due to lack of habitat, or where a population was until recently present, habitat creation measures also could be considered.

At disused lead mine sites in, for example, the Mendip Hills in Somerset, natural succession of former lead mines has rendered spoil unsuitable for *D. plumbicola*. However, the creation of scrapes has been successful in some areas, stripping off the upper horizons of the spoil and its vegetation and exposing fresh toxic ground. Such scrapes, where they are made on relatively level ground, are only 15-50cm deep, but still provide sufficiently sheltered conditions for *D. plumbicola*. The main limitation of this method in the Gwydyr Forest would be inaccessibility of most SAC units to a mechanical digger, but careful hand-cutting of small scrapes e.g., 1m x 2m in size may be feasible in e.g., units 13, 37 and 43.

Photo 10. Trees/shrubs threatening *D. plumbicola* (red polygon) in unit 12

Photo 11. Conifers on spoil supporting *D. plumbicola* in unit 33 (red polygon)

Photo 12. Unit 43. Birch trees upslope of habitat of *D. plumbicola* (red polygon)

8. References

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9. Appendices

9.1. Confirmed Colonies of *Ditrichum plumbicola*

Site	Gridref	Date	Remarks
SAC unit 1	SH7653362149	13-Oct-21	50cm^2 patch on lip of crumbling stream bank (spoil).
SAC unit 1	SH7653562171	13-Oct-21	c. 30cm^2 in several patches at upper edge of spoil bank above stream,
SAC unit 1	SH7653462189	13-Oct-21	5cm^2 patch.
SAC unit 1	SH7648462173	13-Oct-21	c. 7cm^2 on spoil below granite rocks.
SAC unit 1	SH7651762165	13-Oct-21	20cm^2 patch at edge of bare spoil patch.
SAC unit 1	SH7651462170	13-Oct-21	50cm^2 patch on flat ground.
SAC unit 1	SH7651462177	13-Oct-21	120cm^2 patch at the edge of concrete footings near buildings.
SAC unit 1	SH7652162157	13-Oct-21	At least 8 separate patches totalling c. 60cm^2 on very toxic-looking spoil close to a ruined mine building.
SAC unit 3	SH7660161786	13-Oct-21	15cm^2 in two small patches.
SAC unit 3	SH7659561798	13-Oct-21	15cm^2 on spoil a few metres from edge of shaft.
SAC unit 3	SH7660461803	13-Oct-21	25cm^2 in two patches on eroding sediment trapped between stones on E-facing spoil slope.
SAC unit 3	SH7659661782	13-Oct-21	4cm^2 tiny plants close to shaft head.
SAC unit 3	SH7658261790	13-Oct-21	5cm^2 by shaft.
SAC unit 3	SH7657761790	13-Oct-21	2 x 1cm^2 patches 1m apart, between stones.
SAC unit 4	SH7620561120	13-Oct-21	Several tiny patches totalling c. 3cm^2 on toxic-looking ground at the top of a spoil heap.
SAC unit 9	SH7820960571	12-Oct-21	Several small tufts occupying 2cm^2 area in total on consolidated silt.
SAC unit 9	SH7819860568	12-Oct-21	Around 20cm^2 in total, spread between 6 small patches on flat ground by a line of stones on spoil heap.
SAC unit 9	SH7817460561	12-Oct-21	Near top of bare ground on spoil heap. 5cm^2 total, over one diffuse patch of very small plants.
SAC unit 9	SH7815360553	12-Oct-21	Several small patches on sloping spoil, minute plants. Total area 5cm^2.
SAC unit 10	SH7652559869	13-Oct-21	Single 6cm^2 patch in crevice between stones. There is negligible suitable habitat for D. plumbicola at this site.
SAC unit 11	SH7675860057	13-Oct-21	Single patch 3cm^2 on spoil near shaft head.
SAC unit 11	SH7672260016	13-Oct-21	Single 3cm^2 patch on spoil.
SAC unit 11	SH7672359994	13-Oct-21	4cm^2 in several patches at upper edge of spoil bank by heath.
SAC unit 11	SH7665659966	13-Oct-21	A few small patches totalling c. 3cm^2 on clay between stones above a leat.

Site	Gridref	Date	Remarks
SAC unit 12	SH7780760178	12-Oct-21	Several patches totalling c. 40cm^2 at very top of a prominent steep east-facing spoil heap in a 3m stretch. At interface with vegetation on the top of the heap.
SAC unit 14	SH7800560127	12-Oct-21	1 x 15cm^2 patch on a steep tip in woodland. Succession is well underway and little suitable open habitat remains.
SAC unit 14	SH7810660085	12-Oct-21	Quite extensive patch of tiny plants 120cm^2 on bank above road, with a second patch of 20cm^2 on same bank about 4m away.
SAC unit 27	SH7711758756	12-Oct-21	12cm^2 patch and another 1cm^2 patch about 4m away on very bare ground.
SAC unit 27	SH7714958792	12-Oct-21	300cm^2 in numerous small patches over 10m of bare sediment, good habitat.
SAC unit 27	SH7708158730	12-Oct-21	Several patches of minute plants totalling 10cm^2 at edge of bare gravelly area.
SAC unit 27	SH7711658796	12-Oct-21	Numerous small patches totalling c. 50cm^2 on bare spoil near *Calluna*.
SAC unit 27	SH7712758800	12-Oct-21	Abundant on slope of spoil heap on sediment. 300cm^2 upper slope, at least 40cm^2 more downslope.
SAC unit 27	SH7713558796	12-Oct-21	Numerous patches across many metres. At least 300cm^2.
Cyffty Mine	SH7717158797	12-Oct-21	Fenced off area of levelled mine spoil outside the main mine fence (not in SAC unit 27)). Two small patches about 3m apart, totalling 2cm^2.
SAC unit 29	SH7763359107	13-Oct-21	Single 20cm^2 patch.
SAC unit 29	SH7762659109	13-Oct-21	4-5 patches spread over several metres of sloping ground, total area c. 15cm^2.
SAC unit 29	SH7761559109	13-Oct-21	150cm^2 patch by track.
SAC unit 31	SH7803359112	11-Oct-21	30cm^2 across several patches
SAC unit 31	SH7804259121	11-Oct-21	c. 25cm^2 across several small patches on W-sloping spoil near trees.
SAC unit 31	SH7801159137	11-Oct-21	Patch 20cm^2 on silty bank near water.
SAC unit 31	SH7801659143	11-Oct-21	Several small patches total area 10cm^2 on silty bank near water.
SAC unit 33	SH7861759306	11-Oct-21	Single patch 2cm^2 1m away from foot of mine building on fine spoil.
SAC unit 33	SH7862359306	11-Oct-21	Many small patches on spoil where *Calluna* and mixed tree saplings < 2m high are beginning to encroach. Estimated area of patches 100cm^2.
SAC unit 33	SH7862659315	11-Oct-21	Diffuse patches over an area of approx. 2m x 3m on spoil where it transitions into *Calluna*. Total patch area estimated at 150cm^2.
SAC Unit 35	SH7868259172	11-Oct-21	Around 200cm^2 on gently N-sloping fine spoil spilling outside enclosure fence.
SAC unit 35	SH7869159161	11-Oct-21	Several patches on gently N-sloping fine spoil spilling outside enclosure fence, total 150cm^2.

Site	Gridref	Date	Remarks
SAC unit 35	SH7869159161	11-Oct-21	Several small patches on spoil just outside enclosure fence, estimated area 25cm^2. Close to trees and at risk of needle drop.
SAC unit 35	SH7869559115	11-Oct-21	Numerous small patches on damp, east-sloping spoil outside mine enclosure fence, total estimated 300cm^2 over an area 7m x 2m.
SAC unit 35	SH7868259163	11-Oct-21	Around 200cm^2 on gently N-sloping fine spoil spilling outside enclosure fence.
SAC unit 35	SH7868259163	11-Oct-21	Many small discrete patches totalling around 150cm^2 on gently N-sloping fine spoil within enclosure fence.
SAC unit 37	SH7811958454	11-Oct-21	Around 100cm^2 in an area of about 2m^2 on spoil heap, close to trees. Succession to grasses and other mosses and *Cladonia* spp. is underway.
SAC unit 37	SH7814858407	11-Oct-21	10-15 tiny patches, total around 100cm^2 on a steep, N-facing eroding pit bank.
SAC unit 37	SH7816758410	11-Oct-21	Two small patches totalling 25cm^2 in small area of fine-grained spoil between rocks - natural succession is underway.
SAC unit 37	SH7817358413	11-Oct-21	5cm^2 patch on tiny patch of fine soil between rocky waste. Natural succession threatens.
SAC unit 38	SH7886757877	14-Oct-21	c. 70cm^2 in total from numerous small patches over 5m of sloping spoil.
SAC unit 38	SH7887657886	14-Oct-21	Single patch 1cm^2 on level spoil among scattered *Calluna*.
SAC unit 38	SH7887157891	14-Oct-21	5 patches, totalling around 10cm^2.
SAC unit 39	SH7904157621	14-Oct-21	Habitat is a rectangle 2m x 1m in acid grassland. *D. plumbicola* is abundant, in numerous patches totalling around 900cm^2.
SAC unit 39	SH7904857615	14-Oct-21	Around 10 separate patches over several metres on lower spoil slopes, totalling around 40cm^2.
SAC unit 40	SH7923257638	14-Oct-21	Strong population on bare spoil around shaft head, mostly outside fence, to south and E of shaft. c. 25 discrete patches outside fence and 2 inside, totalling 90cm^2. Area of suitable habitat is very small - around 8m^2 and threatened by scrub and adjacent spruce trees.
SAC unit 43	SH8054357309	14-Oct-21	4 tiny patches totalling 5cm^2 just by lightly-used path. Very little suitable habitat present and is succeeding to vegetation.
Gwydyr Forest	SH7827759233	11-Oct-21	Not in SSSI/SAC. Small patch on SW-facing spoil inside fence at mouth of mine shaft.

9.2. Incidental Records of other Notable Taxa

Taxon	Location	Gridref	Date	Remarks
Asplenium septentrionale	SAC unit 14	SH78066014	11-Oct-21	At least 15 plants growing on mine building wall. Sporangia present.
Bryoerythrophyllum campylocarpum	SAC unit 41	SH79505760	14-Oct-21	On steep minor path in woodland.
Campylopus subulatus	Gwydyr Forest	SH79195765	14-Oct-21	Woodland track.
Ditrichum lineare	SAC unit 4	SH76196112	13-Oct-21	On a clayey bank at bottom of mine.
Ditrichum lineare	Gwydyr Forest	SH78115862	11-Oct-21	On a recently constructed trackside bund.
Noccaea caerulescens	SAC unit 26	SH78805967	14-Oct-21	On spoil heap at top of disused lead mine.
Noccaea caerulescens	SAC unit 25	SH78695983	11-Oct-21	On disused lead mine tips.
Noccaea caerulescens	SAC unit 18	SH78756025	11-Oct-21	Plentiful on disused lead mine tips.
Noccaea caerulescens	SAC unit 15	SH78156000	14-Oct-21	Numerous plants on lead mine spoil.
Noccaea caerulescens	SAC unit 10	SH76525986	13-Oct-21	

Data Archive Appendix

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

The final report in Microsoft Word and Adobe PDF formats.

A series of GIS layers on which the maps in the report are based with a series of word documents detailing the data processing and structure of the GIS layers

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'.

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