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# Oak Saprotrophic Fungi surveys of Chirk Castle, Dinefwr Estate and Gregynog 2021

SDS Bosanquet & Alan Lucas



Evidence Report No 574

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We work to support Wales' economy by enabling the sustainable use of natural resources to support jobs and enterprise. We help businesses and developers to understand and consider environmental limits when they make important decisions.

We work to maintain and improve the quality of the environment for everyone and we work towards making the environment and our natural resources more resilient to climate change and other pressures.

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- Having a well-resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

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## 1. Crynodeb Gweithredol

Yn ystod hydref 2021, arolygwyd tri SoDdGA mewn parcdiroedd yng Nghymru i gofnodi'r ffyngau oedd i'w cael yn eu coed derw marw. Canfuwyd bod cyfanswm o 177 o goed yn dal o leiaf un ffwng saprotroffig, o'r cannoedd o goed a arolygwyd i gyd. Cadarnhawyd bod y tri SoDdGa yn pasio'r trothwy dethol ar gyfer ffyngau pren derw marw a nodwyd yn *Guidelines for Selection of Biological SSSIs* (Bosanquet *et al.* 2018), gyda naw rhywogaeth o ffwng derw saprotroffig wedi'u cofnodi ar ddau safle ac wyth ar y llall. Ymhlith y rhain, mae'r rhywogaeth brin *Buglossoporus quercinus* yn SoDdGA Gregynog. Mae gan Blas Dingestow, nad yw'n SoDdGA, gofnodion o 10 rhywogaeth o ffyngau derw saprotroffig, gan gynnwys y rhywogaeth brin *Podoscypha multizonata*.

Mae ffyngau pren derw marw yn gyffredin yn y tri SoDdGA yn ogystal ag yn safle Plas Dingestow. Dim ond 11 o'r 177 o goed a samplwyd oedd â mwy nag un ffwng ysgwydd (bracket fungus) yn ffrwytho arnynt; presenoldeb *Fistulina hepatica* a *Pseudoinonotus dryadeus* oedd y cyfuniad mwyaf cyffredin yn yr un lle – trwy gyd-ddigwyddiad, dyma'r ddwy rywogaeth fwyaf cyffredin ar y rhan fwyaf o safleoedd.

Gallai gwartheg sy'n pori a gorfaethu fod yn niweidio coed y parcdiroedd hyn, ac mae'n bosib fod hyn yn rhoi cyfleoedd cytrefu i ffyngau pren marw na fyddai ar gael iddynt fel arall. Mae cadw coed marw mawr sydd wedi cwmpo yn bwysig ar gyfer poblogaethau sawl rhywogaeth o ffwng saprotroffig. Nid oes unrhyw dystiolaeth fod y ffyngau saprotroffig hyn yn lladd y coed derw y maen nhw'n tyfu arnynt, ac eithrio achos *Daedalea quercina* yn Dingestow o bosib, ac ni ddylid defnyddio'r arolwg hwn fel esgus i gwmpo neu docio degau o goed mewn parcdiroedd!

## 2. Executive Summary

Three parkland SSSI in Wales were surveyed for their oak deadwood fungi during autumn 2021. A total of 177 trees were found to hold at least one saprotrophic fungus, out of several hundred trees examined overall. All three SSSI are confirmed as passing the selection threshold for oak deadwood fungi set out in the *Guidelines for Selection of Biological SSSIs* (Bosanquet *et al.* 2018), with nine species of oak saprotrophic fungi recorded on two sites and eight on the other. These include the rare species *Buglossoporus quercinus* at Gregynog SSSI. Dingestow Court, which is not a SSSI, has records of 10 species of oak saprotrophic fungi, including the rare species *Podoscypha multizonata*.

Oak deadwood fungi are widespread in all three SSSI as well as at Dingestow Court. Only 11 of the 177 sampled trees had more than one bracket fungus fruiting on them, with co-occurrence of *Fistulina hepatica* and *Pseudoinonotus dryadeus* – coincidentally the commonest two species on most sites – being the most frequent combination.

Both cattle grazing and nutrient enrichment may be damaging the parkland trees, and this potentially provides colonisation opportunities for deadwood fungi that would not otherwise be available. Retaining large fallen deadwood is important for populations of several saprotrophic fungus species. There is no evidence of these saprotrophic fungi killing the oaks that they grow on, except perhaps in the case of *Daedalea quercina* at Dingestow, and this survey should not be used as an excuse to fell or prune 10s of parkland trees!

## 3. Introduction

### 3.1 Background

The *Guidelines for Selection of Biological SSSIs* were revised in the late 2010s, and a new chapter covering non-lichenised fungi was published in 2018 (Bosanquet *et al.*, 2018). This included methods for assessing the relative importance of sites for a range of fungal assemblages, including an assemblage of saprotrophic fungi associated with oak deadwood. Sixteen species make up the assemblage: *Buglossoporus (Piptoporus) quercinus*, *Daedalea quercina*, *Fistulina hepatica*, *Fomitiporia (Phellinus) robusta*, *Fuscoporia (Phellinus) torulosa*, *Fuscoporia (Phellinus) wahlbergii*, *Ganoderma lucidum*, *Ganoderma resinaceum*, *Grifola frondosa*, *Gymnopus (Collybia) fusipes*, *Hymenochaete rubiginosa*, *Laetiporus sulphureus*, *Mycena inclinata*, *Podoscypha multizonata*, *Pseudoinonotus (Inonotus) dryadeus* and *Riopa (Ceriporia) metamorphosa*. These 16 species vary in frequency in Wales.

- Five are reasonably common in Wales: *Fistulina hepatica*, *Hymenochaete rubiginosa*, *Gymnopus fusipes*, *Laetiporus sulphureus* and *Mycena inclinata*.
- Four are widespread but relatively scarce: *Daedalea quercina*, *Ganoderma resinaceum*, *Grifola frondosa* and *Pseudoinonotus dryadeus*.
- *Ganoderma lucidum* has NBN records from five Welsh sites, but none of these is definitively identified.
- *Buglossoporus quercinus* is currently known in Wales from Wentwood (Monmouthshire), Cwm Byddog (Radnorshire) and Gregynog (Montgomeryshire).
- *Fomitiporia robusta* was recorded from Llanyblodwel (Montgomeryshire) in 2000 and from Chirk Castle (Denbighshire) in 2018, although the latter was a misidentification.
- *Podoscypha multizonata* is only known in Wales from Dingestow Court (Monmouthshire).
- *Riopa metamorphosa* has only been recorded from one site in north-east Wales in 1910.
- *Fuscoporia torulosa* and *F. wahlbergii* remain unrecorded from Wales.

Although the distribution and frequency of these oak deadwood fungi is reasonably well known at a national scale, their occupancy of trees at any one site was unknown. Surveys at Dingestow Court suggested that some species, such as *Fistulina hepatica* and *Laetiporus sulphureus*, are relatively widespread whilst others including *Daedalea quercina* and *Ganoderma resinaceum* tend to occupy only a handful of trees on any site.

The current report covers surveys of three of the most important parklands for oak deadwood fungi in Wales, with the aims of documenting tree occupancy on these sites and also relocating some of the rarer species.

### 3.2 Previous surveys

There have been no specialist mycological surveys focussed on oak saprotrophic fungi in Wales, although regular *ad hoc* recording at Dingestow Court (Monmouthshire) by Sam

Bosanquet between 2017 and 2020 revealed 10 species of specialist oak deadwood fungus including the only known Welsh population of *Podoscypha multizonata* (Fig. 1).



Figure 1. *Podoscypha multizonata* at Dingestow Court in 2018 (Sam Bosanquet).

A saproxylic invertebrate survey of Chirk Castle by Keith Alexander in 2018 revealed apparent *Fomitiporia robusta*. Unfortunately, when Alan Lucas relocated the colony he considered its appearance did not match *F. robusta* and he collected a small sample for further checking. The microscope showed it to be *Daedalea quercina*, an identification subsequently confirmed by DNA analysis.

Ray Woods recorded *Buglossoporus quercinus* at Gregynog, and there are NBN records of *Ganoderma resinaceum* from Chirk and Dinefwr.

## 4. Introduction

### 4.1 Survey areas

Three sites (Fig. 2) were selected for survey in 2021 based on the diversity of oak saprotrophic fungi recorded previously from those sites. These were Chirk Castle and Parkland SSSI in Denbighshire, Dinefwr Estate SSSI in Carmarthenshire and Gregynog SSSI in Montgomeryshire. In addition, brief *ad hoc* surveys took place at Dingestow Court in autumn 2021, allowing updated maps for that site to be produced.



Figure 2. Map of Wales showing the four survey areas mentioned in the report

### 4.2 Field survey

Alan Lucas spent two days surveying Chirk Castle Park SSSI and two days surveying Gregynog SSSI in September 2021. Sam Bosanquet surveyed the north-western half of Dinefwr Estate on 11<sup>th</sup> August and the south-eastern half on 20<sup>th</sup> October 2021, with some parts near the centre of the SSSI being covered on both visits. As many mature oak trees as possible were examined during the visits to each site, with several hundred checked overall, and GPS tracks were examined to ensure no significant sections of each site were omitted. However, it was impossible to examine every oak on each site and some fungus colonies will have been missed.

All fungi in the Oak Deadwood Fungi Assemblage were identified macroscopically in the field, although a few additional species were collected for subsequent microscope identification.

## 5. Results

### 5.1 Survey coverage

Survey coverage was considered reasonable at all three sites surveyed in 2021, as well as at Dingestow Court where survey has continued since 2017.

### 5.2 Species recorded

#### 5.2.1 *Daedalea quercina*

One tree and a fallen, decorticated oak trunk at Chirk supported the only *D. quercina* seen during the current survey, although this species also remains on a single moribund oak at Dingestow. Its rarity in the parklands is surprising given its widespread distribution in Britain. The maze-like gills on the underside of the thick, white brackets (Fig. 3) are distinctive.



Figure 3. *Daedalea quercina* at Chirk Castle & Parkland SSSI (Alan Lucas).

#### 5.2.2 *Fistulina hepatica*

This was the most frequently recorded oak deadwood fungus on all three survey sites, as well as at Dingestow Court, with 20 occupied trees at Chirk, 21 at Dinefwr, 28 at Gregynog and 10 at Dingestow. It grew in a wide range of niches, including snapped

branch snags on healthy mature oaks, damaged tree roots, and large fallen oak boughs. Records span a range of dates from early August to late October. The blood-like droplets that ooze out of this red-coloured bracket (Fig. 4) are highly distinctive, as is its soft texture compared with most other oak bracket fungi.



Figure 4. *Fistulina hepatica* at Chirk Castle & Parkland SSSI (Alan Lucas).

### 5.2.3 *Ganoderma resinaceum*

This is a relatively uncommon bracket fungus in Welsh parklands, but was recorded during the current survey at Chirk and Gregynog and also has recent records from Dinefwr and Dingestow. It was noted on six trees at Chirk and four at Gregynog, and its Dingestow records span late July to late October. The orange-buff colouration (Fig. 5) is reasonably distinctive, especially when they have areas of resin-like exudate on their surface, although some colonies may be passed over as another *Ganoderma*.



Figure 5. *Ganoderma resinaceum* at Chirk Castle & Parkland SSSI (Alan Lucas).

#### 5.2.4 *Grifola frondosa*

Only one tree at Chirk and three at Gregynog were found to support *Grifola frondosa* during the September 2021 survey, but this species may be a late fruiter because four of the five colonies recorded at Dinefwr were found during the October survey and just one colony was seen there in August. It is a large and distinctive branched bracket (Fig. 6) and is considered to be uncommon in Wales.

#### 5.2.5 *Gymnopus fusipes*

Two records from Dinefwr and two from Dingestow suggest that this may be a relatively uncommon member of the oak deadwood fungal assemblage, but this may simply be a reflection of its habitat. It tends to grow at the base of trees (Fig. 7) and decays more quickly than most bracket fungi, although it may simply have been ignored during a survey that was primarily focussed on brackets.

#### 5.2.6 *Hymenochaete rubiginosa*

Four records from standing and fallen oak at Dinefwr (Fig. 8) and one from Dingestow may not be a true reflection of the frequency of this crust fungus. Like *Gymnopus fusipes* it may have been ignored because the focus of the survey was on bracket fungi.



Figure 6. *Grifola frondosa* at Gregynog SSSI (Alan Lucas).



Figure 7. decaying *Gymnopus fusipes* at Dinefwr Estate SSSI (Sam Bosanquet).



Figure 8. small *Hymenochaete rubiginosa* at Dinefwr Estate SSSI (Sam Bosanquet).

#### 5.2.7 *Laetiporus sulphureus*

Only a single colony of *Laetiporus* was noted at Gregynog, but this species occupied six trees at Chirk and Dinefwr and four at Dingestow. Most fruitbodies were noted on standing trees, typically where a branch has snapped off, but one at Chirk and two at Dinefwr were on fallen branches. The yellow colour of this branched bracket (Fig. 9) is highly distinctive.

#### 5.2.8 *Meripilus giganteus*

This large, branched bracket (Fig. 10) is not part of the oak deadwood fungi assemblage, although it does score for the beech deadwood assemblage. Nevertheless, it was noted on five oaks at Chirk and six oaks at Gregynog during the current survey.

#### 5.2.9 *Mycena inclinata*

Clusters of this small bonnet fungus (Fig. 11) were noted on oak stumps and trunks at five localities in Dinefwr Estate SSSI, as well as twice at Dingestow Court. This species fruits relatively late in the year and was probably missed on the August visit to Dinefwr and perhaps also on the September visits to Chirk and Gregynog, although it may also have been ignored because the focus of the survey was on bracket fungi.



Figure 9. *Laetiporus sulphureus* at Chirk Castle & Parkland SSSI (Alan Lucas).

#### 5.2.10 *Pseudoinonotus dryadeus*

Oozing droplets of amber coloured liquid make this one of the most striking looking oak deadwood fungi (Fig. 12). It was the second commonest oak deadwood fungus at Chirk, occurring on 17 trees, as well as at Gregynog and Dingestow, with 7 occupied oaks at both. Only at Dinefwr did it appear to be rare, with records from only two oak trees.



Figure 10. *Meripilus giganteus* at Chirk Castle & Parkland SSSI (Alan Lucas)



Figure 11. *Mycena inclinata* at Dinefwr Estate SSSI (Sam Bosanquet)



Figure 12. *Pseudoinonotus dryadeus* at Dinefwr Estate SSSI (Sam Bosanquet).

### 5.3 Habitat notes and management issues

On the face of it, the extensive grazing management with no fertiliser inputs that is currently carried out at all three sites surveyed in 2021 as well as at Dingestow Court seems to be allowing the oak deadwood fungi to thrive. Large deadwood is allowed to lie below trees on all sites, which is important both for saproxylic invertebrates and for saprotrophic fungi.

Eutrophication by reactive nitrogen compounds has been shown to damage mycorrhizal fungi (Lilleskov *et al*, 2011) but the impact of such enrichment on saprotrophs that feed within trees is unknown. Observations at Dingestow Court suggest that the combination of cattle dunging and trampling around parkland oaks may actually be damaging them in such a way that saprotrophic fungi can colonise, especially where cattle trampled roots support *Fistulina hepatica*.

The only oak that currently supports *Daedalea quercina* at Dingestow is moribund, perhaps because of the fungus, and some moribund oaks at Dinefwr held *Fistulina hepatica* or *Laetiporus sulphureus*. Unless there is a safety imperative it is important that moribund and standing dead oaks are left standing to allow fungi and other biodiversity to utilise them, rather than being felled. Large fallen deadwood was seen to support *Daedalea* at Chirk as well as *Fistulina* (Fig. 13), *Laetiporus*, *Hymenochaete rubiginosa* and *Mycena inclinata* at Dinefwr.



Figure 13. fallen oak trunk supporting *Calocera cornea* (foreground) and *Fistulina hepatica* (background) in Dinefwr Estate SSSI (Sam Bosanquet).

## 6. Discussion

### 6.1 SSSI Feature Selection

Bosanquet *et al.* (2018) state that any site reaching or exceeding the selection threshold of eight of the 16 listed oak specialist fungi should be considered for notification as a SSSI. None of the three principal survey sites pass the threshold based solely on records from the current survey, but historic records from NBN indicate that all three sites reach the threshold of 8 oak specialist fungi, as does Dingestow Court. As mentioned above, *Gymnopus fusipes*, *Hymenochaete rubiginosa* and *Mycena inclinata* were not recorded at Chirk or Gregynog, perhaps because of the timing of the survey, but they are assumed still to be present when older records exist. The rarer species recorded historically from these sites may no longer be extant however.

Full assessment of the three sites and Dingestow Court shows that all four reach the SSSI threshold. Given that *Hymenochaete rubiginosa* seems almost guaranteed to be present at both Chirk and Gregynog, there appears to be a set of nine oak deadwood fungi species that occur on SSSI quality Welsh parkland that includes the relatively uncommon *Daedalea quercina*, *Ganoderma resinaceum*, *Grifola frondosa* and *Pseudoinonotus dryadeus*. A single rarer species highlights the importance of two sites: *Buglossoporus quercinus* at Gregynog and *Podoscypha multizonata* at Dingestow; at present Chirk and Dinefwr lack any really rare oak saprotrophic fungal species.

The SSSI boundary at Gregynog includes only the Great Wood and Warren, and many trees supporting oak deadwood fungi are outside the current SSSI. Notification of an expanded Gregynog SSSI may therefore be justified. In addition, the parkland at Dingestow Court, which has the highest Welsh total for oak deadwood fungi, is not yet a SSSI.

Table 1. representation of scoring fungal species for the oak deadwood fungi assemblage on three Welsh SSSI and at Dingestow Court, based on records from this survey and others made since 2000.

Species	Dingestow Court	Dinefwr Estate SSSI	Gregynog SSSI	Chirk Castle & Parkland SSSI
<i>Buglossoporus quercinus</i>	Not recorded	Not recorded	Recent	Not recorded
<i>Daedalea quercina</i>	Recent	Recent	Recent	This survey
<i>Fistulina hepatica</i>	Recent	This survey	This survey	This survey
<i>Ganoderma resinaceum</i>	Recent	Recent	This survey	This survey
<i>Grifola frondosa</i>	Recent	This survey	This survey	This survey
<i>Gymnopus fusipes</i>	Recent	This survey	Recent	Recent
<i>Hymenochaete rubiginosa</i>	Recent	This survey	Not recorded	Not recorded
<i>Laetiporus sulphureus</i>	Recent	This survey	This survey	This survey
<i>Mycena inclinata</i>	Recent	This survey	Recent	Recent
<i>Podoscypha multizonata</i>	Recent	Not recorded	Not recorded	Not recorded
<i>Pseudoinonotus dryadeus</i>	Recent	This survey	This survey	This survey
<b>Total:</b>	<b>10</b>	<b>9</b>	<b>9</b>	<b>8</b>

## 6.2 Distribution within sites

Little or no obvious patterning is visible in the distribution of trees supporting oak deadwood fungi on the three parklands surveyed in 2021 (Figs. 15-20). The only potential pattern is that *Fistulina hepatica* extends into the more intensively cultivated parkland south-west of Dingestow Court whereas *Pseudoinonotus dryadeus* is restricted to the core, grazed parkland (Fig. 14): a pattern which is more or less repeated at Chirk and Dinefwr but falls flat at Gregynog where *Fistulina* is frequent in the Great Wood.

Different species clearly occupy different trees, and there is minimal overlap. Of the 177 oaks studied across the four sites, only 11 held more than one species of bracket fungus (with *Gymnopus*, *Hymenochaete* and *Mycena* excluded): 4 *Fistulina* and *Pseudoinonotus*, 2 *Fistulina* and *Laetiporus*, 2 *Ganoderma resinaceum* and *Pseudoinonotus*, 1 *Fistulina* and *Grifola*, 1 *Ganoderma resinaceum* and *Podoscypha*, and one remarkable tree at Chirk with *Fistulina*, *Grifola* and *Laetiporus*!

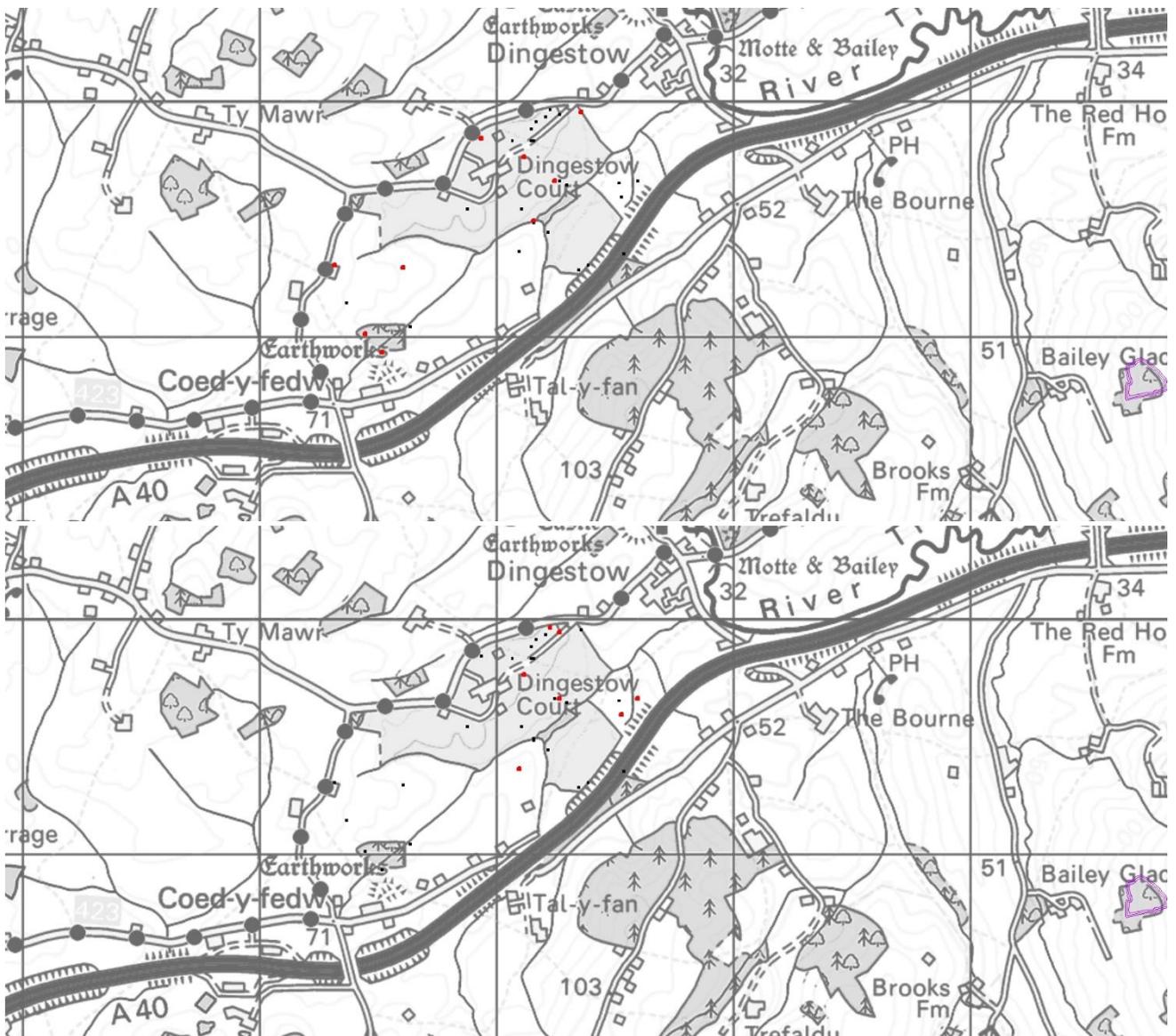


Figure 14. Maps of *Fistulina hepatica* (top) and *Pseudoinonotus dryadeus* (bottom) at Dingestow Court.

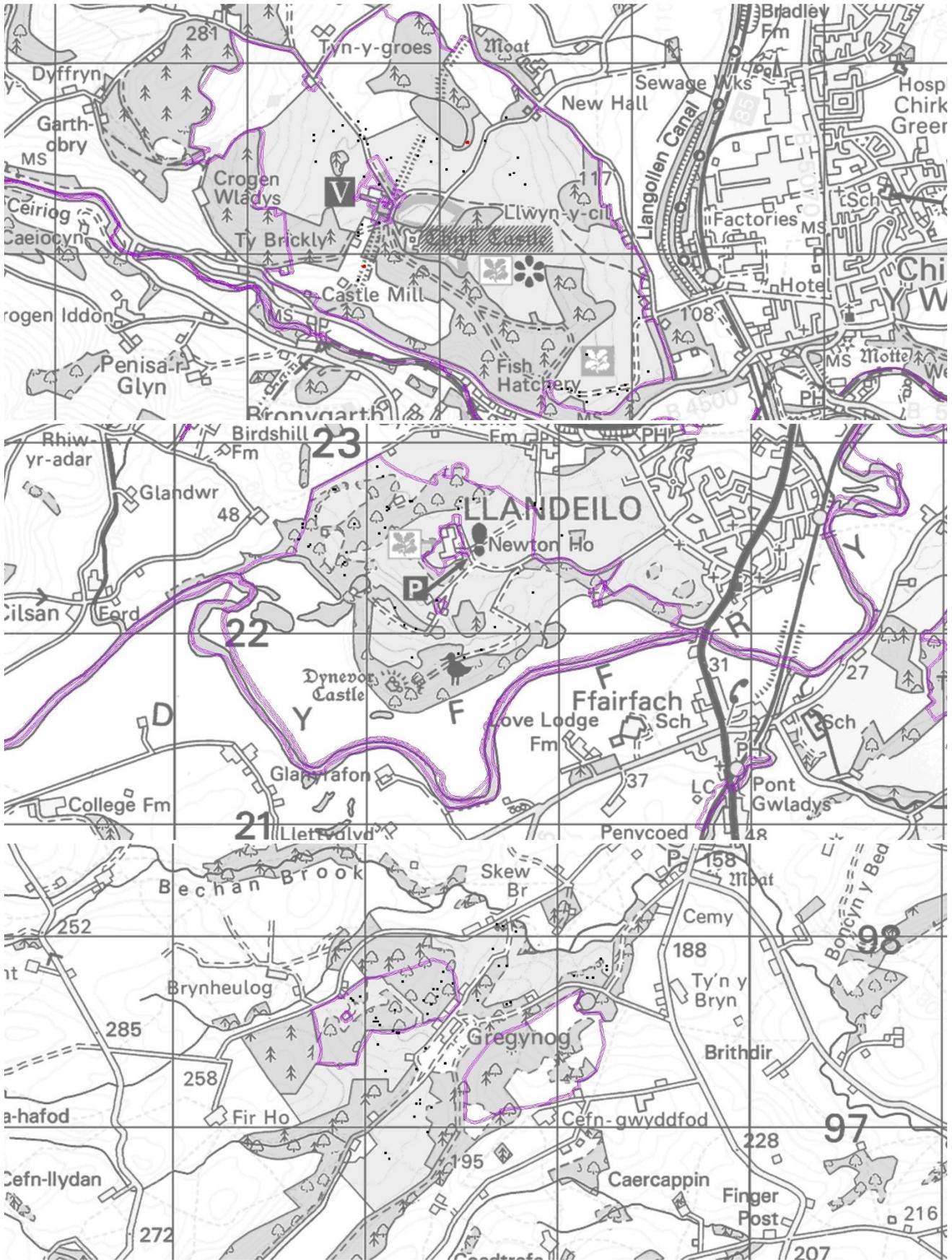


Figure 15. Maps of *Daedalea quercina* at Chirk, Dindefwr and Gregynog.

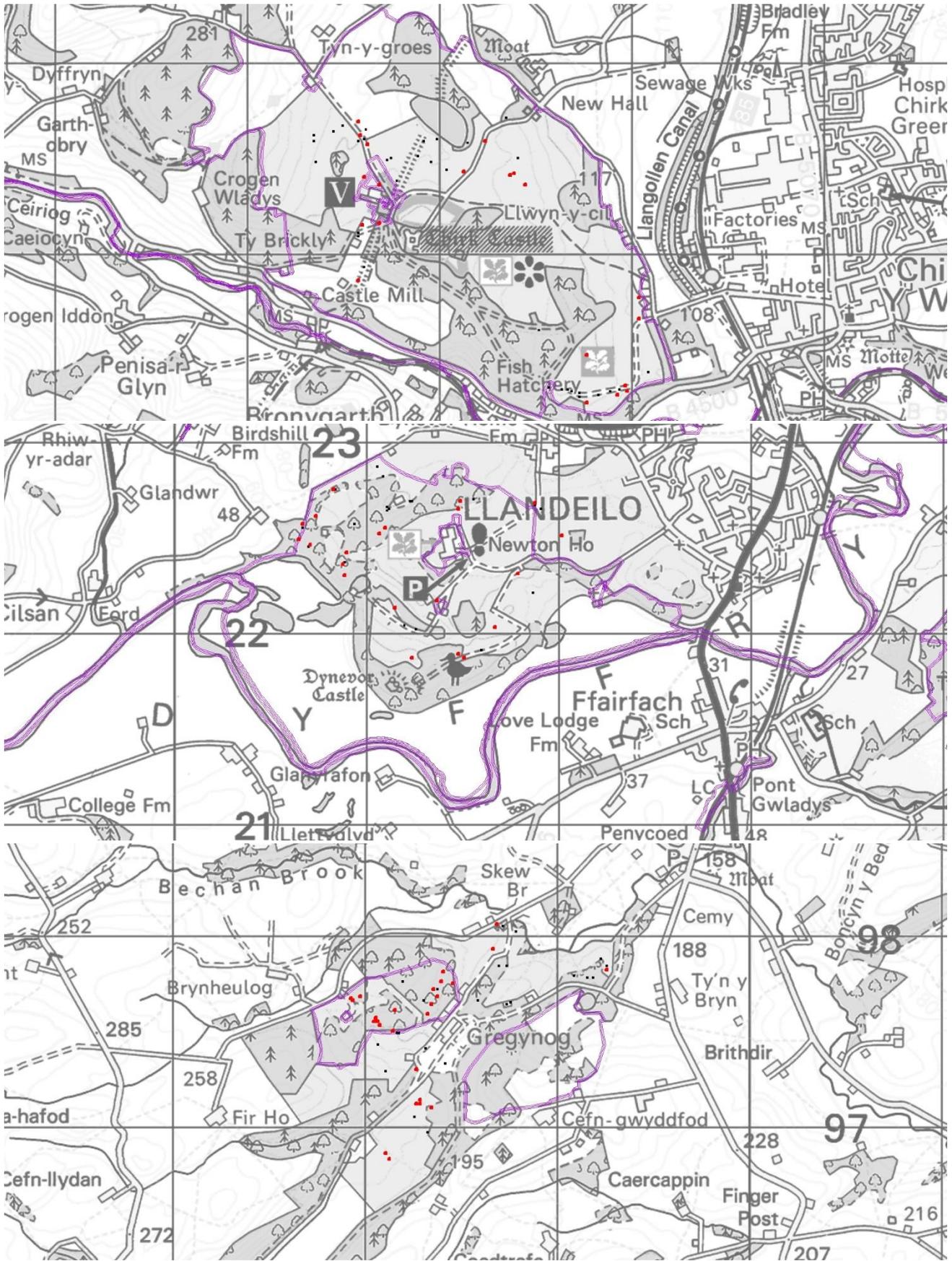


Figure 16. Maps of *Fistulina hepatica* at Chirk, Dinefwr and Gregynog.

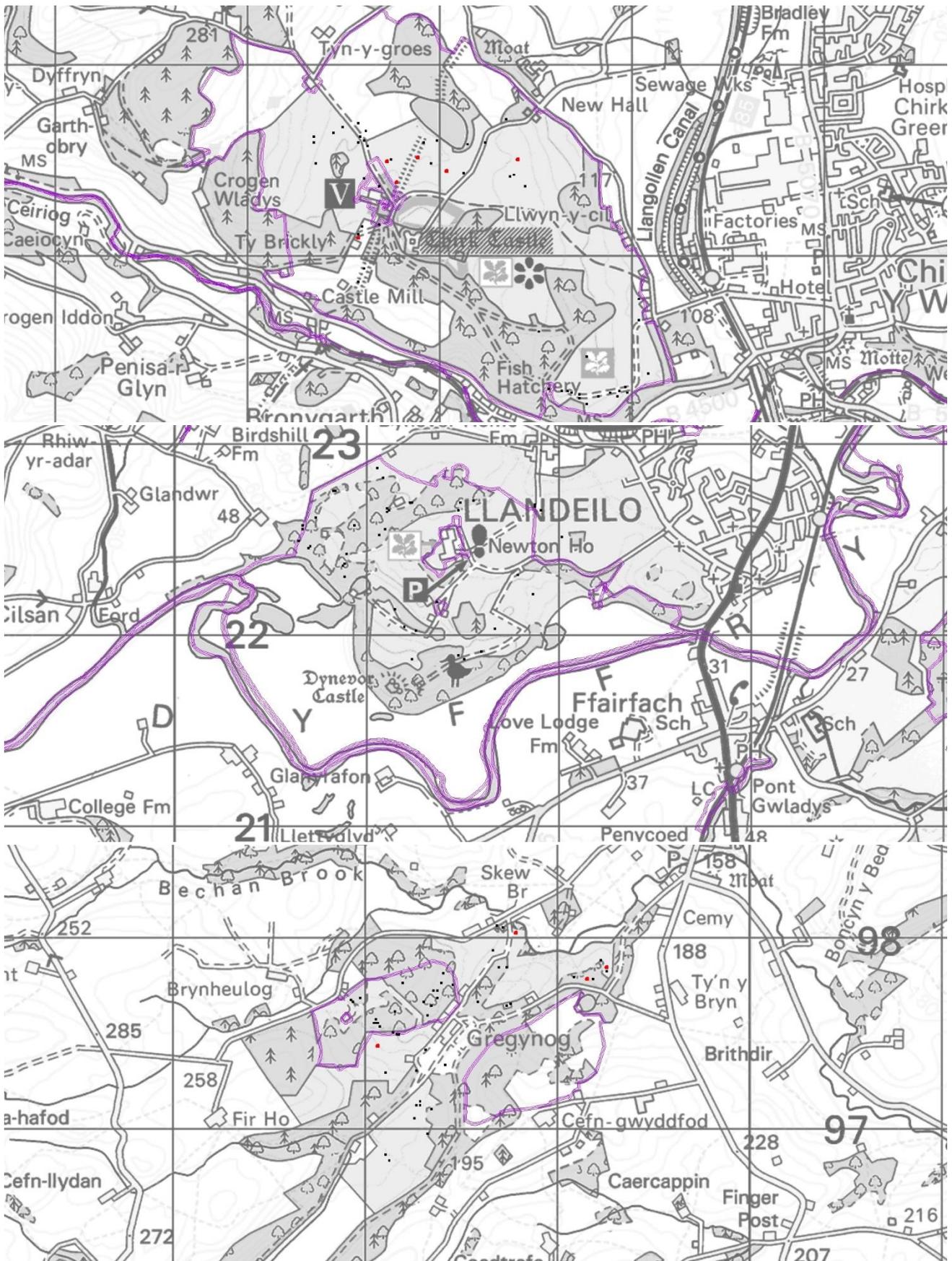


Figure 17. Maps of *Ganoderma resinaceum* at Chirk, Dinewr and Gregynog.

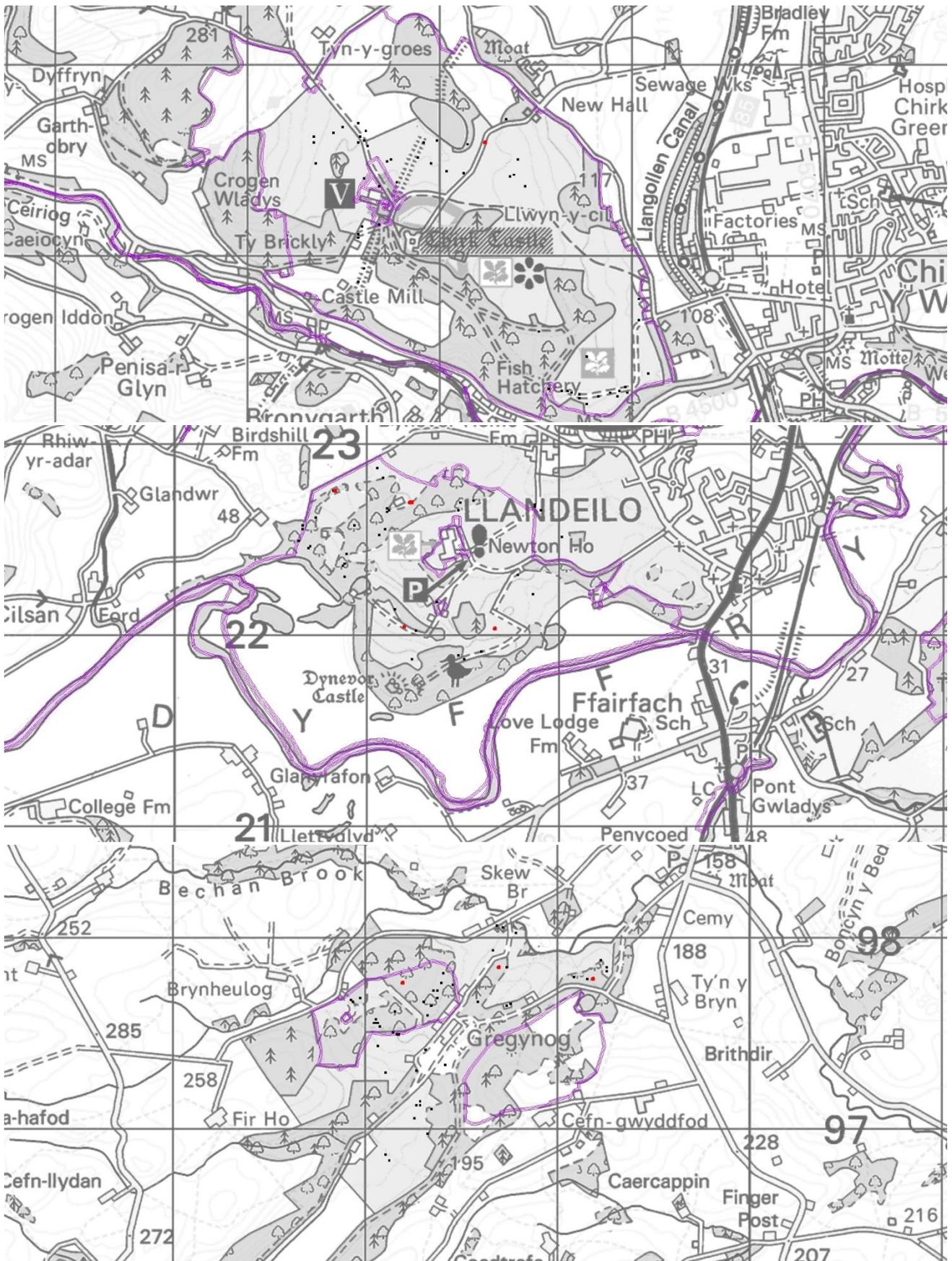


Figure 18. Maps of *Grifola frondosa* at Chirk, Dinewr and Gregynog.

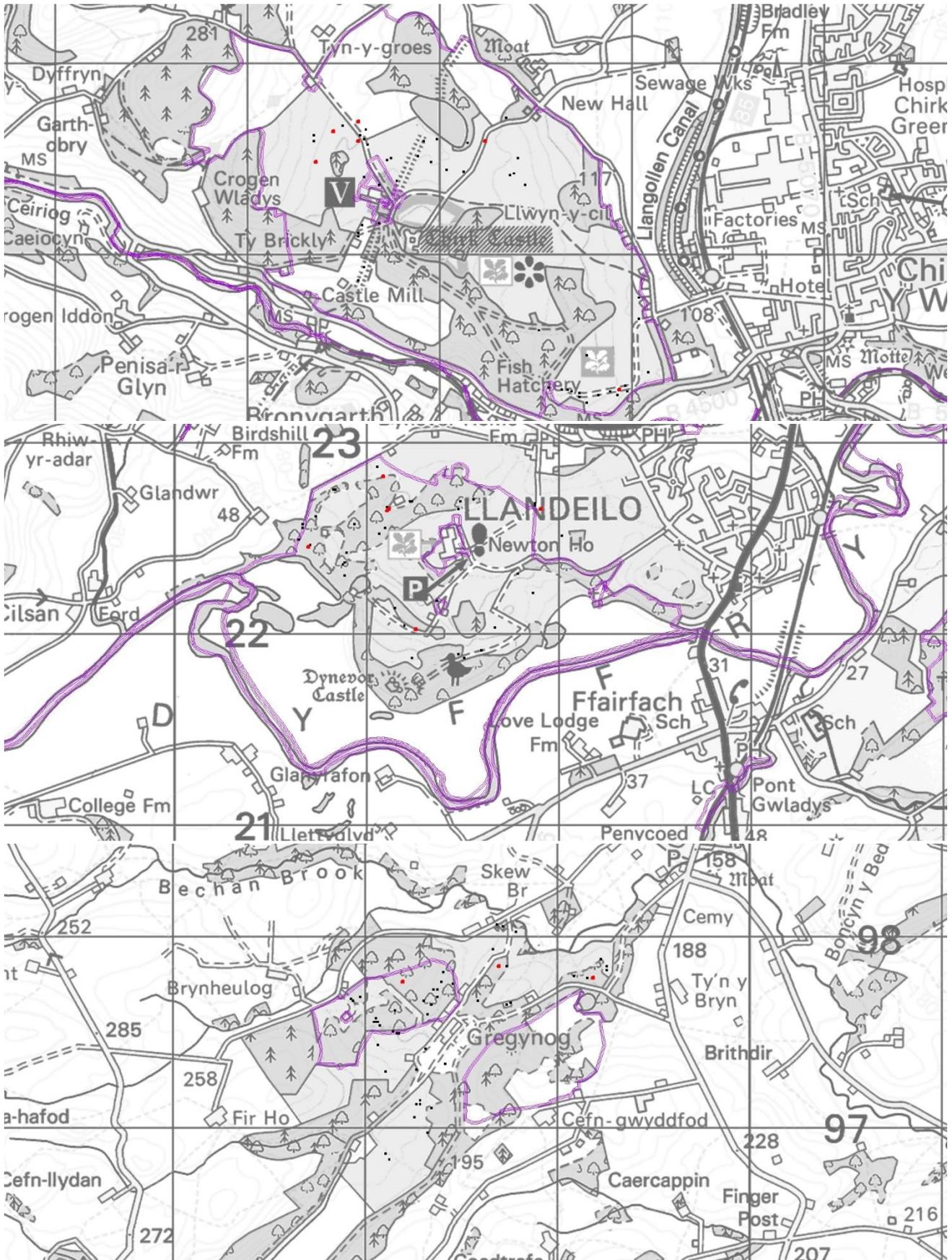


Figure 19. Maps of *Laetiporus sulphureus* at Chirk, Dinefwr and Gregynog.

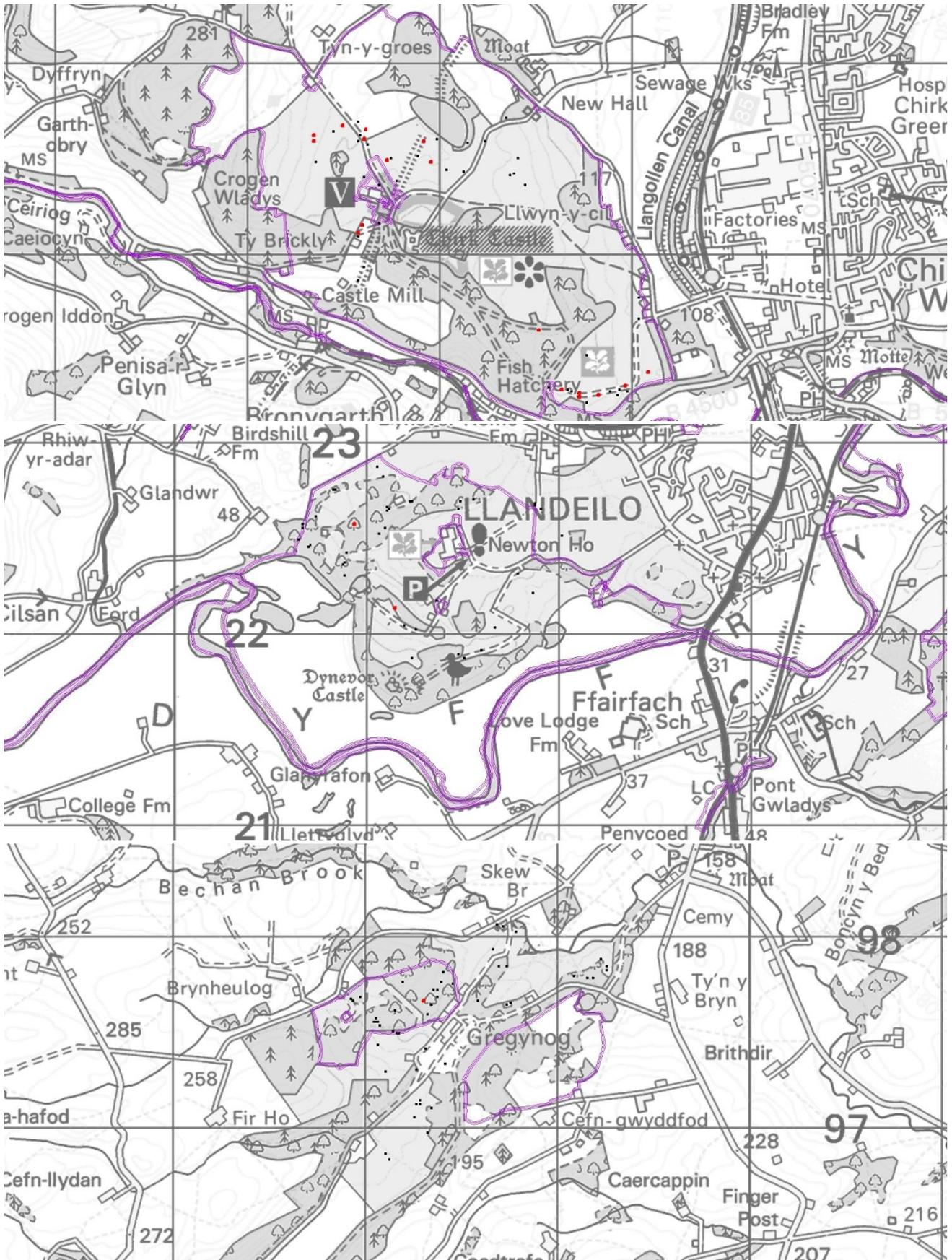


Figure 20. Maps of *Pseudoinonotus dryadeus* at Chirk, Dinefwr and Gregynog.

## 7. Conclusions

Three parkland SSSI in Wales are confirmed as passing the selection threshold for oak deadwood fungi set out in the *Guidelines for Selection of Biological SSSIs* (Bosanquet *et al.* 2018). Two have nine species of oak saprotrophic fungi recorded, including the rare species *Buglossoporus quercinus* at Gregynog SSSI, whilst Chirk Castle & Parkland SSSI holds eight indicator species. Dingestow Court, which is not a SSSI, has records of 10 species of oak saprotrophic fungi, including the rare species *Podoscypha multizonata*.

Oak deadwood fungi are widespread in all three SSSI as well as at Dingestow Court, but there are no obvious distribution patterns across the sites. The older oaks at Chirk, Dinefwr and Gregynog do not generally appear to support more diverse saprotrophic fungi than the 100- to 200-year-old oaks on those sites and at Dingestow. Only 11 of the 177 sampled trees had more than one bracket fungus fruiting on them, with co-occurrence of *Fistulina hepatica* and *Pseudoinonotus dryadeus* – coincidentally the commonest two species on most sites – being the most frequent combination.

Both cattle grazing and nutrient enrichment may be damaging the parkland trees, and this potentially provides colonisation opportunities for deadwood fungi that would not otherwise be available. Retaining large fallen deadwood is important for populations of several saprotrophic fungus species.

## Acknowledgements

Thankyou to local NRW staff for arranging survey permissions.

## Bibliography

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## 8. Appendices

The Appendices have been removed to comply with Accessibility legislation because they comprise complex multi-entry data tables with numerous blanks cells and/or photographs for use during on-site monitoring. They are available in full from the NRW Library.

## Data Archive Appendix

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

The data archive contains:

The final report in Microsoft Word and Adobe PDF formats.

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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