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Saproxylic invertebrates at Carn Gafallt RSPB Reserve in 2022

Natur am Byth! Evidence Report No. 005

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1. Crynodeb Gweithredol

Cynhaliwyd arolwg o infertebratau pren marw (saprotylig) Gwarchodfa RSPB Carn Gafallt dros bedwar diwrnod yn 2022. Mae'r gwaith hwn yn rhan o Natur am Byth! prosiect partneriaeth, sy'n ceisio hyrwyddo adferiad amrywiaeth o rywogaethau allweddol yng Nghymru. Roedd arolwg Carn Gafallt yn cynnwys amrywiaeth o dechnegau chwilio â llaw a gosod pum trap asgellog a roddwyd ar waith rhwng Mai a Medi 2022.

Mae'r arolwg wedi dangos bod Carn Gafallt yn cynnal ffawna di-asgwrn-cefn saprotylig amrywiol iawn sy'n cynnwys nifer o rywogaethau prin. Y casgliad o infertebratau saprotylig yw'r pwysicaf o'i fath sy'n hysbys yng Nghymru. Mae hyn yn adlewyrchiad o'r nifer fawr o goed hynafol (Derw Digoes yn bennaf) sydd yma a phresenoldeb cynefinoedd porfa coed sy'n creu'r microhinsawdd cymharol gynnes, sych sy'n cael ei ffafrio gan lawer o'r rhywogaethau di-asgwrn-cefn saprotylig prinnach. O ganlyniad i'r arolwg hwn, **y Mynegai Parhad Ecolegol (IEC) ar gyfer Carn Gafallt yw 29 a'r Mynegai Ansawdd Safle (SQI) yw 387.8**. Mae hyn yn cymharu'n ffafriol ag asesiadau diweddar o Barc Castell y Waun yn Sir Ddinbych (Alexander, 2019) a Gregynog yn Sir Drefaldwyn (Alexander, 2023).

Mae'r casgliad o bwysigrwydd cenedlaethol sy'n bresennol yn cynnwys cynrychiolaeth lawer cryfach o rywogaethau sy'n gysylltiedig â phydredd calon a saprotylig sy'n gysylltiedig â ffyngau, sy'n adlewyrchu'r niferoedd da o goed hynafol sydd â ffyngau sy'n pydru'r galon fel Cyw Iâr y Coed *Laetiporus sulphureus* a Beefsteak Fungus *Fistulina hepatica*. Mae'r ffawna di-asgwrn-cefn saprotylig hefyd yn cynnwys rhywogaethau fel y Chwilen Gardinal Brin *Schizotus pectinicornis* a'r chwilen grwydr *Bolitochara mulsanti*, sydd ar neu'n agos iawn at eu terfynau dosbarthiad deheuol yma. Mae'r rhywogaethau hyn yn rhan o gasgliad nodedig a phwysig o safleoedd pren marw yng ngogledd a gorllewin Prydain a gynrychiolir orau yng Nghymru yn y coed derw hynafol a'r porfeydd coediog ar hyd cyrion dwyreiniol Mynyddoedd Cambria. Carn Gafallt yw'r enghraifft orau o'r gymuned hon.

Mae rheolaeth gan yr RSPB wedi gwella cyflwr Carn Gafallt ar gyfer infertebratau saprotylig yn sylweddol ers arolwg cynharach gan yr awdur (Boyce, 2014). Rhoddir mesurau rheoli sydd â'r nod o wella ymhellach y casgliad o infertebratau saprotylig o bwysigrwydd cenedlaethol yma dros y tymor hwy.

2. Executive Summary

A survey of the dead wood (saproxylic) invertebrate fauna of the Carn Gafallt Royal Society for the Protection of Birds (RSPB) Reserve was undertaken over four man-days in 2022. This work is part of the Natur am Byth! partnership project, which aims to promote the recovery of a range of key species in Wales. The Carn Gafallt survey involved both a range of hand-searching techniques and the installation of five vane traps that were operated between May and September 2022.

The survey has shown Carn Gafallt to support a very diverse saproxylic invertebrate fauna that includes a number of scarce species. The saproxylic invertebrate assemblage is the most important of its type known in Wales. This is a reflection of the large number of veteran trees (mostly Sessile Oaks) here and the presence of wood-pasture habitats that create the relatively warm, dry microclimate favoured by many of the scarcer saproxylic invertebrate species. As a consequence of this survey, **the Index of Ecological Continuity (IEC) for Carn Gafallt is 29 and the Site Quality Index (SQI) is 387.8**. This compares favourably to recent assessments of Chirk Castle Park in Denbighshire (Alexander, 2019) and Gregynog in Montgomeryshire (Alexander, 2023).

The nationally important assemblage present includes a much stronger representation of heart-rot- and saproxylic fungi-associated species, which reflects the good numbers of ancient trees with heart-rotting fungi such as Chicken-of-the-woods *Laetiporus sulphureus* and Beefsteak Fungus *Fistulina hepatica*. The saproxylic invertebrate fauna also includes species such as the Scarce Cardinal Beetle *Schizotus pectinicornis* and the rove beetle *Bolitochara mulsanti*, which are at or very close to their southern distributional limits here. These species are part of a distinctive and important assemblage of dead wood sites in northern and western Britain that is best represented in Wales in the ancient oak woods and wood-pastures along the eastern fringe of the Cambrian Mountains. Carn Gafallt is the best example of this community.

Management by the RSPB has considerably improved the condition of Carn Gafallt for saproxylic invertebrates since an earlier survey by the author (Boyce, 2014). Management measures are given that aim to further enhance the nationally important saproxylic invertebrate assemblage here over the longer term.

3. Introduction

Over the summer of 2022, the author was contracted by Buglife Cymru to carry out an invertebrate survey of Carn Gafallt and Gilfach Nature Reserves. This report is concerned with the former site, the latter being covered by a separate report (Boyce, 2023). Carn Gafallt lies in the county of Powys, mid-Wales (vice-county [vc] 42, Brecknock). The main emphasis of the contract was to assess the importance and condition of the saproxylic (dead wood) invertebrate assemblage of the site.

This work forms part of an extensive programme funded through the Natur am Byth! project. It is a Wales-wide species recovery project that is being developed by a number of eNGOs and is planning species recovery work for 66 species at risk in Wales from coastal waters to upland crags. More information on the project can be found at the link below (<https://naturalresources.wales/about-us/our-projects/nature-projects/natur-am-byth/?lang=en>).

The survey site is situated on generally steep to moderate north-facing aspects above the Afon Elan (River Elan). A central grid reference for the main block of wooded land at Carn Gafallt that has been the focus of this study approximates to SN934649. All the land surveyed this year is owned and managed by the Royal Society for the Protection of Birds (RSPB). In addition to being a nature reserve, the areas of woodland and wood-pasture are part of the Carn Gafallt Site of Special Scientific Interest (SSSI), which includes the extensive stands of upland heath, grassland, ffridd and woodland to the south of the survey site. The wooded areas are also an element of the Coetiroedd Cwm Elan (Elan Valley Woodlands) Special Area of Conservation (SAC). Figure 1 shows the location of the survey site, which largely corresponds to those areas of the SAC lying within the RSPB reserve.

The SAC is designated for the presence here of extensive stands of old Sessile Oak *Quercus petraea* woodland with Holly *Ilex aquifolium* and Hard Fern *Blechnum spicant*, which is an Annex 1 priority SAC habitat. In National Vegetation Classification (NVC, Rodwell, 1991) terms, this woodland is generally referable to either the W11 Sessile Oak - Downy Birch *Betula pubescens* - Wood Sorrel *Oxalis acetosella* or the W17 Sessile Oak - Downy Birch - *Dicranum majus* woodland communities. The canopy is dominated by Sessile Oak with some Downy Birch and Silver Birch *Betula pendula* in the sub-canopy and a sparse shrub layer of Holly, Rowan *Sorbus aucuparia* and Hazel *Corylus avellana*. The field and ground layers are dominated by acidophilous species such as Common Bent *Agrostis capillaris*, Sweet Vernal-grass *Anthoxanthum odoratum*, Wavy Hair-grass *Deschampsia flexuosa*, Tormentil *Potentilla erecta*, Bilberry *Vaccinium myrtillus* and a range of pleuocarpous mosses, including *Dicranum majus*.

The largest block of ancient oak woodland on the RSPB's Carn Gafallt Reserve runs around its western edge, above Elan Village. This block includes Cwm yr Esgob (Survey Unit 1), Cnwch Wood (Survey Unit 2), Allt Ddu (Survey Unit 3) and Bedw Caemelyn (Survey Unit 5). The woodland structure here is a mix of informal and under-managed wood-pasture and closed-canopy oak woodland that shows evidence of past coppicing. There are scattered over-mature and veteran Sessile Oak specimens scattered throughout, especially in the informal wood-pasture of

Cwm yr Esgob (see Figure 3). There are also a few over-mature Ash *Fraxinus excelsior* trees on the lower slopes of this unit, immediately above Elan Village. Throughout the reserve, specimens of the latter are showing clear evidence of infection with the Ash Dieback fungus *Hymenoscyphus fraxineus*. The canopy is predominantly closed, but there are some patches of open space dominated by Bracken *Pteridium aquilinum* and acid grassland. Additionally, this woodland block includes the small area of more 'formal' wood-pasture, which lies to the west of Caemelyn (survey unit 4). This is much more open in character, with scattered veteran oaks (see Figure 2), as well as one or two Ash and some old birch trees, amongst Bracken and acid grassland. The vast majority of the veteran trees present on the Reserve are located in these five survey areas, and they are the source of most previous records of important saproxylic invertebrates. The 2022 survey has therefore been confined to these parts of Carn Gafallt.

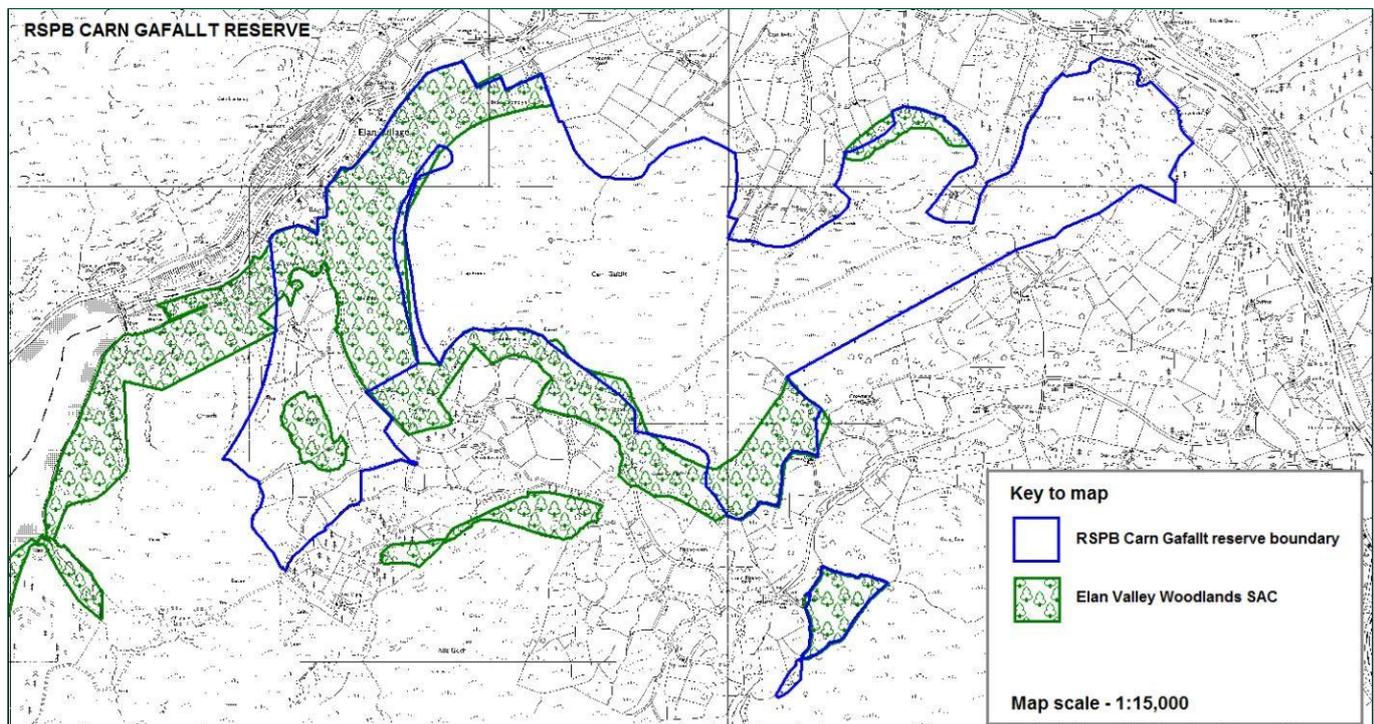


Figure 1. Carn Gafallt RSPB reserve and Elan Valley Woodlands SAC boundaries.

The additional isolated blocks of woodland owned by RSPB that were included in an earlier invertebrate survey of the site in 2013-14 (survey units 6, 7 and 8 on Figure 5) have not been surveyed this year. This is because these areas lacked significant numbers of over-mature or veteran trees and were therefore unlikely to add significantly to our understanding of the saproxylic invertebrate fauna here. Both fallen and standing dead wood are abundant with most of this being Sessile Oak. However, there are also significant quantities of dead and dying birch and a little Ash.

Dead wood habitat features such as red-rotten heartwood, sapwood decay and bracket fungi are all well-represented, though the exceptionally hot, dry conditions over the spring and summer of 2022 had limited the growth of fungal fruiting bodies. The main saproxylic fungi encountered was the Razor Strop *Piptoporus betulinus* on birch, with a handful of Chicken-of-the-woods *Laetiporus sulphureus* (see Figure 4) and Beefsteak Fungus *Fistulina hepatica* brackets on oak.



Figure 2. Veteran oak, Cae-melyn (SU4).



Figure 3. Cwm yr Esgob (SU1) Informal wood-pasture with veteran Sessile Oaks.



Figure 4. Cwm yr Esgob (SU1) Chicken-of-the-woods brackets on fallen oak branch.

This report sets out findings of the work carried out in 2022. The methods used to undertake the survey are laid out in Section 4. The results are presented in Section 5, which includes a list of all the invertebrates recorded during fieldwork at Carn Gafallt in 2022. Sub-section 5.1 provides short accounts of any key species found during the survey. These include brief notes on their identification, British distribution, ecology and occurrence at Carn Gafallt. In sub-section 5.2, the key species list is used to identify key invertebrate habitat features at Carn Gafallt. This sub-section also analyses the importance of dead wood invertebrate assemblages at Carn Gafallt using the Revised Index of Ecological Continuity (RIEC) and the Saproxylous Quality Index (SQI). Section 6 gives some conclusions on the overall importance of the site for invertebrates and Section 7 lists management works that aim to maintain and enhance the importance of the site for dead wood invertebrates.

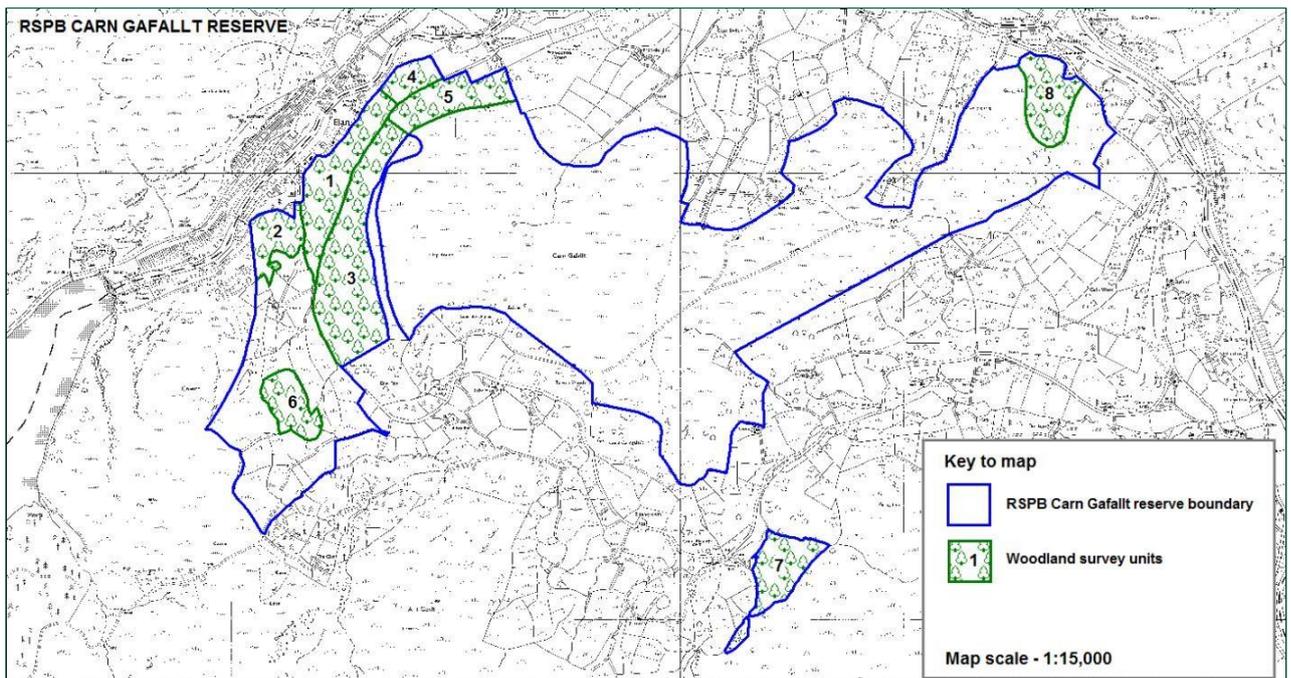


Figure 5. Carn Gafallt invertebrate survey units, 2022.

4. Methods

4.1. Objectives

The aim of this project was to assess the importance of Carn Gafallt for saproxylic invertebrates. The methods used are outlined below, but generally follow the advice given by Webb & Hackmann (2018).

4.2. Desk Study

Carn Gafallt has been the subject of a number of earlier invertebrate surveys. The most significant of these was carried out for RSPB by the author in 2012 and 2013 (Boyce, 2014). Other records for the site are derived from the coleopterists field meeting held here in 1986 and the British Entomological and Natural History Society field meeting in 2004 (Telfer, 2004).

4.3. Field Survey

Four man-days' fieldwork have been undertaken over five days at Carn Gafallt: on the 25th May, 22nd June, 28th July, 14th September and 21st December 2022. The main focus of recording effort has been on dead wood beetles, which make up the largest and most important element of the specialist saproxylic fauna. Casual records of other invertebrate species that could be identified in the field (e.g. butterflies, Orthoptera etc.) have also been made. Figure 5 shows the location of the survey units (SU) into which Carn Gafallt has been divided. These are the same as those employed by the author when carrying out an earlier survey of the saproxylic invertebrate fauna of the site (Boyce, 2014).

Five vane traps were set up at each site during the May visit, with details of the location and siting of these provided in Table 1 below. In May, beating flowering Hawthorn was a major focus of sampling effort. Additionally, on all visits much time has been spent beating foliage and dead branches of mature and veteran trees and hand-searching under bark and in heart-rot of veteran trees. During the September visit, the vane traps were emptied and removed and sampling effort focused on hand-searching saproxylic fungi. The December visit aimed to search for northern-distributed saproxylic species that are known to have occurred in the upland oak woods on the fringes of the Cambrian Mountains.

Table 1. Vane trap location and siting at Carn Gafallt in 2022.

Vane trap No.	Grid Reference	Survey Unit (SU) No.	Siting
CG1	SN93636532	4	Old coppiced Alder with heart rot and trunk cavities, wet woodland, Cae-melyn.
CG2	SN93736524	3	Veteran Sessile Oak with exposed red heart-rot, closed-canopy wood-pasture, Allt Ddu.
CG3	SN93726522	3	Veteran Sessile Oak with hollowed trunk cavity, closed-canopy wood-pasture, Allt Ddu.
CG4	SN93546518	1	Broken-off Sessile Oak trunk with sap wounds and exposed heart-rotted cavity, Cwm yr Esgob.
CG5	SN93616509	3	Broken-off Sessile Oak trunk with exposed red-rot, Allt Ddu.

4.4. Limitations

The very hot, dry weather over the spring and summer of 2022 is considered to have been a limiting factor, particularly for groups such as the craneflies (Tipuloidea), many of which favour cool, damp conditions. Certainly, catches of Diptera in the vane traps were small, with surprisingly few interesting saproxylic species.

5. Results

Table 2 is a checklist of the 217 invertebrate species recorded at Carn Gafallt during the 2022 survey. Following this, Table 3 lists all the important species identified here in 2022. The emboldened codes in column three identify those species with a formal threat or rarity status in Britain. The notes at the end of the table explain these threat or rarity codes. The invertebrates listed in Table 3 are described in this report as being 'key species'. For each key species, sub-section 5.1 provides a short account, which outlines their British distribution, ecology and occurrence at Carn Gafallt in 2022. This column also includes those beetles with a high fidelity to wooded sites such as parkland and wood-pasture where there is a long continuity of well-developed dead wood habitats (SFG1, 2 and 3: Harding & Rose, 1986, as updated by Alexander, 2004).

In sub-section 5.2, key saproxylic invertebrate habitats are described. These are defined as those where at least one key saproxylic species was recorded in 2022. This sub-section also includes a discussion of the importance of the various saproxylic habitats at Carn Gafallt for invertebrates.

Table 2. Checklist of invertebrates recorded at Carn Gafallt in 2022.

Species	English name	Status	Samples
<i>Lehmanna marginata</i>	Tree Slug		SU1,2,4
<i>Limacus maculatus</i>	Green Cellar Slug		SU4
<i>Omocestus viridulus</i>	Common Green Grasshopper		SU4
<i>Chorthippus brunneus</i>	Field Grasshopper		SU4
<i>Forficula auricularia</i>	Common Earwig		SU4
<i>Pentatoma rufipes</i>	Forest Shieldbug		SU4; VAT2
<i>Anthocoris nemorum</i>	A flower bug		VAT2
<i>Loricula elegantula</i>	A Microphysid bug		SU4
<i>Empicoris vagabundus</i>	A thread-legged bug		SU4
<i>lassus lanio</i>	A Cicadellid leafhopper		SU4
<i>Calosoma inquisitor</i>	A ground beetle	NS	SU3,5
<i>Carabus granulatus</i>	A ground beetle		SU3
<i>Carabus violaceus</i>	Violet Ground Beetle		SU1
<i>Carabus problematicus</i>	A ground beetle		SU1,3,4
<i>Abax parallelepipedus</i>	A ground beetle		SU1
<i>Pterostichus niger</i>	A ground beetle		SU3
<i>Pterostichus madidus</i>	A ground beetle		SU4
<i>Limodromus assimilis</i>	A ground beetle		SU4
<i>Calodromius spilotus</i>	A ground beetle		SU4
<i>Dromius agilis</i>	A ground beetle		SU4
<i>Dromius quadrimaculatus</i>	A ground beetle		SU4
<i>Acrotrichis danica</i>	A featherwing beetle		VAT5
<i>Anisotoma humeralis</i>	A Leiodid beetle		VAT2,5
<i>Agathidium seminulum</i>	A Leiodid beetle		VAT3
<i>Phosphuga atrata</i>	A Silphid beetle		SU1
<i>Acrulia inflata</i>	A rove beetle		SU4; VAT5
<i>Dropephylla gracilicornis</i>	A rove beetle	NS	SU4
<i>Dropephylla koltzei</i>	A rove beetle		SU1,2
<i>Hapalaraea pygmaea</i>	A rove beetle		VAT1
<i>Omalius rivulare</i>	A rove beetle		SU2
<i>Omalius septentrionis</i>	A rove beetle	NS	SU1
<i>Phloeonomus punctipennis</i>	A rove beetle		SU1; VAT4,5
<i>Bibloporus bicolor</i>	A rove beetle		SU4; VAT2,4
<i>Phloeocharis subtilissima</i>	A rove beetle		SU2
<i>Tachinus marginellus</i>	A rove beetle		VAT4
<i>Aleochara stichai</i>	A rove beetle	N	VAT3
<i>Phloeopora corticalis</i>	A rove beetle	N	SU4
<i>Phloeopora testacea</i>	A rove beetle		SU4; VAT4
<i>Oxypoda recondita</i>	A rove beetle	N	SU4
<i>Oxypoda alternans</i>	A rove beetle		SU3
<i>Autalia impressa</i>	A rove beetle		SU3
<i>Leptusa fumida</i>	A rove beetle		SU2,4; VAT5
<i>Leptusa pulchella</i>	A rove beetle		VAT2,3,5
<i>Leptusa ruficollis</i>	A rove beetle		SU1,4
<i>Bolitochara mulsanti</i>	A rove beetle	N	SU1

<i>Bolitochara obliqua</i>	A rove beetle		SU4
<i>Bolitochara tecta</i>	A rove beetle		SU1
<i>Gyrophaena minima</i>	A rove beetle		SU1
<i>Agaricochara latissima</i>	A rove beetle		SU4
<i>Placusa pumilio</i>	A rove beetle		VAT4
<i>Placusa tachyporoides</i>	A rove beetle	N	SU4; VAT5
<i>Amischa analis</i>	A rove beetle		VAT1
<i>Dinaraea aequata</i>	A rove beetle		SU4
<i>Atheta hybrida</i>	A rove beetle	RDBK	VAT5
<i>Atheta membranata</i>	A rove beetle		VAT3,5
<i>Atheta pallidicornis</i>	A rove beetle		SU4
<i>Atheta corvina</i>	A rove beetle		SU3
<i>Atheta aquatica</i>	A rove beetle		VAT5
<i>Atheta britanniae</i>	A rove beetle		SU3
<i>Atheta castanoptera</i>	A rove beetle		SU1
<i>Atheta crassicornis</i>	A rove beetle		SU1,3,4
<i>Atheta nidicola</i>	A rove beetle		VAT3
<i>Atheta ravilla</i>	A rove beetle		SU1
<i>Atheta vaga</i>	A rove beetle		VAT1,2,3
<i>Atheta coriaria</i>	A rove beetle		VAT4,5
<i>Atheta sordidula</i>	A rove beetle		VAT1
<i>Atheta marcida</i>	A rove beetle		SU2,4
<i>Atheta (Microdota) sp.</i>	A rove beetle		VAT4
<i>Atheta amplicollis</i>	A rove beetle		VAT1
<i>Atheta taxiceroides</i>	A rove beetle		SU2; VAT1,2,3,4,5
<i>Scydmaenus tarsatus</i>	A rove beetle		VAT1
<i>Atrecus affinis</i>	A rove beetle		SU4; VAT3
<i>Xantholinus longiventris</i>	A rove beetle		SU1
<i>Quedius maurus</i>	A rove beetle	SFG3	SU2; VAT5
<i>Quedius mesomelinus</i>	A rove beetle		VAT1,2,5
<i>Quedius truncicola</i>	A rove beetle	NS/SFG3	VAT3
<i>Quedius xanthopus</i>	A rove beetle	NS/SFG3	SU2; VAT3
<i>Gabrius splendidulus</i>	A rove beetle		SU4
<i>Dalopius marginatus</i>	A click beetle		SU4
<i>Melanotus villosus agg.</i>	A click beetle		SU2,4
<i>Athous haemorrhoidalis</i>	A click beetle		SU4; VAT4
<i>Denticollis linearis</i>	A click beetle		SU1; VAT4
<i>Ctenicera cuprea</i>	A click beetle		SU4
<i>Prosternon tessellatum</i>	A click beetle		SU4
<i>Platycis minutus</i>	A net-winged beetle	SFG3	VAT5
<i>Malthodes marginatus</i>	A soldier beetle		SU1,4
<i>Ptinus subpilosus</i>	A spider beetle	NS/SFG2	VAT2
<i>Thymalus limbatus</i>	A Trogossitid beetle	NS/SFG2	SU4
<i>Dasytes aeratus</i>	A Melyrid beetle		SU4
<i>Dacne rufifrons</i>	An Erotylid beetle		SU4
<i>Rhizophagus bipustulatus</i>	A Monotomid beetle		VAT4
<i>Rhizophagus dispar</i>	A Monotomid beetle		SU2

<i>Rhizophagus ferrugineus</i>	A Monotomid beetle		SU1; VAT4
<i>Rhizophagus nitidulus</i>	A Monotomid beetle	Nb/SFG3	VAT5
<i>Cryptophagus dentatus</i>	A Cryptophagid beetle		SU4
<i>Cryptophagus micaceus</i>	A Cryptophagid beetle	RDBK/SFG1	VAT2
<i>Atomaria diluta</i>	A silken fungus beetle	RDBK	VAT5
<i>Atomaria lohsei</i>	A silken fungus beetle		VAT4
<i>Atomaria vespertina</i>	A silken fungus beetle		VAT1
<i>Pediacus dermestoides</i>	A Cucujid beetle	SFG3	SU4; VAT4
<i>Epuraea biguttata</i>	A Nitidulid beetle		VAT2
<i>Epuraea unicolor</i>	A Nitidulid beetle		VAT2,4
<i>Soronia grisea</i>	A Nitidulid beetle		VAT1
<i>Glischrochilus quadriguttatus</i>	A Nitidulid beetle		SU1; VAT1,4
<i>Cerylon ferrugineum</i>	A Cerylonid beetle		SU4
<i>Cerylon histeroides</i>	A Cerylonid beetle		SU4
<i>Adalia decempunctata</i>	10-spot Ladybird		SU1
<i>Orthoperus corticalis</i>	A Corylophid beetle		SU4
<i>Sericoderus brevicornis</i>	A Corylophid beetle		SU4
<i>Cartodere nodifer</i>	A mould beetle		SU4; VAT4,5
<i>Enicmus rugosus</i>	A mould beetle	N/SFG2	VAT3,5
<i>Dienerella vincenti</i>	A mould beetle		SU4
<i>Corticaria gibbosa</i>	A mould beetle		VAT5
<i>Triphyllus bicolor</i>	A fungus beetle	NS/SFG3	SU1,4
<i>Cis bilamellatus</i>	A Ciid beetle		SU4
<i>Cis fagi</i>	A Ciid beetle		SU4
<i>Cis micans</i>	A Ciid beetle		SU4
<i>Cis vestitus</i>	A Ciid beetle		SU4; VAT1
<i>Tetratoma desmarestii</i>	A Tetratomid beetle	NS/SFG3	SU4
<i>Orchesia micans</i>	A false darkling beetle	NS	VAT1
<i>Orchesia undulata</i>	A false darkling beetle	SFG3	SU4; VAT5
<i>Eledona agricola</i>	A darkling beetle	SFG3	SU1,3
<i>Pyrochroa coccinea</i>	Black-head Cardinal Beetle	SFG3	SU4
<i>Schizotus pectinicornis</i>	Scarce Cardinal Beetle	NR	SU1,4
<i>Vincenzellus ruficollis</i>	A Salpingid beetle		SU4
<i>Salpingus planirostris</i>	A Salpingid beetle		SU1,4
<i>Salpingus ruficollis</i>	A Salpingid beetle		VAT1,5
<i>Anaspis fasciata</i>	A Scaptiid beetle		SU4
<i>Anaspis garneysi</i>	A Scaptiid beetle		VAT2
<i>Anaspis rufilabris</i>	A Scaptiid beetle		VAT3,5
<i>Rhagium mordax</i>	A longhorn beetle		SU4
<i>Rutpela maculata</i>	A longhorn beetle		SU1
<i>Pyrrhidium sanguineum</i>	A longhorn beetle	SFG1	VAT4
<i>Lochmaea crataegi</i>	A leaf beetle		SU1
<i>Archarius pyrrhoceras</i>	A weevil		SU4
<i>Orchestes horticorum</i>	A flea weevil		SU4
<i>Euophryum confine</i>	A weevil		SU4; VAT2,3
<i>Strophosoma melanogrammum</i>	A weevil		SU4
<i>Otiorhynchus singularis</i>	A weevil		SU4

<i>Phyllobius argentatus</i>	A weevil		SU4
<i>Trachodes hispidus</i>	A weevil	Nb/SFG3	SU4
<i>Platypus cylindrus</i>	Oak Pine-hole Borer beetle	Nb/SFG3	VAT4
<i>Hylesinus varius</i>	A bark beetle		SU1
<i>Dryocoetes villosus</i>	A bark beetle		VAT4,5
<i>Scolytus intricatus</i>	A bark beetle		SU1; VAT4
<i>Xyleborus dryographus</i>	A bark beetle	Nb/SFG3	VAT4
<i>Trypodendron domesticum</i>	A bark beetle	SFG3	VAT4
<i>Trypodendron signatum</i>	A bark beetle	Nb/SFG3	VAT4
<i>Synanthedon vespiformis</i>	Yellow-legged Clearwing moth	Nb	VAT4
<i>Pieris napi</i>	Green-veined White butterfly		SU1
<i>Gonepteryx rhamni</i>	Brimstone butterfly		SU4
<i>Maniola jurtina</i>	Meadow Brown butterfly		SU1
<i>Aglais io</i>	Peacock butterfly		SU4
<i>Thyatira batis</i>	Peach Blossom moth		VAT2
<i>Scoliopteryx libatrix</i>	Herald Moth		VAT1
<i>Apamea monoglypha</i>	Dark Arches moth		VAT3
<i>Tholera decimalis</i>	Feathered Gothic moth		VAT4
<i>Dictenidia bimaculata</i>	Twin-mark Comb-horn cranefly		VAT3
<i>Tipula confusa</i>	U-tailed Mottle cranefly		VAT1
<i>Limonia nubeculosa</i>	Three-banded Limonia cranefly		VAT1,2,3,4,5
<i>Ormosia nodulosa</i>	Common Tabbed Bead cranefly		VAT3
<i>Orfelia ochracea</i>	A Keroplatid fungus gnat		VAT2
<i>Leia cylindrica</i>	A Mycetophilid fungus gnat		VAT2
<i>Brachycampta alternans</i>	A Mycetophilid fungus gnat		VAT2
<i>Mycomya annulata</i>	A Mycetophilid fungus gnat		VAT5
<i>Mycomya wankowiczii</i>	A Mycetophilid fungus gnat		VAT5
<i>Mycomya winnertzi</i>	A Mycetophilid fungus gnat		VAT2
<i>Mycomya fimbriata</i>	A Mycetophilid fungus gnat		VAT5
<i>Neoempheria pictipennis</i>	A Mycetophilid fungus gnat		VAT5
<i>Sylvicola cinctus</i>	An Anisopodid fly		VAT1
<i>Sylvicola fenestralis</i>	An Anisopodid fly		VAT3
<i>Sylvicola punctatus</i>	An Anisopodid fly		VAT3
<i>Mycetobia pallipes</i>	A Mycetobiid fly		VAT5
<i>Rhagio lineola</i>	Small Fleck-winged Snipefly		VAT4
<i>Rhagio scolopacea</i>	Downlooker Snipefly		SU4
<i>Euthyneura myrtilli</i>	A Hybotid dance fly		VAT4
<i>Tachypeza nubila</i>	A Hybotid dance fly		VAT2,4
<i>Trichina clavipes</i>	A Hybotid dance fly		VAT2
<i>Rhamphomyia erythrophthalma</i>	A dance fly		VAT1
<i>Sciapus platypterus</i>	A long-headed fly		VAT3
<i>Rhingia campestris</i>	A hoverfly		SU1
<i>Dryomyza anilis</i>	A Dryomyzid fly		VAT1,2,3,5
<i>Suillia affinis</i>	A Heleomyzid fly		VAT3,5
<i>Suillia variegata</i>	A Heleomyzid fly		VAT5
<i>Scathophaga stercoraria</i>	A dung fly		VAT3
<i>Hylemya nigrimana</i>	An Anthomyiid fly		VAT3,5

<i>Prosema siberita</i>	A parasite fly		VAT4
<i>Gymnocheta viridis</i>	A parasite fly		VAT3
<i>Empria tridens</i>	A Tenthredinid sawfly		VAT4
<i>Crossocerus podagricus</i>	Trilobed Boxhead Wasp		VAT3
<i>Crossocerus styrius</i>	A hunting wasp		VAT4
<i>Psenulus pallipes</i>	A hunting wasp		SU4; VAT3
<i>Andrena fuscipes</i>	Heather Mining Bee		SU4
<i>Bombus lucorum agg.</i>	White-tailed Bumblebee		SU1
<i>Bombus lucorum/terrestris</i>	Buff-tailed/White-tailed Bumblebee workers		SU1
<i>Bombus hortorum</i>	Garden Bumblebee		VAT2
<i>Bombus lapidarius</i>	Red-tailed Bumblebee		SU4
<i>Bombus hypnorum</i>	Tree Bumblebee		SU1,3
<i>Bombus pascuorum</i>	Common Carder Bumblebee		SU1,4
<i>Nomada flavoguttata</i>	Little Nomad Bee		VAT4
<i>Lasius flavus</i>	Yellow Meadow Ant		SU1
<i>Leptothorax acervorum</i>	A Myrmicine ant		SU4
<i>Myrmica ruginodis</i>	A red ant		SU1; VAT2
<i>Myrmica scabrinodis</i>	A red ant		SU1,4
<i>Vespa crabro</i>	Hornet		SU1,2
<i>Vespula rufa</i>	Red Wasp		VAT2
<i>Vespula vulgaris</i>	Common Wasp		VAT1
<i>Oniscus asellus</i>	Common Shiny Woodlouse		SU1,3,4; VAT1
<i>Porcellio scaber</i>	Common Rough Woodlouse		SU4; VAT1,2,3,5
<i>Segestria senoculata</i>	A Segestriid spider		SU4
<i>Harpactea hombergi</i>	A Dysderid spider		SU4
<i>Oonops pulcher</i>	An Oonopid spider		SU4
<i>Labulla thoracica</i>	A money spider		SU4
<i>Gibbaranea gibbosa</i>	An orb-weaving spider		SU4
<i>Nuctenea umbratica</i>	An orb-weaving spider		SU1,4
<i>Amaurobius similis</i>	An Amaurobiid spider		SU4
<i>Diaea dorsata</i>	A crab spider		SU4

5.1. Key Invertebrate Species recorded at Carn Gafallt in 2022.

Table 3 lists the 26 key species recorded at Carn Gafallt in 2022 in emboldened font. These are defined as those with a formal threat or rarity status and are considered to be of greatest importance in assessing the importance and management of Carn Gafallt. Beetles with a high fidelity to wooded sites such as parkland and wood-pasture where there is a long continuity of well-developed dead wood habitats (SFG1, 2 and 3: Harding & Rose, 1986, as updated by Alexander, 2004) are also listed in Table 3. Note that these habitat specialists are not regarded as key species unless they also have a formal threat/rarity status. Following the table, species profiles are given for all of the key species.

Table 3. Important invertebrate species recorded at Carn Gafallt in 2022. Species in emboldened text are described in detail in sections 5.1.1 to 5.1.26.

Species	Status	SU recorded
<i>Calosoma inquisitor</i>	NS	SU3,5
<i>Dropephylla gracilicornis</i>	NS	SU4
<i>Omalium septentrionis</i>	NS	SU1
<i>Aleochara stichai</i>	NS	VAT3
<i>Phloeopora corticalis</i>	NS	SU4
<i>Oxypoda recondita</i>	NS	SU4
<i>Bolitochara mulsanti</i>	NS	SU1
<i>Placusa tachyporoides</i>	NS	SU4; VAT5
<i>Atheta hybrida</i>	RDBK	VAT5
<i>Quedius maurus</i>	SFG3	SU2; VAT5
<i>Quedius truncicola</i>	NS/SFG3	VAT3
<i>Quedius xanthopus</i>	NS/SFG3	SU2; VAT3
<i>Platycis minutus</i>	SFG3	VAT5
<i>Ptinus subpilosus</i>	NS/SFG2	VAT2
<i>Thymalus limbatus</i>	NS/SFG2	SU4
<i>Rhizophagus nitidulus</i>	NS/SFG3	VAT5
<i>Cryptophagus micaceus</i>	RDBK/SFG1	VAT2
<i>Atomaria diluta</i>	RDBK	VAT5
<i>Pediacus dermestoides</i>	SFG3	SU4; VAT4
<i>Enicmus rugosus</i>	NS/SFG2	VAT3,5
<i>Triphyllus bicolor</i>	NS/SFG2	SU1,4
<i>Tetratoma desmarestii</i>	NS/SFG3	SU4
<i>Orchesia micans</i>	NS	VAT1
<i>Orchesia undulata</i>	SFG3	SU4; VAT5
<i>Eledona agricola</i>	SFG3	SU1,3
<i>Pyrochroa coccinea</i>	SFG3	SU4
<i>Schizotus pectinicornis</i>	NR	SU1,4
<i>Pyrrhidium sanguineum</i>	SFG1	VAT4
<i>Trachodes hispidus</i>	NS/SFG3	SU4
<i>Platypus cylindrus</i>	NS/SFG3	VAT4
<i>Xyleborus dryographus</i>	NS/SFG3	VAT4
<i>Trypodendron domesticum</i>	SFG3	VAT4
<i>Trypodendron signatum</i>	NS/SFG3	VAT4
<i>Synanthedon vespiformis</i>	NS	VAT4

5.1.1. *Calosoma inquisitor* **NS**

Calosoma inquisitor (Linnaeus, 1758) is an unmistakable black ground beetle with a bronze or green metallic sheen. It was always very local in Britain, but was formerly found quite widely throughout England and Wales, with a handful of additional sites in western Scotland. It now seems to have disappeared from all of its former sites in eastern Britain, with only single sites in the New Forest and Devon remaining in southern England. Wales appears to be its current stronghold, with a number of recent records from ancient oak woodlands in the northern and central parts of the country. There are also some recent sites in Cumbria. The adults climb trees at night to feed on the abundant caterpillars of various moth species that feed on the young oak foliage at this time of year. Larvae are thought to be predators inhabiting the

woodland soil. The presence of a colony of *C. inquisitor* at Carn Gafallt has been known since the coleopterist's field meeting here in 1986. The 2004 BENHS survey confirmed its continued presence (Telfer, 2004) and in June 2013 a night visit to the site found seven adults climbing tree trunks at dusk in survey units 3 and 5 (Boyce, 2014). The current survey recorded single adults in these two compartments by examining tree trunks after dark.

5.1.2. *Dropephylla gracilicornis* NS

Dropephylla gracilicornis (Fairmaire & Laboulbène, 1856) is a small, reddish-brown rove beetle that is closely similar to its congeners, being most easily recognised by a combination of the relatively straight sides of the pronotum, the presence of fine ridges on the frons and the form of the male genitalia. It has a very thinly scattered distribution across England and Wales. Most records are from dead branchwood of broadleaved trees, but it has also been found in reed litter. At Carn Gafallt, a number of adults were beaten from dead oak branches in the Cae Melyn wood-pasture (SU4) in July 2022.

5.1.3. *Omalium septentrionis* NS

The genus *Omalium* includes 13 British species of rove beetle. *Omalium septentrionis* Thomson, C.G., 1857 is one of the larger species, with triangular furrows and quite dense puncturation on the head. It has a very scattered distribution throughout Britain, including Orkney. Like other members of the genus, it is associated with 'patch habitats' where it is thought to be saprophagous. Most records are from carrion but it has also been found in rotting fungi, dung and grass cuttings. There are also records from badger and rabbit burrows. At Carn Gafallt a female was tapped from old Chicken-of-the-woods brackets in Cwm yr Esgob (SU1) in July 2022.

5.1.4. *Aleochara stichai* NS

Aleochara is a large genus of small, shiny rove beetles with a characteristic, broad body form. *Aleochara stichai* Likovsky, 1965 is one of four black shiny species with reddish legs and antennal bases in the *A. sparsa* group that can only be distinguished with certainty by microscopic examination of the male aedeagus or female spermatheca. There are scattered records of this species across much of Britain. Like other members of the genus, it is believed to be a parasitoid of fly larvae, with adults most frequently found in patch habitats, such as carrion, dung, rotting fungi and decomposing vegetation that are rich in fly larvae. Most records of *A. stichai* are from woodland, where it has been found in various habitats, including tree holes, rotting fungi, carrion, dung and bird's nests. A female was collected at Carn Gafallt in vane trap CGVAT3 on a veteran Sessile Oak in closed-canopy upland oak woodland in May-June 2022.

5.1.5. *Phloeopora corticalis* NS

The genus *Phloeopora* includes five British representatives, all of which are small rove beetles found in saproxylic habitats. *Phloeopora corticalis* (Gravenhorst, 1802) can be distinguished from its congeners by its narrow body form, dark colouration and the strong microsculpture on the top of the thorax, which gives it a rather matt appearance. The form of the male aedeagus and female spermatheca are also useful guides to identification. Like other members of the genus, *P. corticalis* is most often found under bark, with broadleaves such as oak, Beech and Field Maple being

the most frequent hosts, though it has also been found occasionally under conifer bark. A single adult was beaten from dead Sessile Oak branches in the Cae Melyn wood-pasture (SU4) in July 2022.

5.1.6. *Oxypoda recondita* NS

The genus *Oxypoda* includes about 30 British species of small rove beetles that are hard to distinguish. *Oxypoda recondita* Kraatz, 1856 is a small, pitchy-brown species with yellow appendages, short antennae and a moderately transverse pronotum with rounded hind angles. Examination of the male aedeagus or female spermatheca is required to confirm its identity. It has a wide but very scattered distribution across Britain, including southern Scotland and Wales. It is a woodland and parkland species that is usually found in association with dead wood habitats, often where there are colonies of tree-dwelling ants such as the Brown Tree Ant *Lasius brunneus*. At Carn Gafallt, a single adult was collected in flight in the wood-pasture at Cae-Melyn (SU4).

5.1.7. *Bolitochara mulsanti* NS

The five British members of this rove beetle genus are all shiny, heavily punctate rove beetles with strikingly patterned black and orange bodies. *Bolitochara mulsanti* Sharp, 1875 has raised lines running under the eyes. It can be distinguished specifically by its relatively large size and the sharp, almost right-angled pronotal hind angles. Like other *Bolitochara* species, it is associated with saproxylic bracket fungi, with most British records from Razor Strop *Piptoporus betulinus*. It has also been found on a dead Scot's Pine. The very few British records of this beetle are mostly from northern England and Scotland. There is a single previous Welsh record on the NBN database, from the Berwyn Mountains, Montgomery (vc47). Though it is probably under-recorded, it is clearly a genuinely scarce species that is probably an element of the important northern-distributed saproxylic beetle assemblage found along the eastern flank of the Cambrian Mountains. A single female was tapped from Sulphur Polypore *Laetiporus sulphureus* brackets in Cwm yr Esgob (SU1) on the 28th of July. It was also collected at Gilfach in 2022 (Boyce, 2023).

5.1.8. *Placusa tachyporoides* NS

The rove beetle genus *Placusa* contains four British species all of which are predominantly black to pitchy, with a broad, tapering body form. *Placusa tachyporoides* (Waltl, 1838) can be recognised by its small size, shining integument and yellow basal antennal segments. In addition, the male has very long processes on the hind edge of the sixth abdominal tergite and the genitalia of both sexes are distinctive. It is quite widely, but very locally, distributed across England and Wales and appears to be absent from Scotland. It is a species of freshly fallen or cut deciduous trees, often being found where the wood is still sappy. It has also been found in sappy piles of sawdust. At Carn Gafallt, a male was collected in vane trap CGVAT5 in Allt Ddu (SU3) in June-July and a female was found in the Cae-Melyn wood-pasture (SU4) in September 2022.

5.1.9. *Atheta hybrida* RDBK

With 125 British species as currently constituted, *Atheta* is the largest genus of British beetles and also one of the most challenging to identify accurately to species level. *Atheta hybrida* Sharp, 1869 is a small black rove beetle with obscurely lighter

elytra and is best distinguished from its numerous congeners by examination of the very distinctive male aedeagus or female spermatheca. It has only been found on a few occasions in Britain, though these records are widely distributed across Scotland, Wales and England. Its ecology is not well understood, but most records with habitat data refer to dead wood habitat features, particularly bracket fungi and sap runs in woodland or parkland. It has also been found in a rabbit nest once and it is possible there may be an association with mammal nests. At Carn Gafallt, three males were collected in vane trap CGVAT5 in Allt Ddu (SU3) in June-July 2022.

5.1.10. *Quedius truncicola* NS/SFG3

Quedius truncicola Fairmaire & Laboulbène, 1856 is easily distinguished from other rove beetle members of the sub-genus *Microsaurus* by its predominantly black body with red apical abdominal segments. It has a scattered distribution in England and Wales, which reaches northern Scotland, though most sites are in southern and eastern England. It is also known from a very few sites in eastern Wales and southwest England. *Q. truncicola* is a saproxylic specialist that is found in rotten heartwood of a range of broadleaved trees. A single male was collected at Carn Gafallt from vane trap CGVAT3 (Allt Ddu, SU3) in July-September 2022. This is one of a suite of species that are collectively characteristic of ancient, wooded habitats with dead wood (Harding & Rose, 1986; Alexander, 2004).

5.1.11. *Quedius xanthopus* NS/SFG3

Quedius xanthopus Erichson, 1839 is a medium-sized, shiny, pitchy-red rove beetle. It is placed within the sub-genus *Microsaurus* that are characterised by their relatively small eyes. It can be distinguished from other members of this group by its orange basal antennal segments and legs, quadrate sub-apical antennomeres and the very distinctive asymmetrical form of the male aedeagus. *Q. xanthopus* is found in a scatter of old woodlands and parklands across northern and western Britain but is absent from eastern England. It is a saproxylic species, found under the bark of various broadleaved trees and also occasionally in association with dead conifers. This is one of a suite of species that are collectively characteristic of ancient, wooded habitats with dead wood (Harding & Rose, 1986; Alexander, 2004). In Wales, it appears to be restricted to high-quality woods and parks in the southern and eastern part of the country. At Carn Gafallt, a female and male were collected under oak bark in Coed Cnwch (SU2) on the 22nd of December and a female was also recorded in CGVAT3 in Allt Ddu (SU1).

5.1.12. *Ptinus subpilosus* NS/SFG2

The spider beetle *Ptinus subpilosus* Sturm, 1837 usually has a pitchy-red ground colour with patches of white scales forming an obscure pattern on the elytra, though these may become abraded in older specimens. It is widely distributed across Britain, north as far as central Scotland but is very localised. This is one of a suite of beetles that are mainly found in ancient, wooded habitats with abundant dead wood (Harding & Rose, 1986; Alexander, 2004). It is found in dry, dead wood of a range of native broadleaves with oak being especially favoured. At Carn Gafallt, a single adult was collected in vane trap CGVAT2 at Allt Ddu (SU3) in June-July 2022.

5.1.13. *Thymalus limbatus* NS/SFG2

The trogossitid beetle *Thymalus limbatus* (Fabricius, 1787) is a very distinctive pitchy-red beetle, with a broad and rather flattened body shape and a weak bronze-metallic sheen. It is a very local species in Britain, with most records from northern England, Wales and the southwest peninsula. In Wales it is quite widely distributed in ancient Sessile Oak woods and old parks. It is a saproxylic species, usually found under the bark of oak trees, though it can also be found in association with dead Beech and other broadleaves and occasionally on conifers such as Scot's Pine and other conifers. Both adults and larvae are mycophagous, with larvae feeding on various saproxylic fungi. This is one of a suite of beetles that are mainly found in ancient, wooded habitats with abundant dead wood (Harding & Rose, 1986; Alexander, 2004). In 2022, a number of adults were found in the Cae-Melyn wood pasture (SU4) at Carn Gafallt, under Sessile Oak bark and in Razor Strop brackets.

5.1.14. *Rhizophagus nitidulus* Nb/SFG3

The monotomid beetle genus *Rhizophagus* comprises 13 British species of small, cylindrical beetles. *Rhizophagus nitidulus* (Fabricius, 1798) is one of the larger members of the genus and usually has the elytra obscurely bicoloured black and pitchy-red. The most diagnostic character is the concave thickening of the outer margin of the mid- and hind-tibiae. It has a localised distribution across much of England and Wales. Most records are from under the bark of dead Beech, though it can also be found in association with dead wood of a range of other broadleaves. Both adults and larvae feed on wood-decaying fungi. It is one of a suite of beetles that are collectively characteristic of ancient wooded habitats with dead wood (Harding & Rose, 1986; Alexander, 2004). A single adult was collected at Carn Gafallt in vane trap CGVAT5 in Allt Ddu (SU3).

5.1.15. *Cryptophagus micaceus* RDBK/SFG1

Cryptophagus is a large genus of small, reddish cryptophagid beetles in which the thorax has well-marked lateral teeth and callosities on the antero-lateral angles. *Cryptophagus micaceus* Rey, 1889 is one of only two British species in which the first segment of the antennal club is markedly narrower than the second. It can be distinguished from the more frequent *C. pubescens* by having a shorter last antennal segment and a larger callosity on the thorax. It is known from a handful of sites in England and Wales, north as far as Derbyshire and Denbighshire. It is usually found in and around ancient heart-rotted trees, often those where there are nests of Hornets or other tree-living social wasps. It is known to have occurred in recent times only in areas believed to be wood-pastures or ancient woodland with abundant dead wood habitats (Harding and Rose, 1986; Alexander, 2004). At Carn Gafallt, a single adult was collected in vane trap CGVAT2 in Allt Ddu (SU3) in July-September 2022.

5.1.16. *Atomaria diluta* RDBK

Amongst this large and difficult genus of silken fungus beetles, *Atomaria diluta* Erichson, 1846 can be quite readily recognised by a combination of its elongate body form, reddish colouration and very long, thick antennae. It has a very scattered distribution as far south as Oxfordshire, though most records are from northern England and Scotland. This would appear to be the first Welsh record for this species. Its ecology is poorly understood, but there seems to be a strong association with riparian woodland. Adults have been found in moss and also in rotten

heartwood. A single female was collected in June-July 2022 from vane trap CGVAT5 set on a broken-down veteran Sessile Oak with exposed heart-rot in Allt Ddu (SU3).

5.1.17. *Enicmus rugosus* NS/SFG2

There are six British *Enicmus* species of mould beetles. *Enicmus rugosus* (Herbst, 1793) is a matt, pitchy-black beetle with a moderately transverse thorax, relatively long antennae and femoral lines on the metasternum. It has a wide but very localised distribution in Britain from central Scotland southwards, though most records are south of a line from the Mersey to The Wash. In Wales, it appears to be restricted to eastern counties. *E. rugosus* is a saproxylic specialist, which is most often found in old parks and wood-pastures in association with powdery slime moulds (Myxomycetes) or fungi on dead wood. This is one of a suite of beetles that are mainly found in ancient, wooded habitats with abundant dead wood (Harding & Rose, 1986; Alexander, 2004). At Carn Gafallt, an adult was collected from vane trap CGVAT3 in Allt Ddu (SU3) in June-July 2022.

5.1.18. *Triphyllus bicolor* NS/SFG2

The only British member of this genus, *Triphyllus bicolor* (Fabricius, 1777) is a very distinctive, mid-sized fungus beetle, with a shiny, heavily punctured body, orange-red head, thorax, legs and antennae and dark elytra with prominent orange patches at the base and apex. It has a scattered distribution across Wales and England, north as far as Yorkshire. Like all Mycetophagids, it is a fungus feeder, which is primarily found on Beefsteak Fungus *Fistulina hepatica*, though it can also be found less frequently on other soft brackets such as Chicken-of-the-woods *Laetiporus sulphureus*. This is one of a suite of beetles that are mainly found in ancient, wooded habitats with abundant dead wood (Harding & Rose, 1986; Alexander, 2004). In 2022, larvae and adults were found in a Razor Strop bracket on a fallen birch trunk in the Cae-Melyn wood-pasture (SU4) and on Chicken-of-the-woods in Sessile Oak woodland in Cwm yr Esgob (SU1).

5.1.19. *Tetratoma desmarestii* NS/SFG3

The tetratomid *Tetratoma desmarestii* Latreille, 1807 is a black beetle, with a greenish-metallic lustre and orange appendages, except for the darkened antennal clubs. Though it is widely distributed across England and southern Scotland, *T. desmarestii* is extremely scarce throughout its British range. In Wales, it is very rare, with just a handful of records from the eastern part of the country. It is usually found on dead oak branches where it is thought to feed on encrusting fungi of the genus *Stereum*. This is one of a suite of species that are collectively characteristic of wooded habitats with dead wood (Harding & Rose, 1986; Alexander, 2004). At Carn Gafallt, an adult was tapped from dead oak branches in the wood-pasture at Cae-Melyn (SU4) in 2022. It was also recorded here in 2012-13 (Boyce, 2014).

5.1.20. *Orchesia micans* NS

Orchesia micans (Panzer, 1793) is a small, elongate, pitchy-red melandryid beetle that jumps vigorously when disturbed. It has a wide, but very scattered distribution in wooded areas throughout Britain. The adults are most easily found in the autumn by tapping Shaggy Bracket *Inonotus hispidus* or Alder Bracket *I radiatus*, which are primarily heart-rotters of Ash and Alder respectively. The pink larvae feed in these

fungi and can be found throughout much of the year. Two adults were found at Cae-Melyn (SU4) in the vane trap set up on an ancient heart-rotted Alder (CGVAT1).

5.1.21. *Schizotus pectinicornis* NR

The Scarce Cardinal Beetle *Schizotus pectinicornis* (Linnaeus, 1758) is a medium-sized beetle of a distinctive appearance. The ground colour, other than the black head, is red, with a dark pitchy mark in the centre of the thorax. The head has obtuse hind angles, the elytra have broadly explanate margins and the male antennae are strongly pectinate. Adults appear to be short-lived and elusive and the distinctive larvae, which have curved terminal cerci, are more frequently recorded. *S. pectinicornis* is one of the saproxylic specialities of the Elan woodlands, with this area of mid-Wales being the only place in Britain it occurs outside the Scottish Highlands, where it is also of very local occurrence. Larvae are predators under the bark of various broadleaves, with birch being particularly favoured. During the current survey, larvae were noted under the bark of birch, Ash and Sessile Oak in Cwm yr Esgob (SU3) and Cae-Melyn (SU4).

5.1.22. *Trachodes hispidus* NS/SFG3

Trachodes hispidus (Linnaeus, 1758) is a very distinctive weevil, which has strongly toothed femora and conspicuous erect scales on the body. It occurs across much of England and Wales and though widespread, is very local everywhere. The larvae develop in the dead limbs of a range of broadleaved trees. Recently fallen or hanging oak branches appear to be especially favoured. It is found in a range of wooded habitats but is part of a group of species that are collectively characteristic of ancient wooded sites with dead wood habitats (Harding & Rose, 1986; Alexander, 2004). A single individual was beaten from dead oak branches in the Cae-Melyn wood-pasture (SU4) at Carn Gafallt in 2022.

5.1.23. *Platypus cylindrus* NS/SFG3

The Oak Pin-hole Borer *Platypus cylindrus* (Fabricius, 1792) is a very distinctive pitchy-black, elongate bark beetle with long golden hairs at the elytral apex. It is widely, but very locally distributed across England and Wales, north as far as Caernarfon and Norfolk. It is often first detected by the large piles of sawdust that accumulate where the beetle burrows into the dead wood of large oak trunks and boughs, though it is also occasionally found in other native broadleaves. It is found in a range of wooded habitats but is part of a group of species that are collectively characteristic of ancient wooded sites with dead wood habitats (Alexander, 2004; Harding & Rose, 1986). At Carn Gafallt, adults were found in abundance in the vane trap sited on a recently fallen veteran oak (CGVAT4) in Cwm yr Esgob (SU1).

5.1.24. *Xyleborus dryographus* NS/SFG3

Xyleborus are small, dark bark beetles in which the thorax is elongate. In *Xyleborus dryographus* (Ratzeburg, 1837), the elytral declivity is more convex, densely setose and coarsely punctate compared to the other British species, *X. monographus*. It has a very localised distribution in England, with most sites lying to the south and east of a line from the Severn estuary to the Wash. It has also been recorded in south Wales. Larvae develop in and under the bark of a range of broadleaves, with oak and Sweet Chestnut being the usual hosts. It is found in a range of wooded habitats but is part of a group of species that are collectively characteristic of ancient wooded sites

with dead wood habitats (Harding & Rose, 1986; Alexander, 2004). At Carn Gafallt, an adult was collected in vane trap CGVAT4 in Cwm yr Esgob (SU1) in May-June 2022. This record represents a significant north-western expansion to its known British range.

5.1.25. *Trypodendron signatum* NS/SFG3

There are three British species of *Trypodendron* bark beetle. *Trypodendron signatum* (Fabricius, 1792) can be distinguished from its congeners by its truncate antennal clubs and strongly punctured elytral striae. The body colour varies from pitchy-yellow to black and paler forms often have a dark mark on the thorax and pitchy stripes on the elytra. It is a scarce species nationally that is most frequently found in upland oak woods and wood-pastures in western Britain though there are also a very few records from eastern districts. Its largest populations are in Wales and southwest England. Larvae develop in recently dead trunks and larger branches of a range of native broadleaves, though oak and Beech appear to be most favoured. It is part of a group of species that are collectively characteristic of ancient wooded sites with dead wood habitats (Harding & Rose, 1986; Alexander, 2004). At Carn Gafallt, adults were collected in May-June 2022 from the vane trap CGVAT4 set on a recently fallen veteran oak in Cwm yr Esgob (SU1).

5.1.26. *Synanthedon vespiformis* NS

As its scientific name suggests, the Yellow-legged Clearwing moth *Synanthedon vespiformis* (Linnaeus, 1758) bears a strong superficial resemblance to a wasp. The yellow-banded abdomen and red marks on the wings make it easily distinguished from other clearwings. It is very locally distributed across England and Wales, north as far as Yorkshire. The larvae develop beneath the bark around wounds and sappy exudations on living broadleaved trees or on very recently cut stumps. Oak is much the most important host, though it has occasionally been found on other trees. A single adult male was collected at Carn Gafallt in vane trap CGVAT4 in Cwm yr Esgob (SU1) in July-September 2022.

5.2. Key Invertebrate Habitats

Harding & Rose (1986) listed 196 beetle species as indicators of ancient parklands and wood pastures with well-developed dead wood habitats. They assigned these to one of three saproxylic fauna groups (SFG). SFG1 species were those having the highest fidelity to ancient wood-pasture and parkland sites with abundant dead wood habitats and SFG3 species had the lowest, being found across a range of landscapes with old trees, though still showing a significant association with ancient parks and wood-pastures that are rich in dead wood. Using this list as a basis, Alexander (1988) devised a simple index of ecological continuity (IEC) for scoring sites where SFG1 beetles score three points, SFG2 species, 2 points and SFG3 species, 1 point. Alexander (2004) subsequently created a revised index of ecological continuity (RIEC). This reduced the list down to 180 qualifying species to take into account the considerable body of additional data on saproxylic beetles generated since Harding & Rose (*ibid.*) was published. The index is calculated simply by adding up the points for the various qualifying species. Fifteen SFG3, four SFG2 and two SFG1 beetles status were recorded at Carn Gafallt in 2022, giving a **RIEC score of 29**. Column 4 of Table 4 shows the 21 qualifying species recorded at Carn Gafallt that are included in the RIEC.

The second widely-used index to assess sites is the Saproxylic Quality Index (SQI) developed by Fowles *et. al.* (1999). This has the advantage of employing a much longer list of saproxylic Coleoptera, including many that are common and widely distributed across Britain. It can therefore be particularly valuable in assessing saproxylic beetles at sites where there are not many of the veteran trees required by many of the species included in the RIEC. The full list of beetles recorded at Carn Gafallt in 2022 that are used in calculating the SQI can be found in Table 4. The scoring system is based on the rarity of the species, as defined in the original Coleoptera status reviews (Hyman & Parsons, 1992 & 1994), with these Rarity Scores ranging from one for a common species up to 32 for those considered Endangered or Vulnerable. The Rarity Score for all qualifying species is given in the third column of Table 4. The Saproxylic Quality Index (SQI) is then calculated by totalling the scores for all qualifying species to give an overall Saproxylic Quality Score (SQS), then dividing this figure by the total number of qualifying species and multiplying the result by 100. A total of 74 qualifying dead wood beetles were recorded at Carn Gafallt in 2022 (see Table 4), giving a SQS of 287 and a **SQI score of 387.8**.

Table 4. Saproxylic beetles recorded at Carn Gafallt in 2022.

Species	Status	Rarity Score	RIEC
<i>Anisotoma humeralis</i>		2	
<i>Agathidium seminulum</i>		2	
<i>Acrulia inflata</i>		2	
<i>Dropephylla koltzei</i>		1	
<i>Hapalaraea pygmaea</i>		2	
<i>Phloeonomus punctipennis</i>		2	
<i>Bibloporus bicolor</i>		2	
<i>Phloeocharis subtilissima</i>		2	
<i>Phloeopora corticalis</i>	NS	8	
<i>Phloeopora testacea</i>		1	
<i>Leptusa fumida</i>		1	
<i>Leptusa pulchella</i>		2	
<i>Leptusa ruficollis</i>		1	
<i>Bolitochara mulsanti</i>	NS	8	
<i>Bolitochara tecta</i>		2	
<i>Gyrophana minima</i>		2	
<i>Agaricochara latissima</i>		2	
<i>Placusa pumilio</i>		2	
<i>Placusa tachyporoides</i>	NS	8	
<i>Dinaraea aequata</i>		1	
<i>Atrecus affinis</i>		1	
<i>Quedius maurus</i>		4	SFG3
<i>Quedius truncicola</i>	NS	8	SFG3
<i>Quedius xanthopus</i>	NS	4	SFG3
<i>Gabrius splendidulus</i>		1	
<i>Melanotus villosus agg.</i>		1	
<i>Denticollis linearis</i>		1	

<i>Platycis minutus</i>		8	SFG3
<i>Malthodes marginatus</i>		1	
<i>Ptinus subpilosus</i>	NS	8	SFG2
<i>Thymalus limbatus</i>	NS	8	SFG2
<i>Dasytes aeratus</i>		2	
<i>Dacne rufifrons</i>		2	
<i>Rhizophagus bipustulatus</i>		1	
<i>Rhizophagus dispar</i>		1	
<i>Rhizophagus ferrugineus</i>		2	
<i>Rhizophagus nitidulus</i>	NS	4	SFG3
<i>Cryptophagus dentatus</i>		1	
<i>Cryptophagus micaceus</i>	RDBK	16	SFG1
<i>Atomaria vespertina</i>		2	
<i>Pediacus dermestoides</i>		4	SFG3
<i>Epuraea biguttata/unicolor</i>		2	
<i>Soronia grisea</i>		2	
<i>Glischrochilus quadriguttatus</i>		2	
<i>Cerylon ferrugineum</i>		2	
<i>Cerylon histeroides</i>		4	
<i>Enicmus rugosus</i>	NS	8	SFG2
<i>Triphyllus bicolor</i>	NS	4	SFG2
<i>Cis fagi</i>		2	
<i>Cis micans</i>		4	
<i>Cis vestitus</i>		2	
<i>Tetratoma desmarestii</i>	NS	16	SFG3
<i>Orchesia micans</i>	NS	4	
<i>Orchesia undulata</i>		4	SFG3
<i>Eledona agricola</i>		4	SFG3
<i>Pyrochroa coccinea</i>		4	SFG3
<i>Schizotus pectinicornis</i>	NR	16	
<i>Vincenzellus ruficollis</i>		2	
<i>Salpingus planirostris</i>		1	
<i>Salpingus ruficollis</i>		1	
<i>Anaspis fasciata</i>		2	
<i>Anaspis rufilabris</i>		1	
<i>Rhagium mordax</i>		1	
<i>Rutpela maculata</i>		1	
<i>Pyrrhidium sanguineum</i>		24	SFG1
<i>Pogonocherus hispidulus</i>		2	
<i>Trachodes hispidus</i>	NS	8	SFG3
<i>Platypus cylindrus</i>	NS	8	SFG3
<i>Hylesinus varius</i>		1	
<i>Dryocoetes villosus</i>		2	
<i>Scolytus intricatus</i>		2	
<i>Xyleborus dryographus</i>	NS	8	SFG3
<i>Trypodendron domesticum</i>		2	SFG3

<i>Trypodendron signatum</i>	NS	8	SFG3
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Table 5 compares the RIEC and SQI scores achieved at Carn Gafallt in 2022 with those from Gilfach and three other parkland or wood-pasture sites on the fringes of the Cambrian Mountains in mid-Wales. A great advantage of the SQI is that it should be less influenced by the amount of recording effort than is the strictly cumulative RIEC index, which will continue to increase with further survey work. This can clearly be seen in Table 5, with the RIEC and SQI scores for Carn Gafallt given for both 2022 only and across all the surveys undertaken at the site since 2004. The cumulative RIEC score is much higher (39), while the SQI is roughly similar (387.8 this year only against 372.3 for 2004-2022).

Table 5 also includes RIEC and SQI scores for the top five saproxylic invertebrate sites in Wales, with contemporary assessments having been completed for the Wye Valley Woodlands SAC (Howe *et al.*, 2022), Chirk Castle Park (Alexander, 2019) and Gregynog (Alexander, 2023).

Table 5. RIEC and SQI scores for Carn Gafallt and other sites.

Site	No. Saproxylic Beetles	RIEC	SQI
Carn Gafallt, Brecon (vc42) 2022 only	74	29	387.8
Carn Gafallt 2004-2022	112	39	372.3
Gilfach, Radnor (vc43)	56	5	314.3
Cwm Llyfnant, Ceredigion (vc46)	44	4	284.1
Parc Pont-faen	45	11	260.0
Parc Nanteos, Ceredigion (vc46)	46	8	253.3
Wye Valley SAC (vc35)		90	504.7
Chirk Castle Park (vc50)		75	439.0
Powis Castle Park (vc47)		63	308.0
Dinefwr Park (vc44)		54	381.0
Gregynog (vc47)		53	409.0
Notes on Table 5.			
The SQI scores for other mid-Welsh sites that meet the threshold for number of saproxylic beetles (40) considered sufficient by Fowles <i>et al.</i> (1999) for a valid assessment of their importance for this assemblage included here are taken from the regularly updated list maintained online ¹ .			

5.2.1. Northern and Western Species

The ancient oak woodlands on the eastern edge of the Cambrian Mountains experience a rain shadow effect that results in a somewhat drier and colder climate relative to other areas of mid-Wales. Allied to the presence here of relatively large stands of ancient oak woodland and informal wood-pasture with good numbers of overmature and veteran trees, this has allowed for the survival of an unusually rich assemblage of northern-distributed saproxylic beetles that are at or close to their southern range limits. The Scarce Cardinal Beetle is perhaps the best example of this group. It occurs in a band of woods, parks and wood-pastures from near Llandovery in the south to Abbey Cwm-hir in the north and is otherwise only known in Britain from the Scottish Highlands. There are also a number of northern-distributed,

¹ Further information on SQI can be found at <http://khepri.uk/main/>

dead wood rove beetles in these woods, including *Phyllodrepoidea crenata*, *Xylostiba monilicornis* and *Bolitochara mulsanti*. The Scarce Cardinal Beetle, and *B. mulsanti* were both recorded at Carn Gafallt in 2022. The rare silken fungus beetle *Atomaria diluta*, which was also recorded here, may also belong to this faunal element but its ecology is insufficiently understood to state that it is an obligate saproxylic.

These woods also have populations of a group of western species that are scarce or absent in the lowlands of central and eastern England. To some extent, the distribution of this element overlaps with the northern element described in the preceding paragraph, as some can also be found in northwest England and western Scotland. However, they also have strong populations across Wales and southwest England. This group is well represented at Carn Gafallt, with records of three key saproxylic species, *Quedius xanthopus*, *Thymalus limbatus* and *Trypodendron signatum*.

5.2.2. Heartwood Decay

The presence of a rich heartwood decay fauna at Carn Gafallt is one of the most important differences between this site and other upland woodlands around the fringes of the Cambrian Mountains (including the Gilfach reserve). This includes some of the rarest saproxylic beetles known from the site, including *Cryptophagus micaceus*, recorded here for the first time in 2022 and the false darkling beetle *Hypulus quercinus*, which was found in 2014 but not during the current study.

This is one of the main reasons for the much higher RIEC score achieved by Carn Gafallt than for any other ancient upland woodland or wood-pasture around the Cambrian Mountains. The maintenance and enhancement of the stock of over-mature and veteran trees with heartwood decay is a key objective of management here.

5.2.3. Bark and Sapwood Decay

Most of the saproxylic invertebrates collected at Carn Gafallt in 2022, including the majority of the northern and western species described in the preceding sub-section, are associated with this habitat feature. Unsurprisingly for a site with a good stock of over-mature and veteran trees, there is a good supply of standing and fallen dead wood at Carn Gafallt. In general, the most valuable fallen timber for invertebrates comprises larger items, such as trunks and larger branchwood. As with the heart-rot assemblage, dead wood that experiences a drier, warmer microclimate tends to have a richer beetle fauna that includes many of the scarcer saproxylic beetles. For the same reason, standing or hanging dead wood tends to be of greater importance than that which is lying on the woodland floor, as the latter has a cooler, damper microclimate.

Good numbers of Scarce Cardinal Beetle larvae were recorded at Carn Gafallt in 2022. These tended to be found under bark of fallen branches of birch, Ash and oak where it was lying in at least partially open situations. However, they were also found in more shaded conditions on 'hanging' oak branches that were still well above ground level and therefore experienced a drier microclimate.

The classic management prescription for dead wood is to leave it in 'dappled shade'. However, damper, more shaded conditions may be of greater value for groups such

as Nematoceran Diptera (e.g. craneflies and fungus gnats). It is therefore necessary to retain dead wood in a full range of situations, from dry, sun-exposed situations to deep shade, but being mindful that it is intermediate positions that will usually have the richest saproxylic assemblage.

5.2.4. Fungal Fruiting Bodies

Many of the most important fungi for saproxylic invertebrates are heart-rotting brackets such as Chicken-of-the-woods *Laetiporus sulphureus*, Beefsteak Fungus *Fistulina hepatica*, Shaggy Bracket *Inonotus hispidus* and the Weeping Bracket *I. dryadeus*. Most of these bracket fungi favour relatively dry, warm conditions and in western woodlands at least, are most numerous on relatively open-grown trees in wood-pastures and parks. As has already been pointed out in sub-section 5.2.1, Carn Gafallt has a good stock of overmature and veteran oaks with active heart-rot that are growing in open-structured, informal wood-pasture and previous surveys have shown it to have a rich mycophagous fauna of saproxylic invertebrates.

Some key mycophagous species were found here in 2022, including the northern- and western-distributed *Bolitochara mulsanti* and *Thymalus limbatus*. The exceptionally dry conditions across much of the sampling period led to a relative dearth of saproxylic fungi and most records of key mycophagous species came from the birch-rotting Razor Strop fungus, which was the only relatively frequently recorded bracket at Carn Gafallt this year.

5.2.5. Management Considerations

Carn Gafallt is unique amongst the Elan woodlands in the large number of surviving over-mature and veteran Sessile Oaks growing in relatively open, informal wood-pasture. The RSPB are to be congratulated on their recent management of the site, which has improved its condition markedly for saproxylic invertebrates (and for other important groups such as epiphytic lichens) since the 2014 survey. In particular their cutting back of dense halo regeneration of oak saplings from around open-grown veterans in Cwm yr Esgob (SU1) allied to the introduction of cattle grazing has been very beneficial. This has restored the open wood-pasture character of part of this area and follow-up browsing is clearly achieving at least a degree of control over further excessive regeneration.

This programme should be continued and could be expanded into other closed-canopy areas where the presence of spreading veteran trees suggests that the woodland is derived from neglected wood-pasture. Other sections of Cwm yr Esgob would be the prime candidate for such works, but it could also be considered on the lower slopes of Allt Ddu (SU3).

6. Conclusions

Carn Gafallt is the most important site for saproxylic invertebrates in mid-Wales, hosting a nationally important assemblage that includes a unique mix of faunal elements. It is one of a group of old woods and wood-pastures (including Gilfach) along the eastern fringe of the Cambrian Mountains that have an unusually diverse and important assemblage characteristic of dead wood sites in northern and western

Britain. Its interest (and vulnerability to ongoing climate change) is enhanced by its position at or close to the southern range limits of a number of its constituent species. For example, there appears to be a strong population of the Scarce Cardinal Beetle here and other northern and western elements noted in 2022 include the rove beetle *Bolitochara mulsanti* and the Trogossitid *Thymalus limbatus*. It also has populations of saproxylic species more associated with lowland parks and wood-pastures in eastern Britain such as the fungus-associated beetles *Triphyllus bicolor* and *Tetratoma desmarestii* and the rare Cryptophagid *Cryptophagus micaceus*.

The outstanding interest of the saproxylic invertebrate fauna at Carn Gafallt is a consequence of the large stock of over-mature and veteran trees still present here growing in relatively open-structured wood-pasture conditions. Recent management by the RSPB has markedly improved the condition of the site for this invertebrate assemblage, by opening up areas of neglected wood-pasture that were reverting to shaded high forest as a consequence of under-grazing.

A list of management measures are suggested in the following section that aim to further enhance this very important saproxylic invertebrate assemblage over the longer term.

7. Management Recommendations

The development and implementation of a programme of capital works for the saproxylic invertebrate assemblage at Carn Gafallt is one of the key aims of the Natur am Byth! project. A list of management proposals is given below that should maintain and enhance the condition of both the key saproxylic habitat features outlined in the previous sections and the important species they support. An attempt has been made to order this list to reflect their importance in maintaining the saproxylic invertebrate interest of this site.

- In the 2014 report, it was suggested that around the lower fringe of Cwm yr Esgob (SU1) dense 'haloes' of regenerating oak around veteran oaks should be cut back in order to prevent excessive shading of the old trees. This has been done and has been very successful in restoring open-structured, informal wood-pasture that is of much greater value to saproxylic invertebrates (and also to epiphytic lichens and saproxylic fungi). The prolific oak regeneration on the lower slopes of Cwm yr Esgob is detrimental to the ecological interest (and long-term survival) of the open-grown veteran trees in this area. Younger growth of shading trees and shrubs should continue to be cut back from around old specimens, especially where it forms thickets around veteran trees. Extension of this management into other areas of Cwm yr Esgob should be considered in places where there are still densely shaded old trees. It may also be worth extending this management into other units where there are shaded veteran trees (e.g. the lower slopes of Allt Ddu, SU3). When carrying out this work, it is important to identify younger trees for retention that will act as long-term replacements for the existing cohort of old-growth.

- It would be valuable to undertake a tree survey that identified the resource of veteran, over-mature and mature trees. Identification of cohorts of younger trees that can be managed to act as replacements for these and to increase the resource of over-mature and veteran trees would be extremely valuable.
- Sessile Oak should continue to be the main species promoted for saproxylic invertebrates at Carn Gafallt. However, a continuity of over-mature and veteran birch is also very important. This is one of the main larval hosts of the Scarce Cardinal Beetle (though larvae at Carn Gafallt were more frequent under Ash and oak bark in 2022). Very often dead birch branches and trunks host colonies of the Birch Polypore bracket fungus, which itself hosts a diverse invertebrate fauna.
- Though Ash is only a minor component of the old tree resource at Carn Gafallt, its ongoing loss to Ash dieback disease is detrimental to the diversity of the saproxylic invertebrate fauna (and to epiphytic lichens and many other elements of overall biodiversity). Ash should be retained where there are not compelling safety reasons for its removal. In the longer term, it is hoped that some resistant trees can be favoured to replace and increase the representation of this species.
- Across much of Carn Gafallt, veteran and over-mature trees are found within closed-canopy ancient woodland or neglected wood-pasture. In those places where the structure and known history suggests a long continuity of woodland cover, it is probably most appropriate to restrict intervention to the thinning of younger trees from around mature, over-mature and veteran specimens (e.g. around old oaks in the closed-canopy woodland with veteran oaks above the road [SU3 and SU5]). The retention of relatively closed-canopy conditions, especially on north-facing slopes, may also be very important in maintaining a cooler microclimate that is suitable for northern-distributed specialists, such as the Scarce Cardinal Beetle in the face of ongoing climate change.
- Throughout the stands of woodland and wood-pasture, it is preferable for saproxylic invertebrates if the shrub, field and ground layers are sparse and open, in order to maintain a relatively dry microclimate around old trees and dead wood. Preferably, this is achieved through light to moderate grazing, which is at a level that prevents excessive regeneration of young trees, shrubs and Bramble. Grazing pressure should be at a level where it controls the regeneration of young growth, but it may also be necessary to carry out periodic cutting where important trees and dead wood items are becoming excessively shaded. Bracken can also be controlled by cutting, rolling and trampling by cattle and/or horses.
- Standing and fallen dead wood, and especially that derived from over-mature or veteran trees, should be retained in-situ unless there are compelling safety reasons for it to be moved. Of particular importance are large dead oak branches that are well above ground level. These may, for example, still be hanging from the tree, or be resting against the trunk. In general, larger items of dead wood, such as snags and fallen trunks or main branches are of greater importance than smaller pieces. If it is necessary to move dead wood, it should generally be placed in 'dappled shade' where the microclimate is relatively warm and dry. However, dead wood should be available across the full range of microclimatic conditions, from deep shade to full sun, as all of these situations have their own

saproxylic invertebrate community. No items of dead wood with significant invertebrate habitat features such as heart-rot or saproxylic fungi should be destroyed and should only be moved if there are compelling safety considerations.

- Pollarding of young- to mid-aged trees should be considered, as this can accelerate the development of dead wood habitat features.

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9. Data Archive Appendix

The data archive contains:

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

~~[B] A full set of maps produced in JPEG format.~~

~~[C] 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.~~

~~[D] A set of raster files in ESRI and ASCII grid formats.~~

~~[E] A database named [name] in Microsoft Access 2000 format with metadata described in a Microsoft Word document [name.doc].~~

~~[F] A full set of images produced in [jpg/tiff] format.~~

[G] Species records held in Welsh Invertebrate Database (WID).

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'. The metadata is held as record no 125466.



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