A survey and assessment of the saproxylic invertebrate fauna of Dinefwr Estate in 2023

NRW Evidence Report No. 760

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Mae'r GNG yn cynnwys Parc Ceirw hanesyddol a dwy ardal arall o dir parc, pob un yn eiddo i'r Ymddiriedolaeth Genedlaethol (NT) ers y 1990au, yn ogystal â Gwarchodfa Natur Coed y Castell, sy'n eiddo i Ymddiriedolaeth Natur De a Gorllewin Cymru (YNDGC) ers 1979. Nododd arolwg manwl o goed ym 1978 bresenoldeb 655 o goed hynafol ar draws Parc y Ceirw, coed derw yn bennaf (545). Y ddwy ardal ychwanegol o dir parc yw'r Parc Blaen, a oedd yn cael ei bori gan fuches o wartheg gwyn yn 2023, ac ardal fwy i'r de y cyfeirir ati yma fel y Parc Isaf, ac a oedd yn cael ei phori gan ddiadell fasnachol o ddefaid dan drwydded bori gyda'r Ymddiriedolaeth Genedlaethol. Mae'r ardal wedi bod yn destun amryw o arolygon infertebratau o 1986 ymlaen, gan arwain at arolwg ac asesiad mwy dwys o'r diddordeb saprosylig (pren marw) sylweddol cydnabyddedig ym 1996.

Mae'r ddogfen bresennol yn adrodd ar asesiad cyfoes o'r ffawna infertebratau saprosylig yn 2023 ac a gomisiynwyd i bennu cyflwr presennol y casgliad. Gan ddefnyddio cyfuniad o ddal trwy ryng-gipio infertebratau wrth iddynt hedfan a chwilio â llaw, cofnodwyd cyfanswm o 92 o rywogaethau o chwilod saprosylig ar draws y safle gan gynnwys 21 rhywogaeth sydd â statws Prin yn Genedlaethol ym Mhrydain Fawr neu statws cyfatebol. O'r 92 rhywogaeth, nid yw 21 (23%) yn ymddangos yn rhestr y safle a ddarparwyd gan CNC. Mae'r rhywogaethau ychwanegol hyn yn cynnwys deg sy'n cael eu hystyried yn rhywogaethau dangosydd o ansawdd uchel, y mwyaf nodedig yw *Aderus populneus, Enicmus rugosus, Hallomenus binotatus, Quedius microps, Q. truncicola* a *Scraptia testacea* - mae'r darganfyddiadau hyn yn awgrymu bod y cofnod cyfredol o'r ffawna sy'n bresennol ymhell o fod yn gyflawn.

Fodd bynnag, ni chanfuwyd enghreifftiau o'r rhywogaethau prin allweddol a adroddwyd gan Dinefwr yn y gorffennol – *Abraeus granulum, Batrisodes venustus, Hypulus quercinus* a *Ptinella limbata*. Ystyrir bod y rhain yn debygol o fod yn bresennol o hyd gan nad oes disgwyl i samplu un blwyddyn ganfod yr holl rywogaethau sy'n bresennol – mae cynefin addas ar gael yma o hyd.

Nodwyd cyfanswm o 177 rhywogaeth o Diptera o'r trapiau, y mae 83 ohonynt o leiaf yn rhannol saprosylig. Dim ond trwy chwilio â llaw y daethpwyd o hyd i ddau Diptera saprosylig ychwanegol gan ddod â'r cyfanswm saprosylig o arolwg 2023 i 85 o rywogaethau. Mae hyn ychydig yn llai na'r Coleoptera saprosylig. Cynhwyswyd naw rhywogaeth ychwanegol o wybed ffwng sy'n dod â chyfanswm y rhywogaethau o wybed ffwng sydd wedi'u cofnodi yn GNG Dinefwr i 203 - y cyfrif rhywogaethau uchaf o unrhyw safle yng Nghymru. Mae'r rhain yn cynnwys un rhywogaeth sy'n brin yn genedlaethol nad

yw wedi'i chanfod yng Nghymru o'r blaen, *Mycetophila caudata*. Mae'r 177 rhywogaeth yn cynnwys 14 gyda statws cadwraeth, ac mae'n ymddangos bod deg ohonynt yn newydd i'r safle – mae'r rhain gan mwyaf yn rhywogaethau y mae'n ymddangos eu bod yn fwy tebygol o gael eu canfod trwy'r trapiau hedfan wedi'u targedu'n well a ddefnyddiwyd gan arolwg 2023. Maent yn cynnwys *Lasiambia brevibucca* (Chloropidae) a'r pryf teiliwr *Rhipidia uniseriata* (Limoniidae) yn ogystal ag *Odinia trinotata* (Odiniidae) nad ymddengys iddo gael ei gofnodi yng Nghymru o'r blaen. Er ei fod yn hysbys o dir parc yn y gororau, Dinefwr yw'r unig safle hysbys yng nghanol y wlad am *Fannia aequilineata* (Fanniidae).

Mae'r Mynegai Parhad Ecolegol (IEC) yn darparu asesiad o gyfoeth rhywogaethau'r ffawna chwilen arbennig sy'n gysylltiedig ag amodau hen dyfiant. Credir bod gan safleoedd ag IEC o 25 neu uwch arwyddocâd ar lefel Prydain Fawr a bod yn IEC o 80 neu uwch yn dynodi arwyddocâd Ewropeaidd. Mae gwaith arolwg 2023 wedi codi'r IEC o 59 i isafswm o 72. Mae hyn yn gosod Dinefwr ymhlith y pedwar safle uchaf yng Nghymru, ochr yn ochr â Pharc Castell y Waun (IEC o 90), Ardal Cadwraeth Arbennig (ACA) Coetiroedd Dyffryn Gwy (IEC o 90 o leiaf) a Pharc Piercefield (76), a'r unig safle o'r ansawdd uchel hwn yn ddwfn yn y wlad yn hytrach nag yn siroedd y gororau.

Mae'r Mynegai Ansawdd Saprosylig (SQI) yn darparu cynllun cyfochrog sy'n asesu cyfran y rhywogaethau prin sy'n bresennol, ac sy'n ymddangos yn fwyaf defnyddiol at ddibenion monitro safonau cyffredin. Y SQI a gyfrifwyd gan ddefnyddio data 2023 yw 374.4, sy'n gymharol agos at y ffigur o 350.7 a gyflawnwyd o ddata arolwg 1996. Mae hyn yn awgrymu na fu unrhyw newid sylweddol yng nghyflwr y safle ar gyfer chwilod saprosylig.

Mae trapio yn darparu methodoleg samplu y gellir ei defnyddio ar gyfer cymharu uniongyrchol. Y gwerthoedd SQI ar gyfer y tri phrif faes a samplwyd yn 2023 yw:

- 306 ar gyfer Parc y Ceirw (data o bum trap rhyng-gipio hediadau);
- 323 ar gyfer Coed y Castell (pedwar trap);
- 384 ar gyfer gweddill y tir parc - y Parc Blaen a'r Parc Isaf (pum trap).

Mae hyn yn awgrymu bod ansawdd y cynefinoedd yn fwy y tu allan i'r Parc Ceirw ar hyn o bryd nag oddi mewn iddo. Yn sicr, mae parcdir mwy agored y Parc Isaf a'r Parc Blaen, yn ogystal ag ardal gwarchodfa'r Ymddiriedolaeth Natur, yn cynnwys rhai o'r coed derw hynod a hynafol mwyaf trawiadol yn y GNG.

Mae'r un patrwm yn amlwg o'r niferoedd o rywogaethau Prin yn Genedlaethol a ganfuwyd yn ystod 2023:

- 8 rhywogaeth o chwilod Prin yn Genedlaethol ym Mharc y Ceirw;
- 10 rhywogaeth o chwilod Prin yn Genedlaethol yng Nghoed y Castell;
- 15 rhywogaeth o chwilod Prin yn Genedlaethol yng ngweddill y tir parc (y Parc Blaen a'r Parc Isaf).

Mae'r canlyniadau hyn yn ddiddorol iawn gan mai'r rhagdybiaeth flaenorol fu mai'r Parc Ceirw oedd yr ardal gyfoethocaf. Mae'n galonogol, felly, bod ardal ddynodedig y SoDdGA a'r GNG yn cynnwys yr ardaloedd eraill hyn.

Ar y cyfan, mae cyflwr y cynefinoedd ar gyfer infertebratau saprosylig yn ymddangos yn ffafriol ar hyn o bryd - fel y nodir gan gyfoeth rhywogaethau parhaus y ffawna. Fodd bynnag, mae rhesymau i bryderu yn y tymor hir:

- Mae lleoliad a sefyllfa'r coed hynafol pwysicach wedi'u gwahanu i raddau helaeth i glystyrau yn y coedwigoedd uchel a choed sbesimen unigol, gyda phwyslais yn cael ei roi ar y cyntaf yn ôl pob tebyg;
- Mae clystyrau o goed yn y Parc Isaf wedi'u ffensio oddi wrth y tir pori ar draul eu ffurf wrth dyfu a'u hirhoedledd;
- Mae'n ymddangos bod plannu coed unigol wedi canolbwyntio mwy ar lenwi bylchau yn y clystyrau mwy hyn yn hytrach nag allan yn y tir parc agored lle mae coed hynafol sy'n tyfu'n agored bellach yn brin;
- Mae'n ymddangos bod hen foncyffion yn dominyddu pren marw ar lawr a bod prinder cymharol o bren sydd newydd farw – ymddengys bod dynamig naturiol twf, marwolaeth a phydru wedi dirywio ar brydiau dros y degawdau diwethaf, gan adlewyrchu strwythur oedran presennol y coed efallai.

Mae'r ffawna saprosylig yn cynnwys rhywogaethau sy'n dibynnu ar argaeledd parhaus o:

- goed sy'n tyfu'n agored mewn tir parc a choed pori;
- coed hynafol â phydredd rhuddin a cheubrennau yn ogystal â thyllau pydru, nodweddion sy'n gofyn am ddigon o le agored o amgylch y coed;
- canghennau marw yn y goron isaf sy'n dal ynghlwm wrth y goeden;.
- canghennau sydd wedi torri yn hongian o'r coed;
- pren sy'n pydru ar lawr yn fwy cyffredinol – ac wedi'i adael yn gyfan lle bynnag y bo'n ymarferol; a
- blodau o lwyni blodeuo, yn enwedig y ddraenen wen a'r ysgawen.

Nid yw'n ymddangos bod y gofynion hyn yn cael eu gwerthfawrogi'n llawn wrth reoli'r tir ar hyn o bryd. Mae'n ymddangos bod y dehongliad o ddiddordeb bywyd gwyllt arbennig yr ystad yn gyfyngedig iawn ar hyn o bryd ac nid yw profiad yr ymwelydd wedi'i dargedu'n dda at agweddau naturiol y safle unigryw hwn.

Prif argymhellion

- Mae angen datblygu cynllun plannu coed ar frys sy'n rhoi pwyslais ar gynnal coed tir parc sy'n tyfu'n agored fel nodwedd, ac mae brys arbennig am hyn yn y Parc Blaen a'r Parc Isaf, lle nad oes llawer o goed ar ôl bellach;
- Mae angen llai o blannu i lenwi bylchau gan adael llennyrch sydd heb eu plannu;
- Mae angen i'r ardaloedd o goed sydd wedi'u ffensio yn y Parciau Blaen ac Isaf gael eu teneuo'n drwm, er mwyn ffafrio coed sydd â datblygiad canghennau ochrol o hyd, ac sydd â'r potensial i ddatblygu ffurf fwy agored;
- Dylid tynnu ffensys o amgylch y clystyrau coed hynny cyn gynted â phosibl ac adfer cynefin coed pori'r ardaloedd hynny gan y byddai hyn o fudd sylweddol i fioamrywiaeth;
- Mae angen corongylchu o amgylch coed hynod a choed hynafol yn eang ar draws y GNG i atal twf ifanc mwy egnïol rhag gor-gysgodi'r coed hŷn pwysicaf. Mae hyn yn arbennig o bwysig yng Nghoed y Castell ond hefyd yn lleol o fewn Parc y Ceirw a'r ardaloedd sydd wedi'u ffensio;

- Mae angen mynd i'r afael â'r tagio coed presennol, er mwyn darparu strwythur ymarferol at ddibenion cofnodi, gan ddefnyddio tagiau mwy gwydn. Mae angen y data hwn i lywio ein dealltwriaeth o gyfanswm yr adnoddau sydd ar gael ar hyn o bryd ac i asesu'r anghenion recriwtio ar gyfer sefydlu cenedlaethau newydd o goed.

Argymhellion eraill sy'n codi o waith arolwg 2023 yw:

- monitro cyflwr y safle'n barhaus gan ddefnyddio technegau arolygu safonol;
- parhau gyda rheoli tir sy'n sensitif i iechyd coed;
- parhau i gadw coed marw a choed sy'n pydru *yn y fan a'r lle* lle bynnag y bo'n ymarferol gwneud hynny;
- na ddylai torri a symud pren marw sydd wedi cwympo ond fod yn dderbyniol er mwyn ei glirio o waith cerrig sydd wedi'i ddifrodi neu o lwybrau mynediad allweddol.

Dylai'r dynodiad GNG ddarparu cyfleoedd da ar gyfer hyrwyddo arferion cadwraeth da trwy raglen addysgol. Nodwyd fodd bynnag ei bod yn ymddangos nad yw'r Ymddiriedolaeth Genedlaethol na'r Ymddiriedolaeth Bywyd Gwyllt yn gwneud defnydd llawn o gyfleoedd o'r fath.

Mae gan bob un o'r uchod oblygiadau sylweddol o ran adnoddau wrth gwrs ond dylid rhoi blaenoriaeth i GNG ar gyfer cyllid ac adnoddau eraill.

Executive summary

The Dinefwr Estate SSSI and NNR includes a notably large expanse of ancient parkland and wood pasture habitats - 224ha - within the historic county of Carmarthenshire. The SSSI was designated for its lichen and invertebrate assemblages which are principally associated with the trees. It has been demonstrated more recently that those same trees are also of national interest for wood-decay fungi. The Grade 1 Historic Park and Garden designated by Cadw in 2022 covers a larger area of parkland, extending to about 390ha.

The NNR includes a historic Deer Park and two further areas of parkland, all owned by the National Trust (NT) since the 1990s, as well as Castle Woods Nature Reserve, owned by the Wildlife Trust of South and West Wales (WTSWW) since 1979. A detailed tree survey in 1978 noted the presence of 655 veteran trees across the Deer Park, mainly oak (545). The two additional areas of parkland are Front Park, grazed by a herd of white park cattle in 2023, and a larger area to the south referred to here as Lower Park, and which was being grazed by a commercial herd of sheep under a grazing licence with the NT. The area has been subject to various invertebrate surveys from 1986 onwards, culminating in a more intensive survey and assessment of the recognised considerable saproxylic (wood-decay) interest in 1996.

The present document reports on a contemporary assessment of the saproxylic invertebrate fauna in 2023 which was commissioned to determine the current condition of the assemblage. Using a combination of flight interception trapping and hand-searching, a total of 92 saproxylic beetle species was recorded across the site including 21 species with GB Nationally Scarce or equivalent status. Of the 92 species, 21 (23%) do not feature in the site list provided by NRW. These additional species include ten which are regarded as high-quality indicator species, the most notable being *Aderus populneus, Enicmus rugosus, Hallomenus binotatus, Quedius microps, Q. truncicola* and *Scraptia testacea* - these discoveries suggest that the current record of the fauna present is far from complete.

However, key rarities reported from Dinefwr in the past were not detected – *Abraeus granulum, Batrisodes venustus, Hypulus quercinus* and *Ptinella limbata*. These are considered likely to still be present as one year's sampling cannot be expected to detect all species present – suitable habitat remains available here.

A total of 177 species of Diptera were identified from the traps, of which 83 are at least in part saproxylic. Two additional saproxylic Diptera were only found by hand-search bringing the saproxylic total from the 2023 survey to 85 species. This is somewhat less than the saproxylic Coleoptera. Nine additional species of fungus gnat were included which brings the Dinefwr NNR up to 203 species of recorded fungus gnat – the highest species count of any Welsh site. These include one Nationally Scarce species which has not previously been found in Wales, *Mycetophila caudata*. The 177 species include 14 with conservation status of which ten appear to be new to the site – these are predominantly species which appear most readily found by the better-targeted flight traps used by the 2023 survey. These include *Lasiambia brevibucca* (Chloropidae) and the cranefly *Rhipidia uniseriata* (Limoniidae) as well as *Odinia trinotata* (Odiniidae) which appears not to have been

reported in Wales previously. While known from the Welsh border parklands, Dinefwr is the only known site in the heart of the country for *Fannia aequilineata* (Fanniidae).

The Index of Ecological Continuity (IEC) provides an assessment of the species richness of the special beetle fauna associated with old growth conditions. Sites with an IEC of 25 or above are believed to be of GB significance and 80 or above of having European significance. The 2023 survey work has raised the IEC from 59 to a minimum value of 72. This places Dinefwr amongst the top four sites in Wales, alongside Chirk Castle Park (IEC 90), the Wye Valley Woodlands SAC (IEC at least 90) and Piercefield Park (76), and the only site of this high quality deep within the country as opposed to being in the border counties.

The Saproxylic Quality Index (SQI) provides a parallel scheme which assesses the proportion of rare species present, and which appears to be most useful for common standards monitoring purposes. The SQI calculated using the 2023 data is 374.4, moderately close to the figure of 350.7 achieved from the 1996 survey data. This suggests that no significant change in site condition for saproxylic beetles has taken place.

Trapping provides a directly comparable sampling methodology. The SQI values for the three main areas sampled in 2023 are:

- 306 for the Deer Park (data from five flight interception traps);
- 323 for Castle Woods (four traps);
- 384 for the rest of the parkland - Front Park and Lower Park (five traps).

This suggests that habitat quality is currently greater outside of the Deer Park than within. Certainly, the more open parkland of Lower and Front Parks, as well as the Wildlife Trust reserve area, contain some of the most impressive veteran and ancient oak trees within the NNR.

The same pattern is discernible from the numbers of Nationally Scarce species found during 2023:

- 8 Nationally Scarce beetle species in the Deer Park;
- 10 Nationally Scarce beetle species in Castle Woods;
- 15 Nationally Scarce beetle species in the rest of the parkland (Front Park and Lower Park).

These results are very interesting as the past assumption has been that the Deer Park was the richest area. It is therefore very welcome that the designated area of SSSI and NNR includes these other areas.

Overall, habitat condition for saproxylic invertebrates appears favourable at present – as indicated by the continuing species-richness of the fauna. However, there are causes for concern for the long term:

- The disposition and situation of the more important veteran trees are very polarised into high forest stands and individual specimen trees, with emphasis apparently being given to the former;

- The stands of trees in the Lower Parkland have been fenced-out from the grazing land to the detriment of their growth form and longevity;
- Individual tree planting appears to have been more focused on gap-filling to these larger stands rather than out into the open parkland where open-grown veteran trees are now notably few and far between;
- Lying dead wood appears to be dominated by old trunks and a relative lack of freshly dead timber – the natural dynamic of growth, death and decay appears to have become stilted over recent decades, perhaps reflecting the present age structure of the trees.

The saproxylic fauna includes species which rely on continued availability of:

- open-grown parkland and wood pasture trees;
- veteran trees with heartwood decay and hollowing trunks as well as rot-holes, features which require the availability of ample open space around the trees;
- dead branches in the lower crown which are still attached to the tree;.
- broken branches hanging from trees;
- lying decaying wood more generally – and left intact wherever feasible; and
- blossom from flowering shrubs, notably hawthorn and elder.

These requirements do not appear to be fully appreciated in the land management at present. Interpretation of the special wildlife interest of the estate appears to be very limited at present and the visitor experience is not well-targeted at the natural aspects of this unique site.

Key recommendations

- There is an urgent need for a tree-planting plan to be developed which gives emphasis to maintaining open-grown parkland trees as a feature, and this is especially urgent in Front Park and Lower Park, where few trees now remain;
- Gap-planting needs to be toned down and glades left unplanted;
- The fenced plantation areas in Front and Lower Parks need to be subject to heavy thinning, to favour trees which still have lateral branch development, and which have the potential to develop a more open-grown form;
- Fencing around those tree stands should be removed at the earliest opportunity and the stands returned to wood-pasture habitat as this would be of considerable biodiversity benefit;
- Haloing around ancient and veteran trees is needed widely across the NNR to prevent more vigorous young growth from over-shading the more important aging trees. This is especially important in Castle Woods but also locally within the Deer Park and the fenced enclosures;
- The current tree-tagging needs to be addressed, to provide a workable structure for recording purposes, using more durable tags. This data is needed to guide our understanding of the total resource currently available and to assess the recruitment needs for establishment of new generations of trees.

Other recommendations which arise from the 2023 survey work are:

- continued site condition monitoring using standardised survey techniques;

- continued land management that is sympathetic to tree health;
- continued retention of dead and decaying wood *in situ* wherever practical to do so;
- Cutting and displacement of fallen dead wood should only be acceptable to clear from damaged stonework or from key access routes.

The NNR designation should provide good opportunities for promoting good conservation practice through an educational programme. It was noted however that neither the NT not the WT appear to be making full use of such opportunities.

All of the above have considerable resource implications of course but an NNR should be given top priority for funding and other resources.

1. Introduction

1.1 Background

Dinefwr Park currently comprises large areas of pasture with enclosed plantation woodlands surrounding a mid-17th century mansion, Newton House (Figures 1 & 2). Ancient and veteran trees vary in density across the site, from very isolated open-grown trees through to relatively overcrowded stands of trees. The present designed landscape dates primarily from the mid-18th century but incorporates much older features, notably the large number of ancient and veteran trees, a herd of white park cattle, the Deer Park and the medieval castle ruins.

Figure 1. Aerial image of Dinefwr Estate © Crown copyright and database right.

The two key features from a nature conservation perspective are i) the ancient and other veteran trees, within a matrix of ii) long-established grasslands and grazing livestock. Both of these features pre-date the landscape gardening of the 18th Century onwards and are therefore of greater historic and ecological significance as survivors of the medieval landscape and providing continuity of habitat for the nationally important wildlife surviving today. The oldest veteran trees appear to date back to the early medieval period and provide ecological continuity with even earlier landscapes. A herd of white cattle originates from at least the 10th Century. Neither the maps of Saxton (1578) nor Speed (1610) show an enclosed deer park here, which may suggest that the area was under a more informal wood-pasture or pasture woodland style of land use at the time, perhaps more suited to the herd of white cattle. A deer park – the first? – is known to have been laid out in 1660

although the present high stone walls were completed around 1774. There have been a number of phases of landscape gardening but the present lay-out essentially reflects the 1757-1779 phase which was in the style developed by Lancelot Brown – Brown is known to have visited the site and to have admired it (Cadw website) and though several refinements followed Brown's visit, Dinefwr Park had in essence already been created before he came (Colvin & Moggridge, 2003).

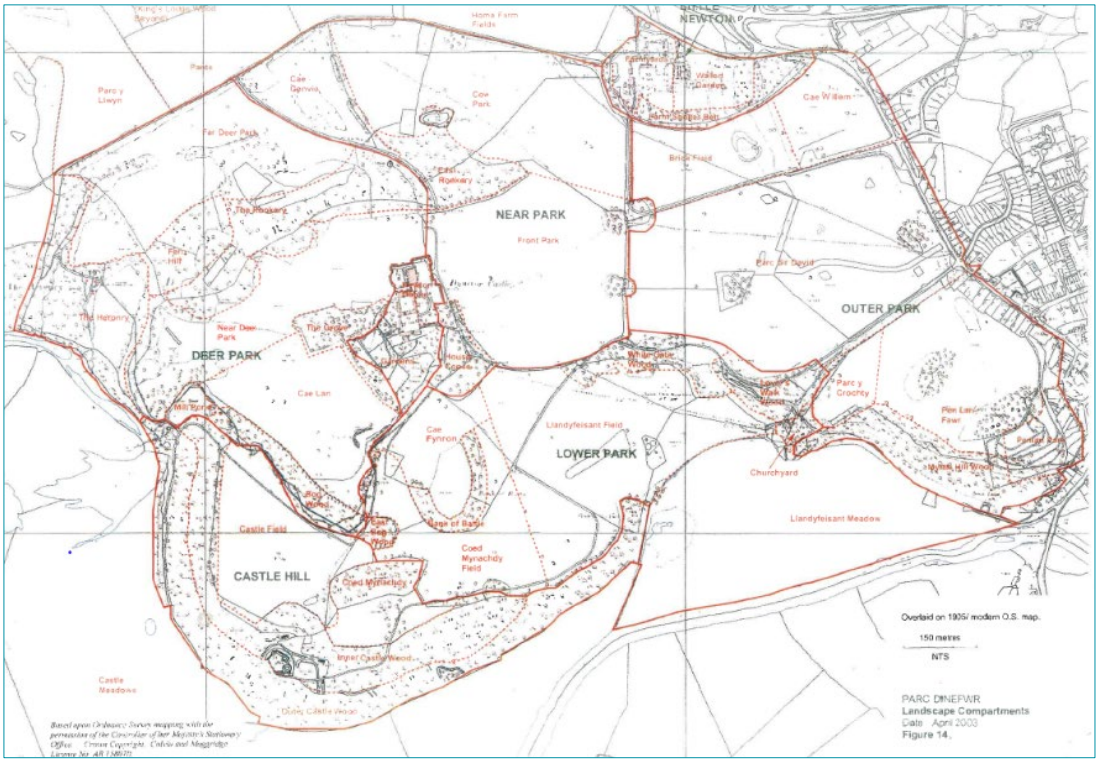

Figure 2. National Trust compartment map of Dinefwr Estate.

The steeper slopes were naturally more tree-covered than much of the gentler parkland and some sections were eventually taken out from the parkland and wood pasture by enclosing with barbed wire fences. Between 1885 and 1905 several plantations were made to improve shooting (Colvin & Moggridge, 2003). These include what is now Castle Woods Nature Reserve (formally known as Dinefwr/Dynefor Castle Woods, Llandeilo) which is owned and managed by the Wildlife Trust of South & West Wales. Some of these areas have engulfed veteran trees and threaten their long-term survival if not actively managed for conservation.

Livestock grazing continues as follows: a herd of fallow deer in the walled and fenced deer park (Parc Ceirw), white park cattle in Front Park (Parc Blaen) and sheep in the Lower Park to the south. The sheep were present during the April survey visit but not subsequently – the arrangement with the grazier has since been terminated. Castle Field - the large grassy area between the medieval castle ruins and the deer park – remained ungrazed throughout 2023.

Dinefwr Park and surrounding woodlands including Castle Woods comprise Dinefwr Estate SSSI and NNR.

1.2 Tree survey data

The largest trees at the time were documented by a previous owner, Lord Dynevor (1934), but formal tree surveys were carried out much later. Paul Harding of the Institute of Terrestrial Ecology documented the Deer Park trees in 1978 as part of the Nature Conservancy Council's *Mature Timber Habitat* project (Harding, 1979). He noted a total of 655 'overmature' trees (now named veteran trees), comprising 545 oak plus 40 beech, 31 sycamore, 15 sweet chestnut, 9 ash, 8 horse chestnut and 7 common lime. Harding (1990) also reported on the extent of storm damage within the Deer Park in 1989.

Interestingly, the oldest oaks on the site today appear to be thinly scattered through the Lower Park and within those parts of Castle Woods Nature Reserve most distant from the ruins of the medieval Dinefwr Castle. These trees were not covered by the Harding survey.

Treework is reported to have carried out a new tree survey for the National Trust (Colvin & Moggridge, 2003) but only the digital mapping has been made available for use during the 2023 survey – not the spreadsheet with the details of the tree features. Ben Rose of Treework (2008) carried out a dead wood survey in late May 2008 using a transect methodology.

Individually numbered tree tags occur on many of the trees across the NNR but their derivation is mostly unclear – many trees have more than one style of tag, with different numbers. Some are round aluminium tags, others oval aluminium tags. A few green plastic Latschbacher tags are almost certainly derived from lichen surveys as these were adopted for use by the National Trust central Estates Advisory Office in the late 1980s. Aluminium tags are very prone to damage and removal by squirrels and so are not recommended for tree surveys where long-term resilience is important.

The long history of tree cover plus the presence of many ancient and other veteran trees is reflected by the rich epiphytic lichen flora and the rich saproxylic mycota, as well as by an exceptional saproxylic invertebrate fauna.

1.3 Lichen surveys

The Dinefwr Estate, but particularly the Deer Park, is the most important parkland site for lichens in South Wales (Orange, 1996). The most recent survey took place in 2022 (Windle & Douglass, 2023). Reduction/exclusion of grazing from certain areas was identified as a matter of concern.

1.4 Fungal surveys

The first ever fungal survey of Dinefwr NNR was carried out in 2021 (Bosanquet & Lucas, 2021) and confirmed as passing the selection threshold for oak deadwood fungi set out in the *Guidelines for Selection of Biological SSSIs* (Bosanquet *et al*., 2018). The most frequently recorded bracket fungus at Dinefwr proved to be Beefsteak *Fistulina hepatica* being recorded fruiting from 21 oak trees in that year. The relatively uncommon *Ganoderma resinaceum* is

also known here. Six trees were noted with Chicken-of-the-Woods *Laetiporus sulphureus* but only two with *Pseudoinonotus dryadeus*.

1.5 Saproxylic invertebrate interest

A key objective of the *Mature Timber Habitat* project had been to identify sites of potential interest for saproxylic invertebrates. Harding (1976) was the first to highlight the potential of Dinefwr Park for the specialist saproxylic invertebrates associated with veteran trees in historic parklands and wood pastures. The first invertebrate survey work was carried out in 1986 and was followed by a national Coleopterists' Meeting in 1989. Alexander & Pavett (1992) provided a collation of the beetle data together with other records which had been made by various recorders who had visited more casually. Morgan (1992) provided a parallel review of other invertebrate records, most notably saproxylic hoverflies (Syrphidae) and digger wasps (Sphecidae). The Countryside Council for Wales commissioned further exploratory survey work in 1994 as part of their Welsh parklands project (Hammond & Hine, 1994) and which was followed up with a more detailed survey and assessment in 1996 (Levey & Pavett, 2000). The Index of Ecological Continuity had now reached 58, making Dinefwr one of the top three sites in Wales for saproxylic beetles and of GB significance.

Table 1. The more notable saproxylic beetle records from Dinefwr Estate NNR. The Henronry and Rookery areas lie within the Deer Park.

Species name	Year	Situation found	Location
Abraeus granulum	1996	In trap	Deer Park: The Heronry
Batrisodes venustus	1996	In traps near ancient oaks	Deer Park: The Heronry & The Rookery
Cryptophagus micaceus	1996	In oak	Deer Park
Hypulus quercinus	1996	In trap on oak	Deer Park
Mycetophagus piceus	1988 1996	at sap-run on beech In trap among ancient oaks	Deer Park Deer Park: The Rookery
Prionychus ater	1989	Larvae in collapsed old oak	Deer Park
Ptinella limbata	1994	Under bark of old beech logs	In plantation north side of Front Park
Ptinus subpilosus	1996	In traps next to ancient red-rotten oak & under ancient oaks	Deer Park: The Heronry
Quedius scitus	1989	One specimen	Deer Park
Thymalus limbatus	1986 1988 1989 1994 1996	Sporadically & in small numbers	Deer Park & Lower Park
Triphyllus bicolor	1996	In traps under ancient oaks	Deer Park: The Heronry & The Rookery

The most important beetle species (Grades 1 and 2 of the Index of Ecological Continuity) reported from Dinefwr in the past are detailed in Table 1. All records arose from sampling in Dinefwr Deer Park, the only exceptions being *Ptinella limbata* which was found in the

plantation area on the north side of Front Park and *Thymalus limbatus* which has been found both in the Deer Park and in Lower Park. Very little survey effort appears to have been made in Front Park, Lower Park or Castle Woods.

From Table 1, it is clear that most of the more notable beetle species known from Dinefwr are based on records from a single year only. *Thymalus limbatus* has been found most often, with *Mycetophagus piceus* noted in two separate years. The data also suggest that the Deer Park is the core area of interest for saproxylics, although this almost certainly reflects recording bias rather than objective data – recorders have assumed that the Deer Park is the more interesting area and so have neglected other areas of the Estate.

Levey & Pavett (2000) state that 247 species of saproxylic Diptera were found at Dinefwr during their survey. They also note that 194 species of fungus gnat were found and that this compares favourably with the richest sites known across Britain. At the time, 26 of these had conservation status. Peter Chandler (pers. comm., 2023) has stated that Dinefwr has the longest list of fungus gnats from anywhere in Wales. Morgan (1992) provides the best record of the more interesting saproxylic hoverflies known from Dinefwr. Three species of the spectacular comb-horned craneflies – the Nationally Scarce *Ctenophora pectinicornis* and *Tanyptera atrata,* as well as the uncommon *Dictenidia bimaculata* - have been reported in the Deer Park. Nationally Rare or Scarce saproxylic Diptera records from the Dinefwr Estate are detailed in Table 2.

Table 2. Nationally Rare and Nationally Scarce saproxylic Diptera records from Dinefwr Estate NNR.

Species name	Status	Situation found	Location
Callicera aurata (Syrphidae)	NS	At blossom	“Below Castle Woods”
Ctenophora pectinicornis (Tipulidae)	NS	Not recorded	Deer Park
Rhipidia ctenophora (Limoniidae)	NR	not recorded	Deer Park
Scenopinus niger (Scenopinidae)	NS	On veteran oak with large cavity to hollow interior	Lower Park
Tanyptera atrata (Tipulidae)	NS	Not recorded	Deer Park
Tipula selene (Tipulidae)	NS	Not recorded	Data not released to National Biodiversity Network by Local Records Centre
Xylota xanthocnema (Syrphidae)	NS	Not recorded	Deer Park

Morgan (1992) also collated records of the digger wasps (Sphecidae) which include the Nationally Scarce *Crossocerus binotatus*, as well as the more widespread *C. megacephalus*, *Ectemnius cavifrons*, *E. continuus*, *Psen dahlbomi* (now known as *Mimumesa dahlbomi*), *Rhopalum coarctatum* and *Pemphredon lugubris* which are all cavity-nesters favouring, to some extent at least, dead wood. Levey & Pavett (2000) only reported on beetles and flies and provided no information on any digger wasps found.

The NRW contract brief states that following a more comprehensive collation of data and analysis using the Pantheon analytical tool, a total of 388 saproxylic invertebrates is now known from Dinefwr Park and Estate of which 170 are regarded as key species.

1.6 Objective

The NRW contract brief was as follows: Using a combination of visual searches and aerial emergence traps, a contemporary assessment of the saproxylic invertebrate fauna and the availability of the deadwood resource will be undertaken from April to October 2023 in order to determine the current condition of the assemblage at Dinefwr Estate. An assessment should also be made of the current veteran tree and deadwood resource, and threats and other management issues which impact upon the saproxylic fauna should be highlighted. The 170 key species should be used when determining feature condition.

Although initially targeted at the National Trust ownership at Dinefwr, Castle Woods was added to the contract at a later date.

2. Methods

2.1 Dates and number of visits

The baseline standard for saproxylic invertebrate surveys is for three visits to be carried out across the field season, targeting late spring, high summer and autumn (Drake *et al.*, 2007). Given the large extent of the NNR and the desire to operate some flight interception trapping in parallel with field survey – see below – each visit involved more than one day.

The first exploratory visit was carried out over 17th and 18th April 2023. An exploration of the parkland and wood pasture areas led to a number of veteran trees being identified as suitable for flight interception trapping. These were then whittled down to five trees in the Deer Park, five in the rest of the parkland (Front Park, Lower Park and Castle Field) and two in the western area of Castle Woods which has some of the best ancient oaks within the NNR. The second visit took place over 8th, 9th and 10th June. By now, the contract had been extended to fully include Castle Woods and two further traps were placed there, in the eastern area with veteran oaks. The third visit covered 14th and 17th August. The final visit was over 16th and 17th October when the traps were taken down and removed.

2.2 Hand sampling techniques

The main hand-sampling techniques applied were as follows:

- visual inspection of vegetation and accessible wood-decay for invertebrates;
- spot-sweeping, i.e. targeting observed invertebrates for netting;
- general sweep-netting, i.e. targeting ground vegetation which might contain resting invertebrates;
- hand search, e.g. by searching amongst woody debris;

- beating foliage and branches of trees, shrubs and dwarf shrubs using beating tray;
- beating blossom on flowering shrubs.

Wherever possible, specimens encountered were identified in the field, retaining voucher specimens of the more critical species. Other specimens were taken away for inspection under microscope.

2.3 Flight interception trapping

Flight interception trapping has become a standardised way of extending the sampling periods so that sampling continues uninterrupted between each visit by the surveyor. It is especially valuable in wet climates as continuous trapping enables sampling to take place during any more favourable warm and dry periods which might otherwise have been missed by the infrequent visits. The most productive sampling occurs during such warm and dry conditions.

The flight interception traps used by Levey & Pavett (2000) were all based on black terylene netting and included standard Malaise traps, Owen-style traps placed across the ground surface, and what they termed ‘composite flight-interception traps’ which appear to have been a type of vane trap which was hung in the lower canopy of ancient oaks. They also mention using one Owen emergence trap to sample fallen branches as well as a small number of artificial bird nest traps placed inside tree cavities. Flight interception trap designs have advanced considerably since then (Alexander *et al*., 2016).

The 14 flight interception traps used in the 2023 study are of a standardised construction:

- Four 2l plastic drinks bottles, with a window cut into their side, and the bases bolted onto a plastic base (a standard plant pot stand), the four resulting windows facing outwards;
- The trap hung across the entrance to a rot-hole, larger cavity, or other saproxylic habitat features from an available horizontal tree branch or attached using a metal hook screwed into the tree trunk – usually at 1 to 1.5m above ground level – using baler twine, with the bottles hanging upside down beneath. The height is a compromise between keeping the traps out of reach of livestock and ground predators while keeping them accessible to the surveyor without the use of a ladder;
- The upside-down bottle tops were filled with a preservative solution (initially propylene glycol, 50/50 with tap-water, plus a little washing up liquid to reduce surface tension) which can then be drained through the plastic cap into a collecting pot for sorting in the lab later. The preservative was switched to red antifreeze (ethylene glycol) during the June visit after it had become obvious that hive bees were removing the fluid from the traps – see 3.1. below)

Flight traps of this construction were chosen in preference to Malaise traps as the latter trap design has a reputation for killing large volumes of flying insects which then become a logistical problem to sort and identify. Malaise traps are also typically placed on the ground surface in open areas and so target tourist species rather than saproxylic specialists. The position of Malaise traps additionally has a major influence on catch size and composition.

The bottle flight traps are multidirectional; they are also small and flexible to position on the target trees. The bottle traps are also preferable to modern vane traps as bottle traps are smaller and more compact and can therefore be used in a more targeted way, such as placing inside tree cavities. They are also easier to manufacture, the component parts being available from any supermarket, garden centre and/or hardware store. No studies comparing the bottle traps with the terylene netting type traps have been carried out, but it appears that Malaise traps are better at capturing large strongly flying insects such as hoverflies – although not in the case of the Levey & Pavett (2000) survey which comments on the lack of hoverflies in the samples. Vane traps tend to be biased towards beetles and are relatively poor at trapping Diptera which are a key group for saproxylic assessments. Bottle traps have consistently been shown to capture a good quality sample of saproxylic Coleoptera and Diptera.

The selected situations for the flight interception traps used during the 2023 survey are detailed in Figure 3 and Table 3 and an example is illustrated in Figure 4.

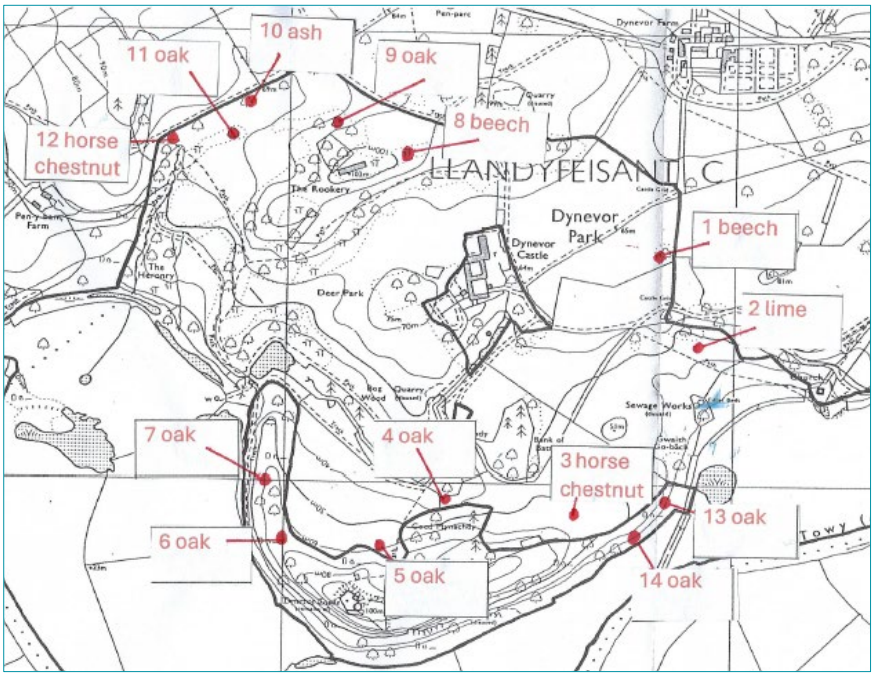

Figure 3. The location of flight interception traps on Dinefwr Estate in 2023.
Trap 1 = Front Park; Trap 2 = Lower Park (Llandyfeisant Field); Trap 3 = Lower Park (Coed Mynachdy Field); Trap 5 = Castle Field; Traps 6 & 7 = Castle Woods west; Traps 8-12 = Deer Park; Traps 13 & 14 = Castle Woods east.

Table 3. Details of the flight trapping locations in Dinefwr Estate NNR in 2023.
(Note that none of the trees selected had visible tree tags).

Location & trap code no.	Grid reference	Tree girth (m)	Description
Front Park	-	-	-
1	SN618225	4.35	Beech; veteran; rot-holes
Sheep Park	-	-	-
2	SN619223	3.62	Common lime; shattered stump; much lying dead wood; shaded situation

Location & trap code no.	Grid reference	Tree girth (m)	Description
3	SN617219	3.73	Horse chestnut; shattered trunk base 2m high; old *Pleurotus* & fresh *Polyporus squamosus*
4	SN613219	5.25	Oak; ancient; hollow & rotten; red-rot
5	SN612218	5.95	Oak; large hollow stump; wood mould bed in base
Castle Woods west	-	-	-
6	SN610218	6.13	Oak; ancient; basal cavity; red-rot
7	SN609220	5m approx	Oak; veteran; basal cavity; white rot
Deer Park	-	-	-
8	SN612227	4.82	Beech; hollow stump; 1-3m high
9	SN611228	4.23	Oak; veteran; exposed red-rot
10	SN609228	>5m	Ash; collapsed tree; hollow stump
11	SN608227	5.07	Oak; hollow base; red-rot
12	SN607227	4.6	Horse chestnut; multi-stem at 2-3m; socket cavity
Castle Woods east	-	-	-
13	SN618219	3.35	Oak; old lightning strike split trunk; red-rot
14	SN617218	3.68	Oak; vertical tear; Laetiporus sulphureus old & dry

Figure 4. Trap Location No. 1 (Front Park), showing the position in relation to two small rot-holes and a large, hanging dead branch.

3. Results & discussion

3.1 Impacts of changing weather conditions and accessibility of wood-decay habitats on sampling programme

While flight interception trapping is a valuable way of avoiding weather impacts on sampling success, the general pattern of weather during the sampling season and even in preceding years can impact on the range of species available to be found as well as their relative abundance. This always needs to be borne in mind when assessing survey results. The 2023 field season was notable for both a prolonged period of very hot and dry weather during the late spring period followed by a relatively cool and very wet high summer and autumn period. This had followed a prolonged summer drought the year before. Such dramatic weather patterns can result in poor abundance of invertebrates making the detection of the species present problematic. This is compounded in the deer park at Dinefwr by the prominence of tall and dense bracken which makes fallen dead wood much less visible.
Although the spring drought with its prolonged high temperatures and sunshine might be thought to be good for invertebrate sampling, this is not the case as the wood-decay habitats can become dehydrated. Supposedly sun-loving insects were notably difficult to find on demand.

Additionally, the general impression from searching for saproxylic invertebrates at Dinefwr in the 2023 field season was that there was very little freshly dead wood accessible for investigation and that it was particularly difficult to find key species by hand-searching techniques. The one exception was the large fallen oak which had damaged one of the water pump-houses in the sheltered valley on the east side of The Heronry in the Deer Park. This tree had had to be partially sawn and moved in order to initiate repairs to the pump-house. Heavy equipment was presumably brought in to minimise damage to the fallen trunk – certainly impressively large sections were kept intact yet moved away from the damaged building. These trunk sections proved to be a major hot spot for specialist invertebrates.

Another problem which arose during the extended hot dry late spring period was of honeybees robbing the preservative fluid from the flight traps. The culprits were obvious as they left honey residues in the robbed traps. The same problem had arisen during the summer drought of 2022 but had been assumed to be a one-off due to what had seemed the special circumstances. The April-June samples were largely lost as a result but fortunately the solution trialled in 2022 of replacing the transparent propylene glycol preservative with commercially available anti-freeze - which contains a red dye – proved effective again.

However, despite all of the problems outlined above, the flight traps proved to be very effective at sampling the fauna and generated most of the interesting records.

3.2 Species totals

The 2023 survey work in Dinefwr Estate NNR led to the identification of 119 species of Coleoptera of which 92 are saproxylic species. For Diptera, 179 species were identified of which 85 are at least partly saproxylic. Of the saproxylic Coleoptera, 21 species have Nationally Scarce status in Britain, while 14 of the Diptera are also Nationally Rare or Nationally Scarce, including 13 saproxylic species. Amongst other groups, nine aculeate Hymenoptera taken in the traps are saproxylic, plus two species of Heteroptera, all widespread species. A larval snake fly was also found – *Phaeostigma notata*, which has been reported here in the past (Morgan, 1992). A total of 189 species of saproxylic insects were found during the 2023 survey.

Both the saproxylic Coleoptera and Diptera lists include a large number of species additional to the previous record, as outlined in the Contract Brief. The Coleoptera additions – 13 in total or 14% of the 92 - are as follows:

The majority of the beetle additions are either Nationally Scarce species which can be difficult to find on demand or species whose range is increasing, due almost certainly to climate change. The only exception to this is the common and widespread species *Anobium punctatum*, which may just not have been noted in the past because it is so common and widespread.

Table 4. Coleoptera species found on Dinefwr Estate NNR in 2023 and which are apparently additions to the site.

Species	British status	Welsh status	Comments
Agrilus biguttatus (Buprestidae)	LC	LC	Recently expanding native
Anobium punctatum (Ptinidae)	LC	LC	Overlooked native
Dorcatoma flavicornis (Ptinidae)	NS	Rare	-
Enicmus rugosus (Latridiidae)	NS	Rare	Overlooked native
Epiphanis cornutus (Eucnemidae)	LC	Rare	Status unclear, but apparently expanding
Euplectus infirmus (Pselaphinae)	LC but should be NS	Rare	Overlooked native
Hallomenus binotatus (Tetratomidae)	NS	Rare	Overlooked native
Mycetophagus multipunctatus (Mycetophagidae)	LC	Rare	Overlooked native
Phymatodes testaceus (Cerambycidae)	LC	LC	Recently expanding native
Plegaderus dissectus (Histeridae)	NS (Hyman, 1994), regraded LC (Lane, 2017)	Rare	Overlooked native
Prionocyphon serricornis (Scirtidae)	NS	Rare	Overlooked native
Quedius microps (Staphylinidae)	NS	Rare	Overlooked native
Q. truncicola (Staphylinidae)	NS	Rare	Overlooked native
Scraptia testacea (Scraptiidae)	NS	Rare	-
Uleiota planatus (Silvanidae)	LC	LC	Introduction, expanding

The Diptera additions amount to 37 species – too many to detail here. These represent 44% of the 2023 sample of species which are at least partly saproxylic. These statistics are difficult to interpret as the NRW Contract Brief list does not include some of the Diptera families. Phoridae and Heleomyzidae, for example, include saproxylic species found by Levey & Pavett (2000) but which do not feature on the NRW list. It is clear however that Levey & Pavett (2000) include notably few identifications from the Calyptratae families,

and it may be that the sampling techniques that they used are poor at capturing these Diptera. Other families also feature surprisingly poorly and may come into the same category: Sciaridae, Psychodidae, Mycetobiidae, Trichoceridae and Odiniidae. The 2023 list of saproxylic Diptera does also suggest a relative lack of Diptera recording at Dinefwr in comparison with Coleoptera.

Five of the Hymenoptera and one of the Heteroptera are new to the Dinefwr list. This all indicates that the site list is currently far from complete and that continued searching will continue to build on this list over time. A single year of study cannot be expected to detect every species that is present. And, in addition to resident species, the site will continue to be colonised by mobile species which are spreading across Britain in response to changing climate and continued introduction of non-native species.

The 35 Nationally Rare and Nationally Scarce species are detailed in Table 5 below. The Nationally Rare species are both Diptera – the cranefly *Rhipidia uniseriata* and the fungus gnat *Acnemia amoena*. The fungus gnat and one of the Nationally Scarce species *Scenopinus niger* also have Near Threatened status.

Table 5. Nationally Rare & Scarce invertebrate species found on Dinefwr Estate NNR in 2023. * denotes species which are rare in Wales.

Species	Habitat associations	Dinefwr Estate locations
Coleoptera	-	-
*Aderus populneus** (Aderidae)	Heartwood decay	Deer Park (Trap 2); Front Park (Trap 1)
*Anaspis thoracica** (Scraptiidae)	Heartwood decay	Castle Woods (Trap 7); The Rookery (Trap 8) & elsewhere in Deer Park
Cis festivus (Ciidae)	Small standing dead stems, especially hazel	Castle Woods (Trap 7)
*Dorcatoma flavicornis** (Ptiniidae)	Heartwood decay	Castle Woods (Traps 7 & 13)
*Enicmus brevicornis** (Latridiidae)	Slime moulds	Castle Woods (Traps 13 & 14)
*Enicmus rugosus** (Latridiidae)	Slime moulds	Castle Field (Trap 5); Castle Woods (Traps 7 & 13); Deer Park (Trap 10); Front Park (Trap 1)
Euglenes oculatus (Aderidae)	Heartwood decay	Castle Field (Trap 5); Castle Woods (Traps 6, 7, 13 & 14); Deer Park (one specimen only); Front Park (Trap 1); Lower Park (Trap 4);
*Euplectus infirmus** (Staphylinidae)	Decaying wood	Deer Park, The Rookery (Trap 8)
*Hallomenus binotatus** (Tetratomidae)	Bracket fungi	Deer Park, The Rookery
Malthodes pumilus (Cantharidae)	not known	Deer Park, Upper Deer Park & The Heronry
Microrhagus pygmaeus (Eucmenidae)	Well-decayed heartwood in trunks and branches	Deer Park, Upper area; Front Park (Trap 1)
Phloiophilus edwardsi (Phloiophilidae)	Dead lateral branches under tree crown	Deer Park, The Rookery; Lower Park
Platypus cylindrus (Curculionidae)	Freshly dead sapwood	Deer Park
Prionocyphon serricornis (Scirtidae)	Water-filled cavities	Deer Park, The Rookery (Trap 8); Front Park (Trap 1); Lower Park (Trap 2)
Ptinus subpilosus (Ptinidae)	Large cavities in veteran trees	Castle Woods (Trap 6); Lower Park (Trap 4)
*Quedius microps** (Staphylinidae)	Tree hollows-	Deer Park, The Rookery (Trap 8)
*Q. truncicola** (Staphylinidae)	Tree hollows	Castle Woods (Trap 14)
*Scraptia testacea** (Scraptidae)	Heartwood decay	Front Park (Trap 1); Lower Park (Trap 2)
Sphindus dubius (Sphindidae)	Slime moulds	Deer Park (Trap 10)

Species	Habitat associations	Dinefwr Estate locations
Thymalus limbatus (Trogosittidae)	White-rotten branch wood	Lower Park
*Triphyllus bicolor** (Mycetophagidae)	Bracket fungi	Castle Woods (Traps 7 & 13); Deer Park (Traps 10,11 & 12); Lower Park (Traps 4 & 5)
Diptera	-	-
*Acnemia amoena** (Mycetophilidae)	Decaying wood	Castle Woods (Trap 7); Deer Park (Trap 11); Front Park (Trap 1); Lower Park (Traps 4 & 5)
*Ectrepesthoneura colyeri** (Mycetophilidae)	Decaying wood	Lower Park (Trap 4)
*Fannia aequilineata** (Fanniidae)	Sap runs & rot-holes	Deer Park, The Rookery (Trap 9); Front Park (Trap 1); Lower Park (Trap 2)
Fannia speciosa (Fanniidae)	not known	Deer Park, The Rookery (Trap 9)
Helina abdominalis (Muscidae)	Rot-holes	Castle Woods (Trap 7)
*Lasiambia brevibucca** (Chloropidae)	Rot-holes	Castle Field (Trap 5); Castle Woods (Traps 6, 7, 13 & 14); Deer Park (Traps 9, 11 & 12); Front Park (Trap 1); Lower Park (Traps 2, 3 & 4)
*Mycetophila caudata** (Mycetophilidae)	Wood-decay fungi?	Deer Park (Trap 10)
Mycetophila lastovkai (Mycetophilide)	Wood-decay fungi?	Lower Park (Trap 4)
*Odinia trinotata** (Odiniidae)	Sap runs	Deer Park, The Rookery (Trap 9)
Phaonia pratensis (Muscidae)	Sap runs & rot-holes	Deer Park, The Rookery (Trap 9)
*Rhipidia uniseriata** (Limoniidae)	Decaying wood	Deer Park, The Rookery (Trap 8)
*Scenopinus niger** (Scenopinidae)	Heartwood decay	Castle Woods (Traps 6 & 7); Deer Park, The Rookery (Trap 9); Front Park (Trap 1); Lower Park (Trap 4)
*Sciophila geniculata** (Mycetophilidae)	Bracket fungi	Castle Woods (Trap 14)
*Sciophila interrupta** (Mycetophilidae)	Terrestrial fungi	Lower Park (Trap 2)

3.3 Nationally Scarce beetle species found in 2023

The following sections provide more detailed information about the more important saproxylic beetle species detected within Dinefwr Estate NNR during 2023, organised alphabetically. Four species are of particular note in appearing to have unusually strong populations here: the hairy fungus beetle *Triphyllus bicolor* (Mycetophagidae), the tumbling flower beetle *Anaspis thoracica* (Scraptiidae) and the ant-like *Euglenes oculatus* (Aderidae), which are all associated with red- or brown-rotting heartwood decay in veteran oak trees; and the mould beetle *Enicmus rugosus* (Latridiidae) which is associated with slime moulds in decaying wood. While the *Euglenes* is often found in notable abundance, the other three species are typically found as single or few specimens of adult beetles, and so the multiple encounters duringthe current survey are thought to suggest that the species concerned are currently performing very well at present. Interestingly, the *Enicmus* has not been reported from Dinefwr previously and so the 2023 abundance does appear particularly exceptional. Without knowledge of the ecology of slime moulds, this is difficult to explain but it appears that slime mould species richness is greater in warmer and drier climes and so the recent drought periods may have increased the availability of habitat for the beetle.

A total of 48 of the 143 key Coleoptera species identified in the contract brief were re-found in 2023. 14 of the species first found at Dinefwr in 2023 should also undoubtedly be added to the list of key species.

3.3.1 *Aderus populneus* (Aderidae)

The larvae of this ant-like beetle inhabit the red-rotten heartwood of various broad-leaved veteran trees. The adults are typically found by beating the foliage of the host tree over a net. Dispersing adults have occasionally been found in other decay situations and are clearly attracted to the warmth and scent of active decay. They overwinter as adults and often select overwintering sites where either fermentation or a building affords a little warmth in comparison with other situations; the thermal environment in winter appears to be crucial to survival. The physical character of the dead wood also appears to be important; adults have been found overwintering in contraction-spaces between the annual rings of dry, delignified, papery, soft heartwood, i.e. white-rot. Overwintered adults have been reported at willow catkins in the spring, presumably using the nectar as flight fuel and/or the pollen as a protein source. Successful populations may be limited to individual isolated trees, in which they may breed for decades. It is not known to be attracted to blossoms.

Although not currently recognised as an old growth species, it clearly is and will be added to the Index of Ecological Continuity species (see 3.9.1. below) in due course. Its British distribution is distinctly southern and south-eastern, extending westwards into south Devon and Monmouthshire, and north to south Yorkshire; its discovery here at Dinefwr therefore considerably extends its known occurrence in Wales. Single specimens were found in flight Traps 1 (on the veteran beech in Front Park) and 11 (on the red-rotten oak in the far side of the Deer Park. It has high conservation value across its European range.

3.3.2 *Anaspis thoracica* (Scraptiidae)

The larvae of this rare ‘tumbling flower beetle’ have been reported as developing in red-rotten wood of oak and adult beetles are typically associated with the most ancient oaks and are attracted to hawthorn and elder blossom. On the Continent, they have also been associated with recently dead wood of trunks and boughs of birch, poplar, alder, beech, hornbeam, elm, lime and hazel as well as oak, but without information on the type of decay present. The species is poorly known in Britain and may also use other types of decaying wood for larval development.

The apparent association with ancient oaks means that the beetle is best known in Britain from ancient forests, historic parklands and other ancient wood pasture situations. The species is regarded as a Grade 1 species of old growth conditions, under a synonym, *A. septentrionis* (Alexander, 2004). The beetle has been widely reported across Britain but very sparingly so. Identification has been plagued by taxonomic problems and the species is undoubtedly under-recorded at present.

Two males – the more reliable gender for identification – and one female were found by sweep-netting in the Deer Park close to flight Trap 9, on the edge of The Rookery. One

further female was taken in flight Trap 7 (in Castle Woods) and three more in Trap 8 (also on the edge of The Rookery). Although not a dramatic number, seven individuals is a good catch. There is clearly a substantial population here. Levey & Pavett (2000) added the species to the Dinefwr list in 1996 but only found a single specimen in The Heronry area of the Deer Park.

3.3.3 *Dorcatoma flavicornis* (Ptinidae)

This beetle also develops in red-rotten heartwood within the trunks and larger branches of large, open-grown broad-leaved trees. Most *Dorcatoma* species appear to have a two-year development time and hibernate in the larval stage. The adults are active from May to August. Female *Dorcatoma* are attracted to the volatiles produced by the host fungus - typically Chicken-of-the Woods *Laetiporus sulphureus* or Beefsteak *Fistulina hepatica* - whereas males are attracted to conspecific females . This behaviour is regarded as an adaptation to scattered resources as there is no point in males being attracted to the host fungus if they arrive when no females are present. It is not known to be attracted to blossoms.

It is recognised in Britain as a species with a moderate association with ecological continuity of saproxylic habitat. The requirement for concentrations of veteran trees means that the beetle is best known from ancient wood pastures and historic parklands, but it also occurs in linear and isolated sites. Host trees are typically open grown rather than high forest trees, although it may occur in well-lit high forest situations. It is widespread over much of lowland England but rare across Wales. This is the first time it has been found at Dinefwr Estate NNR. Three were identified among the more abundant *D. chrysomelina* in flight Trap 7 (in the west end of Castle Woods) while one was found amongst *D. chrysomelina* in flight Trap 13 (in the east end of Castle Woods). *D. chrysomelina* was noted in the Deer Park by Hammond & Hine (1994) and Levey & Pavett (2000) but not *D. flavicornis*. It seems unlikely that the Dinefwr population is confined to Castle Woods, but it may be that the reserve presently offers the best available habitat.

3.3.4 *Enicmus brevicornis* (Latridiidae)

This is a mould beetle associated with old dead bark of various broad-leaved tree species including beech, birch, ash and sycamore. It has been associated with Ascomycete fungi by continental authors but may have a stronger association with slime moulds (Myxomycetes). It has been suggested that the beetle has been favoured in recent years following the arrival of sooty bark disease *Cryptostroma corticale* on sycamore, introduced into Britain from about 1950. It is not known to be attracted to blossoms.

It has a thinly scattered distribution across much of southern Britain. The species was first found at Dinefwr by Levey & Pavett (2000) in Oxbow Wood and The Rookery area in the Deer Park. Single specimens were found in flight Traps 13 and 14 (the east end of Castle Woods) in 2023. Again, it seems unlikely that the Dinefwr population is currently confined to Castle Woods, but it may be that the reserve presently offers the best available habitat.

3.3.5 *Enicmus rugosus* (Latridiidae)

This mould beetle lives amongst slime mould growth on the decaying wood of veteran trees in sites with long continuity of suitable habitat; mainly oak, but also known from ash, beech, alder and especially pine in Scotland. It has a disjunct distribution in Britain: i) it is now known to be widely distributed across lowland England, penetrating into Wales along the Border country, but no further north than Dunham Massey near Manchester, ii) in the Scottish Highlands and SW Scotland. Its discovery at Dinefwr Estate NNR in 2023 represents the only record deep within Wales. Specimens were found in five of the flight traps: Trap 1 (the beech in Front Park), Trap 5 (the hollow oak stump below Castle Woods), Trap 7 (an ancient oak in the west end of Castle Woods), Trap 10 (collapsed ash on far side the Deer Park) and Trap 13 (veteran oak in eastern end of Castle Woods). Its widespread detection is almost certainly due to the use of the flight trap design which better targets wood-decay habitats. It is not known to be attracted to blossoms.

3.3.6 *Euglenes oculatus* (Aderidae)

The larvae of this small ant-like beetle live in large colonies in moist, crumbly, red-rotten heartwood in various broad-leaved trees but especially oak. The adults are typically detected by beating the foliage of the host tree over a net but are also strongly attracted to elder blossom for nectaring. Dispersing adults may be found in other decay situations. The adult activity period is of some 8-10 weeks in mid to late summer. It has been suggested that this species seems to have relatively stable populations at a local scale and is possibly sedentary in nature, only infrequently moving into new areas. For example, the main Somerset population is centred on the ancient oak landscape of Long Ashton Park and Leigh Woods NNR, a pattern which seems to fit this suggestion. The species is regarded as a Grade 3 species of old growth conditions (Alexander, 2004).
In Britain, it is known from a thin scattering of sites across lowland England, from east Cornwall to Yorkshire, with a small number of sites known across south Wales – including Dinefwr Deer Park - and the border country, where it is known from Powis and Chirk Castle Parks. It was first discovered at Dinefwr by Levey & Pavett (2000) when a single specimen was found on an ancient oak in the Deer Park. In contrast it, was found in large numbers during 2023, reflecting the more targeted flight trapping operation. The largest catch, of 55 individuals was taken in Trap 4, the ancient oak in the narrow corridor of parkland which links Lower Park with Castle Field. Twelve were taken in Trap 7, on the ancient oak in the western end of Castle Woods, while 8 were taken in Trap 13 and seven in Trap 14, on veteran oaks in the eastern end of Castle Woods. Single specimens were taken in Traps 1 (beech in Front Park), 5 (oak above Castle Field) and 6 (ancient oak in western end of Castle Woods). Only one specimen was found by hand-searching in the Deer Park. Basically, Dinefwr Estate NNR is a major hot spot for this species in Wales and it seems that the veteran oaks outside of the Deer Park provide the best quality habitat for it.

3.3.7 *Euplectus infirmus* (Staphylinidae)

The paucity of past records for the *Euplectus* species of short-winged mould beetles at Dinefwr has been surprising as this genus contains many saproxylic species, feeding on

mite species living amongst the decay debris within tree cavities and around trees with collapsing branches. It is not known to be attracted to blossoms.

E. infirmus is a rare saproxylic species, associated particularly with ancient wood pastures and parklands. While not given any conservation status by Hyman (1994), published records are only available for 33 hectads, of which only 7 have been in the past 25 years, and so it very readily fits within the criteria for Nationally Scarce. Most records come from, or close by, large items of decaying wood, including old stumps, while it has been reported more widely outside of the field season. Known sites include such ancient wood pastures and parklands as the New Forest, Burnham Beeches NNR, Attingham Park SSSI, Donington Park SSSI and Sherwood Forest. Welsh records are notable few, with just Gregynog Great Wood (1988), Plas Newydd (1994) and St Fagans (1999). One was taken in Trap 8, the hollow beech stump at the edge of The Rookery in the Deer Park.

3.3.8 *Hallomenus binotatus* (Tetratomidae)

The evidence currently suggests that this beetle develops in a wide variety of soft annual bracket fungi and may visit hard perennial brackets to feed on fungal spores, etc. - they may conceivably develop in such hard fungi although definitive proof of breeding is not available. The most widespread larval habitat appears to be provided by Chicken-of-the-Woods *Laetiporus sulphureus* and the conifer bracket *Phaeolus schweinitzii*. These are both red-rot forming heartwood-decay fungi, the former in broadleaves in the lowlands, the latter in Scottish Highland pine forests. It has also been reared from Oak Polypore *Piptoporus quercinus* on oak and *Tyromyces chioneus* found on birch. Adults use hard, dry red-rot and seasoned wood as refugia when no bracket fungi are available for feeding. Flight activity has been noted after dark in the late summer and autumn, the beetles being captured at MV light traps. It is not known to be attracted to blossoms.

Site association tends to be with ancient wood pastures and historic parklands, but it is also known from a few conventional ancient woodland situations. Continuity of suitable habitat appears to be important – this species is known for its extreme localization rather than its mobility. The species is regarded as a Grade 3 species of old growth conditions (Alexander, 2004). It is known from a small number of sites across much of lowland England and extending into Wales where it is known from eight other sites including Carn Gafallt, Chirk Castle Park, Llanover Park and Graigllech Woods at Coelbren Junction. It appears to be relatively widespread in parts of Scotland. One adult was tapped from fresh growth of Chicken-of-the-Woods on a lying old dead oak trunk on the lower southern slopes within The Rookery in the Deer Park.

3.3.9 *Phloiophilus edwardsi* (Phloiophilidae)

Phloiophilus edwardsi is a species of open-grown trees rather than high forest trees as its primary food is the fungus *Peniophora* spp. which develop solely on dead lateral branches in the lower crown of the tree, and which are shaded out as the crown expands above. The habitat begins to appear as the crown begins to mature. Most records of the beetle are from oak trees and the beetle may be found on oak trees aged from 30 years upwards, reaching a peak in habitat availability up to 200 – 250 years old but then declining as the

optimum crown is achieved and the tree moves towards natural crown retrenchment. The beetle does however require large populations of trees such that, at any one time, there are sufficient host trees available to support viable populations. The beetle is not known to be very mobile, flying from tree to neighbouring tree, and hence habitat continuity at site level is crucial to its long-term survival. This makes the key vegetation structures required to support populations to be open wood pastures or parklands. It is not known to be attracted to blossoms.

The life cycle is also an interesting feature as the adult stage – the stage most readily detected when surveying a site – begins in the autumn and extends into the early winter period. The final visit was timed to be within this period although the habitat had been sought during earlier visits in order to identify suitable trees in advance. However, it had quickly become apparent that the habitat was highly localised on the Dinefwr Estate due to a combination of recent block-planting of young oak trees around the fringes of existing stands of trees, gap-planting within those stands, and relatively few new plantings of specimen trees across the open parkland areas. Aerial dead branches with *Peniophora* development are now few and far between.

Levey & Pavett (2000) were the first to record this species at Dinefwr, taking it in both of their composite flight interception traps placed in the lower crown of ancient oak trees in the Deer Park. They reported one specimen in one trap and five in the other. The 2023 survey targeted the habitat by tapping suitable dead branches with *Peniophora quercina* growth over a sweep-net. Specimens were readily found on the two large veteran oaks in the centre of Lower Park, and one was also found on a single example of the habitat noted within The Rookery area of the Deer Park.

3.3.10 *Prionocyphon serricornis* (Scirtidae)

This beetle is unusual in belonging to a semi-aquatic group of beetles and has long-horned and flattened larvae adapted to living amongst the bottom debris of water-filled tree hollows and cavities. Although most readily detected in decaying root buttresses, the adult beetles are reported to favour tree crown situations for oviposition. The adults are short-lived and so larval habitat is best targeted for recording purposes. The species is known widely across central and south-eastern England, extending into southern Scotland, but with very few known Welsh sites. It is not known to be attracted to blossoms.

The species appears to have been overlooked at Dinefwr Estate until larvae were found in a hole in a large beech in the Deer Park during 2009 (Denton, 2010). The targeted flight traps used in 2023 took a total of five adult beetles in Traps 1 (beech in Front Park), 2 (collapsed lime in the Lower Park), and 8 (hollow beech stump on the edge of The Rookery in the Deer Park). This suggests that the species may be widespread in veteran trees across the NNR but typically favouring tree species other than oaks. Cavities caused by white-rot are likely to provide better habitat conditions that red-rotten ones as the debris tends to be more water-retaining.

3.3.11 *Ptinus subpilosus* (Ptinidae)

This hairy spider beetle develops in decaying wood of broad-leaved tree species, particularly in old hollow oaks but also under loose dead bark on the trunks of veteran trees more generally. It has also been reported from *Lasius* spp. ant nests on the Continent although has only been found with tree-nesting species in Britain. The adult beetle has been found from February to April and again in June/July. It is not known to be attracted to blossoms.

It is a characteristic species of old growth situations, known in Britain from ancient forests (New Forest, Forest of Dean, Savernake, Windsor and Sherwood), historic deer parks (Moccas, Powis, Dinefwr) and ancient wood pasture situations (e.g. Tycanol NNR in Pembrokeshire). Although very widespread across Britain, it is highly localised by habitat availability – it is one of the few Dinefwr rarities to also occur in Scottish pine forests. The species is regarded as a Grade 2 species of old growth conditions (Alexander, 2004). Levey & Pavett (2000) found it in two of their traps in the Deer Park. In 2023, it was found in just two of the flight traps placed across Dinefwr Estate NNR – Trap 4 (the ancient hollow oak in the narrow section of parkland between Lower Park and Castle Field) and Trap 6 (an ancient oak on the lower slope at the western end of Castle Woods), i.e. not in the Deer Park where suitable trees are much scarcer.

3.3.12 *Quedius microps* (Staphylinidae)

Quedius microps belongs to a group of rove beetles which develop in patch habitats supporting dense populations of insect larvae that serve as prey; underground nests, compost heaps, decaying fungi and tree hollows containing bird nests or squirrel dreys are all habitats exploited by these species. Several species are predominantly found in just one of these habitats. The majority of the saproxylic species are associated with late successional stages of wood decay. Some are mainly found in tree hollows probably due to their preference for sheltered micro-environments. *Q. microps* is mainly found in damp wood mould in tree hollows, more rarely in rotting fungi. It has been suggested that it possibly prefers closed canopy woodland to open situations but records from Dingestow Court and Llanover Park (both Monmouthshire) and Nettlecombe Park (Somerset) demonstrate that it can live in open parkland in the far west of its range at least but may increasingly prefer moister conditions of high forest woodland in the drier east. It is not known to be attracted to blossoms.

It is widespread in lowland England, north to the Midlands, but is noticeably lacking in much of the west. A male was found in Trap 9, on a veteran oak on the edge of The Rookery in the Deer Park, during 2023. This is the first time that it has been detected at Dinefwr Estate and is the only Welsh record away from Monmouthshire.

3.3.13 *Quedius truncicola* (Staphylinidae)

Like *Q. microps*, this rove beetle is found in the damp decaying wood mould of hollow trees (elm, lime, oak, etc.) as well as in fungi growing from decaying trees. It is not known to be attracted to blossoms. Although widespread across lowland England, it has been

recorded from just nine other sites in Wales including Carn Gafallt, Chirk Castle Park, Dingestow Court, Erddig Park and Powis Castle Park. One was taken in Trap 14 on a veteran oak in the eastern end of Castle Woods.

3.3.14 *Scraptia testacea* (Scraptiidae)

This is a classic ancient parkland species of beetle. The larvae develop in relatively soft, white-rotten heartwood within the standing trunks of old and usually hollowing live trees, especially oak, but also beech, alder, and poplar. The adults have tended to be found by beating the branches of ancient oaks with advanced heart-rot development, often with colonies of Brown Tree Ant *Lasius brunneus* or Jet Ant *L. fuliginosus*, from late June to mid-July. It has most often been found in recent years through flight interception trapping. The adult beetles have never been found at blossom.

The species is known from a thin scatter of sites across Midland and south-east England, with outlying populations at: Sherwood Forest, Nottinghamshire; Attingham Park, Shropshire; Moccas Park, Herefordshire; and – until now – just three sites in Wales: Dan y Parc (VC44), Dingestow Court (VC35) and Gregynog (VC47). Single specimens were taken in Traps 1 (veteran beech in Front Park) and 2 (collapsed lime in Lower Park).

3.3.15 *Thymalus limbatus* (Trogossitidae)

This is the most consistently recorded of all the Nationally Scarce species reported from Dinefwr Estate NNR. The larvae and adults are found beneath loose bark on the decaying wood of a wide variety of trees - broad-leaves and conifers - and in the later stages of white-rot decay when the heartwood is dry and soft. The larvae are reported to develop in the fungus *Daedaleopsis confragosa* on birch *Betula*, willow *Salix*, aspen *Populus tremula*, or in the wood of these trees in Russia and the Ukraine, while they are more closely associated with oak *Quercus* in Britain. The adult is also often found on the fruiting bodies of various bracket fungi and are assumed to be feeding on fungal material; they are active usually in June and July. It is not known to be attracted to blossoms. The life cycle is between one and two years. Sites tend to be old wood pastures.

Widespread across much of Britain but absent from East Anglia and much of the east and south Midlands – it is apparently associated with relatively cooler and moister conditions. It tends to be found by hand-searching rather than trapping and was reported in the Deer Park in 1988 and in Lower Park in 1996 and 2023.

3.3.16 *Triphyllus bicolor* (Mycetophagidae)

The larvae of this hairy fungus beetle develop in soft, annually fruiting, bracket fungi on veteran oak trees. The adult beetles have been found all year round, although they are mainly found feeding at the fresh annual fruiting bodies of Beefsteak fungus *Fistulina hepatica* from early July until mid-October. They have also been reported from Chicken-of-the Woods *Laetiporus sulphureus* and Oak Polypore *Piptoporus quercinus*, and very

occasionally at fresh Oyster mushroom *Pleurotus* on veteran beech trees and even at Honey fungus *Armillaria*. Overwintering adults have been found under bark on dead beech and fallen oak boughs and also use these situations as temporary refugia while mobile during the flight season. It is not known to be attracted to blossoms.

Sites are predominantly old medieval forests, historic parklands, common wood pastures, ancient woodlands and old hedgerows. It has been assessed as a Grade 2 indicator species of old growth (Alexander, 2004) and is also regarded as a high-quality indicator species in France.

This beetle is widespread across the English lowlands, although absent from the far west and north, extending into the Welsh Borders. There is also a small, isolated population in the central lowland belt of Scotland. Only seven other Welsh sites are known including Allt-yr-esgair, Carn Gafallt, Chirk and Powis Castle Parks and Gregynog. It was taken in seven of the fourteen traps: Traps 4 and 5 in Lower Park, Traps 10, 11 and 12 in the Deer Park, and Traps 7 and 13 in Castle Woods. The largest catches were of nine specimens in Trap 4 and seven in Trap 11. Dinefwr appears to be a Welsh stronghold for the species.

3.4 Other significant beetle species found in 2023

Some of the saproxylic beetles which are additions to the Dinefwr Estate list are species known to be expanding their ranges in Britain:

- *Agrilus biguttatus* (Buprestidae);
- *Epiphanis cornutus* (Eucnemidae);
- *Phymatodes testaceus* (Cerambycidae);
- *Uleiota plana* (Silvanidae).

But others appear to be overlooked long-term residents:

- *Plegaderus dissectus* (Histeridae);
- *Phloeophagus lignarius* (Curculionidae).

Both of these previously overlooked beetle species develop in decaying heartwood deep inside suitable trees and may be most readily found using the type of flight interception traps used at Dinefwr in 2023 the first time. *P. dissectus* lives among the humid wood mould in tree cavities while the weevil *P. lignarius* burrows in partially decayed heartwood in the trunk above. *P. dissectus* was taken in Traps 3 (horse chestnut in Lower Park) and 7 (ancient oak in western end of Castle Woods). *P. lignarius* was taken in Trap 3 but also in Trap 4 (the ancient oak at the western edge of Lower Park), In may be significant that these two species were only detected in the less well-surveyed areas of the NNR.

3.5 Nationally Rare and Scarce Diptera

The following sections provide more detailed information about the more important fly species detected within Dinefwr Estate NNR during 2023, organised alphabetically.

3.5.1 *Acnemia amoena* (Mycetophilidae)

This fungus gnat has Near Threatened status in Britain although this merits revision in the light of recent records from flight trapping studies. It has been obtained in emergence traps placed over decaying wood as well as flight interception traps targeting this habitat and is assumed to be primarily saproxylic. A population was discovered in Dinefwr Deer Park by Levey & Pavett (2000) and specimens were taken in five of the fourteen traps operated across the NNR during 2023: Traps 1 (Front Park), 4 and 5 (Lower Park), 7 (Castle Woods) and 11 (Deer Park). Dinefwr and Powis Castle Park were the only two Welsh sites known in Falk & Chandler (2005) and so it may be that Dinefwr Estate NNR is the single most important site in Wales for this species. It is currently known from five Welsh localities.

3.5.2 *Ectrepesthoneura colyeri* (Mycetophilidae)

This Nationally Scarce fungus gnat is known from scattered records from ancient wood pasture sites across Britain. It has been reared from decaying spruce wood bearing the fungus *Skeletocutis amorpha* and is regularly taken in emergence traps placed over decaying wood – broad-leaved as well as conifer - and by flight interception traps targeted at wood-decay habitats. Known Welsh sites are Dinefwr Deer Park (Levey & Pavett, 2000), Coed Tycanol NNR, Hafod Garregog NNR and Chirk Castle Park. Dinefwr is now the only Welsh site where it has been found on more than one occasion, demonstrating a resident population. A total of 22 specimens were taken across three traps in The Heronry and The Rookery in the Deer Park in 1996 but just a single male was taken in trap 4 in 2023 – in the hollow ancient oak in the narrow section of parkland between Lower Park and Castle Field.

3.5.3 *Fannia aequilineata* (Fanniidae)

The larval habitat of this Nationally Scarce fly is decayed wood and wood detritus as well as old fungi on decaying wood, and detritus in the nests of birds, social wasps and hornets, and even small mammals within tree cavities. Females are attracted to sap-runs for feeding while males have been noted hovering beneath the tree canopy. The known sites include ancient woodland, ancient wood pasture and parkland, traditional orchards, and other situations with plentiful veteran trees.

The species has been found sparingly across much of lowland Britain but there are very few records from Wales. A total of 17 were taken across three traps at Dinefwr in 2023 making it surprising that it had not been found here before. The three traps were Trap 1 (on the veteran beech in Front Park), 2 (on the collapsed lime in Lower Park) and 9 (on a veteran oak on the edge of The Rookery in the Deer Park.

3.5.4 *Fannia speciosa* (Fanniidae)

The larvae of this Nationally Scarce species have been reared from the soil beneath an oak tree in woodland and so the species may not be saproxylic. Males have been noted hovering beneath the tree canopy in rather shaded and constricted situations.

It has been found to be widespread but uncommon in England, from Devon to Kent and northwards to Yorkshire and Westmorland. The only previous Welsh records however appear to be from the Gower Peninsula, Gregynog NNR and Pierce Wood. A female was taken by Trap 9, the veteran oak on the edge of The Rookery in the Deer Park.

3.5.5 *Helina abdominalis* (Muscidae)

The larvae of this Nationally Scarce muscid fly develop in wet rot-holes in veteran trees and the species has been reported sparingly across much of England and Wales. Many records come from wet woodland with alder. Previous Welsh records have been along the southern coastal counties plus Gregynog NNR. While not found at Dinefwr before, a female was taken in Trap 7, an ancient oak in Castle Woods.

3.5.6 *Lasiambia brevibucca* (Chloropidae)

This Nationally Scarce species develops in rot-holes in living veteran trees. It has also been reared from sappy horse chestnut bark. No association with any particular tree density or light levels has been found, nor with ecological continuity. The adult flies have been recorded flying about exposed heartwood of a beech, around sap runs and at rot holes on oak.

Records are sparing but widespread across lowland England, with additional reports from Glamorganshire, Chirk Park, Gregynog NNR, the Wye Gorge and also Midlothian. It was found to be very widespread at Dinefwr, being taken in twelve of the fourteen traps and often in numbers. It is therefore widespread across the Dinefwr Estate NNR and surprising that it has not been detected previously. Only Traps 8 and 10 in the Deer Park failed to capture specimens.

3.5.7 *Mycetophila caudata* (Mycetophilidae)

This Nationally Scarce fungus gnat species has not previously been found anywhere in Wales and so is an important discovery for Dinefwr. Interestingly, it has a Holarctic distribution, occurring in North America as well as Europe. Most British records have come from the Scottish pine forests, but it has also been found in Surrey, Sussex, Essex and Suffolk. Its discovery at Dinefwr in 2023 is therefore a real surprise. While the biology is not yet known, it is thought likely that it develops in wood-decay fungi. A female was taken in Trap 10, on the collapsed ash tree in the Deer Park.

3.5.8 *Mycetophila lastovkai* (Mycetophilidae)

The larval habits of this Nationally Scarce fungus gnat are not known but it almost certainly develops in wood decay fungi. It is best known in Britain from the New Forest, but it has also been found widely across the south-west of Britain. Known Welsh sites are Llanover Park (Monmouthshire), Pencelli Mire (Breconshire), Gregynog NNR (Montgomery) and Dinefwr Deer Park, Carmarthenshire. It was first found here by Levey & Pavett (2000) who

trapped it in good numbers in 1996. A male was taken in Trap 4 during 2023, the hollow ancient oak in the narrow section of parkland between the Lower Park and Castle Field.

3.5.9 *Odinia trinotata* (Odiniidae)

All the members of this small family are found on old trees, and it seems probable that they regularly develop as commensals in the workings of other insects. Adults of the Nationally Scarce *O. trinotata* have been observed at sap runs on oak and the larvae are thought to be associated with the borings of the Oak Jewel Beetle *Agrilus biguttatus* – which develops in freshly dead woody stems - and of Goat Moth *Cossus cossus*, which burrows into the living tissues of oak trunks. This raises an interesting issue since *Agrilus biguttatus* was also first noted at Dinefwr in 2023 – it's range has been expanding westwards in recent decades. Goat Moth has yet to be noted at Dinefwr. However, there may be other causes of sap-runs on oaks present within the NNR and it seems feasible that the fly may also exploit sap-runs of other broad-leaved trees. Leopard Moth *Zeuzera pyrina* has been reported from Dinefwr and has larvae which burrow into the woody stems of a variety of broadleaves, especially willow but also woody Rosaceae and ash. It may be a potential habitat-creator for the fly.

Odinia trinotata has been found at about fifteen localities across lowland England, mainly ancient wood pasture and parkland sites, and including the New Forest, the Forest of Dean, and Epping and Windsor Forests. Some of these also have the situation of the fly being found before the jewel beetle had colonised, making it more likely that other burrowing insects may provide suitable habitat. Dinefwr is the first Welsh record. One female was taken in Trap 9, on a veteran oak at edge of The Rookery in the Deer Park.

3.5.10 *Phaonia pratensis* (Muscidae)

The larvae of this Nationally Scarce muscid develop in rot holes in veteran trees as well as in sap runs. The adult flies have also been found at sap-runs. Known sites include ancient wood pasture, historic parkland, traditional orchards, hedgerow trees and plantation woodland.

Its British distribution appears to be very southern, occurring northwards only to Herefordshire, Cheshire and Derbyshire. In Wales, it has previously been found only at Oxwich NNR in Glamorganshire, Monmouthshire (Dingestow Court) and Montgomeryshire (Gregynog NNR). One female was taken in Trap 9, on a veteran oak at edge of The Rookery in the Deer Park.

3.5.11 *Rhipidia uniseriata* (Limoniidae)

This cranefly has Nationally Rare status. It is associated with decaying wood of broad-leaved trees in a wide variety of situations including ancient wood pasture and parkland as well as traditional orchards. It is most typically found at large rot-holes in the side of living trees, but some records are from large rotting logs (Stubbs, 2021). It is widely known across southern England as far north as Yorkshire and it has also been reported from south Wales. This is the first record from Dinefwr Estate NNR – two females and a male

were taken in Trap 8, in the hollow beech stump on the upper edge of The Rookery in the Deer Park.

3.5.12 *Scenopinus niger* (Scenopinidae)

The larvae of the Nationally Scarce & Near Threatened Forest Windowfly develop in decaying wood in large old veteran trees where they feed on other insect larvae, including various woodworm beetle species. Adults have been found at rest on sunny exposed dead heartwood on old parkland trees. Known sites are mostly historic parklands across southern Britain and including Chirk, Dinefwr, Erddig, Powis and Gregynog. Fourteen individuals were found across Traps 1 (veteran beech in Front Park), 4 (hollow ancient oak in Lower Park), 6 and 7 (ancient oaks in the western end of Castle Woods) and 9 (veteran oak one the edge of The Rookery in the Deer Park). It is clearly widespread across the veteran parkland trees of the NNR.

3.5.13 *Sciophila geniculata* (Mycetophilidae)

This Nationally Scarce fungus gnat is only known in Britain from 21 hectads (by 2021; P.J. Chandler, pers. comm.). Its biology is not yet known but it has been found in situations with either trees and/or bogs. Where known, larvae of this genus mainly develop in webs on the surface of tough wood-decay fungi and are considered to be spore feeders. Known sites include historic parklands (Scadbury in Kent), ancient wood pastures (Bucklebury Common in Berkshire and the Forest of Dean in Gloucestershire). Falk & Chandler (2005) list just three other Welsh sites - Figyn Blaenbrefi (Ceredigion), Cwm Ystwyth (Montgomeryshire) and Cae'r Felin (Caernarvonshire) - but it has been found at Chirk Park since then. Adult gnats were found around veteran beech trees at the Kent site. A male was taken in Trap 14, on a veteran oak in the east end of Castle Woods.

3.5.14 *Sciophila interrupta* (Mycetophilidae)

This Nationally Scarce fungus gnat has a wide distribution across southern Britain, with just four previous Welsh records - Oxwich NNR on Gower, Chirk Park, Dingestow Court and Wyndcliff Wood. Sites tend to be classic ancient wood pastures, including the New Forest, Savernake Forest, Wychwood Forest, Bucklebury Common, Burnham Beeches NNR. There is an old Continental record from the terrestrial tooth fungus *Hydnum repandum* which grows in shady woodland situations, often beneath beech trees. Several other *Sciophila* species are known to develop in this fungus. Three males and one female were taken in Trap 2, the collapsed lime in the Lower Park.

3.6 Other invertebrates

3.6.1 Aculeate Hymneoptera

Species	Main prey	Location	Welsh distribution
Pompilidae	-	-	-
*Dipogon subintermedius**	*Segestria senoculata* (spider)	Castle Wood, Trap 7	Rare. Virtually confined to Border region (Edwards *et al*., 2005)
Sphecidae	-	-	-
Crabro cribrarius	Large Diptera	Castle Wood, Trap 7	Mainly coastal
Crossocerus dimidiatus	Snipe flies (Rhagionidae)	Castle Wood, Trap 7	Mostly southern (Edwards *et al*., 2001)
C. podagricus	Small flies	Castle Wood, Trap 7 and Deer Park, Trap 10	Mostly southern (Edwards & Roy, 2009)
C. pusillus	Small Diptera	Front Park, Trap 1	Few records, mainly in SE
Ectemnius cavifrons	Hoverflies	Front Park, Trap 1; Lower Park, trap 5; Castle Wood, Trap 7 & Deer Park, Trap 10	Widely scattered
E. cephalotes	Medium-sized flies	Trap 10	Records from coastal areas and extending along Border counties (Edwards, 1997)
E. lituratus	Medium-sized flies	Deer Park, Trap 1	Very few records
Pemphredon lugubris	Aphids and planthoppers	Castle Wood, Trap 7	Widely known in south Wales and strong populations along Border region (Collins & Roy, 2012)
Psenulus concolor	Psyllid bugs	Lower Park, Traps 3 & 5; Castle Wood, Trap 7 & Deer Park, Trap 10	Very few records.

Deadwood-nesting wasps were a feature of the flight trap catches and comprised six species of digger wasp (Sphecidae) and one of spider-hunting wasp (Pompilidae). One additional digger wasp *Crossocerus pusilus* is a ground-nesting species, and another, *Psenulus concolor*, nests in hollow plant stems and especially common reed, not deadwood. All are considered widespread in lowland Britain, but most appear to be under-recorded in central Wales (Table 6).

Table 6. Solitary wasp species found on Dinefwr Estate during 2023.
* denotes species which are rare in Wales.

3.6.2 Bark bugs (Hemiptera)

The predatory *Xylocoris cursitans* was found in association with the fallen oak on the pump-house in the Deer Park. *Aradus depressus* was taken in flight Trap 10, on the collapsed ash tree in the Deer Park. Both are widespread species nationally.

3.6.3 Snake flies (Raphidioptera)

A larval snake fly was found in a fallen oak branch in The Rookery area of the Deer Park. Larvae are not identifiable to species at present. However, only one species is currently known from the Estate - *Phaeostigma notata*. This is a widespread species across southern Britain and apparently confined to oak.

3.7 Significant wood-decay habitat types

3.7.1 Open-grown parkland trees

Open-grown parkland trees are the most important form of tree for both saproxylic and epiphytic organisms. There are many reasons for this, including the following:

- A tree given adequate space has the potential to develop its optimal form for light-gathering, with well-developed lateral branches;
- The lower trunk remains relatively well-lit and suitable for epiphyte growth and for sun-basking behaviour of insects;
- In the absence of crown competition, the tree also has the potential for a long life and for the crown to eventually grow old and decline naturally through crown retrenchment;
- As the crown expands and develops so the lowest lateral branches become over-shaded and die, creating a unique sheltered situation for specialist wood-decay fungi such as *Peniophora* spp. and *Vuilleminia comedans* to begin to decay the wood and for an also unique assemblage of saproxylic invertebrates to colonise - see 3.7.4 below;
- With a long life, the central dead heartwood tissues - which increase annually - become colonised by bracket fungi and decay is initiated and progresses to form either red- (or brown) rot or white-rot, depending on the fungus species. Habitat is thereby created for a wide range of specialist invertebrates, including many of our rarest saproxylics - see 3.7.2 below;
- A fully developed crown absorbs more carbon dioxide from the atmosphere than that of an overcrowded ‘woodland’ tree and produces a much larger crop of acorns which then have the potential to grow on as new generation trees as well as feeding a wide range of dependent organisms.

The older open-grown parkland trees at Dinefwr therefore offer the most diverse wood-decay habitats. The best trees noted in 2023 are in the Front Park area, Lower Park, around the fringes of Castle Field, and in Castle Woods, although overall few in number. These should be the top priority trees for conservation action.

Younger open-grown parkland trees are extremely scarce throughout Dinefwr Estate. There is an urgent need to look after those already in place and to establish many more across the open parkland.

3.7.2 Heartwood decay and hollowing trees

Heartwood decay is arguably the most important wood-decay habitat as it mainly develops as the trees age and – with oaks – after 200-250 years. The process of heartwood decay supports a succession of saproxylic invertebrates. The majority of the Dinefwr oaks appear to be actively decaying by the red- or brown-rot process caused by Beefsteak Fungus *Fistulina hepatica*, with just a few showing evidence of the cuboidal red-rot of Chicken-of-the-Woods *Laetiporus sulphureus*. White rot in oaks is mainly caused by *Inonotus dryadeus* but also *Ganoderma resinaceum,* both species noted as present by Bosanquet & Lucas (2021) but only a single example of the former was noted during the 2023 survey.

While their mycelia are creating heartwood decay and wood mould, the sporophores – fruit bodies or brackets - of the bracket fungi also provide habitat for specialist invertebrates. The Nationally Scarce hairy fungus beetle *Triphyllus bicolor* is associated with Beefsteak Fungus and was found to be unusually abundant in the flight traps. The Nationally Scarce beetle *Hallomenus binotatus* also develops in bracket fungi and was found at Chicken-of-the-Woods in the Rookery area of the Deer Park. The darkling beetle *Eledona agricola* develops in old and dry brackets of Chicken-of-the-Woods and although reported in the past from the Deer Park was only found in Castle Woods in 2023.

Dinefwr Estate NNR has now been shown to support a rich red-rot fauna, with key species such as the beetles *Anaspis thoracica*, *Triphyllus suturalis*, *Euglenes oculatus*, *Dorcatoma chrysomelina* and *D. flavicornis* all found during 2023 – the last being overlooked by earlier recorders. Other important heartwood decay species previously overlooked but found during the current survey are the beetles *Scraptia testacea* – a white-rot associate - and *Aderus populneus*, associated with red-rot. The rarest red-rot associate known from Dinefwr – the darkling beetle *Hypulus quercinus* – was not found during 2023. **The richest heartwood-decay assemblages found during 2023 were in Lower Park and Castle Woods, not the Deer Park** (see section 3.8 below).

The next main phase in heartwood decay is the composting of the decayed heartwood material to form wood mould in the bases of the cavities formed, but this habitat appears to currently be very localised at Dinefwr, with few accessible examples found. The associated specialist fauna also appears to be relatively species-poor across Wales. While hollowing and wood mould may be present out of view on site, it is notable that few of the specialist beetle fauna of wood mould has been found at Dinefwr. Of the characteristic species of darkling beetles *Prionychus ater*, *Pseudocistela ceramboides* and *Mycetochara humeralis* (Tenebrionidae), only the first named has been found at Dinefwr in the past and the others may truly be absent. They appear to be - more surprisingly - absent from Powis Castle Park, despite its large number of ancient oaks. *P. ater* is known in Wales from Chirk Castle Park, Erddig Park, Dinefwr Deer Park and a number of sites in Monmouthshire, while *Pseudocistela ceramboides* is only known in Wales from the eastern Gwent Levels and the Lower Wye Valley & Gorge in Monmouthshire. There is an old ‘Swansea’ record for *M. humeralis* but no modern Welsh records. It may be that this entire faunal assemblage is largely absent from the whole of central Wales. Special effort was made to search for *P. ater* during the 2023 visit, but suitable habitat was scarce and no larvae could be found. It

may well still be present as the specialist fine and friable wood mould habitat can be difficult to access in the basal hollows of ancient and veteran trees.

The large cavities formed during heartwood decay are a valuable habitat in their own right. The Nationally Scarce spider beetle *Ptinus subpilosus* is a good example of a species with strong associations with hollow trees.

3.7.3 Rot-holes

Rot-holes comprise smaller pockets of decay and wood mould in situations where a lateral branch has broken off or has been cut and removed. They are therefore mostly found in open parkland or woodland edge situations where trees have had enough lateral light for lateral branches to develop. Once the trunk has a patch of exposed heartwood or torn woody tissues where the branch has been lost, entry is possible for specialist fungi, and especially Dryad's Saddle *Polyporus squamosus*. However, oak is not a particularly good tree species for rot-hole formation – ash, beech and horse chestnut provide better quality rot-hole habitat.

Rot-hole invertebrates were not therefore found to be prominent at Dinefwr. The only Nationally Scarce associates found were the Diptera *Fannia aequilineata*, *Helina abdominalis*, *Lasiambia brevibucca* and *Phaonia pratensis*, all additions to the Dinefwr Estate species list.

3.7.4 Aerial dead branches

Dead branches - in situ, attached to the tree - are a characteristic feature of veteran trees and an important specialist habitat for invertebrates. The most important are those lateral branches which are shaded out by the higher crown as that crown develops. Since the death of these branches is under the control of the tree, nutrients are removed back into the main living tissues of the tree before death makes the tissues inaccessible. The dead aerial branches are therefore comprised mostly of cellulose and lignin but little else. These generally remain attached to the trunk where they grew and are decayed by specialist fungi, notably *Peniophora quercina* and *Vuilleminia comedans* with open-grown oaks. These fungi provide habitat for a notably rich specialist fauna, mainly beetles so far as is known. A limited representative fauna has been reported here at Dinefwr in the past, with the Nationally Scarce beetle *Phloiophilus edwardsi* associated with *Peniophora* fruiting on the dead twigs of oak. These were typically mostly found in the more open areas of parkland (Lower Park) but also, more sparingly, in the Deer Park.

3.7.5 Hanging snapped branches

The fauna of snapped or broken branches is quite different in character as death occurs suddenly and unpredictably. Nutrients cannot be removed by the tree before the connection is lost. They therefore provide richer habitat for the fungi and invertebrates which quickly colonise them. Prominent amongst these species is the Oak Bark Beetle *Scolytus intricatus* which occurs in plenty at Dinefwr. More significantly is the 1996 record

at Dinefwr of the Nationally Scarce two-spotted click beetle *Calambus bipustulatus* which is a specialist predator of the bark beetle larvae. This was not encountered during the 2023 survey but almost certainly still occurs here. A more widespread bark beetle predator - the Ant Beetle *Thanasimus formicarius* – has also been reported at Dinefwr and was found again in Trap 9, in the Deer Park. Welsh, or Fiery, Longhorn *Pyrrhidium sanguineum* is another species which depends on these freshly broken oak branches as larval habitat and, again, features on the Dinefwr list. The failure to re-find most of these broken branch specialists in 2023 is most probably due to a combination of i) the density of trees in much of the Deer Park and which makes hanging branch-wood difficult to spot, and ii) the tidiness apparent within Lower Park, where fallen wood has largely been cleared away.

3.7.6 Blossom for feeding on nectar and pollen

The white blossom of flowering trees and shrubs has long been known to provide an important feeding resource for insects developing in decaying wood. Hawthorn is the best-known amongst the associations, supporting the greatest variety of flying insects. However, other species should not be overlooked. Elder blossom is known to be the key resource for beetle species which are active after hawthorn blossom has gone over. One of the key elder favouring beetle species is present in good numbers at Dinefwr - the Nationally Scarce *Euglenes oculatus.*

3.7.7 Epiphyte assemblages

Although strictly not saproxylic habitat, the aerial dead branches and the dead outer bark of the trees provides important surfaces for the growth of epiphytic algae, lichens and other micro-organisms. These are fed upon by a large suite of invertebrates of which the barkflies (Psocoptera) are the most prominent. Eleven species were found during 2023. Of particular interest is the presence of *Epicaecilius pilipennis*, originally thought a Madeiran endemic, but which has only recently colonised Britain. On Madeira, it was a species of humid heath conditions but is associated in Britain more with epiphyte communities on trees. It was taken in flight Trap 14 in Castle Woods. Three of the larger picture-winged barkflies *Loensia fasciata, Metylophorus nebulosus* and *Trichadenotecnum sexpunctatum* were also taken by the traps; these are widespread but thinly scattered across Britain. *L. fasciata* was also taken in Trap 14 in Castle Woods, while *M. nebulosus* was taken in Trap 4 in Lower Park and *T. sexpunctatum* in Trap 2, also in Lower Park. This group is clearly another example of species favoured by the older open-grown oak trees outside of the Deer Park. The shadier conditions maintained by the high tree density over much of the Deer Park provide poorer quality habitat for epiphyte communities.

Predatory bugs are also a feature of epiphyte communities and two widespread species were noted during the survey: *Cardiastethus fasciiventris* and *Loricula elegantula.* The spider *Nuctenea umbratica* is also part of this assemblage, sheltering by day in cavities on the tree and coming out to feed over the bark surfaces after dark.

3.8 The different compartments on Dinefwr Estate NNR

The designated area comprises a mosaic of different areas, each of wood pasture origins but with different management histories.

3.8.1 Front Park

Front Park is largely devoid of trees of current value for saproxylic organisms. An ancient hollow and red-rotten sweet chestnut is present near the north-west corner and the magnificent ancient oak pictured on the front cover of this report currently stands outside of the grazing enclosure. Two areas along the eastern boundary have both been fenced out from the white cattle grazed pastures and gap-filled by recent plantings at 2m forestry spacing. The southernmost fenced area has the greatest current interest as it still contains a few veteran beech and common lime trees.

A veteran beech at SN618225 was selected for flight interception Trap 1 – see Figure 4 (see 2.3 above), no tag but probably digital mapping code 0826. This tree was measured at 4.35m girth at breast height (gbh) and has a small (10cm across) cavity at about 2m up the trunk and a larger cavity (about 15cm across) above. Fine dry powdery white-rotten wood fragments were found within. The root buttresses have pools of rainwater with decay debris. A large branch has ripped out from the crown and now touches the ground below.

The more significant catches from this trap are shown in Table 7.

Table 7. Near Threatened & Nationally Scarce insects taken in Trap 1, Front Park.
* indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
*Aderus populneus**	NS	Heartwood decay
*Enicmus rugosus**	NS	Slime moulds on decaying wood
Euglenes oculatus	NS	Heartwood decay
Microrhagus pygmaeus	NS	Well-decayed heartwood in trunks and branches
*Prionocyphon serricornis**	NS	Wet rot-holes
*Scraptia testacea**	NS	Heartwood decay
Diptera	-	-
*Acnemia amoena**	NT	Decaying wood
*Fannia aequilineata**	NS	Rot-holes & sap-runs
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs
*Scenopinus niger**	NT	In decaying wood inside large old veteran trees

As a relatively large girthed broad-leaved tree, this beech tree clearly supports a diverse heartwood decay and rot-hole invertebrate fauna as well as a specialist of water-filled cavities. *Aderus populneus* and *Scraptia testacea* are two of the rarest beetle species added to the Dinefwr list in 2023 as are *Fannia aequilineata* and *Lasiambia brevibucca* amongst the Diptera. All four species were also found in the trap operated below Church

Wood in Lower Park – see Trap 2 below. The fungus gnat *Acnemia amoena* and Forest windowfly *Scenopinus niger* have been found at Dinefwr previously. This tree has produced the largest counts of the latter in the flight traps, with seven specimens taken over the year. This single large veteran beech is clearly well above average in the range of rare saproxylic invertebrates that it is supporting.

Management considerations

The two enclosed areas of tree cover require active management if they are to achieve their true potential for saproxylic invertebrates, and for epiphytic lichens. Restoration of grazing is important to reduce the domination of bramble in the ground layer and to hold back ivy from smothering tree trunks. Recent tree-planting has been at forestry spacing and the young trees will not provide future valuable trees unless they are heavily thinned to encourage the development of lateral branching. A very high proportion of these young trees will need to be removed (or reduced) before they begin to cause competitive problems for the older trees present. A careful assessment needs to be made on a tree-by-tree basis starting with the largest and oldest trees.

Figure 5. Forestry style planting of young oaks within the edge of a fenced out area of Front Park and in need of active management.

A few new open-grown specimen oak and/or beech trees need to be planted across Front Park as a matter of urgency, to maintain the process of developing valuable new

generation parkland trees. The positioning of new specimen trees will be important to the designed landscape aspects so close to Newton House but there are far too few new generation trees in this area at present.

See also the general principles outlined in Sections 4.1 (Land Management Issues) and 5 (Recommendations) below.

3.8.2 Lower Park

The name Lower Park is used in this report to cover the area between the old church in the east and Castle Field in the west and includes the currently fenced-out plantation woodlands on ‘Bank of Battle’ and alongside the current car park (it is not named on the National Trust’s display mapping or the dog-walkers leaflet). Both fenced out areas contain important veteran trees which are currently at risk of being damaged by the young growth around them.

Figure 6. Veteran oak engulfed by dense plantation in fenced out area between car park and Lower Park.

Lower Park currently contains notably few old parkland trees but those that do survive are extremely important for saproxylic invertebrates.

The pair of ancient oaks (code numbers 100 and 101 on the digital tree survey mapping; tags not found) are especially important for their open-grown form which is currently providing some of the best lateral branch habitat within the NNR. The dead branches in the lower crown – killed by shading out by the higher crown – produced the only examples of the uncommon *Cis pygmaeus* beetles found on the estate during 2023 and had the strongest population of the Nationally Scarce beetle *Phloiophilus edwardsi*. The fallen branches beneath were also found to be rich in beetle species including the Nationally Scarce *Thymalus limbatus.* Oak 100 has basal cavities with red-rot visible as well as old branch stubs on the trunk. It provides excellent wood-decay habitats. Oak 101 has many torn branch stubs which provide valuable habitat for saproxylic invertebrates.

The lone large veteran oak (code 87) below Bank of Battle – see Figure 7 - is undoubtedly another important tree for saproxylics but is currently in a condition that makes sampling difficult. It has had major rip-outs of massive branches which have exposed extensive red-rotten heartwood at many metres above ground level. Unfortunately, the fallen timber has not been left in situ as it should have been in a SSSI and NNR but has been cut up with a chainsaw and heaped together, seriously reducing its value for saproxylic invertebrates. Searching amongst the stacked wood revealed larvae of the uncommon click beetle *Stenagostus rhombeus* and of a cardinal beetle species *Pyrochroa* sp.

Figure 7. Isolated veteran oak in centre of Lower Park showing the valuable fallen dead wood which has been damaged by excessive chainsaw activity. Note a future replacement tree has been established close by.

Two other ancient oaks were noted at the fringes of Lower Park, one at the top of a steep bank close to the boundary with Castle Wood, the other in the narrow neck of parkland towards Castle Field. There are also a small number of large parkland ash, common lime and horse chestnut.

The trees selected for flight interception trapping were a collapsed lime on the slopes below the enclosed woodland extending westwards from the old church, a horse chestnut with its top recently split out and largely in situ, and the ancient oak at the western end, towards Castle Field.

The collapsed lime at SN619223, Trap 2, has a shattered stump of 3.62m at 0.5m height above the ground surface, with the main broken trunk lying across – the position of the broken trunk shifted between the June and August visits, but the cause is unknown. The stump has live regrowth. It stands amongst a group of mature sycamore and oak trees with plentiful lying dead wood. It is therefore in a very sheltered and mostly shady situation, with Church Wood protecting it from northerly winds.

Table 8. Nationally Scarce insects taken in Trap 2, Lower Park.
* indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
*Aderus populneus**	NS	Heartwood decay
*Prionocyphon serricornis**	NS	Wet rot-holes
*Scraptia testacea**	NS	Heartwood decay
Diptera	-	-
*Fannia aequilineata**	NS	Rot-holes & sap-runs
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs
*Sciophila interrupta**	NS	Terrestrial tooth fungi?

It is notable that all of the Nationally Scarce species found here are new to the Dinefwr list suggesting that this area of the NNR may have been very under-recorded. *Aderus populneus* and *Scraptia testacea* are two of the rarest beetle species added to the Dinefwr list in 2023 as are *Fannia aequilineata* and *Lasiambia brevibucca* amongst the Diptera. All four species were also found in the trap operated in Front Park – see above (3.8.1).

Interestingly, the shaded and sheltered situation was reflected by the presence of a few typical 'woodland' saproxylics. The most interesting being the fungus gnat *Sciophila interrupta* which may develop in the woodland terrestrial tooth fungus *Hydnum repandum*. None of this fungus was seen during the survey but it may occur in the woodland nature reserve above. This was the only trap to produce specimens of this fungus gnat, new to the Dinefwr list. Three males and a female were found, suggesting a small local breeding colony nearby. The uncommon net-winged beetle *Platycis minuta* and the common and widespread click beetle *Denticollis linearis* are also examples of 'woodland' insects found here and nowhere else on the estate during the 2023 survey season. A single example of the uncommon heartwood-decay beetle *Dorcatoma chrysomelina* was also taken here but presumably was a stray from old oaks on the bank above as this requires red-rotten heartwood.

The **collapsed horse chestnut at SN617219, Trap 3**, (no tag but probably digital tree code 85) also has a shattered stump, 2m high in this case, with a major part of the top ripped out and *in situ*, still attached to the stump and still alive. The tree was selected for trapping due to the presence of old oyster mushroom growth *Pleurotus ostreatus* and fresh

growth of *Polyporus squamosus* on the stump. These are both important decay fungi for saproxylic invertebrates. A small cavity in the base of the trunk was later in the year colonised by Hornet *Vespa crabro*, which resulted in the collecting of the trap samples being rather more careful than usual.

This proved to be one of the least productive traps, generating just one species with Nationally Scarce status, the rot-hole fly *Lasiambia brevibucca.* It did however also produce specimens of the uncommon white-rot heartwood-decay beetles *Plegaderus dissectus* and *Phloeophagus lignarius*, both new to the Dinefwr list. The shining fungus beetle *Triplax aenea* was also only taken here - it develops in oyster mushroom growth. This was also where the digger wasp *Psenulus concolor* was found in good numbers.

The ancient oak at SN613219, Trap 4 – no tag but presumably digital tree code 79. It has a girth of 5.25m, is hollow and red-rotten. A large bracket of Beefsteak Fungus *Fistulina hepatica* was evident late in the season. The top appears to have snapped off and fallen long ago into the adjoining fenced plantation part of Bog Wood, leaving areas of exposed heartwood but two lateral branches remain alive. It is however being over-shaded by an oak and merits some haloing work to protect it into the future.

The more significant catches from this trap are detailed in Table 9.

Table 9. Near Threatened & Nationally Scarce insects taken in Trap 4, Lower Park.
* indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
Euplenes oculatus	NS	Heartwood decay
Ptinus subpilosus	NS	In large cavities in veteran trees
Triphyllus bicolor	NS	Beefsteak Fungus *Fistulina*
Diptera	-	-
*Acnemia amoena**	NT	Decaying wood
*Ectrepesthoneura colyeri**	NS	Decaying wood
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs
*Mycetophila lastovkai**	NS	Bracket fungi
*Scenopinus niger**	NT	In decaying wood inside large old veteran trees

The beetle *Euglenes oculatus* was particularly abundant in the trap placed within the hollow cavity of this tree, with 57 individuals taken. Another of the Nationally Scarce beetles - *Triphyllus bicolor* - was also unusually plentiful, with nine captured. Other species taken include the uncommon beetles *Abraeus globosus* (Histeridae) and the weevil *Phloeophagus lignarius* (Curculionidae) – the latter was first recorded at Dinefwr this year but is clearly widespread in Lower Park at least.

This was the only trap of the fourteen to produce examples of the nationally scarce fungus gnats *Ectrepesthoneura colyeri* and *Mycetophila lastovkai*. The other three rare Diptera were found more widely across the estate.

Management considerations

Lower Park has few large old open-grown parkland trees remaining and is in urgent need of a new management plan targeted at increasing the tree resource for the long-term future. Haloing is needed around oak 79, at the western end of this parkland area, before it becomes too outshaded and dies prematurely.

Figure 8. Illustrating the current sparseness of the trees in this important area of parkland and the similarly sparse new plantings; the large oak shown in close up in Figure 7 is to the left.

New tree plantings in individual cages close to the horse chestnut have been of sycamore, larch and common lime, when one might have expected oak in this important oak landscape but also horse chestnut to replace an existing feature.

The removal of the commercial sheep flock from Lower Park provides a valuable opportunity for nutrient stripping the degraded pastures. It has also enabled the survival of numerous seedlings close to the old oaks 100 and 101. Those farthest out from the mother trees should ideally have protective cages provided. The closer-in seedlings could be transferred to a tree nursery and brought on for replanting elsewhere in the parkland – their current situation is too close to the veteran oaks as they will be badly affected by shading as they develop and are better off used elsewhere on the estate.

Areas with a higher density of trees have been fenced out from grazing and planted up with high densities of trees and these areas need re-consideration. **The Bank Of Battle** for instance contains large open-grown oaks which are now threatened by the growth of high density planted young beech and oak. The fencing has enabled the development of some hawthorn and elders at the fringes – and even at least one guelder rose - and which offer valuable nectaring for insect life in an area otherwise largely devoid of such. Sampling was

not feasible in the core of these plantations due to there being no provision of gates nor styles. The fence-lines need removing at the earliest opportunity and the planted trees heavily thinned, selecting for retention those with better form. The older generation trees require haloing, to remove competitive growth.

See also the general principles outlined in Sections 4.1 (Land Management Issues) and 5 (Recommendations) below.

3.8.3 Castle Field

This large area of grassland is mostly devoid of trees but the upper fringes, towards the path up to the Castle, have a small concentration of trees continuous with Castle Wood and so might be considered part of that wood. However, for the purposes of this report and guided by the different ownership, an oak selected for trapping is considered part of the Lower Park group of flight traps.

Trap 5 was hung inside the **tall hollow stump of an oak at SN612218** of 5.95m gbh. The tree has no tag and was difficult to relate to the digital tree mapping. The shattered walls of the hollow stump rose to between 1 and 2m tall. The inside of the large cavity contained a deep bed of wood mould. The fallen tree top lay downslope and showed signs of red-rotten heartwood and later had brackets of beefsteak fungus *Fistulina hepatica*. An elder bush close by provides a valuable nectar source.

The more significant catches from this trap are detailed in Table 10.

Table 10. Near Threatened & Nationally Scarce insects taken in Trap 5, Castle Field.
* indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
*Enicmus rugosus**	NS	Slime moulds on decaying wood
Euglenes oculatus	NS	Heartwood decay
Triphyllus bicolor	NS	Beefsteak Fungus *Fistulina*
Diptera	-	-
Acnemia amoena	NT	Rotten wood
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs

This trap was the only one of the 14 to take an example of the Oak Jewel Beetle *Agrilus biguttatus*, presumably attracted to the freshly dead stump for egg-laying.

Management considerations

The main issue in Castle Field is the lack of trees other than at some of the margins. The grassland appeared to be being used for hay in 2023. This is no reason though for a lack of tree planting as more can be planted around the fringes and on steeper slopes not suitable for hay-cutting.

See also the general principles outlined in Sections 4.1 (Land Management Issues) and 5 (Recommendations) below.

3.8.4 Castle Woods Nature Reserve

The Wildlife Trust's information panel in Castle Woods states that the reserve is particularly important for its mature and veteran trees. The interests include invertebrates, fungi and epiphytes. The reserve occupies a striking arc of craggy high ground with the ruined castle in the centre, overlooking the Afon Tywi floodplain below. The steepest slopes, with rocky crags, tower above the flood plain. The digital mapping tree survey includes about 35 trees within the reserve area with two main concentrations – i) on the east-facing side and upper ridge to the west of the castle ruins and ii) more of a scatter through the area to the east of the ruins. Effectively, this is not ancient woodland in the widely understood sense but a section of the ancient wood-pasture of the estate which was fenced out as part of landscaping in the Georgian period, combining forestry development with game cover. The surviving ancient and other veteran former wood-pasture trees are currently either enveloped in secondary woodland growth or plantation forestry.

The steep rocky ground has however enabled some aspects recognisable as characteristic of enclosed ancient woodland to persist despite a long history of management as wood-pasture. The ground flora is noticeably rich in ancient woodland type plants in places, including sanicle, wood anemone and dog's mercury.

Two flight interception traps were placed on trees in the western area (Traps 6 & 7) and two more in the eastern area (Traps 13 & 14).

Trap 6 was attached to oak 9460 (SN610218), close to the large basal cavity with red-rotten heartwood visible within. This tree is an ancient oak with a girth measured at 6.13m and stands low down on the steep slope above Castle Field. It has plentiful epicormic burring which is a valuable feature should the higher crown be damaged, enabling rapid regrowth. This tree has young sycamore trees close by which need to be removed before they grow up into the oak's canopy and start to shade this ancient tree. A neighbouring oak is already suffering from overshading from young sycamores.

The more significant catches from Trap 6 are detailed in Table 11.

Table 11. Nationally Scarce insects taken in Trap 6, Castle Woods Nature Reserve.
* indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
Euglenes oculatus	NS	Heartwood decay
Ptinus subpilosus	NS	In large cavities in veteran trees
Diptera	-	-
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs
*Scenopinus niger**	NS	In decaying wood inside large old veteran trees

Trap 7 was placed inside the entrance to a massive basal cavity in **an ancient burry oak atop the ridge of Castle Woods, SN609220**, no tag but probably digital tree code 9472. The tree has old brackets of *Ganoderma australe* (a white-rot causing fungus) as well as Beefsteak Fungus *Fistulina hepatica* (a red-rot species), and so this single ancient oak has the potential to be supporting the full range of heartwood-decay associated invertebrates. This appears to be the tree mapped digitally as 9472. The girth below a massive burr was estimated at 5m. This tree is not yet affected by the developing secondary sycamore growth but a mature sycamore alongside needs removing before the situation deteriorates.

The more significant catches from Trap 7 are detailed in Table 12.

Table 12. Near Threatened & Nationally Scarce insects taken in Trap 7, Castle Woods Nature Reserve. * indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
*Anaspis thoracica**	NS	Heartwood decay
Cis festivus	NS	Fungal decay of small stems.
*Dorcatoma flavicornis**	NS	Heartwood decay
Euglenes oculatus	NS	Heartwood decay
Triphyllus bicolor	NS	Beefsteak Fungus
Diptera	-	-
*Acnemia amoena**	NT	Rotten wood
Helina abdominalis	NS	Wet rot-holes
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs
*Scenopinus niger**	NT	In decaying wood inside large old veteran trees

The uncommon beetle *Plegaderus dissectus* – a species not previously found at Dinefwr – was also taken in this trap, as were other uncommon beetle species *Dorcatoma chrysomelina* and *Mycetophagus piceus*, all three being heartwood decay specialists of ancient and veteran trees. The presence of specimens of the minute fungus beetle *Cis festivus* presumably derives from the proximity of some large old hazel bushes, a shrub with which this beetle is most strongly associated. This was the only trap to take a specimen of the Nationally Scarce fly *Helina abdominalis*.

Overall, this was one of the richest trees trapped for saproxylic invertebrates at Dinefwr in 2023, including both of the Diptera with Near Threatened status. The range of Nationally Scarce heartwood decay species is especially notable.

Trap 13 was placed on a veteran oak at SN618219 of 3.35m gbh, possibly digital code 9519. This tree was selected as it has an old lightning strike scar down the trunk which has exposed a red-rotten interior. It stands on the lower slope, towards the eastern edge of the nature reserve and has an abundance of elder bushes below.

The more significant catches from Trap 13 are detailed in Table 13.

This tree predictably proved rich in heartwood decay species and especially those associated with red-rot and the red-rot causing beefsteak fungus *Fistulina hepatica*. Four of the species not previously reported from Dinefwr were found here.

Table 13. Nationally Scarce insects taken in Trap 13, Castle Woods Nature Reserve.
* indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
*Dorcatoma flavicornis**	NS	Heartwood decay
*Enicmus brevicornis**	NS	Slime moulds
*Enicmus rugosus**	NS	Slime moulds
Euglenes oculatus	NS	Heartwood decay
Triphyllus bicolor	NS	Beefsteak Fungus
Diptera	-	-
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs

Trap 14 was placed on another veteran oak deeper into the nature reserve and on a steep south-east-facing slope, next to an active badger sett. This tree is notable for having retained its tree tag from the digital mapping exercise, 9536, and stands at SN617218. Its girth was measured at 3.68m. It has a vertical tear in the trunk and a large body of old and dry *Laetiporus sulphureus* bracket fungus. The bracket was full of the uncommon Chicken-of-the-Woods darkling beetle *Eledona agricola*. This was a key reason for placing a trap on this tree as the author has a special interest in the ecology of this beetle.

The more significant catches from Trap 14 are detailed in Table 14.

Table 14. Nationally Scarce insects taken in Trap 14, Castle Woods Nature Reserve.
* indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
*Enicmus brevicornis**	NS	Slime moulds
Euglenes oculatus	NS	Heartwood decay
*Quedius truncicola**	NS	Damp wood mould of hollow trees & wood-decay fungi
Diptera	-	-
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs
*Sciophila geniculata**	NS	Spore-feeder on bracket fungi

The selection of this tree proved fortuitous as this trap was the only one to find the rove beetle *Quedius truncicola* and the fungus gnat *Sciophila geniculata*, neither known from Dinefwr Estate NNR previously. The association may be directly due to the presence of so much old bracket of Chicken-of-the-Woods *Laetiporus sulphureus*, the only tree like it found during the early season site exploration. Two examples of the darkling beetle *Eledona agricola* were also found in the trap covering the August to October period, demonstrating flight activity in this species late in the field season.

Overall, the range of saproxylic invertebrates found in the flight traps within the nature reserve is excellent and clearly demonstrates the high quality of the old oaks across the reserve for saproxylic invertebrates here.

Interestingly, hand searching across the nature reserve area was much less productive in saproxylic invertebrates. The key features of interest are the veteran trees and the high-quality habitats present within them are difficult to access and sampling might otherwise involve destructive operations if flight interception trapping had not been developed as the more sensitive sampling technique. However, the reserve does include many mature trees – especially towards the eastern end and along the steeper slopes – which are veteran trees of the future. These are however of high forest form, grown up under conditions of intense competition for light. They will almost certainly be shorter-lived than the older, spreading, wood pasture trees, as natural crown retrenching with age is likely to result in overshading and early death. They will develop valuable saproxylic habitats but for a shorter period than the older wood pasture trees.

In many ways, the high forest form trees are now less valuable than any sapling trees which have become established in relatively open areas across the reserve. Saplings and young trees generally may now be selectively managed to provide them with more space and light, to develop lateral branching, and to not be drawn up with tall and thin stems, more prone to wind-blow.

Management considerations

The key issues appear to:

- Active conservation of the remaining veteran trees;
- Selection of future replacement trees from amongst the younger cohorts present;
- Creating conditions for seeding of new trees and for sapling development.

The most urgent need is for removal of competing young growth from around the veteran trees. This appears to be mainly young sycamore trees.

Flowering shrubs such as hawthorn and elder also need to be kept free from over-shading which has the potential to suppress flowering. Elder blossom is especially important in relation to veteran oaks.

Given the early history of the reserve as actively grazed wood pasture and the special interest of the surviving trees from this management history, it seems advisable to consider to what extent grazing restoration might be feasible here. Low levels of browsing would reduce competitive growth of sycamore, the foliage of which is more palatable to large herbivores than is oak. It would also control growth of ivy on the tree trunks which would threaten epiphyte communities.

See also the general principles outlined in Sections 4.1 (Land Management Issues) and 5 (Recommendations) below.

3.8.5 The Deer Park

The present Deer Park appears to have originated by enclosure in the mid-17th century. The lay-out of the tree cover mirrors that of the surrounding area, with denser tree cover on the steeper slopes and wetter ground where grazing pressure would naturally have been lowest, as well as more open 'lawns' on the gentler ground and more exposed slopes where grazing animals would have tended to concentrate and have the greatest impact of the vegetation. The predominant tree is native oak with some ash along stream-sides and alders in the boggiest area – Bog Wood. These natives have been supplemented by landscape plantings from the 18th century onwards, notably with beech. Tree plantings in more recent decades appear to have focused on gap-planting in the denser stands along the steeper ground. The Rookery is a prominent stand along a ridge of high ground through the northern part of the Deer Park. The Heronry is the densest area of tree cover centred on the small stream which cuts down through the western edge of the Deer Park. Bog Wood follows the lowest slope of the Deer Park in the south-eastern corner. The area between The Rookery and The Heronry is good lichens on numerous old trees (Sam Bosanquet, pers. comm.)

The Rookery

The tree cover of The Rookery area is more akin to grazed high forest than to typical parkland as tree density is relatively high and lateral branch development restricted as a result – the trees are effectively over-crowded from a biodiversity point of view. The trees are mainly of mature age with limited veteran features. Very few trees could be found with good lateral branch development, but a few did have dead small branches under the crown with key decay fungi such as *Peniophora quercina* and *Vuilleminia comedans*. One such tree was found to be supporting a population of the Nationally Scarce beetle *Phloiophilus edwardsii.*

Examination of relatively recent fallen branch wood noted emergence holes and galleries of the Oak Bark Beetle *Scolytus intricatus* and, in a major branch, galleries of the Tanbark Borer *Phymatodes testaceus* which also contained a larval snakefly (Raphidiidae). Old lying oak trunks are a feature of the area and one with fresh development of Chicken-of-the Wood bracket fungus was found to have attracted a specimen of the Nationally Scarce false darkling beetle *Hallomenus binotatus* as well as the more widespread hairy fungus beetle *Mycetophagus quadripustulatus* and an abundance of aleocharine rove beetles.

Two flight traps were positioned on trees towards the north-eastern edge where conditions are more open.

Trap 8 was hung inside **the hollow stump of a hollow beech** which had collapsed downslope to the south, the stump being 1 to 3m high. No tag could be found but the tree is probably digital tree code 271. The situation is well-sheltered by trees to the west and south, but open to the north.

The more significant catches from Trap 8 are detailed in Table 15.

Table 15. Nationally Rare & Scarce insects taken in Trap 8, The Rookery, Deer Park. * indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
*Anaspis thoracica**	NS	Heartwood decay
*Euplectus infirmus**	NS	Cavities in veteran trees
*Prionocyphon serricornis**	NS	Water-filled cavities in veteran trees.
Diptera	-	-
*Rhipidia uniseriata**	NR	Decaying wood in large cavities

This was the only trap to capture specimens of the Nationally Rare cranefly *Rhipidia uniseriata*, with two females and a male captured. Three of the four Nationally Rare or Scarce species taken by this trap have not been found at Dinefwr previously.

Trap 9 was placed by an old branch scar on the trunk of a 4.23m girth **veteran oak at SN611228**. No tag could be found but the tree is probably digital tree code 277. The branch scar is effectively a large gap in the living trunk backed by red-rotten heartwood. The trap was placed here to sample insects coming and going from this red-rotten heartwood.

The more significant catches from Trap 9 are detailed in Table 16.

Table 16. Near Threatened & Nationally Scarce insects taken in Trap 9, The Rookery, Deer Park. * indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
Platypus cylindrus	NS	Freshly dead sapwood on oak
*Quedius microps**	NS	Cavities in veteran trees
Diptera	-	-
*Fannia aequilineata**	NS	Rot-holes & sap-runs
*Fannia speciosa**	NS	Soil beneath oak trees
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs
*Odinia trinotata**	NS	Sap runs
*Phaonia pratensis**	NS	Sap runs
*Scenopinus niger**	NT	Heartwood decay

The above assemblage of species found in this trap is very surprising as it had been expected to have been dominated by species associated with red-rotten heartwood, especially beetles, but only Forest Windowfly *Scenopinus niger* fits that assemblage type. Also, domination by beetles rather than flies was expected. The fauna found suggests that there are cavities within the trunk behind the scar and even sap-runs somewhere close by. *Fannia aequilineata* was represented by nine female flies, the largest count from the three traps which produced this species. Some uncommon beetle species were also taken – the Ant Beetle *Thanasimus formicarius* which is a predator of bark beetles (Scolytinae), the Cobweb Beetle *Ctesias serra*, and the false darkling *Orchesia undulata* which is believed to develop mainly in dead lateral branches of oak trees. Overall, this was a very productive trap, albeit not in the way expected.

The Heronry

This area of the Deer Park is largely dominated by high forest form trees and may have originally been established as a plantation. It is crossed by a small stream and provides a cooler and damper corner. Deadwood habitats are relatively limited here, and sampling was confined to the use of a sweep-net. Two Nationally Scarce beetles were found amongst the sweep-net samples: *Euglenes oculatus* and *Malthodes pumilus*, both species associated more with veteran trees and presumed not to be breeding in the immediate area but strays from elsewhere in the Deer Park.

The Pump-house Oak

General searching and hand-sampling was relatively unproductive throughout the Deer Park, partly it is thought to the difficulty of spotting the best areas for search due to the density and height of the predominant bracken cover. One hotspot for saproxylic invertebrates was the recently fallen large high-forest form oak which had fallen across a pump-house on the edge of the lawn area in the lower western area of the deer park. Although relatively fresh, the shattered hollow stump had been colonised by Oak Jewel Beetle *Agrilus biguttatus*, the first time this species has been seen at Dinefwr in particular, as well as Carmarthenshire and west Wales in general. This species has been expanding out from its refugia in lowland England since the 1980s, partly as a result of the increasing availability of dying and freshly dead mature oaks due to various diseases and increasing impacts of soil compaction about tree roots, but also due to warmer and drier summers arising through climate change. As one of the first saproxylic insects to colonise dead woody stems, it has been mistakenly proposed as an actual cause of oak decline by laboratory-based tree pathologists but, while its arrival is an early product of tree decline and death, there is only circumstantial evidence that it is involved in that decline or death. Knowledge of the beetle's ecology suggests no involvement in disease.

The fallen trunk had been partly sawn up, to enable clearance from the damaged pump-house building, and the lop and top removed. The large trunk sections – around 1.2m dbh - are in the very early stages of being colonised by saproxylic organisms. The activities of an ambrosia beetle species are visible in the form of small piles of sawdust emanating from tiny holes in the bark. This is most likely due to a *Trypodendron* species of beetle – both *T. domesticus* and *T. signatum* have been reported in the deer park previously. Where the trunk bark is beginning to loosen, then larvae of the longhorn beetle *Rhagium mordax* and a cardinal beetle species (*Pyrochroa* sp.) could be found – only the Red-headed Cardinal *P. serraticornis* has been reported from Dinefwr so far. The predatory bug *Xylocoris cursitans* and the uncommon beetles *Paromalus flavicornis* and *Platypus cylindrus* were also present. The thick trunk bark had been colonised by the bark beetle *Dryocoetes villosus*. The main trunk sections appeared to be undecayed when the tree fell, with no sign of any heartwood decay, other than the basal cavity, although a small bracket of Beefsteak Fungus appeared towards the end of the autumn, suggesting some early heartwood decay.

Cae Lan area of Upper Deer Park

The high ground within the Deer Park close to Newton House has relatively dense tree cover. It has a mixture of mature high forest form sycamore, oak, common lime and other tree species over a tall grassy sward. Sweep-netting through here revealed the presence of the Nationally Scarce soldier beetle *Malthodes pumilus* and the false click beetle *Microrhagus pygmaeus* as well as more widespread saproxylic beetles such as the longhorn *Leiopus nebulosus*.

Trees along the outer boundary

The north-western boundary of the Deer Park is lined by a series of mature and veteran broad-leaved trees. These include many damaged trees, presumably due to exposure to northerly winds. Traps were placed on two of these collapsed trees.
A collapsed ash tree was selected for Trap 10 which was hung amongst the considerable wood-decay debris around the hollow core of the original tree, from which trunk sections lay in two directions. The original trunk girth is estimated to have been at least 5m. The tree is located at SN609228. It had no tag and could not readily be associated with the digital tree coding.

The more significant catches from Trap 10 are detailed in Table 17.

Table 17. Nationally Scarce insects taken in Trap 10, The Deer Park.
* indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
*Enicmus rugosus**	NS	Slime moulds
Sphindus dubius	NS	Slime moulds
Triphyllus bicolor	NS	Beefsteak Fungus
Diptera	-	-
*Mycetophila caudata**	NS	Wood-decay fungi?

As an ash tree, the associated fauna is distinctly different in character to that of the oak trees. White-rotten heartwood and a richer assemblage of slime moulds (Myxomycetes) is reflected in the capture of two slime mould specialist beetles. Ash bark beetles featured strongly in the trap catches, including the uncommon *Hylesinus taranio* as well as the common *H. varius*. The uncommon beetles *Biphyllus lunatus* and *Mycetophagus atomarius* are also typical of ash trees and are associated with Ascomycete fungi developing in the decaying wood. This was the only trap to capture one of the comb-horned craneflies, the uncommon *Dictenidia bimaculata*, as well as the Nationally Scarce fungus gnat *Mycetophila caudata* which has not been found in Wales previously.

A group of old and decaying horse chestnut trees are a feature of the western end of this park boundary strip and were producing an abundance of bracket fungi including *Ganoderma austriaca* and *Polyporus squamosus*. Tapping *P. squamosus* brackets over a net produced an abundance of the hairy fungus beetles *Mycetophagus multipunctatus* and

M. quadripustulatus, together with the shining fungus beetle *Dacne bipustulata* and a female *Anaspis thoracica* (Nationally Scarce). The uncommon false ladybird beetle *Endomychus coccineus* was found under loose bark. This appears to be the first time that the hairy fungus beetle *M. multipunctatatus* has been found at Dinefwr.

Trap 12 was attached to one of these horse chestnut trees in the socket cavity formed by the ripping-out of a major limb. The tree must have been multi-stemmed at 2-3m height with four fallen stems on the ground around leaving a single live stem standing. The main trunk was measured at 4.6m gbh. The location is SN607227. The tree had no tag but is thought to be digital tree code 360. This was surprisingly the least productive of the traps and produced only a single insect with Nationally Scarce status, the hairy fungus beetle *Triphyllus bicolor*. This is really an oak associate and may have been attracted to the horse chestnut for feeding on fungal spores.

A ridge of higher ground lies immediately to the south of Trap 12 and is lined by veteran oak trees. **Trap 11 was placed inside a veteran oak** with a vertical split down the twisted trunk exposing a large hollow cavity with red-rot development. The trunk is 5.07m gbh and is located at SN608227, possibly being digital tree code 365.

The more significant catches from Trap 11 are detailed in Table 18.

Table 18. Near Threatened & Nationally Scarce insects taken in Trap 11, The Deer Park. * indicates species which are new to Dinefwr Estate.

Species name	GB status	Known habitat associations
Coleoptera	-	-
*Aderus populneus**	NS	Heartwood decay
Triphyllus bicolor	NS	Heartwood decay
Diptera	-	-
Acnemia amoena	NT	Rotting wood
*Lasiambia brevibucca**	NS	Rot-holes & sap-runs

This catch is somewhat disappointing for the lack of typical beetles for a red-rotten and hollow oak but the discovery of *Aderus populneus* in a second tree at Dinefwr is very significant – one was also found in Trap 1 in Front Park. This was the only trap to produce an example of the classic red-rot associated click beetle *Ampedus balteatus*.

Bog Wood

This area of woodland is of greatest interest for its old alder trees. These have the potential to be supporting some saproxylic beetle species not found elsewhere on the Estate. Some fresh growth of the Alder Bracket fungus *Inonotus radiatus* was noted in the autumn and could potentially have larvae of the Nationally Scarce beetle *Abdera flexuosa*, a species reported from the Estate in the past but not seen during 2023.

Management considerations

Overall, the Deer Park has a good age structure of oak trees – the most important tree species for the saproxylic invertebrate fauna at Dinefwr. There are plentiful young trees in the 30-50 years cohort, plenty of mature trees, plenty of veterans and a few ancient trees. This is very good but there are a number of problems which need addressing in such an important National Nature Reserve.

A key problem across the Deer Park is the domination of bracken which makes finding fallen dead wood for survey very difficult. It also provides a potential fire risk in prolonged periods of drought – something experienced both in 2022 and 2023, and something likely to feature much more in future. The National Trust estate team has been using bracken-rolling to try and control bracken but such rolling is time-demanding and needs to be carried out far more regularly than they have been able to achieve with current resources (S. McDonnell, pers. comm.). Chemical control is no longer permitted.

Tree plantings in recent decades have been targeted at gap-filling and block-planting rather than careful and sensitive siting of new trees intended to form new generations of open-grown parkland trees. One tree cage with a young oak was noted beneath the crown of beech trees, where it has no hope of long-term survival but every chance of causing damage to the older tree's crown (Figure 9). Another oak had been planted under sycamore canopy (Figure 10).

Figure 9. Poor planting of young oak tree in Dinefwr Deer Park.

Figure 10. Young oak tree planted under shade of sycamore.

Areas were noted with standard 2m forestry spacing of young oaks. One block in The Rookery appears to have been completely abandoned after planting, with no thinning and no removal of the plastic tree guards (see Figure 11). It is recommended that a heavy thin is carried out as a matter of urgency, focusing on retaining at least one tree centrally which shows some signs of lateral branch development, and which may still have the potential to grow into a valuable parkland tree. The rest of the young trees could be used for trial management, e.g. topping to see if a smaller pollard-type crown might develop and which won't threaten neighbouring trees with over-shading. Some could also be damaged, to create sap-runs and rot cavities – high quality saproxylic habitats.

One example of good practice in tree-planting was noted in the northern end of The Rookery where young oaks, perhaps 50-70 years old, had been planted in a sufficiently large open area for them to be developing crowns to their full potential. These trees were number tagged 783, 784? and 825 (Figure 12).

Figure 11. Large oak plantation in Dinefwr Deer Park where trees are overcrowded and have grown up tall and spindly as a result. No sign of any thinning work and plastic tree tubes have been left.

Figure 12. An example of sensitive tree planting in Dinefwr Deer Park. Note space for full crown development.

One individual veteran oak within the western end of The Rookery (possibly 0951 in the digital tree coding but with an aluminium tag showing 0258) has large lateral branch development to the south showing that it has had more space than many other trees here, but it is now being damaged by a large sycamore which has grown up on its north side (Figure 13). The sycamore needs to be dramatically reduced, to remove the overshading problem while retaining the core of the tree as potential wood-decay habitat. This tree also has a green Latschbacher tree tag numbered 13844 which presumably derives from an early lichen survey as tags of this type were in use by lichen surveyors in the 1980s and 1990s. Such tags were only placed on trees with substantial interest for epiphytic lichens.

Figure 13. Veteran oak which has had space for good growth up until now, but which is threatened by shading from a large neighbouring sycamore (to the right in this image).

Other examples of overcrowded planting of young oaks could be thinned using the same guidelines as outlined above. Fortunately, many young, planted oaks across the Deer Park have had their growing points chewed by grey squirrels and the young trees are now forming good lateral growth. Such squirrel-managed trees have the potential to form short squat trees that offer less damage from crown competition and may develop into very valuable habitat trees for the important saproxylic communities for which this park is renowned (Figure 14).

Figure 14. Young oak showing squirrel damage to growing point, but which is developing into an excellent open-grown form despite this.

Quite a few of the mature oaks in the northern part of the Deer Park are dead or dying. It is not obvious what has been causing this, but early death of mature oak trees is a widespread problem in historic parklands across the country. At places like Moccas Park NNR in Herefordshire the most likely cause has been the past agricultural use of the pasture which has left these trees especially vulnerable by damaging their root systems through compaction and nutrient-enrichment – trees of this age appear to have the greatest need for a healthy root system to keep the still actively developing crown in good vigour. It is not obvious that the Deer Park has similar problems, but this would be the contractor's provisional suggestion. The grazing regime and grassland management will have changed from that of the private estate and the impacts of their earlier regime may still be being felt.

One tree with a numbered tag (862) was closely inspected but no obvious signs of damage to the aerial part of the tree were apparent. But the surrounding root protection zone contained abundant nettle amongst the bracken which might suggest a nutrient-enrichment issue and perhaps also soil compaction from livestock concentrating beneath the tree canopy.

See also the general principles outlined in Sections 4.1 (Land Management Issues) and 5 (Recommendations) below.

3.9 Site assessment using Index of Ecological Connectivity (IEC) and Saproxylic Quality Index (SQI)

Two systems have been devised for the relative assessment of site quality for nature conservation using saproxylic beetles: the Index of Ecological Continuity (revised in Alexander, 2004) and the Saproxylic Quality Index (Fowles *et al*., 1999). No parallel scheme has yet been developed for use with the Diptera.

3.9.1 Index of Ecological Connectivity (IEC)

The Index of Ecological Continuity (IEC) has been used to identify Britain's most important sites for the saproxylic beetles of ancient trees and wood-pasture and parkland type habitats, and a hierarchical site table has been developed. The Index calculation is based on the presence or absence of a select list of beetle species (revised by Alexander, 2004, but with a few subsequent up-dates). The species are graded according to their degree of association with Britain's remaining areas of old growth – mainly the ancient wood pastures and historic parklands - and these grades are used as the basis for a scoring system. The total of these scores provides the Index.

The IEC listing has become somewhat out of date and an up-date is in preparation. Two important changes have been made in the current report:

- *Uleiota planatus* has been shown to be an expanding species following introduction and so no longer merits a score;
- *Pyrrhidium sanguineum* has spread widely around Britain in recent decades (Alexander, 2019b) and its presence at a site no longer merits a score of 3 in the IEC calculation.

The species in the qualifying list include many which are difficult to find on demand and so the Index is best built up over a number of years. Records from earlier recording therefore contribute to the Index. A control on old records is however imposed, with only post-1950 records being used in the calculation. With Dinefwr Estate NNR, all records have arisen from 1986 onwards and so this control is not relevant here. The cumulative nature of the IEC means that the figure at any one time is a minimum figure, the Index can only increase as previously overlooked species are revealed. 'Missing' species were accordingly targeted in 2023 and a relatively small number were discovered.

Experience has suggested that sites of national (GB) importance have an IEC in the range of 25-80 while IEC values of 15-24 are of regional importance (Alexander, 2004). Sites in excess of 80 are considered to be of European significance.

The IEC value of the Dinefwr Estate NNR has now reached 72:

- This is a substantial increase on the 1996 figure which was 58, increasing by 24%;
- An IEC of 72 exceeds the threshold for GB importance;
- The value is close to achieving European significance.

It places Dinefwr Estate NNR:

- amongst the top four sites in Wales, alongside Chirk Castle Park (90), the Wye Valley Woodlands SAC (90) and Piercefield Park (76) (see Table 19);
- as the top site in the heart of Wales, away from the border country;
- amongst the top 30 sites in Britain.

Table 19. Key Welsh saproxylic invertebrate sites with Saproxylic Quality Index (SQI) and Index of Ecological Continuity (IEC) values. SQI & IEC scores in () for Wye Valley Woodlands are for the Welsh part only. Note that sites are not directly comparable as this assessment for Dinefwr Estate excludes *Pyrrhidium sanguineum* and *Uleiota planatus*.

Site	SQI	IEC	Source
Carn Gafallt	387.8	29	Boyce (2023a)
Chirk Castle Park	439	90	Alexander (2019a)
Dinefwr Estate	374	72	current survey
Dingestow Court	525	39	Alexander (2020); Howe *et al*. (2022)
Gilfach	314.5	5	Boyce (2023b)
Gregynog	409	53	Alexander (2023)
Piercefield Park	539.1	76	McGill (2024)
Powis Castle Park	308	63	Judd (1999)
Wye Valley Woodlands SAC	504.7 (493.8)	90 (85)	Howe *et al*. (2022)

It is still very feasible that further species remain undiscovered in the NNR. The presence of many of the key species discovered in 2023 was only detected as single adult specimens. This is an important point as one fewer and the species would have remained overlooked. These are not highly mobile species and so a single specimen does imply a local resident breeding population. There are still more IEC species which could potentially fall in the same category as long overlooked species where the probability of detection on demand remains small. Continued survey effort is required in order to move further towards a more complete species inventory.

3.9.2 Saproxylic Quality Index (SQI)

The Saproxylic Quality Index (Fowles *et al*., 1999) is a more recent development designed to take the whole saproxylic beetle fauna into account and to include some control of recording effort. The species are scored according to the level of their national status (in 1999 – now very out-of-date) and on a geometric scale – from 1 point for common species through to 32 points for the rarest. The total of these scores is termed the Saproxylic Quality Score and the Saproxylic Quality Index is calculated by dividing this score by the number of qualifying saproxylic species recorded and then multiplying the result by one hundred.

The SQI calculation has certain provisos:

- a threshold of 40 qualifying species have been recorded from the site;
- the list should be complete, i.e. include all qualifying species recorded during surveys;

- the same attention should have been applied to recording common species as rare ones.

The scores allocated to species for the SQI have become increasingly out-of-date and, rather than rely solely on the 1990's listing, a few adjustments have been made to make the SQI more consistent with modern knowledge:

- *Euplectus infirmus* is a rare saproxylic but was not given any conservation status by Hyman (1994) and so only given a score of 2 in the SQI calculation. It has been included for the Dinefwr SQI with a score of 8;
- *Malthodes pumilus* now has Nationally Scarce status and so its score has been increased from 2 to 8 for the purposes of the 2023 Dinefwr survey;
- *Uleiota planatus* has been shown to be an expanding species following introduction and so no longer merits a score;
- *Pyrrhidium sanguineum* has had its conservation status removed as it has spread widely around Britain in recent decades.

Many other adjustments are needed but these four are the most significant.

The 2023 survey produced records of 85 qualifying beetle species and an SQI of 374. This is a high figure and compares well with those for Chirk Castle Park (439 in 2018), Powis Castle Park (308 for 1990-98), Gregynog (409 in 2022) and the Wye Valley Woodlands SAC (504.7).

Fowles *et al*. (1999) suggest that an SQI of 500 is probably an appropriate threshold for assessing national importance. The NNR therefore falls below this provisional threshold for national importance. However, Fowles *et al*. (1999) were unable to present data for more than 14 sites with an SQI of 500 or more and it does seem likely that the threshold had been set much too high. Many sites which are nationally famous for their saproxylic beetles have SQI figures in the 300s and 400s. The SQI does therefore effectively indicate national significance for Dinefwr Estate NNR.

The SQI approach is of particular use in comparing a series of datasets from a single site – the IEC is less useful for this as the list of qualifying species needs to be built up with continuing recording effort. Three independent datasets - arising from formal surveys - are available for Dinefwr Estate NNR and so it is instructive to see how the SQI figures have changed over time and changes in site management. The SQI figures are presented in the Table 20.

Table 20. Site Quality Index calculations for Dinefwr Estate NNR datasets.

Dataset	Recording period	SQS	SPP	SQI
Hammond & Hine (1994)	1994	62	18	344.4
Levey & Pavett (2000)	1996	526	150	350.7
Alexander (2024)	2023	319	85	374.4

The data is however problematic as i) the amount of time spent in the various areas has varied, ii) the 1994 dataset does not meet the threshold requirement of 40 species, and iii)

the methodologies of survey have been very different. Flight interception trapping in particular is a more effective way of sampling many of the smaller species and was not used by the 1994 survey. Whether or not the data indicates a real change in site quality is therefore unclear.

Periodic repeating of this comprehensive style of survey is however recommended so that the SQI statistic can be used as a simple monitoring tool.

3.10 Incidental records of Phorid flies

The Phoridae are minute to small, very active flies with few experts specialising in their identification. Most appear to develop in decaying organic matter, in its multitude of forms and situations, with some associated with dead snails and other carrion, while others use decaying fungi. A few species live as parasites in ant nests.

Peter Chandler passed on to Mark Welch (a specialist based at the Natural History Museum) for identification phorids that he picked from the Dinefwr flight interception trap catches. A number of very interesting species were found to be present including *Megaselia insons*, *Megaselia melanocephala*, *Megaselia rubescens* and, most surprisingly, *Puliciphora borinquenensis*. The 3 *Megaselia* mentioned above are all rarely recorded species. Although Phoridae is an under-recorded family (probably due to their usually small size, difficulty of identification and the consequent frequent need for dissection and slide mounting), these 3 species are likely to be genuinely uncommon. As far as Dr Welch knows, *Puliciphora borinquenensis* has only been recorded in the British Isles in Oxford as a "laboratory pest" (Mann, 2007), so its occurrence at Dinefwr is surprising and worthy of further study. The females of this species are wingless and are carried to suitable habitat by the males.

4. Land management issues

4.1 Tree care

The importance of the open-grown form to trees needs to be fully appreciated across the NNR and action taken where the more important ancient and veteran trees are at risk from over-shading from more vigorous young trees. Oak is the main tree of interest across Dinefwr Estate and is well-known to be a light-demanding tree. It acts as a pioneer tree species in open grasslands and does not grow well under shade. When growing with sufficient space, it develops a broad crown with strong lateral branching. The lateral branches provide an important saproxylic habitat which is not replicated by any other tree species.

In many cases – and especially where the more heavily wooded areas have been fenced out from the parkland – veteran trees are at risk from dense young growth. Fencing removes the browsing pressure on: i) ivy which may then begin to smother epiphyte

communities on the tree trunk, ii) bramble which can develop rampantly, smothering the understorey, iii) holly, which may dominate the understorey. Young trees planted at standard 2m forestry spacing are unsuitable for parkland situations – especially where thinning is neglected – as they grow up tall and straggly due to competition from neighbouring trees and do not develop the lateral branch structure that is desired for parkland trees. Young oaks in particular will grow directly towards lateral light where overshaded by existing mature trees and so develop into unbalanced forms. Where they enter the canopy of veteran trees, they will cause the foliage of the older trees to die back and eventually they will kill the older trees through crown competition. These processes are described more fully in the two key veteran tree management manuals (Lonsdale, 2013; Read, 2000).

Root damage needs to be minimised. The current extension to the car park has resulted in severe decline in the health of a mature oak on the edge (Figure 15). This tree may be around 150 years old – that is 150 years of time invested in this tree being put at risk merely for car parking for visitors. Fortunately, only a single example of such damage was noted during the 2023 survey.

Figure 15. Decline and imminent death of a mature open-grown parkland oak caused by soil compaction from car parking.

Key tree care needs identified on Dinefwr Estate are as follows:

- Haloing around all veteran oak where they are being crowded in the crown by competing trees, especially heavy shade trees such as sycamore and beech;

- Remove or reduce recent plantings which have been positioned too close to veteran trees;
- Do not plant new trees close to existing trees – oak needs to be planted at about 30m spacing not 2m spacing;
- Thin out recent plantings where inappropriately sited.

A new standard of tree management appropriate to a National Nature Reserve needs to be agreed with NRW and change initiated. The current approach appears too much in favour of landscape gardening rather biodiversity conservation.

4.2 Tree planting

Much of the recent tree-planting which was noted as the parkland was being explored for invertebrates leaves a lot to be desired. Gap-planting within The Rookery for instance has widely failed, largely it is thought due to oak being a light-demanding species and so planting in small glades will lead to death by shading. The frequency of old tree guards with no surviving tree within speaks volumes.

Oak seedlings and saplings were noted at various points around the Estate where they would better be dug and moved to places more in need of new generation trees. The big advantages of these young trees are that they derive from the same genetic stock as the veteran trees and have developed in the local soil conditions. In contrast, the origin of nursery stock is often unclear and the trees have been grown in a different medium to that found at Dinefwr. Ideally acorns could be collected from selected ancient Dinefwr trees and grown on in an organic tree nursery on site.

4.3 Tree tagging

There is presently a confusion of individually numbered tree tags across the NNR. Not only are different types of tag in use, but multiple numbering systems, and even the methods of attachment vary. The predominant style of tag in use seems to be flimsy aluminium tags which are prone to damage and/or removal by the grey squirrels – this explains the fact that so many trees no longer have tags. Where more resilient tags have been used, they have been hammered directly into the tree bark where they will become damaged by tree growth.

Figure 16. A numbered Latschbacher tree tag which has been attached directly to tree bark, not allowing for any future growth, resulting in early damage to the tag which is already folding.

The industry standard which has been developed for number-tagging veteran tree populations is to use 6cm stainless steel tags and aluminium nails (Read, 2000; from which the following text is repeated). The nails should be long and hammered only 2cm into the tree, such that the tags are able to swing freely, and the tree can grow a considerable amount before the tag is engulfed in the bark. An alternative is to attach the label to 6cm of stainless steel or plastic-coated wire and knock a 3cm aluminium nail all the way into the tree. While the nail will quickly become surrounded by the bark the wire will not. Plastic tags can be used but become brittle and do not last well. Aluminium tags are easily damaged by squirrels, birds and people. Aluminium nails are less likely to prove toxic to the tree and is more sympathetic to any later need for chainsaw work. Galvanised nails are suitable for use with trees but are harmful to lichens.

There is not yet a really good reliable and permanent method for tagging trees, but developments in this field will undoubtedly occur. The use of GPS and hand-held computer technology to locate individually coded trees is an attractive option for tree surveyors but tends not to be practical for day to day use by natural history recorders.

4.4 Interpretation and promotion

Dinefwr Estate has been designated as a SSSI and a NNR and yet visitors are not being made aware of this distinction nor informed about the reasons, nor implications. The venue does not appear to be being promoted as an important wildlife site nor as an educational resource. The Castle Oak has been named and picked out for visitors, but the ancient oak wood pasture and parkland landscape appears to receive no publicity, no interpretation. This seems to be a huge, missed opportunity to explain to visitors what is important here and why, to promote good conservation understanding.

5. Conclusions and recommendations

Dinefwr Estate NNR has long been known to be amongst the top sites in Wales and of national GB importance for saproxylic beetles. It also has significant interest for saproxylic Diptera and is the richest Welsh site for fungus gnats. Along with its importance for epiphytic lichens and for saproxylic fungi, these interests all derive from a long and unbroken history of the ancient oak landscape and the wood pasture and parkland habitat. This needs to be celebrated and communicated to the local teams who work here as well as to the visiting public.

At present site conservation management seems not to reflect this importance, and improvements are urgently needed. The key recommendations arising from the 2023 survey are outlined in the following sections.

5.1 Monitoring site quality using standard survey techniques

The standardised saproxylic invertebrate survey carried out in 2023 can be used to provide a baseline for future monitoring of site quality. The SQI system provides a simple system for periodic monitoring of site quality as this Index has the capacity to increase or decrease. The IEC has a different underlying philosophy and can only increase with further survey work. The IEC of the Dinefwr Estate NNR is second only to Chirk Castle Park in the border country and so Dinefwr is unique as an outstandingly rich central Wales site. The four historic parkland and wood pasture sites of Chirk (Alexander, 2019a), Dinefwr, Gregynog (Alexander, 2023) and Powis are likely to remain the top saproxylic sites in Wales, amongst the best sites in Britain, and to be bettered in Wales only by the Wye Valley Woodlands SAC (Howe *et al*., 2022).

5.2 Land management sympathetic to tree health

Habitat quality and condition for saproxylic invertebrates depend on four key factors:

- the total number of veteran trees available – the more the better for maintaining population viability of invertebrates and fungi;
- the density pattern of the trees – open-grown trees provide the greatest diversity of wood-decay habitats, and space is also needed for sun penetration and availability of nectar plants, notably flowering shrubs;
- the age structure of the trees, providing for new generations of veteran trees continually becoming available;
- continuity – site history – the above three dimensions need to have been met for many centuries, if not millenia, to conserve the less mobile species present.

Conservation management therefore needs to focus especially on tree health, as it is living parkland trees which generate the important decaying wood habitats.

Some of the greatest threats to tree health and survival arise from the management of the land in which the tree stands, especially through activities which impact upon the root systems and the important mycorrhizal fungal connections.

In a site of such great nature conservation importance as Dinefwr Estate NNR, nature conservation should ideally have priority over agriculture and forestry – grazing and trees are essential, but the primary objective should be nature conservation and not agricultural or forestry productivity. Any products which can be sold are a bonus and should not be a prerequisite. The historic designed landscape aspects are also recognised as of significant importance at Dinefwr and are similarly dependent on continued tree health.

A grazing regime is essential across Dinefwr Estate NNR to maintain the structure and dynamic of the wood pasture habitat - mechanical management is not a good substitute as it is incapable of interacting with the vegetation with the same precision, but it can be valuable to supplement the impacts of the livestock where necessary. The key issues are:

- relatively low stocking levels, to maintain the structural diversity of vegetation and ideally to allow some development of low-growing thorn scrub locally which would enable natural recruitment of open-grown trees and shrubs;
- careful choice of livestock, to avoid animals which -
    - congregate beneath tree canopy – causing soil compaction and nutrient enrichment over the roots;
    - damage tree bases by gnawing and kicking;
- avoidance of routine use of antibiotics or other veterinary formulations, the residues of which in dung and urine might damage tree roots and mycorrhizal fungi communities;
- placement of any water troughs, supplementary feeds, etc. well away from any trees, providing supplementary shelter where considered necessary;
- avoidance of applications of fertilisers, farmyard manure, slurry, lime, etc. which each have detrimental impacts on tree health and associated biological communities;
- no other pasture management practices which are designed to improve grazing for the livestock, such as topping, which encourages grass growth at the expense of other plants, and involves the movement of cutting vehicles over tree roots, with consequent risk of increased soil compaction; topped swards are conventionally left to mulch, but this exacerbates nutrient enrichment problems;
- no removal of boughs to facilitate vehicle access beneath canopies.

On balance, larger and heavier livestock – particularly beef cattle – create the better habitat mosaic for wood pasture interests, although combinations of cattle and sheep can be suitable too. Ponies can also be valuable in maintaining vegetation structure. For more information consult the *Breeds Profile Handbook*.

It is therefore recommended that livestock grazing management practices are kept as near-natural as possible throughout the NNR, and that standard agricultural practices – as

outlined above – are not permitted. It has been demonstrated that managing the land and livestock in-hand is the most effective way of achieving good conservation practice (see Cox & Sanderson, 2001 - *Livestock Grazing in National Trust Parklands*).

Cutting and removal of nettle patches would help to strip nutrients from the soil around the trees. It is important that any cut material is removed from ground overlying live tree roots - the root protection zone of the trees.

Livestock congregating beneath tree canopy can be a serious problem and is damaging to tree health. If shelter for livestock is an important consideration, then one option might be to open up the adjoining enclosed plantations to allow access for the stock. These areas comprise mainly dense young growth of limited value to nature conservation, in contrast to the high value of the parkland trees which is being compromised. The plantations appear to have been created by enclosing former areas of parkland and so restoration of grazing has the potential to meet both nature conservation and historic landscape objectives. Alternatively, purpose-built shelters could be provided.

5.3 Deadwood management

Obviously, fallen timber is best left where it falls in order to maintain as natural a system as possible, leaving the items within their natural context, intact and not displaced. Timber lying in water can be essential for certain species. Taller vegetation can be valuable in protecting the timber from extremes of weather but swamping within tall vegetation can be damaging as it shades the timber, hides it from potentially colonising insects, and creates a potential fire risk in the spring.
In the rare event of it being essential that fallen timber is moved, e.g. where it is obstructing an access route which cannot be moved, then the basic principles are to move it:

- sooner rather than later, before it has begun to attract and accumulate organisms which may develop in it;
- as intact as possible, as larger timber has the potential to support a greater variety of organisms than fragmented timber;
- as short a distance as possible, to optimise linkages of its contents with its tree of origin, to maximise the potential for colonisation from the parent tree;
- and leave in similar conditions to where it fell, e.g. light and humidity levels, such that any species already present are not lost through any changes.

It is recommended therefore that a presumption should be agreed – if not already in place - that all fallen and aerial deadwood be left in situ unless there is very good reason for doing otherwise and agreed by all interested parties. Where displacement is agreed to be unavoidable then it should be minimal.

5.4 Educational opportunities

It is important that the nature conservation interests and management implications in Dinefwr Estate NNR are broadly understood by all relevant people; property staff and their advisers, contractors and visitors. This may be achieved through a combination of educational talks, walks, leaflets and posters. For a conservation plan to succeed, it needs support from all interest groups. Encouraging and targeting visitor interest may help with site monitoring and discouragement of damage such as breaking off bracket fungi.

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8. Appendices

Appendix 1. Full list of Saproxylic beetles known from Dinefwr Estate with SQI and IEC calculations

NB. The numbers under the three survey columns are the score used for calculating the SQI. Entries with '0' are species present on site but which have been excluded from the calculation. The final column shows the scores for calculating the IEC. Note that *Pyrrhidium sanguineum* (SQS = 24; IEC = 3) and *Uleiota planatus* (SQS = 16; IEC = 2) are excluded from calculations. SQS scores for *Euplectus infirmus* and *Malthodes pumillus* have been increased from 2 to 8 (see sections 3.9.1 & 3.9.2).

Species by taxonomic order	GB status	SQI score	2023 KNAA	1996 L&P	1994 H&H	Misc records	IEC score
Abraeus granulum	NS	8	-	8	-	-	3
Abraeus perpusillus	-	4	4	4	-	4	-
Plegaderus dissectus	-	8	8	-	-	-	2
Paromalus flavicornis	-	2	2	2	-	2	-
Margarinotus merdarius	-	-	-	0	-	-	-
Nossidium pilosellum	NS	8	-	8	-	-	-
Ptinella cavelli	-	-	-	-	0	0	-
Ptinella errabunda	-	-	-	0	-	-	-
Ptinella limbata	RDBK	16	-	-	16	-	2
Anisotoma humeralis	-	2	2	2	-	-	-
Anisotoma orbicularis	-	2	-	2	-	-	-
Agathidium seminulum	-	2	-	2	-	-	-
Phyllodrepoidea crenata	NS	8	-	8	-	-	-
Acrulia inflata	-	2	2	2	-	2	-
Dropephylla devillei	-	2	-	2	-	-	-
Dropephylla gracilicornis	NS	-	-	0	-	-	-
Dropephylla ioptera	-	1	1	1	-	-	-
Dropephylla vilis	-	1	-	1	1	-	-
Phloeonomus punctipennis	-	2	-	2	-	2	-
Phloeonomus pusillus	-	2	-	-	-	2	-
Phloeostiba plana	-	2	-	2	-	2	-
Batrisodes venustus	NS	8	-	8	-	-	3
Euplectus infirmus	-	8	8	-	-	-	-
Euplectus piceus	-	2	-	2	-	-	-
Bibloporus bicolor	-	2	-	2	-	-	-
Phloeocharis subtilissima	-	2	-	2	-	-	-
Sepedophilus littoreus	-	2	-	2	-	-	-

Species by taxonomic order	GB status	SQI score	2023 KNAA	1996 L&P	1994 H&H	Misc records	IEC score
Atheta liturata	-	2	-	2	-	-	-
Dinaraea aequata	-	1	-	1	-	-	-
Dinaraea linearis	-	2	-	2	-	-	-
Bolitochara lucida	-	2	-	2	-	-	-
Bolitochara obliqua	-	-	-	0	-	-	-
Leptusa fumida	-	1	-	1	1	-	-
Leptusa pulchella	-	2	-	2	-	-	-
Leptusa ruficollis	-	1	-	1	-	-	-
Agaricochara latissima	-	2	-	2	-	-	-
Gyrophaena affinis	-	-	-	0	-	-	-
Gyrophaena bihamata	-	2	-	2	-	-	-
Gyrophaena fasciata	-	-	-	0	-	-	-
Gyrophaena gentilis	-	-	-	0	-	-	-
Gyrophaena joyi	NS	8	-	8	-	-	-
Gyrophaena manca	NS	8	-	-	8	-	-
Gyrophaena minima	-	2	-	2	-	-	-
Gyrophaena munsteri	RDBK	16	-	16	-	-	-
Gyrophaena strictula	NS	8	-	8	-	-	-
Homalota plana	-	2	-	2	-	-	-
Haploglossa gentilis	-	2	-	2	-	-	-
Ischnoglossa prolixa	-	2	-	2	-	-	-
Phloeopora bernhaueri	-	2	-	2	-	-	-
Phloeopora testacea	-	1	-	1	1	-	-
Placusa pumilio	-	2	-	2	-	-	-
Placusa tachyporoides	NS	8	-	8	-	-	-
Scaphidium quadrimaculatum	-	2	-	2	-	2	-
Scaphisoma agaricinum	-	2	-	2	-	2	-
Scaphisoma boleti	NS	8	-	8	8	-	-
Siagonium quadricorne	-	2	-	2	-	2	-
Neuraphes praeteritus	NS	-	-	0	-	-	-
Stenichnus bicolor	-	4	-	4	4	-	1
Atrecus affinis	-	1	-	1	-	1	-
Gabrius splendidulus	-	1	-	1	-	1	-
Quedius microps	NS	8	8	-	-	-	1
Quedius maurus	-	4	-	-	-	4	1
Quedius scitus	NS	8	-	8	-	8	2
Quedius truncicola	NS	8	8	-	-	-	1
Dorcus parallelipipedus	-	2	2	-	-	-	-

Species by taxonomic order	GB status	SQI score	2023 KNAA	1996 L&P	1994 H&H	Misc records	IEC score
Sinodendron cylindricum	-	2	2	2	2	2	-
Prionocyphon serricornis	NS	8	8	-	-	-	1
Agrilus biguttatus	-	8	8	-	-	-	-
Epiphanis cornutus	-	8	8	-	-	-	-
Microrhagus pygmaeus	RDB3	8	8	8	-	-	1
Calambus bipustulatus	NS	8	-	8	-	8	1
Denticollis linearis	-	1	1	1	-	1	-
Stenagostus rhombeus	-	4	4	4	4	4	1
Ampedus balteatus	-	2	2	2	-	2	-
Melanotus castanipes	-	1	1	1	-	1	-
Platycis minutus	-	8	8	8	-	-	1
Malthinus balteatus	-	8	-	8	-	-	-
Malthinus flaveolus	-	1	-	1	-	-	-
Malthinus frontalis	NS	8	-	8	-	-	-
Malthinus seriepunctatus	-	2	2	2	-	-	-
Malthodes marginatus	-	1	1	1	-	1	-
Malthodes minimus	-	1	1	1	-	-	-
Malthodes mysticus	-	2	-	2	-	-	-
Malthodes pumilus	NS	8	8	8	-	-	-
Ctesias serra	-	4	4	4	-	4	-
Ptinus subpilosus	NS	8	8	8	-	-	2
Grynobius planus	-	2	2	2	-	-	-
Dryophilus pusillus	-	2	-	2	-	-	-
Ochina ptinoides	-	2	2	-	-	-	-
Anobium punctatum	-	1	1	-	-	-	-
Ptilinus pectinicornis	-	1	1	1	-	1	-
Dorcatoma chrysomelina	-	4	4	4	4	-	1
Dorcatoma flavicornis	NS	8	8	-	-	-	1
Phloiophilus edwardsii	NS	8	8	8	-	-	1
Thymalus limbatus	NS	8	8	8	-	8	2
Thanasimus formicarius	-	4	4	4	-	4	1
Dasytes aeratus	-	2	2	2	-	2	-
Malachius bipustulatus	-	1	-	-	-	1	-
Sphindus dubius	NS	8	8	8	-	-	-
Aspidiphorus orbiculatus	-	2	2	2	-	-	-
Epuraea biguttata	-	2	-	2	-	-	-
Epuraea marseuli	-	1	-	1	-	-	-
Epuraea melina	-	-	-	0	-	-	-

Species by taxonomic order	GB status	SQI score	2023 KNAA	1996 L&P	1994 H&H	Misc records	IEC score
Epuraea pallescens	-	2	-	2	-	-	-
Cychramus luteus	-	-	-	0	-	-	-
Glischrochilus quadriguttatus	-	2	-	2	-	-	-
Rhizophagus bipustulatus	-	1	1	1	1	1	-
Rhizophagus cribratus	-	2	-	2	-	-	-
Rhizophagus dispar	-	1	1	1	1	1	-
Rhizophagus ferrugineus	-	2	-	2	-	2	-
Rhizophagus nitidulus	-	4	-	4	-	-	1
Rhizophagus perforatus	-	2	-	2	-	-	-
Uleiota planatus	-	0	0	-	-	-	0
Pediacus dermestoides	-	4	-	2	-	2	1
Cryptolestes ferrugineus	-	2	-	2	-	-	-
Henoticus serratus	-	2	-	2	-	-	-
Cryptophagus dentatus	-	1	1	1	1	1	-
Cryptophagus micaceus	RDBK	16	-	16	-	-	3
Cryptophagus scanicus	-	-	0	0	-	-	-
Atomaria lohsei	-	16	-	16	-	-	-
Atomaria pulchra	-	2	-	-	-	2	-
Dacne bipustulata	-	2	2	2	-	2	-
Triplax aenea	-	2	2	2	-	2	-
Biphyllus lunatus	-	4	4	-	-	4	1
Cerylon ferrugineum	-	2	-	2	2	2	-
Cerylon histeroides	-	4	-	4	4	4	-
Endomychus coccineus	-	2	2	2	-	-	-
Orthoperus nigrescens	NS	4	-	-	-	4	-
Mycetaea subterranea	-	2	-	2	-	-	-
Stephostethus allernans	-	4	-	4	-	-	-
Enicmus brevicornis	NS	8	8	8	-	-	1
Enicmus rugosus	NS	8	8	-	-	-	2
Enicmus testaceus	-	2	2	2	-	-	-
Triphyllus bicolor	-	4	4	4	-	-	2
Litargus connexus	-	2	2	2	-	2	-
Mycetophagus atomarius	-	2	2	2	-	-	1
Mycetophagus multipunctatus	-	2	2	-	-	-	-
Mycetophagus piceus	-	4	4	4	-	4	2
Mycetophagus quadripustulatus	-	2	2	2	-	2	-
Octotemnus glabriculus	-	1	1	1	-	1	-
Sulcacis nitidus	-	2	-	2	-	-	-

Species by taxonomic order	GB status	SQI score	2023 KNAA	1996 L&P	1994 H&H	Misc records	IEC score
Cis bidentatus	-	2	-	2	-	2	-
Cis bilamellatus	-	-	-	0	-	-	-
Cis boleti	-	1	1	1	1	1	-
Cis castaneus	-	2	2	2	-	2	-
Cis fagi	-	2	2	-	2	-	-
Cis festivus	NS	2	2	2	-	2	-
Cis micans	-	4	-	4	-	4	-
Cis pygmaeus	-	2	2	2	-	2	-
Cis vestitus	-	2	-	-	-	2	-
Ennearthron cornutum	-	2	2	-	-	-	-
Hallomenus binotatus	NS	8	8	-	-	-	1
Orchesia micans	NS	4	-	4	-	4	-
Orchesia undulata	-	4	4	4	-	4	1
Abdera flexuosa	NS	8	-	8	-	-	-
Hypulus quercinus	NT	16	-	16	-	-	3
Melandrya caraboides	-	4	-	4	-	4	1
Conopalpus testaceus	-	8	-	8	-	8	1
Mordellochroa abdominalis	-	4	-	4	-	-	-
Bitoma crenata	-	4	-	4	-	4	1
Eledona agricola	-	4	4	4	-	4	1
Nalassus laevioctostriatus	-	-	-	-	-	0	-
Prionychus ater	-	8	-	-	-	8	1
Ischnomera cyanea	-	4	-	4	-	-	1
Pyrochroa serraticornis	-	1	1	1	-	1	-
Salpingus planirostris	-	1	1	1	-	1	-
Salpingus ruficollis	-	1	-	1	1	-	-
Aderus populneus	NS	8	8	-	-	-	-
Euglenes oculatus	NS	8	8	8	-	-	1
Scraptia testacea	NS	16	16	-	-	-	3
Anaspis fasciata	-	2	2	2	-	-	-
Anaspis frontalis	-	1	1	1	-	-	-
Anaspis garneysi	-	-	0	0	-	-	-
Anaspis maculate	-	-	0	0	-	0	-
Anaspis pulicaria	-	1	1	-	-	-	-
Anaspis regimbarti	-	-	0	0	-	0	-
Anaspis rufilabris	-	1	-	1	-	1	-
Anaspis thoracica	NS	8	8	8	-	-	3
Prionus coriarius	-	16	-	-	-	16	1

Species by taxonomic order	GB status	SQI score	2023 KNAA	1996 L&P	1994 H&H	Misc records	IEC score
Rhagium bifasciatum	-	1	-	1	-	1	-
Rhagium mordax	-	1	1	1	-	1	-
Stenocorus meridianus	-	2	-	-	-	2	-
Grammoptera ruficornis	-	1	1	1	-	1	-
Leptura quadrifasciata	-	2	-	-	-	2	1
Pachytodes cerambyciformis	-	2	-	2	-	2	-
Alosterna tabacicolor	-	2	-	2	-	2	-
Rutpela maculata	-	1	1	-	-	1	-
Pyrrhidium sanguineum	-	0	-	0	-	-	0
Phymatodes testaceus	-	4	4	-	-	-	1
Clytus arietis	-	1	-	1	-	1	-
Leiopus nebulosus	-	2	2	-	-	2	-
Platyrhinus resinosus	NS	4	-	-	-	4	1
Platystomus albinus	NS	8	-	-	-	8	1
Rhopalomesites tardyi	NS	8	-	-	-	8	1
Euophryum confine	-	-	0	-	0	0	-
Phloeophagus lignarius	-	2	2	-	-	-	-
Acalles misellus	-	2	2	2	-	-	-
Acalles ptinoides	NS	-	-	0	-	0	-
Magdalis armigera	-	2	-	-	-	2	-
Magdalis ruficornis	NS	2	-	2	-	-	-
Scolytus intricatus	-	2	2	2	-	2	-
Dryocoetes autographus	-	2	-	2	-	-	-
Dryocoetes villosus	-	2	2	2	-	2	-
Xyleborinus saxesini	-	4	-	4	-	-	1
Xyleborus dispar	NS	8	-	8	-	-	1
Trypodendron domesticum	-	2	-	2	-	2	1
Trypodendron signatum	NS	8	-	8	-	8	1
Hylesinus crenatus	-	2	-	2	-	2	-
Hylesinus toranio	-	2	2	-	-	2	-
Hylesinus varius	-	1	1	1	-	1	-
Platypus cylindricus	NS	8	8	8	-	8	1
-	-	SQS	318	526	62	-	-
-	-	SPP	85	150	18	-	-
-	**TOTALS**	**SQI**	**374.4**	**350.7**	**344.4**	-	**72**

Appendix 2. Full list of invertebrate species recorded from Dinefwr Estate NNR in 2023

Group & family	Species	Saproxylic	Status
COLEOPTERA	-	-	-
Aderidae	*Aderus populneus*	sapro	NS
-	*Euglenes oculatus*	sapro	NS
Biphyllidae	*Biphyllus lunatus*	sapro	-
Buprestidae	*Agrilus biguttatus*	sapro	-
Cantharidae	*Cantharis cryptica*	-	-
-	*Malthinus seriepunctatus*	sapro	-
-	*Malthodes marginatus*	sapro	-
-	*Malthodes minimus*	sapro	-
-	*Malthodes pumilus*	sapro	NS
-	*Rhagonycha fulva*	-	-
-	*Rhagonycha lignosa*	-	-
Carabidae	*Caladromius spilotus*	-	-
-	*Leistus fulvibarbis*	-	-
-	*Leistus rufomarginatus*	-	-
-	*Ocys tachysoides*	-	-
-	*Pterostichus madidus*	-	-
Cerambycidae	*Grammoptera ruficornis*	sapro	-
-	*Leiopus nebulosus ss*	sapro	-
-	*Phymatodes testaceus*	sapro	-
-	*Rhagium mordax*	sapro	-
-	*Rutpela maculata*	sapro	-
Ciidae	*Cis boleti*	sapro	-
-	*Cis fagi*	sapro	-
-	*Cis festivus*	sapro	-
-	*Cis nitidus*	sapro	-
-	*Cis pygmaeus*	sapro	-
-	*Ennearthron cornutum*	sapro	-
-	*Octotemnus glabriculus*	sapro	-
Cleridae	*Thanasimus formicarius*	sapro	-
Coccinellidae	*Chilocorus bipustulatus*	-	-
-	*Halyzia 16-punctata*	-	-
Corylophidae	*Orthoperus sp (? Corticalis)*	sapro	-
Cryptophagidae	*Cryptophagus dentatus*	sapro	-
-	*Cryptophagus scanicus*	-	-
Cucujidae	*Uleiota planata*	sapro	-
Curculionidae	*Acalles misellus*	sapro	-
-	*Euophryum confine*	sapro	-
-	*Phloeophagus lignarius*	sapro	-
Curculionidae: Scolytinae	*Dryocoetes villosus*	sapro	-

Group & family	Species	Saproxylic	Status
-	*Hylesinus toranio*	sapro	-
-	*Hylesinus varius*	sapro	-
-	*Scolytus intricatus*	sapro	-
-	*Trypodendron sp*	sapro	-
Dascillidae	*Dascillus cervinus*	-	-
Dermestidae	*Anthrenus fuscus*	-	-
-	*Ctesias serra*	sapro	-
Elateridae	*Ampedus balteatus*	sapro	-
-	*Athous haemorrhoidalis*	-	-
-	*Dalopius marginatus*	-	-
-	*Denticollis linearis*	sapro	-
-	*Melanotus castanipes*	sapro	-
-	*Stenagostus rhombeus*	sapro	-
Endomychidae	*Endomychus coccineus*	sapro	-
Erotylidae	*Dacne bipustulata*	sapro	-
-	*Triplax aenea*	sapro	-
Eucnemidae	*Epiphanis cornutus*	sapro	-
-	*Microrhagus pygmaeus*	sapro	RDB3
Histeridae	*Abraeus globosus*	sapro	-
-	*Paromalus flavicornis*	sapro	-
-	*Plegaderus dissectus*	sapro	-
Latridiidae	*Aridius fasciatus*	-	-
-	*Cartodere nodifer*	-	-
-	*Cortinicara gibbosa*	-	-
-	*Enicmus brevicornis*	sapro	NS
-	*Enicmus rugosus*	sapro	NS
-	*Enicmus testaceus*	sapro	-
-	*Enicmus transversus*	-	-
Leiodidae	*Anisotoma humeralis*	sapro	-
-	*Catops fuscus*	-	-
Lucanidae	*Dorcus parallelepipedus*	sapro	-
-	*Sinodendron cylindricum*	sapro	-
Lycidae	*Platycis minuta*	sapro	-
Melandryidae	*Orchesia undulata*	sapro	-
Melyridae	*Dasytes aeratus*	sapro	-
Monotomidae	*Rhizophagus bipustulatus*	sapro	-
-	*Rhizophagus dispar*	sapro	-
Mycetophagidae	*Litargus connexus*	sapro	-
-	*Mycetophagus atomarius*	sapro	-
-	*Mycetophagus multipunctatus*	sapro	-
-	*Mycetophagus piceus*	sapro	-
-	*Mycetophagus quadripustulatus*	sapro	-
-	*Triphyllus bicolor*	sapro	NS

Group & family	Species	Saproxylic	Status
Phloiophilidae	*Phloiophilus edwardsii*	sapro	NS
Platypodidae	*Platypus cylindrus*	sapro	NS
Ptinidae	*Anobium punctatum*	sapro	-
-	*Dorcatoma chrysomelina*	sapro	-
-	*Dorcatoma flavicornis*	sapro	NS
-	*Grynobius planus*	sapro	-
-	*Ochina ptinoides*	sapro	-
-	*Ptilinus pectinicornis*	sapro	-
-	*Ptinus subpilosus*	sapro	NS
Pyrochroidae	*Pyrochroa sp.*	sapro	-
Salpingidae	*Salpingus planirostris*	sapro	-
Scirtidae	*Prionocyphon serricornis*	sapro	NS
Scraptiidae	*Anaspis fasciata*	sapro	-
-	*Anaspis frontalis*	sapro	-
-	*Anaspis garneysi*	sapro	-
-	*Anaspis maculata*	sapro	-
-	*Anaspis pulicaria*	sapro	-
-	*Anaspis regimbarti*	sapro	-
-	*Anaspis thoracica*	sapro	NS
-	*Scraptia testacea*	sapro	NS
Silphidae	*Nicrophorus humator*	-	-
-	*Nicrophorus vespilloides*	-	-
-	*Silpha atrata*	-	-
Sphindidae	*Aspidiphorus orbiculatus*	sapro	-
-	*Sphindus dubius*	sapro	NS
Staphylinidae	*Acrulia inflata*	sapro	-
-	*Dropephylla ioptera*	sapro	-
-	*Ocypus olens*	-	-
-	*Othius punctulatus*	-	-
-	*Quedius levicollis*	-	-
-	*Quedius mesomelinus*	-	-
-	*Quedius microps*	sapro	NS
-	*Quedius truncicola*	sapro	NS
Staphylinidae: Pselaphinae	*Euplectus infirmus*	sapro	-
Tenebrionidae	*Eledona agricola*	sapro	-
-	*Lagria hirta*	-	-
Tetratomidae	*Hallomenus binotatus*	sapro	NS
Trogosittidae	*Thymalus limbatus*	sapro	NS
DIPTERA	-	-	-
Tipulidae	*Dictenidia bimaculata*	sapro	-
-	*Nephrotoma quadrifaria*	-	-
-	*Tipula confusa*	-	-
-	*Tipula scripta*	-	-

Group & family	Species	Saproxylic	Status
Pediciidae	*Ula mollissima*	sapro	-
Limoniidae	*Austrolimnophila ochracea*	sapro	-
-	*Dicranomyia autumnalis*	-	-
-	*Limonia nubeculosa*	-	-
-	*Neolimonia dumetorum*	sapro	-
-	*Ormosia nodulosa*	-	-
-	*Rhipidia maculata*	-	-
-	*Rhipidia uniseriata*	sapro	RDB3
-	*Rhypholophus bifurcatus*	-	-
Bibionidae	*Dilophus febrilis*	-	-
Ditomyiidae	*Symmerus annulatus*	sapro	-
Keroplatidae	*Antlemon servulum*	-	-
-	*Cerotelion striatum*	sapro	-
-	*Macrorrhyncha flava*	-	-
-	*Orfelia fasciata*	sapro	-
-	*Orfelia nemoralis*	sapro	-
-	*Orfelia ochracea*	sapro	-
Mycetophilidae	*Acnemia amoena*	sapro	NT
-	*Acnemia nitidicollis*	sapro	-
-	*Apolephthisa subincana*	sapro	-
-	*Brachycampta alternans*	sapro	-
-	*Brachycampta grata*	sapro	-
-	*Brachypeza bisignata*	sapro	-
-	*Brevicornu griseicolle*	-	-
-	*Brevicornu sericoma*	sapro	-
-	*Coelosia tenella*	-	-
-	*Cordyla crassicornis*	-	-
-	*Cordyla flaviceps*	-	-
-	*Cordyla murina*	-	-
-	*Docosia gilvipes*	sapro	-
-	*Dynatosoma fuscicorne*	sapro	-
-	*Ectrepesthoneura colyeri*	sapro	NS
-	*Ectrepesthoneura hirta*	sapro	-
-	*Epicypta aterrima*	sapro	-
-	*Exechia bicincta*	-	-
-	*Exechia pseudofestiva*	-	-
-	*Exechiopsis intersecta*	sapro	-
-	*Exechiopsis leptura*	sapro	-
-	*Leia fascipennis*	-	-
-	*Megophthalmidia crassicornis*	-	-
-	*Monoclona rufilatera*	sapro	-
-	*Mycetophila abiecta*	sapro	-
-	*Mycetophila autumnalis*	sapro	-

Group & family	Species	Saproxylic	Status
-	*Mycetophila caudata*	-	NS
-	*Mycetophila fungorum*	sapro	-
-	*Mycetophila ichneumonea*	sapro	-
-	*Mycetophila lastovkai*	-	NS
-	*Mycetophila marginata*	sapro	-
-	*Mycetophila ocellus*	sapro	-
-	*Mycetophila perpallida*	sapro	-
-	*Mycetophila rudis*	-	-
-	*Mycetophila stylatiformis*	-	-
-	*Mycetophila tridentata*	sapro	-
-	*Mycetophila unipunctata*	sapro	-
-	*Mycomya cinerascens*	sapro	-
-	*Phronia conformis*	sapro	-
-	*Phronia nigricornis*	sapro	-
-	*Phronia nitidiventris*	-	-
-	*Phronia signata*	-	-
-	*Platurocypta testata*	sapro	-
-	*Polylepta guttiventris*	-	-
-	*Saigusaia flaviventris*	sapro	-
-	*Sciophila geniculata*	-	NS
-	*Sciophila interrupta*	-	NS
-	*Synapha fasciata*	-	-
-	*Synapha vitripennis*	-	-
-	*Trichonta melanura*	sapro	-
-	*Trichonta vitta*	sapro	-
Sciaridae	*Bradysia nitidicollis*	-	-
-	*Bradysia placida*	sapro	-
-	*Cratyna nobilis*	-	-
-	*Leptosciarella rejecta*	-	-
-	*Phytosciara flavipes*	-	-
-	*Schwenckfeldina carbonaria*	sapro	-
-	*Trichosia confusa*	sapro	-
-	*Trichosia splendens*	sapro	-
Psychodidae	*Boreoclytocerus ocellaris*	-	-
-	*Trichomyia urbica*	sapro	-
Mycetobiidae	*Mycetobia pallipes*	sapro	-
Anisopodidae	*Sylvicola cinctus*	sapro	-
-	*Sylvicola punctatus*	-	-
Trichoceridae	*Trichocera annulata*	sapro	-
Scatopsidae	*Anapausis soluta*	-	-
-	*Apiloscatopse flavicollis*	-	-
-	*Ectaetia platyscelis*	sapro	-
-	*Scatopse notata*	-	-

Group & family	Species	Saproxylic	Status
Rhagionidae	*Chrysopilus asiliformis*	-	-
-	*Ptiolina obscura*	-	-
-	*Rhagio lineola*	-	-
-	*Rhagio scolopaceus*	-	-
Tabanidae	*Haematopota pluvialis*	-	-
Stratiomyidae	*Beris vallata*	-	-
Scenopinidae	*Scenopinus niger*	sapro	NT
Asilidae	*Machimus atricapillus*	-	-
Hybotidae	*Elaphropeza ephippiata*	-	-
-	*Tachydromia umbrarum*	sapro	-
-	*Tachypeza nubila*	sapro	-
-	*Trichinomyia flavipes*	-	-
Empididae	*Empis aestiva*	-	-
-	*Empis chioptera*	-	-
-	*Empis stercorea*	-	-
-	*Phyllodromia melanocephala*	-	-
Dolichopodidae	*Chrysotimus molliculus*	-	-
-	*Chrysotus gramineus*	-	-
-	*Dolichopus trivialis*	-	-
-	*Medetera impigra*	sapro	-
-	*Neurigona pallida*	sapro	-
-	*Sciapus platypterus*	sapro	-
-	*Xanthochlorus galbanus*	-	-
Opetiidae	*Opetia nigra*	sapro	-
Platypezidae	*Agathomyia unicolor*	sapro	-
Phoridae	*Anevrina thoracica*	sapro	-
-	*Chaetopleurophora erythonota*	-	-
-	*Diplonevra florescens*	-	-
Syrphidae	*Episyrphus balteatus*	-	-
-	*Myathropa florea*	sapro	-
-	*Syrphus vitripennis*	-	-
Lauxaniidae	*Meiosimyza decempunctata*	-	-
-	*Meiosimyza rorida*	-	-
-	*Peplomyza litura*	-	-
-	*Tricholauxania praeusta*	-	-
Dryomyzidae	*Dryomyza anilis*	-	-
Clusiidae	*Clusia flava*	sapro	-
-	*Clusiodes albimanus*	sapro	-
Agromyzidae	*Agromyza pseudoreptans*	-	-
Heleomyzidae	*Heteromyza rotundicornis*	-	-
-	*Suillia affinis*	-	-
-	*Suillia bicolor*	sapro	-
-	*Suillia variegata*	sapro	-

Group & family	Species	Saproxylic	Status
-	*Tephrochlamys flavipes*	sapro	-
Chloropidae	*Gaurax fascipes*	-	-
-	*Lasiambia brevibucca*	sapro	NS
Odiniidae	*Odinia boletina*	sapro	-
-	*Odinia trinotata*	sapro	NS
Drosophilidae	*Drosophila funebris*	sapro	-
-	*Drosophila obscura*	sapro	-
-	*Drosophila suzukii*	-	-
-	*Drosophila tristis*	sapro	-
-	*Hirtodrosophila confusa*	sapro	-
Scathophagidae	*Scathophaga stercoraria*	-	-
Anthomyiidae	*Anthomyia procellaris group*	-	-
-	*Delia florilega*	-	-
-	*Emmesomyia grisea*	-	-
-	*Hydrophoria ruralis*	-	-
-	*Hylemya nigrimana*	sapro	-
-	*Hylemya vagans*	-	-
-	*Mycophaga testacea*	-	-
-	*Pegomya transversa*	sapro	-
-	*Pegoplata infirma*		
Fanniidae	*Fannia aequilineata*	sapro	NS
-	*Fannia lustrator*	-	-
-	*Fannia serena*	-	-
-	*Fannia speciosa*	-	NS
-	*Piezura pardalina*	sapro	-
Muscidae	*Helina abdominalis*	sapro	NS
-	*Helina depuncta*	-	-
-	*Helina impuncta*	-	-
-	*Helina obscurata*	-	-
-	*Helina pertusa*	sapro	-
-	*Muscina prolapsa*	-	-
-	*Mydaea urbana*	-	-
-	*Phaonia halterata*	-	-
-	*Phaonia pallida*	sapro	-
-	*Phaonia pratensis*	sapro	NS
-	*Phaonia rufiventris*	sapro	-
-	*Phaonia subventa*	sapro	-
-	*Phaonia tuguriorum*	-	-
-	*Phaonia valida*	-	-
-	*Potamia littoralis*	sapro	-
-	*Stomoxys calcitrans*	-	-
Calliphoridae	*Calliphora vicina*	-	-
-	*Melanophora roralis*	sapro	-

Group & family	Species	Saproxylic	Status
-	*Paykullia maculata*	sapro	-
Polleniidae	*Pollenia angustigena*	-	-
Sarcophagidae	*Sarcophaga carnaria*	-	-
HEMIPTERA	-	-	-
Acanthosomatidae	*Acanthosoma haemorrhoidale*	-	-
Anthocoridae	*Cardiastethus fasciiventris*	-	-
-	*Loricula elegantula*	-	-
-	*Xylocoris cursitans*	sapro	-
Aradidae	*Aradus depressus*	sapro	-
Cicadellidae	*Iassus lanio*	-	-
-	*Graphocephala fennahi*	-	-
Miridae	*Cyllecoris histrionicus*	-	-
-	*Phylus melanocephalus*	-	-
Nabidae	*Himacerus apterus*	-	-
Pentatomidae	*Pentatoma rufipes*	-	-
HYMENOPTERA	-	-	-
Apidae	*Apis mellifera*	-	-
Ponpilidae	*Dipogon subintermedius*	sapro	-
Sphecidae	*Crabro cribrarius*	sapro	-
-	*Crossocerus dimidiatus*	sapro	-
-	*Crossocerus podagricus*	sapro	-
-	*Crossocerus pusillus*	-	-
-	*Ectemnius cavifrons*	sapro	-
-	*Ectemnius cephalotes*	sapro	-
-	*Ectemnius lituratus*	sapro	-
-	*Pemphredon lugubris*	sapro	-
-	*Psenulus concolor*	-	-
Vespidae	*Vespa crabro*	-	-
ORTHOPTERA	-	-	-
Acrididae	*Chorthippus parallelus*	-	-
PSOCOPTERA	-	-	-
Caeciliusidae	*Epicaecilius pilipennis*	-	-
-	*Valenzuela flavidus*	-	-
Ectopsocidae	*Ectopsocus briggsi*	-	-
-	*Ectopsocus petersi*	-	-
Elipsocidae	*Elipsocus hyalinus*	-	-
Mesopsocidae	*Mesopsocus immunis*	-	-
Psocidae	*Loensia fasciata*	-	-
-	*Metylophorus nebulosus*	-	-
-	*Trichadenotecnum sexpunctatum*	-	-
Stenopsocidae	*Graphopsocus cruciatus*	-	-
-	*Stenopsocus immaculatus*	-	-
RAPHIDIOPTERA	-	-	-

Group & family	Species	Saproxylic	Status
Raphidiidae	larva only	sapro	-
ARANEAE	*Nuctenea umbratica*	-	-
ONISCIDEA	*Porcellio scaber*	-	-
MOLLUSCA	*Arion subfuscus*	-	-
-	*Ashfordia granulata*	-	-
-	*Balea heydeni*	-	-
-	*Clausilia bidentata*	-	-
-	*Discus rotundatus*	-	-
-	*Lauria cylindracea*	-	-
-	*Lehmannia marginata*	-	-
-	*Limax maculatus*	-	-
-	*Oxychilus alliarius*	-	-
-	*Trochulus striolatus*	-	-

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. XXXXXX.