An Assessment of the Current Condition of the Saproxylic Invertebrate Assemblage at Castell y Waun a'i Barcdir/Chirk Castle and Parkland SSSI in 2018

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NRW Evidence Report No. 317

Hornbeam with extensive decay and hollowing

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1. Crynodeb Gweithredol

Mae'r parcdir sy'n amgylchynu Castell y Waun wedi'i ddynodi yn Safle o Ddiddordeb Gwyddonol Arbennig (SoDdGA Castell y Waun a'i Barcdir) am fod yn un o'r enghreifftiau gorau o borfa a pharcdir coed hynafol yng Nghymru, sy'n cynnwys nifer fawr o rywogaethau amrywiol o goed hynafol. Mae'r safle o ddiddordeb arbennig yn ogystal oherwydd y rhywogaethau infertebratau pwysig sy'n cael eu cynnal gan y coed hyn, ac mae'r casgliad o infertebratau saprosylig yn nodwedd hysbysedig o'r Safle o Ddiddordeb Gwyddonol Arbennig. Cafodd y dynodiad ei wneud yn dilyn arolwg infertebratau manwl a gynhaliwyd ym 1996.

Mae'r ddogfen hon yn adrodd ar ailasesiad o'r casgliadau o infertebratau saprosylig (pydredd coed), ar sail arolwg maes newydd a gynhaliwyd yn ystod 2018, gyda'r bwriad o ail-asesu eu cyflwr presennol, eu pwysigrwydd cenedlaethol ac a yw'r arferion rheoli cyfredol yn ddigonol i warchod y ffawna infertebrat pwysig hyn. Gwneir cymariaethau â'r arolwg a'r asesiad blaenorol a gynhaliwyd ym 1996.

Yn gyffredinol, roedd isafswm o 313 o rywogaethau infertebrat pydredd coed gwahanol yn hysbys o'r parcdir, cyfanswm rhyfeddol ar gyfer un safle, ond mae'n adlewyrchu hanes hir y safle fel porfa coetir a pharcdir. Mae'r rhain yn cynnwys 207 rhywogaeth chwilen, 82 pryfyn, un pryfyn neidr, dau fyg, 12 gwenynen a gwenynen feirch, un gwyfyn, chwe chorryn a dau filtroed.

Dadansoddwyd ac aseswyd y ffawna chwilen saprosylig yn nhermau ei bwysigrwydd o ran cadwraeth natur gan ddefnyddio dwy fethodoleg:

- Mae'r Mynegai Dilyniant Ecolegol yn rhoi asesiad o ansawdd y ffawna chwilen arbenigol sy'n gysylltiedig ag amodau 'hen dyfiant' ac yn cynnig ffigur lleiaf oherwydd gallai rhywogaethau na sylwyd arnynt o'r blaen fod yn bresennol hefyd. Cafodd rhywogaethau 'coll' eu targedu yn 2018 o ganlyniad a chanfuwyd llawer ohonynt. Mae gwerth y Mynegai Dilyniant Ecolegol wedi cyrraedd 75 erbyn hyn - cynnydd o dua 10% ar 1996, a sgôr o arwyddocâd arbennig i'r DU, gan osod parcdir Castell y Waun ymhlith 25 uchaf Prydain a'r cyfoethocaf yng Nghymru (y safle cyfoethocaf agosaf yng Nghymru yw Parc Castell Powis sydd â sgôr Mynegai Dilyniant Ecolegol o 65).
- Mae'r Mynegai Ansawdd Saprosylig yn darparu asesiad o brinder y casgliad o chwilod; gall hwn gynyddu neu leihau rhwng digwyddiadau arolwg, gan ddibynnu ar amrediad y rhywogaethau a ganfuwyd yn ystod pob digwyddiad samplu, a gellir ei defnyddio felly'n ganllaw i gyflwr y safle. Mae Mynegai Ansawdd Saprosylig y parcdir wedi newid o 368 ym 1996 i 439 yn 2018, cynnydd o bron 20%.

Mae'r canlyniad hwn yn awgrymu bod cyflwr y safle yn gwella a bod rheolaeth tir yr Ymddiriedolaeth Genedlaethol ym Mharc Castell y Waun ar hyn o bryd yn ffafriol ar y cyfan i gadwraeth hirdymor y ffawna pwysig hyn.

Er bod y Mynegai Ansawdd Saprosylig yn ganllaw eang defnyddiol ar gyfer cyflwr y safle, argymhellir y dylid defnyddio cyfres o grwpiau o gasgliadau saprosylig a nodir (gyda gwerthoedd trothwy) ochr yn ochr â hwn ar gyfer digwyddiadau monitro dilynol. Byddai'r rhain yn darparu trosolwg manylach o gyflwr y safle a byddai ganddynt y potensial i amlygu meysydd sy'n achosi problemau ar gyfer rheoli'r safle. Mae'r

grwpiau a awgrymir fel a ganlyn: chwilod pydredd coch penodol, chwilod pydredd rhuddin uwch, chwilod cawell gwyn mawr, chwilod brigau marw erial, diptera tyllau pydredd, cyfanswm o rywogaethau gwybed ffwng, a rhywogaethau pryf hofran allweddol. Gellir datblygu a mireinio'r saith grŵp saprosylig hyn a'r trothwyon priodol ar gyfer cynrychiolaeth rhywogaethau ymhellach gyda phob digwyddiad monitro dilynol.

Cofnododd gwaith arolwg 2018 80 o rywogaethau chwilod saprosylig, y mae 26 ohonynt yn newydd i'r safle. Mae gan 17 rywogaeth statws cadwraeth, pob un ohonynt yn 'brin yn genedlaethol', ac roedd 12 ohonynt yn rhywogaethau na sylwyd arnynt o'r blaen ac sy'n newydd i restr y safle. Yr ychwanegiadau mwyaf nodedig yw'r chwilen *Ischnomera cinerascens* (nad oedd wedi'i adrodd yng Nghymru yn flaenorol) a'r chwilen *Quedius truncicola*, y chwilen *Symbiotes latus*, y chwilen *Tetratoma desmaresti*, y chwilen *Mordellistena neuwaldeggiana* a'r chwilen *Anthocomus fasciatus* . Mae pob un o'r rhain yn brin iawn yng Nghymru. Yn ogystal, cafodd chwilen *Epiphanis cornutus* sydd ar y rhestr goch ar gyfer rhywogaethau o dan fygythiad Ewropeaidd ei ganfod yn 2018, sy'n gwneud cyfanswm o bedair rhywogaeth sydd ar y rhestr goch Ewropeaidd sy'n hysbys o'r safle hwn.

Nid oes cymaint o ddealltwriaeth ynghylch casgliadau o diptera pydredd coed ac nid oes teclynnau dadansoddi ar gael ond am gyfansymiau rhywogaethau â statws cadwraeth. Gwnaeth arolwg 2018 ganfod 13 o rywogaethau â statws cadwraeth, roedd pob un ond un yn rhywogaethau na sylwyd arnynt yn flaenorol ac yn newydd i restr y safle. Yr ychwanegiadau mwyaf nodedig yw jac-y-baglau *Rhipidia ctenophora* sydd 'dan fygythiad' ac yn y Llyfr Data Coch, y pryf *Anthalia beatricella* sydd o dan beth bygythiad a'r pryf hofran *Ferdinandea ruficornis* sy'n brin yn genedlaethol. Yn ôl pob golwg, mae'r pryf *Anthalia beatricella* yn rhywogaeth arall nad oedd wedi cael ei adrodd yng Nghymru o'r blaen. Cafodd rhywogaeth o dan beth bygythiad arall ei ganfod, yr anthomyiid *Pegomya testacea*, ond nid yw bioleg y rhywogaeth hon yn hysbys – mae rhywogaethau cysylltiedig yn datblygu mewn cyrff ffwng sy'n cnydio. Mae un o'r rhywogaethau sy'n brin yn genedlaethol a gafodd ei chanfod, *Fannia aequilineata*, yn rhywogaeth arall yng Nghymru na sylwyd arni'n flaenorol.

Roedd infertebrata saprosylig eraill a nodwyd yn 2018 yn cynnwys y pryf *Phaeostigma notata*, rhywogaeth sy'n hysbys yng Nghymru mewn nifer fach iawn o leoliadau yn siroedd y gororau.

Mae cyfoeth y ffawna saprosylig heb amheuaeth yn deillio'n rhannol o gyfoeth y casgliad o ffwng pydredd coed. Nodwyd deg rhywogaeth ffwng ysgwydd yn 2018 gan gynnwys *Phellinus robustus* ar goed derw sy'n brin yn genedlaethol ac *Inonotus cuticularis* a welir ar goed ffawydd. Mae Parc Castell y Waun yn cael ei ystyried yn un o'r prif safleoedd yng Nghymru ar gyfer gweld ffwng ysgwydd derw.

Mae Parc Castell y Waun yn amlwg yn safle ansawdd uchel nodedig ar gyfer infertebratau hen dyfiant a ffwng. Mae arferion rheoli tir cyfredol wedi gwella'n sylweddol ers y 1990au ac maent yn gyffredinol gydnaws ag arfer cadwraeth da mewn porfa coetir a pharcdir. Mae cyflwr y safle wedi'i asesu'n 'ffafriol' yn gyffredinol yn 2018, ar sail ansawdd y cynefinoedd pydredd coed sydd ar gael. Mae cynefinoedd pren marw sy'n sefyll ac sydd wedi cwympo ar gael yn awr ar draws llawer o'r parcdir ac mae iechyd y coed yn ymddangos yn dda yn gyffredinol, mewn cyferbyniad amlwg â'r hyn a welwyd gan yr awdur ym 1993 a 1996 pan oedd llawer o goed y parcdir yn

dirywio ac yn marw, o ganlyniad yn bennaf i arferion rheoli pori gwael. Ychydig o awgrymiadau rheoli cymharol fân ar gyfer gwella sy'n cael eu hawgrymu o ganlyniad i ymweliadau 2018, a'r blaenoriaethau yw:

1. Corongylchu coed hynafol sydd o fewn planhigfeydd amgaeedig ar hyn o bryd, i'w rhyddhau rhag cystadleuaeth, ac adfer yr ardaloedd i borfa coetir yn ddelfrydol. Mae Garden Wood yn ardal broblemus arbennig.

2. Mae angen gwyliadwriaeth barhaus er mwyn:
   a) cadw coed sy'n marw ac sydd wedi marw ar draws y parcdir – nodwyd arwyddion o waith dianghenraid â llif gadwyn mewn rhai mannau, yn enwedig yn y parcdir uwch;
   b) cadw dwysedd pori yn lled isel; mae'r parcdir uchaf yn ymddangos fel petai'n cael ei bori'n ddwys o hyd, ac argymhellir ymlacio pellach yn yr ardaloedd hyn; dylid rhoi ystyriaeth i gyfnod treialu heb bori trwy gydol y flwyddyn er mwyn lleihau lefelau maethynnau pridd ac i wella iechyd coed; petai'r argymhelliad hwn yn cael ei fabwysiadu, byddai angen toriad gwair â phori adladd;
   c) wrth glirio danadl o dan goed, sicrhau bod y deilliannau yn cael eu cribinio a'u gwaredu, er mwyn osgoi cyfoethogi maethynnau uwchben parth gwreiddiau'r goeden.

3. Ystyrio defnyddio tagiau rhifau Latschbacher ar gyfer y coed yn hytrach na rhai alwminiwm gan eu bod yn fwy gwydn ac yn gallu cael eu hategu'n llac â hoelen er mwyn galluogi ehangiad parhaus cwmpas y goeden. Byddai hyn yn hwyluso arolygu a monitro yn y dyfodol.

4. Ystyried sefydlu rhesi cyflinellol o goed ar hyd y lôn dderwen trwy Barc Baddy, fel cyfraniad at gynaliadwyedd hirdymor nodwedd y lôn.

5. Ystyried symud y ffens sy'n amgylchynu Pwll Jericho, er mwyn ei adfer fel pwll parcdir sy'n agored i bori.

6. Mae'n bwysig cydnabod nad yw'r disgrifiad presennol fel Safle o Ddiddordeb Gwyddonol Arbennig (SoDdGA) yn cydnabod gwerth cadwraeth mawr y casgliad o ffwng pydredd coed. Wrth ystyried ei arwyddocâd cenedlaethol, dylai'r casgliad hwn gael ei gydnabod fel un o nodweddion cymhwyso Safle o Ddiddordeb Gwyddonol Arbennig Castell y Waun a'i Barcdir.

2. Executive Summary

The parkland which surrounds Chirk Castle has been designated as a Site of Special Scientific Interest (Castell y Waun a'i Barcdir/Chirk Castle and Parkland SSSI) for being one of the best examples of ancient wood pasture and parkland in Wales, containing a large number and diverse species of veteran and ancient trees. The site is also of special interest for the important invertebrate species that these trees support, with the saproxylic invertebrate assemblage being a notified feature of SSSI. The designation followed a detailed invertebrate survey carried out in 1996.

This document reports on a re-assessment of the assemblages of saproxylic (wood-decay) invertebrates, based on new field survey carried out during 2018, with the objective of re-assessing their current condition, national importance and whether current management practices are sufficient to conserve this important invertebrate fauna. Comparisons are made with the previous survey and assessment carried out in 1996.

Overall, a minimum of 313 different species of wood-decay invertebrate are now known from the parkland, a remarkable total for a single site, but reflecting its long history as wood pasture and parkland. These include 207 species of beetle, 82 of fly, one snake fly, two bugs, twelve bees and wasps, one moth, six spiders and two millipedes.

The saproxylic beetle fauna has been analysed and assessed in terms of its nature conservation importance using two methodologies:

- The Index of Ecological Continuity (IEC) provides an assessment of the quality of the specialist beetle fauna associated with 'old growth' conditions and provides a *minimum* figure as previously overlooked species may also be present. 'Missing' species were accordingly targeted in 2018 and many found. The IEC value has now reached 75 – an increase of about 10% on 1996, and a score of high GB significance, placing the parkland at Chirk Castle amongst the top 25 sites in Britain and the richest in Wales (the next richest Welsh site is Powis Castle Park with an IEC of 65).
- The Saproxylic Quality Index (SQI) provides an assessment of the rarity of the beetle assemblage; this may increase or decrease between survey events, depending on the range of species found during each sampling event, and can therefore be used as a guide to site condition. The SQI of the parkland has changed from 368 in 1996 to 439 in 2018, an increase of nearly 20%.

This result suggests that site condition is increasing and that the National Trust's land management at Chirk Castle Park is currently broadly favourable to the long-term conservation of this important fauna.

While the SQI provides a useful broad guide to site condition, it is recommended that a series of identified saproxylic assemblage groups (with threshold values) are used in parallel for subsequent monitoring events. These would provide a more detailed overview of site condition and would have the potential to highlight problem areas for site management. The suggested groups are as follows; selected red-rot beetles, advanced heartwood decay beetles, large bracket fungus beetles, aerial dead branch beetles, rot-hole Diptera, total of fungus gnat species, and key hoverfly species.

These seven saproxylic groups and the appropriate thresholds for species representation could be further developed and refined with each subsequent monitoring event.

The 2018 survey work recorded 80 saproxylic beetle species, 26 of which are new to the site. 17 species have a conservation status, all 'Nationally Scarce', of which 12 are previously overlooked species and new to the site list. The most notable additions are the false blister beetle *Ischnomera cinerascens* (not previously reported in Wales) and the rove beetle *Quedius truncicola*, the false ladybird *Symbiotes latus*, the fungus beetle *Tetratoma desmaresti*, the tumbling flower beetle *Mordellistena neuwaldeggiana* and the malachite beetle *Anthocomus fasciatus*, each being very rare in Wales. Additionally, the 'Near Threatened' European Red List false click-beetle *Epiphanis cornutus* was found in 2018, making a total of four European Red List species now known from this site.

Wood-decay Diptera assemblages are more poorly understood and no analytical tools are available other than totals of species with conservation status. The 2018 survey found 13 species with conservation status, all except one previously overlooked species and new to the site list. The more notable additions are the Red Data Book 'Vulnerable' cranefly *Rhipidia ctenophora*, the Near Threatened dance fly *Anthalia beatricella* and the Nationally Scarce hoverfly *Ferdinandea ruficornis*. The dance fly appears to be another species not previously reported from Wales. An additional Near Threatened species was also found, the anthomyiid *Pegomya testacea*, but the biology of this species is not known – related species develop in fungal fruiting bodies. One of the Nationally Scarce species found, *Fannia aequilineata*, is another previously overlooked Welsh species.

Other saproxylic invertebrates noted in 2018 include the snakefly *Phaeostigma notata*, a species known in Wales from very few localities in the border counties.

The richness of the saproxylic fauna is undoubtedly in part due to the richness of the wood-decay fungus assemblage. Ten species of bracket fungi were noted in 2018 including the nationally rare *Phellinus robustus* on oak and *Inonotus cuticularis* on beech. Chirk Castle Park is now shown to be amongst the top sites in Wales for oak bracket fungi.

Chirk Castle Park is clearly a notably high-quality site for old growth invertebrates and fungi. Current land management practices have improved dramatically since the 1990s and are currently broadly compatible with good conservation practice in wood pasture and parkland. Site condition is assessed in 2018 as 'favourable' overall, based on the quality of the available wood-decay habitats. Standing and fallen deadwood habitats are now available across much of the parkland and tree health appears good overall, in marked contrast to the situation observed by the author in 1993 and 1996 when many parkland trees were in decline and dying, due largely to poor grazing management practices. Only a few relatively minor management suggestions for improvements are suggested arising from the 2018 visits, the priorities being as follows:

1. Haloing of veteran trees currently within enclosed plantations, to free them from crown competition, and preferably restore the areas to wood pasture. Garden Wood is a particular problem area.

2. Continued vigilance is needed to:

a) retain dead and dying wood across the parkland – signs of what appeared to be unessential chainsaw work were noted in a few places, especially in the upper parkland;

b) keep grazing intensity relatively low; the upper parkland still appears heavily grazed, and some further relaxation is recommended in these areas; consideration should be given to a trial period without year-round grazing in order to reduce soil nutrient levels and to aid tree health; if this recommendation were to be adopted then a hay-cut with aftermath grazing would be needed;

c) when clearing nettles from beneath trees ensure that the arisings are raked off and removed, to avoid nutrient-enrichment over the tree's root zone.

3. Consider switching from aluminium numbered tree tags to Latschbacher tags as these are more durable and can be attached loosely using a nail, to allow for continued expansion of the tree girth. This would facilitate future survey and monitoring.

4. Consider establishing parallel rows of trees alongside the oak avenue through Baddy Park, as a contribution to long-term sustainability of the avenue feature.

5. Consider removing the fence surrounding Jericho Pond, to restore this to a parkland pond open to grazing.

6. It is important to acknowledge that the present SSSI citation does not recognise the great conservation value of the wood-decay fungal assemblage. Given its national significance, this assemblage should be recognised as a Qualifying feature of Castell y Waun a'i Barcdir/Chirk Castle and Parkland SSSI.

3. Introduction

The parkland which surrounds Chirk Castle was first identified as having significant value for its veteran trees and associated saproxylic invertebrates by the National Trust's own Biological Survey Team in 1993. The extent of that value was clarified through a Countryside Council for Wales initiated 'Welsh Parklands' project which culminated in a detailed survey of the invertebrates at Chirk in 1996 (Judd, 1999). The Chirk Castle and Parkland Site of Special Scientific Interest (SSSI) was designated in 2011. This encompasses areas owned by the Myddleton family as well as the National Trust. The SSSI was designated as/for:

- One of the best examples of ancient wood pasture and parkland in Wales, containing a large number and diverse species of veteran and ancient trees;
- Special interest for the important invertebrate species that these trees support;
- Special interest of the breeding roost of lesser horseshoe bats in the castle buildings;
- One area of grassland supports a diverse assemblage of grassland fungi which is of special interest and of national importance.

The present document considers only the wood pasture and parkland trees and the associated invertebrate assemblages. The author was commissioned by the National Trust – with supplementary funding from Natural Resources Wales – to re-assess the saproxylic (wood-decay) invertebrate assemblages within the NT ownership, acknowledging that considerable time has passed since the 1996 survey and assessment, and also that land management within the parkland is now as sympathetic to the identified interests as possible. How successful have the land management changes been?

The key factors which conserve rich wood-decay invertebrate assemblages are (Alexander, 2008 & 2018):

- 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 nectaring 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.

It is easy therefore to understand the significance of the parkland at Chirk Castle for wood-decay invertebrates. A medieval hunting forest was established here in the 14th century resulting in exceptionally long continuity of wood pasture habitat. The National Trust ownership currently contains at least 186 veteran trees and includes at least 16 ancient trees (preliminary data noted during the 2018 survey visits). Oak is the dominant tree species but there is also a diversity of other tree species, notably beech, horse chestnut, ash, sycamore, hawthorn and a few hornbeam. The trees were mapped and individually tagged as part of a NT Gardens Survey in about 1981, and the aluminium tree tags have been continually maintained and replaced, as

necessary (C. Green, pers. comm.). This has enabled biological records to be allocated on an individual tree basis.

4. Methodology

4.1. 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 parkland and the desire to operate some flight interception trapping in parallel with field survey – see below – each visit involved three days, from midday on day one until midday on day three. The visits were arranged as follows:

- 21-23 May 2018, under bright, warm and sunny conditions, temperatures around 21°C;
- 10-12 July 2018, also with favourable weather conditions, 20-21°C;
- 15-17 October 2018, bright and sunny, 16°C, but following a period of very wet and windy conditions (Storm Callum).

4.2. Sampling techniques

The main field sampling techniques used were as follows:

- Beating lower canopy foliage and branches, using beating tray;
- Sweep-netting vegetation beneath tree canopy;
- Beating blossom on appropriate flowering shrubs, notably hawthorn and elder;
- Tapping of fruiting wood-decay fungi over a net;
- Hand search of fallen branch wood, investigating beneath loose bark and inside decayed heartwood, etc;
- Visual inspection of tree trunks for resting invertebrates;
- Inspection of accessible cavities in tree trunks and investigating within any accumulations of wood mould and other debris in cavities.

Wherever possible specimens encountered were identified in the field, retaining voucher specimens of the more critical species. Other specimens were taken away for determination under microscope. Larvae and pupae were also retained for rearing through to the more readily identifiable adult stage.

An additional technique employed was flight interception trapping. The type of trap employed is particularly good at sampling saproxylic Diptera, which are otherwise difficult to detect with the techniques listed above.

The flight interception traps are of a standardised construction:

- Four 2l plastic drinks bottles, with windows cut in sides, and bases bolted into a plastic base (plant pot saucer), the windows facing outwards;
- The traps hung in front of large trunk cavities or splits – at 1.5 - 2m above ground level - using baler twine, with the bottles hanging upside down beneath;
- The upside-down bottle tops filled with preservative solution (commercial antifreeze 50/50 with tap-water, plus a little washing up liquid to reduce surface tension) which can then be drained through the plastic cap.

These were set up to operate between each of the sampling visits, with captured invertebrates killed and preserved in the solution. The traps were emptied and re-set during each subsequent visit, finally being closed down in October. Trapping enables sampling to take place all through the season and is especially valuable in dry periods when insect activity is greatest – there is always a danger that the site visits may coincide with poor weather conditions.

Six traps were placed - three in the upper park, close to Gwyningar and Mars Woods, and three in Baddy Park - in the following trees:

- Tag no. 565 large veteran oak at SJ26156/38290 with exposed red-rot and much lying dead wood;
- Tag no. 576 large veteran oak at SJ26143/38478 with top fallen, exposing red-rotten interior;
- Tag no. 544 mature oak at SJ26600/38622 with top recently snapped out exposing undecayed moist heartwood and early signs of red-rot formation;
- Tag no. 183 large veteran oak at SJ27978/37417 with extensive trunk cavities;
- Tag no. 200 large veteran oak at SJ27758/37432 with red-rot visible in cavity;
- Tag no. 195 large veteran hornbeam at SJ27729/37479 with extensive exposed white-rotten heartwood.

Each trap was checked the day following setting up, to ensure that the holding twine had remained stable. Some damage was caused by Storm Callum prior to the October visit and samples were partially or entirely lost. Traps 565, 576, 183 and 195 survived the storm but the samples were lost from trees 200 and 576.

Plate 1. Flight interception trap in hornbeam Tag no. 195.

Plate 2. Flight interception trap in oak Tag no. 200.

Plate 3. A split oak showing red-rotten heartwood as well as exposed and undecayed wood. Tag no.544.

4.3. Area recorded

The whole of the National Trust ownership at Chirk Castle was explored during the survey, the key exception being the formal gardens. Wherever feasible, invertebrate records have been related to the tree tag number or - at the very least – to the general area of parkland. Very little time was spent in the plantation areas other than to visit individual veteran trees, where readily visible.

It should be noted that the approach taken by the 1996 Liverpool Museum survey (Judd, 1999) was very different, with all traps being placed within the enclosed plantations to protect them from damage by livestock. The flight interception traps used were of a terylene netting type and placed between stakes pushed into the ground. Malaise traps and Owen traps were also used. No traps were operated within the open parkland in 1996.

5. The Saproxylic Invertebrate Fauna

5.1. Introduction to fungal decay of wood

Very few invertebrates are able to feed directly on dead woody tissues, as the main components - cellulose and lignin - are difficult for them to digest. Most are therefore dependent on fungi and various micro-organisms to break down the wood into substances which are more accessible to invertebrate digestion. Heartwood decay fungi are especially important to invertebrates as they break down the central core of dead wood within living trees, thereby producing decaying wood habitat in large quantity while the tree is still alive and healthy – they rarely enter living tissues as their activity is held in check by the high moisture content. Other fungi are more opportunistic and exploit branches, roots, bark and eventually the trunks, as they die – for a variety of reasons. Wood that dies as a normal part of tree biology and development tends to be decayed by a different range of fungi than wood that dies as a result of sudden catastrophe, such as storm damage, structural failure or pathogens. Similarly, wood that dies in the crown is decayed by a different range of fungi to wood that falls into contact with the soil beneath. Hence *standing* deadwood is of great importance to both invertebrates and fungi – all deadwood eventually falls to the ground and so standing deadwood is much rarer on balance.

Chirk Castle Park was found to be of considerable interest for the abundance and variety of wood-decay fungi and especially bracket fungi. The most widespread bracket fungus observed on the veteran oaks in 2018 was *Inonotus dryadeus*, a widespread species which causes white-rot in the dead basal heartwood tissues. Although red-rot (referred to as brown rot by arborists) is associated especially with old oaks, the two widespread red-rot causing bracket fungi – chicken-of-the-woods *Laetiporus sulphureus* and beefsteak fungus *Fistulina hepatica* – were fruiting much less widely across the parkland than might have been expected. The old oaks also included a few examples with brackets of the common and widespread white-rotting *Ganoderma australe*, but of greater interest was the presence of a few examples of the uncommon *Grifola frondosa* and *Ganoderma resinaceum*, as well as one oak with the rare bracket *Phellinus robustus* (on oak tag no.551) The presence of this last species in particular makes the parkland at Chirk Castle one of the best Welsh sites for oak bracket fungi. The other tree species present also hold some interest for bracket fungi. One ancient beech tree was found to have the rare bracket fungus *I. cuticularis* and one veteran ash tree had fruiting chicken-of-the-woods, a very unusual occurrence with ash trees. Sam Bosanquet (NRW) has been assessing oak saprotrophic fungi in Wales and has provided the following comments:

> a) Chirk is only the 2nd Welsh record of *Phellinus robustus* following one in the Fungus Red Data Book from Llanyblodwel (VC47) in 2000;
>
> b) it takes the Oak Saprotrophic Fungi score for Chirk Castle to 8 points, meeting the SSSI selection threshold. There are now 4 Welsh parklands that meet the threshold, each of which hold the commonest 7 species plus 1 or more rarer (in Wales) fungi:
>
> Dingestow Court: 10 including *Podoscypha multizonata* and *Ganoderma resinaceum*
>
> Chirk Castle: 8 including *Phellinus robustus* and *Ganoderma resinaceum*
>
> Gregynog: 8 including *Piptoporus quercinus*

Dinefwr: 8 including *Ganoderma resinaceum* (which is perhaps not as rare as records suggest).

It is perfectly feasible that Chirk may also have the rare oak polypore *Piptoporus quercinus* as this bracket fungus is rarely visible, the fungus fruiting very erratically and at some occupied sites not being seen for more than 20 years.

As trees mature and the canopy develops its full potential, then some of the lower boughs in the canopy become obsolete, over-shaded from above, and die. These occupy a special situation, sheltered from above and bathed in the moist atmosphere beneath the canopy, and protected from the potentially harsher conditions which surround the tree. These aerial dead boughs are colonised by a wide range of fungi which exploit especially the more nutritious cambial layers. *Peniophora quercina* is a widespread and characteristic species of this situation and many wood-decay invertebrates are associated with its activity, including Nationally Scarce species.

It is important to appreciate the great importance of open-grown trees. A tree given the space to develop its full potential will naturally generate the widest variety of wood-decay habitat and for the longest period of time. Also, many associated species are warmth-loving and require well-lit trunks and boughs, both for the adults sunning, hunting and displaying on the outer wood surfaces, and for larvae developing within the decaying wood. Other species have requirements for shadier conditions.

The fauna of sites with a long history of large old open-grown trees are best termed “old growth” species as the expressions ‘ancient woodland’ and ‘ancient wood pasture’ have caused much confusion in people’s minds with regard to the habitat associations of the species concerned (Alexander, 2004). Many Diptera, for example, which primarily occur in ancient wood pasture and parkland are described in the literature as ‘woodland’ species when they are in reality tree-associated species which require viable populations of host trees and the special types of wood-decay which they require.

5.2. Saproxylic Coleoptera (beetles)

The very intensive Liverpool Museum survey in 1996 (Judd, 1999) found 170 species of wood-decay beetle that feature in the Site Quality Index listing – see Section 6. The 2018 survey work found 80 species of which 26 were additions to the 1996 site list - one had been found by the more recent NT Biological Survey in 2007 (Barker & Foster, 2009). 49 of the saproxylic beetles were taken in the flight traps and 69 by hand search techniques – 14 (29%) of the former have Nationally Scarce status but only 5 (7%) of the latter are Nationally Scarce species. There are also 7 species of saproxylic beetle which do not feature in the SQI list as the list is based on a preliminary version of Alexander (2002) and has not been up-dated. The revised total is therefore 207 species of wood-decay beetles found in the parkland.

It is significant that nearly one third of the 2018 species recorded are new to the site list. This partly reflects the flight interception trapping targeting the veteran trees of the open parkland rather than the enclosed plantations, and partly that species missing from the 1996 list but which might be expected here were specifically targeted during the field survey. But these additions also demonstrate that the site potentially holds many more overlooked species, especially rarities – surveys of

saproxylic insects are necessarily cumulative as many of the species are very elusive and require time and effort to find.

The Liverpool Museum survey found 37 species which currently have Nationally Scarce status in Britain and three Nationally Rare (NR). One of the three has more recently been assessed as Near Threatened in Britain using the IUCN Regional Guidelines for Red-listing (Alexander *et al.*, 2014). Judd (1999) does not go into any details about the ecology of these species and so the three NR species are detailed here:

Agathidium confusum (Leiodidae, round fungus beetles)

- found in fungi fruiting from tree stumps & fallen branches;
- known from woodlands as much as wood pasture and parkland;
- increasingly being found by flight trapping and not as rare as previously thought, but only known from one other Welsh site, a wooded bog in Merioneth.

Cryptophagus micaceus (Cryptophagidae, silken fungus beetles)

- found in tree cavity nests of hornet and social wasps (Vespidae); also reported from rotting timber, fungi, sap and nest debris in general, although a poorly understood species overall;
- very much a species of old wood pasture and parkland rather than woodland;
- otherwise only known in Wales from Dinefwr Park.

Hypulus quercinus (Melandryidae, false darkling beetles)

- appears to favour relatively large volumes of humid old red-rotten heartwood, especially associated with ancient oak trees, but also reported from hazel and birch. Often found on or in old stumps in April and May – possible larval habitat and/or overwintering sites - while flight occurs in June and early July. One has once been beaten from hawthorn blossom.
- the known sites are characterized by concentrations of ancient oaks and/or old decaying stumps.
- although the most significant species of the three, with **Near Threatened** status in Britain, it is also known from three other localities in Wales: Dinefwr Park and two sites in Breconshire - Allt-yr-Esgair and Carn Gefallt.

None of these species was encountered during 2018 although all three are likely to still be present. They are all difficult species to find on demand.

The seventeen Nationally Scarce wood-decay beetles found in 2018 are mostly additions to the site list (12 of the 17), and one - *Ischnomera cinerascens* - appears to be the first known site in Wales:

Quedius truncicola (Staphylinidae, rove beetles)

- lives amongst wet, very rotten heartwood of veteran trees, often with dense, clay-like blackish mould, in tree holes and hollow trunks, generally beneath bird nests; adults have also been reported from rotten fungi and at sap;
- only other known site in Wales is Erddig Park, where found by the author in 1993;
- eight adults taken by the flight trap on veteran oak tag no. 565.

Prionocyphon serricornis (Scirtidae, marsh beetles)

- their long-horned and flattened larvae occur in bottom debris of water-filled tree-holes, especially between root buttresses; probably a scavenging life style, feeding on a wide variety of organic debris; adults fly at dusk;
- increasingly being found as people improve their field techniques; known from Dinefwr Park and Erddig Park as well as other Welsh sites;
- two adults taken by the flight trap on the veteran hornbeam tag no. 195.

Dorcatoma flavicornis (Ptinidae, woodworm relatives)

- large colonies develop in the interior of boughs and trunks of trees which are red-rotten, due to activity of the fungus *Laetiporus sulphureus;*
- very few Welsh sites known, although possibly due to under-recording; Erddig Park, Coedydd Maentwrog, and sites in Ceredigion;
- large numbers taken in flight trap on veteran oak tag no. 565 and two taken by beating oak branches.

Dorcatoma substriata (Ptinidae)

- develops in dead persistent annual bracket fungi on veteran trees, especially *Inonotus* spp on broadleaves, but will also use *Phaeolus schweinitzii* on conifers and normally hard perennial bracket fungi where they have been softened by very damp situations. Usually open-grown trees;
- confined in Wales to the English border country, and known from Powis Castle Park (1996) and Chirk Castle Park (1993);
- the characteristic emergence holes were noted in brackets of *Inonotus dryadeus* in three areas of the park.

Phloiophilus edwardsii (Phloiophilidae)

- develops in *Peniophora* species of fungi, which decay aerial dead lower small-girth branches of various mature and maturing open-grown broad-leaved trees and shrubs, but especially oak; trees as young as 40 years may be suitable, although most records come from 150-250 year old oaks; older trees increasingly become unsuitable as lower limbs are lost; the requirement for lateral branching means that only open grown trees are suitable; most frequent in old wood pasture and parkland situations as a result.
- scattered records throughout Wales;
- adults knocked from two medium-aged parkland oak trees and one found in flight trap on split oak tag no. 544. One of the species targeted in 2018.

Anthocomus fasciatus (Melyridae, malachite beetles)

- larvae probably predatory in borings of anobiid beetles, including woodworm and so exploit roof timbers as well as wild trees; adults usually found by sweeping beneath trees or at blossom;
- very rare in Wales;
- only found on a stunted hawthorn by Home Farm, although plentiful at blossom here.

Symbiotes latus (Endomychidae, false ladybirds)

- in fungi and under bark on deadwood; known from elm, poplar, ash and beech. Evidently feeds on white rot and other fungi characteristic of heartwood decay;
- only previously known in Wales from Llanover and Piercefield Parks in Monmouthshire;
- two adults taken by flight trap on veteran oak tag no.200.

Pseudotriphyllus suturalis (Mycetophagidae, hairy fungus beetles)

- adult beetles can be found all year round; they are associated with the soft fruiting bodies of annual bracket fungi, most often *Laetiporus sulphureus* and *Polyporus squamosus*, but also *Fistulina hepatica*, *Inonotus* species and *Pleurotus* species, and are found on the spore-producing surfaces throughout the period from late June until well into the early winter period; they may remain in air-dried brackets through into the following spring, provided such habitat is available; in the absence of old brackets, beetles can be found inactive in or on deadwood. The larvae are presumed to develop within the dead tissues of the old fungal fruit bodies – it has been reared from *Laetiporus sulphureus* and *Piptoporus quercinus*;
- veteran trees are clearly essential and form the primary habitat type; occupied trees tend to be in open sunny situations. Sites are predominantly old medieval forests, historic parklands, common wood pastures, traditional orchards, ancient woodlands and old hedgerows;
- confined in Wales to the extreme eastern border country and very few localities known;
- a few adults knocked from beefsteak fungus on two veteran oaks, one in Baddy Park, the other in the central parkland; clearly a scarce species at Chirk.

Triphyllus bicolor (Mycetophagidae)

- the larvae develop in the soft annual fruit-body of Beefsteak Fungus *Fistulina hepatica*. Adults are found all year round, although are mainly found feeding at the fresh fruiting bodies of beefsteak fungus from early July until mid-October; they have also been reported feeding at the spore-producing surface of Chicken-of-the-Woods *Laetiporus sulphureus* and Oak Polypore *Piptoporus quercinus*, all on veteran oak trees; but it is also occasionally found at fresh brackets on other broad-leaved trees. Overwintering adults have been found under bark on dead beech and on fallen oak boughs in May and July, presumably inactive while awaiting fungal fruiting of the larval host. Sites are predominantly old medieval forests, historic parklands, common wood pastures, ancient woodlands and old hedgerows.
- rare in Wales and only known from a few of the historic parklands, notably Powis Castle Park;
- a single adult taken by flight trap on veteran oak tag no.200.

Tetratoma desmaresti (Tetratomidae, polypore fungus beetles)

- develops in dead, shaded out, lower large-girth branches of mature and over-mature oaks, presumably feeding on fungal mycelium within the wood; requires large open-grown trees;
- only previously known in Wales from Erddig Park (1993);

- two knocked from large dead branch on ancient oak in upper parkland; one of the 2018 target species.

Anisoxya fuscula (Melandryidae, false darkling beetles)

- larvae in decaying boughs and twigs exposed in the crown of a wide variety of broad-leaved trees; pupate in the decaying wood and the adults usually become active in mid to late June and may be found throughout high summer. Associated particularly with open-grown trees, eg in ancient wood-pasture type situations, including floodplain willow pollard systems, field hawthorns, and traditional orchards;
- rare in Wales and best-known from the south-east;
- one taken by the flight trap on the veteran hornbeam tag no. 195.

Abdera quadrifasciata (Melandryidae)

- develops in aerial dead branches of open-grown broad-leaved trees, especially oak; generally, those in the lower canopy which have been shaded out by the tree's own canopy, although may be particularly numerous on the branches of standing dead mature trees; has also been reared from a beech branch. Most records come from historic forests and parks, as well as common wood-pastures.
- Chirk Castle Park is the only known Welsh site, and it has been found in 1993, 1996 and 2007, as well as 2018;
- knocked from a recently dead snapped and hanging branch on a single ancient oak by Myddleton lake; this species was targeted as the more widespread *A. biflexuosa* has still not been found at Chirk.

Mordellistena neuwaldeggiana (Mordellidae, tumbling flower beetles)

- has been reared from dead branch-wood of hornbeam and field maple in early stages of decay, but biology poorly-known; adults are attracted to blossom;
- the only previously known Welsh record is from St. Fagans, Cardiff with one in a flight trap in 1997;
- one taken by flight trap on veteran oak tag no. 183.

Ischnomera cinerascens (Oedemeridae, false blister beetles)

- develops in white-rotten heartwood of large old wych elms and probably other tree species; adults have often been found in closed-canopy woodlands or at blossom close by, but the species is also known from old wood pastures;
- not previously known to occur in Wales, the nearest known site being Moccas Park, Herefordshire;
- two taken by flight trap on veteran oak tag no. 576.

Aderus populneus (Aderidae, ant-like leaf beetles)

- the larvae inhabit red-rotten heartwood in various broad-leaved trees; the adults may be found by beating the foliage of the host tree; dispersing adults may be found in other decay situations; the thermal environment in winter appears to be crucial to survival – the adults appear often to select overwintering sites where either fermentation or a building affords a little warmth; successful populations may be limited to isolated trees, which they breed in for decades; the physical character of the dead wood appears to be important - adults overwinter in contraction-spaces between the annual rings

of dry, delignified, papery, soft heartwood, *i.e.* white-rot; adults are attracted to elder blossom for nectaring;
- previous Welsh records have all been in the far south-east, including Llanover Park;
- one taken by the flight trap on the veteran hornbeam tag no. 195.

Euglenes oculatus (Aderidae)
- the larvae live in large colonies in red-rotten heartwood in various broad-leaved trees, but especially oak; the adults may be found by beating the foliage of the host tree; dispersing adults may be found in other decay situations; 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;
- known from a few sites across south Wales (Dinefwr Park, St Fagans, Old Cilgwyn) and also Powis Castle Park; first found at Chirk by A.P. Foster in 2007;
- large numbers taken by flight trap on veteran oak tag no.200, with smaller numbers from each of the other three veteran oaks trapped.

Anaspis thoracica (Scraptiidae, false flower beetles)
- the larvae develop in red-rotten wood of oak; also associated with recently dead wood of trunks and boughs on the continent; adults rarely found other than by trapping;
- Chirk may be the only known northern Welsh site; recorded here by Judd (1999); otherwise known from two sites in the south;
- one taken by the flight trap on the veteran hornbeam tag no. 195.

One of the above, the hairy fungus beetle *Pseudotriphyllus suturalis*, has Near Threatened status at a European level (Nieto & Alexander, 2010), and three further species - without conservation status in Britain – are also listed:

Dacne rufifrons (Erotylidae, a shining fungus beetle) – Data Deficient
- primarily breeds in the dead brackets of Dryad's saddle *Polyporus squamosus*, but also in *Laetiporus sulphureus*; adults have been found on or inside a wide range of tree fungi; associated more with beech and horse chestnut than oak;
- in Wales, primarily known along the English border country but very few localities known; found at Chirk in 1993 and 1996;
- a few knocked from Dryad's saddle on collapsed dead horse chestnut trees.

Epiphanis cornutus (Eucnemidae, a false click beetle) - Near Threatened
- on the continent only known from a few remote alpine valleys where it develops in heartwood decay in conifers; in Britain known from decaying heartwood of conifers and broad-leaves, and known to develop even in decaying railway sleepers - exposed sun-baked heartwood may be important
- status in Britain is unclear, and it may have been introduced from N America (a Holarctic species), certainly the British population appears to be thriving and expanding, unlike the continental one;
- one from flight trap on veteran oak tag no.200.

Pediacus dermestoides (Cucujidae, a flat bark beetle) – Data Deficient

- develops beneath bark on freshly dead stems, in the early stages of decay, especially in shattered ends of broken boughs; larvae feed on insect larvae while adults are fungivorous; it is widespread in ancient woodlands and wood pastures;
- widely known across Wales; recorded at Chirk in 1993 and 1996;
- adults taken in flight trap on split oak, tag no.544, and larvae found in freshly fallen oak boughs in the open parkland.

The presence of these species in the Parkland at Chirk provides a European dimension to site quality. These four species appear to be more widespread in Britain than anywhere else in their European ranges and so three of them do not have any conservation status here in GB.

While most of the additions to the list of wood-decay beetles are almost certainly previously overlooked species, a few may well be genuine new arrivals. Oak jewel beetle *Agrilus biguttatus* and the longhorn beetle *Phymatodes testaceus* have been expanding their British ranges over the past 25 years or so, partly in response to climate change and partly due to the increased availability of freshly dead mature oak trees across the country. The latter point is thought to be associated with poor soil conditions making oak trees more vulnerable to stresses from root damage and pathogens. The parkland trees at Chirk Castle were particularly stressed in the 1990s and many mature oaks were in decline and dying at that time. It is likely that these two beetle species were attracted to Chirk as a result of that stress episode. The jewel beetle has been implicated by Forest Research as being a contributory factor in Acute Oak Decline but with no supporting evidence – its known biology belies this as the beetle is only attracted to dying oak trees and not healthy trees (Alexander, 2015). Another beetle noted in 2018, *Uleiota planata*, has only relatively recently been shown to be an invasive species, colonising Britain from across the English Channel, probably via the timber trade – it had previously been assumed to be a rare native and still has a conservation status. Another beetle *Pycnomerus fuliginosus* is an introduction from Australia which has been spreading.

The full list of saproxylic beetle species known from Chirk will be found in Appendix 1 and the species found by flight interception trapping are detailed in Appendix 4.

5.3. Saproxylic Diptera (flies)

Many Diptera are associated with decay and decomposition of plant and fungal material generally and it can be difficult to determine the extent of their association with decaying wood. The following discussion is largely about the most clear-cut cases of wood-decay associates. Judd (1999) listed 50 species of fly found at Chirk as being saproxylic of which one had Nationally Scarce status in Britain and two Vulnerable status: *Acnemia amoena* and *Ectrepesthoneura colyeri*, both fungus gnats. These have subsequently been down-graded, with *Acnemia amoena* now Near Threatened and *Ectrepesthoneura colyeri* Nationally Scarce.

The flight trapping in 2018 captured a total of 155 species of Diptera. With the present inadequate level of ecological knowledge, one needs to be careful in stating categorically that particular species are obligate saproxylics, but 45 of the species found appear to be reliably saproxylic and a further 15 species probably or possibly. Many of the species where biology has not been determined may also be saproxylic.

32 of the 45 saproxylic species are additions to the Judd (1999) list bringing the total of confirmed saproxylic Diptera to 82 species. 11 of the 13 Diptera with conservation status are either saproxylic or probable saproxylic.

What is clear is that the six traps, strategically placed, produced a list comparable to that generated by the much more detailed and intensive survey carried out in 1996 (Judd, 1999) – in terms of species-richness but the 2018 data is richer in species with conservation status. A key difference in techniques is that trapping in 1996 focused entirely on the enclosed plantations whereas veteran trees and wood decay were the primary target of the 2018 trapping programme. The veteran trees of the open parkland appear to be richer in saproxylic Diptera with conservation status than the enclosed plantations.

The 13 flies with conservation status taken by flight trapping during 2018 are as follows:

Vulnerable species

Rhipidia ctenophora (Limoniidae, crane flies)

- the larvae have been reared from a wide range of dead wood situations, incl. rot-holes, sap-runs and rotting stumps; known from elm, horse chestnut and sycamore;
- thin scatter of records across lowland Britain, with three from the southern half of Wales (incl. Dinefwr Park); this the first from North Wales;
- one male and one female in flight trap on veteran oak tree tag no. 576.

Near Threatened species

**Acnemia amoena* (Mycetophilidae, fungus gnats)

- biology not known but adults have been obtained in emergence traps over rotten wood; predominantly known from ancient wood pastures and parklands;
- scattered records across southern Britain, including Chirk Castle Park (1996), Dinefwr Park and Powis Castle Park;
- one female in flight trap on veteran oak tree tag no. 565.

Anthalia beatricella (Hybotidae, dance flies)

- early stages not known but larvae of related genera develop in rotten wood; adults are nectar or pollen feeders and are often found on flowering bushes and on tree foliage; predominantly known from ancient wood pasture and parklands;
- only four British localities known, including Windsor Forest, the New Forest, & Castle Hill, North Yorks; a previously overlooked species in Wales;
- one female in flight trap on veteran oak tree tag no. 200.

Pegomya testacea (Anthomyiidae)

- biology unknown, but related species mostly develop in soft annual fungal fruit bodies;
- the only other records in the past 25 years are also from Wales: Mynydd Du Forest, Monmouthshire and Craig y Cilau NNR, Breconshire;
- one male in flight trap on veteran oak tree tag no. 200.

Nationally Scarce species

Sciophila geniculata (Mycetophilidae, fungus gnats)

- biology not known, but related species develop in webs on the surface of tough bracket fungi and are considered to be spore feeders; western sites tend to be wooded bogs but eastern sites include ancient wood pastures and parklands, such as the Forest of Dean;
- Welsh records known from Ceredigion, Montgomeryshire and Caernarvonshire;
- two males and a female in flight trap on veteran hornbeam tree tag no.195.

Sciophila interrupta (Mycetophilidae, fungus gnats)

- biology not known but there is an old continental record of rearing from the terrestrial tooth fungus *Hydnum repandum*, from which a few other *Sciophila* have also been reared; English sites are mostly ancient wood pastures and parklands or else wooded fens;
- scattered records across southern Britain, including a single known Welsh locality, Oxwich NNR on Gower;
- one male and one female in flight trap on veteran oak tree tag no. 200.

Cladoneura hirtipennis (Trichoceridae, winter gnats)

- unknown in larval stage, probably developing in decaying wood in tree cavities; has once been reared from an old bird best found in a tree rot hole; known sites include ancient wood pastures and parklands as well as wet woodlands;
- widely scattered records across much of Britain; known elsewhere in Wales from Coed Tremadog NNR in Caernarvonshire;
- one male in flight trap on veteran oak tree tag no. 183.

Scenopinus niger (Scenopinidae, Forest Windowfly)

- the larvae feed on beetle larvae - perhaps mainly anobiids - in dry, red- or white-rotten heartwood of various veteran broadleaved trees in ancient wood pastures and historic parklands;
- the majority of British records are from southern England, but including the border parklands of Chirk and Powis Castles;
- one female each in flight traps on veteran oaks tree tags no. 200 and 565.

Australachalcus melanotrichus (Dolichopodidae, long-headed flies)

- larvae develop in wet rot-holes in broad-leaved trees; known sites include ancient woodlands, wood pastures and parklands, and old hedgerows;
- previously only known in Wales from two coastal sites - Morfa Dyffryn NNR and Pantlassau Farm, Morriston, Swansea;
- one male in flight trap on veteran hornbeam tree tag no.195.

Ferdinandea ruficornis (Syrphidae, hoverflies)

- the larvae are filter-feeders on yeasts and bacteria in sap-runs on a variety of broad-leaved trees; adults very rarely seen;
- very rare in Wales, with records from along the north coast, at Treborth Botanic Gardens and Gloddaeth SSSI;
- a total of 4 females taken in flight trap on split oak, tag no.544; and one in flight trap on veteran hornbeam tree tag no.195.

Lasiambia brevibucca (Chloropidae)

- develops in rot-holes in living veteran trees; no association with any particular tree density or light levels, nor with ecological continuity; has also been reared from sappy horse chestnut bark at Moccas Park;
- widely known across lowland England but in Wales only previously known from Glamorganshire;
- a total of one male and 22 females in flight trap on veteran hornbeam tree tag no.195, and a male and a female taken in flight trap on veteran oak, tag no.565.

Fannia aequilineata (Fanniidae)

- larval habitats are rotten wood and wood detritus, fungi on dead wood, & detritus in nests of birds, social Hymenoptera & small mammals; females are attracted to sap-runs; males hover beneath tree canopy; ancient wooodlands, ancient wood pasture and parkland, traditional orchards, etc.
- widely known across lowland England; this appears to be the first time it has been found in Wales;
- taken in flight traps on veteran oaks 200 (one female), 565 (one female) and 576 (male & female), as well as split oak tag no. 544 (one female).

Helina abdominalis (Muscidae)

- larvae in wet rot-holes in old or dead trees; wood pastures and parklands, woodlands and carr;
- only previously known in Wales from Glamorganshire and Pembrokeshire;
- four females taken in flight trap on veteran oak tag no. 565.

One interesting feature of this data set is that most of these saproxylic Diptera with conservation status have been found associated with veteran parkland oaks, belying a common statement made by many dipterists that parkland oaks are not important for rare and threatened Diptera.

The full list of wood-decay Diptera known from Chirk Castle Park is found in Appendix 2 and the Diptera taken by the flight interception traps are detailed in Appendix 3.

5.4. Other saproxylic invertebrates

A wide range of other invertebrate groups include species dependent on decaying wood. While Coleoptera and Diptera are pre-eminent, with in excess of 700 species each nationally, other groups are much less well represented. Judd (1999) recorded ten species of digger wasp and two of solitary bee as saproxylic, plus six species of spider. The ant he recorded as saproxylic is not so. He also found two species of saproxylic bark bug – *Aradus depressus* and *Xylocoris cursitans*. The 2018 survey can now add one species of snake fly *Phaeostigma notata*; *Xylocoris cursitans* was also noted widely.

The snakefly larvae develop as predators beneath loose bark on fallen dead branches, within the first few years following death. It has been reared from larvae found in oak deadwood in particular. It is known from ancient wood pasture and parklands, ancient woodlands and also open-grown in-field and hedgerow trees. This appears to be a rare species in Wales, with the NBN Atlas containing the following

two site records: Ffridd Mathrafal (SJ1110) and Gregynog Great Wood SSSI in Montgomeryshire.

Adults and larvae of the bark bug live beneath the bark of dead trunks and limbs which are in the early stages of decay. They feed on the larvae of beetles as well as springtails, thrips, etc. It is widely known in ancient woodlands and ancient wood pastures and parklands. It is widespread across England and Wales.

The saproxylic micro-moth *Nemapogon cloacella* was reared from a bracket fungus during the 1993 NT Biological Survey. This is a common and widespread moth.

5.5. Total of saproxylic invertebrates known from Chirk Castle Park

Overall, Chirk Castle Park has – so far – been identified as supporting 298 saproxylic invertebrate species.

Group name	No of species reported
Coleoptera	207
Diptera	82
Hemiptera	2
Hymenoptera	12
Lepidoptera	1
Spiders	6
Millipedes	2
Total	**313**

5.6. Epiphytic invertebrate assemblage

Although outside of the remit for this contract, epiphyte invertebrate assemblages tend to get sampled along with saproxylics. Large open-grown trees are rich in epiphytic plants – lichens, mosses and algae – and so it is no surprise that historic wood pastures and parklands are amongst the richest situations for epiphyte invertebrate assemblages.

The flight traps captured eight species of barkfly (Psocoptera) with the larger Psocidae particularly well-represented with four of the eight species. The Psocidae provide the greatest interest, with three of the larger picture-winged species *Loensia fasciata*, *L. variegata* and the uncommon *Trichadenotecnum sexpunctatum*. Barkflies browse on the micro-flora of the bark and wood surfaces.

The presence of a single female *Atlantopsocus adustus* is notable as this is a species which has been spreading into Britain and Ireland over the past 10-15 years. The species originated in the Atlantic islands – Madeira, the Azores and the Canary islands – and is presumed to be being carried on south-westerly air currents and, with climate change, is now able to establish local breeding populations. It has been spreading up Cornwall and into Devon. It is now well-known in Shropshire but Chirk appears to be the first evidence for a population in Wales.

The barkflies are in turn eaten by a range of specialist predators, with true bugs well-represented. The latter included three species *Cardiastethus fasciiventris*, *Loricula elegantula* and *Temnostethus pusillus*, all widespread species.

6. Index of Ecological Continuity and Species Quality Index for Coleoptera

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).

6.1. Index of Ecological Continuity

The Index of Ecological Continuity has been used to identify Britain's most important sites for the saproxylic invertebrates 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). 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 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 Chirk Castle Park all records have arisen from 1993 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 2018 and many found.

Experience has suggested that sites of national 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 Chirk Castle Park has now reached 75 – an increase of about 10% on the 1996 figure, and a score of high GB significance, placing the parkland at Chirk Castle amongst the top 25 sites in Britain and the richest in Wales (the next richest Welsh site is Powis Castle Park with an IEC of 65). It is still feasible that further species remain undiscovered in the parkland and so the European level of significance (80) is well within sight.

6.2. Saproxylic Quality Index

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 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 SQI of the parkland at Chirk Castle has now increased from 368 in 1996 to 439 in 2018, an increase of nearly 20%.

Fowles *et al*. (1999) suggest that an SQI of 500 is probably an appropriate threshold for assessing national importance. The parkland 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 is 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 Chirk Castle Park.

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. Chirk Castle Park has been subject to two NT Biological Surveys and two formal saproxylic surveys and so it is instructive to see how the SQI figures have changed over time and changes in site management. Unfortunately, the 2007 NT Biological Survey Report does not contain a full species list and so cannot be included, nor can the 1993 Biological Survey as the species list was below the 40 threshold. The SQI figures are presented in the following table:

	1996 Survey (Judd, 1999)	2018 Survey
SQS	625	325
N	170	74
SQI	368	439

The key point which arises from the table is that the SQI is substantially higher using the 2018 data than for the 1996 data.

The 1993 NT Biological Survey found a few significant rarities, but the level of survey was not sufficient to build up a sufficiently long list of wood-decay beetles. The findings alerted the Trust to the high quality of the parkland trees and the 1996 survey clarified the extent of the interest as being of SSSI quality.

7. Management Recommendations

As pointed out in Section 3, 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 nectaring 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.

7.1. Land management

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 Chirk Castle Park, 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 not a prerequisite. The historic designed landscape aspects are also recognised as being of significant importance at Chirk.

A grazing regime is essential at Chirk to maintain the structure 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 vegetation structural diversity and ideally to allow some development of low-growing thorn scrub 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;
- placement of any water troughs, supplementary feeds, etc, well away from any trees, providing supplementary shelter where necessary;
- avoidance of applications of fertilisers, farmyard manure, slurry, lime, etc., which each have detrimental impacts on tree health and associated 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 generally left to mulch and 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. 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 parkland at Chirk, 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*).

Grazing arrangements at Chirk have very clearly improved since the 1990s and the pastures appear to be in much better condition as a result. Baddy Park is the area identified in the SSSI citation as the area rich in grassland fungi but grassland fungi were noted very widely across the wider parkland in 2018, with some of the commoner waxcaps evident in areas where they appeared to be absent previously.

The pastures in the upper parkland continue to be grazed by a very large herd of sheep, albeit smaller than in the 1990s – a flock of about 160 head of sheep were in one enclosure in the upper park on July 10th with similar numbers in a neighbouring enclosure. Oak tag no. 60 is showing severe dieback and the ground beneath has clearly been heavily poached by livestock and compacted in the recent past. Opportunities should be sought to reduce stocking further. A change to cutting and baling followed by aftermath grazing, under a “no inputs” regime, for a period could be considered in order to enhance the process of restoration to semi-natural grasslands. This should then be reviewed again, based on actual results.

The presence of beef cattle herds in Baddy and the central parkland is a very welcome initiative. Beef cattle and hardy rare breeds are the preferred livestock for this situation, from a nature conservation aspect. The presence of ponies in the very overgrown area of parkland between Baddy Park and Garden Wood is another very welcome initiative which should enhance the vegetation structure here and favour open-grown trees.

Cutting and removal of nettle patches would help to strip nutrients from the soil around the trees. This is already carried out in Baddy Park and perhaps elsewhere. It is important that the cut material is removed from ground overlying live tree roots - the root protection zone of the trees.

Livestock congregating beneath tree canopy is continuing to be a serious problem and is damaging to tree health. If shelter for livestock is an important issue then consideration could be given to opening up the adjoining enclosed plantations and allowing access to the stock. The shelterbelts 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. Alternatively, purpose-built shelters could be provided. Opening up of the area around Jericho Pond would be especially beneficial in restoring a former pastureland pond to grazing.

7.2. Tree management

A new tree survey was beginning in 2018 (Keith Griffith, pers. comm.) and this is very welcome. The 1981 data is not available electronically and is in need of up-dating

anyway. Once the new survey has been completed the Trust will be a much better position to analyse the age structure of the tree resource at Chirk (presumably using girth as a surrogate for age). The impression gained during the 2018 invertebrate survey was that age structure appeared broadly adequate but that there is a need for more new recruitment of suitable open-grown trees within the more open areas of parkland – notably in the parkland between the visitor car park and Myddleton Lake and in the lower slopes down towards the public road on the eastern boundary of the park. There is also plenty of available space in the parkland immediately below and to the east of the Castle, where so many trees have been lost in the 1990s due to the past intensive pasture use.

A detailed appraisal of the data is needed in order to ascertain the desirable tree recruitment rates, to examine to what extent these are currently being met, and to develop plans for encouraging natural, wild regeneration, supplemented by planting where necessary. Natural regeneration should always be preferred to planting as it optimises tree establishment and subsequent tree health, in relation to soil biota, as well as ensures an open-grown form from the start. Collection of acorns and their distribution into suitable areas is good practice and should be considered. Establishment will be greatest where the trees are protected by thorn bushes. This may mean establishing temporary stock-exclosures across the parkland, on a long-term rotational basis.

It is vitally important that as many of the existing trees remain alive and healthy as possible, to continue to develop the essential wood-decay habitats into their old age - a dead tree provides wood-decay habitats over a relatively short time span in comparison to a living tree. Most of the ancient and veteran trees appear to be in good health but examples were seen where ancient and veteran trees are being overcrowded by younger growth and threatened by over-shading in the enclosed plantations.

The oak avenue within Baddy Park might benefit from the planting of parallel rows of trees on either side, to improve long-term sustainability of the feature as the existing veteran trees decline and collapse. If considered, then the distance between the paired rows needs to be carefully designed as oak is a light-demanding tree and very sensitive to overcrowding.

It is recommended that no trees be felled or their health and/or lives put at risk without written authority from the General Manager and preferably only with the approval by all interests in that tree; this includes dead trees. There are few acceptable reasons for the complete felling of any tree within an SSSI. Routes can be modified to avoid potentially hazardous trees. Selective removal of potentially hazardous boughs may be necessary where moving the route is not an option. It needs to be recognised that all trees are valuable and should not be lost recklessly.

All woody species may be of significant importance to nature conservation, not just the trees but shrubs also. Flowering shrubs may be of particular value as sources of pollen and nectar for insects as well as for their own specialist wood-decay communities. Chirk Castle Park is known to support important species which are dependent of flowering shrubs, particularly hawthorn and elder.

Where important trees are threatened by adjoining younger growth then they should be gradually released, over a period of years;see *Veteran Trees – a guide to good management* (Read, 2000) and *Ancient and other veteran trees: further guidance on management* (Lonsdale, 2013) for detailed advice. Veteran trees within Garden Wood are in need of opening up from crown competition.

7.3. 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.

7.4. Survey and monitoring aspects

With a site as important as Chirk Castle Park it is important to monitor the impacts of land management, etc., on the condition of the habitat and the communities it supports. The simplest options are to monitor the population dynamics of the tree and shrub populations through periodic recording of tree health and recruitment. The timescales for such work need only be fairly infrequent, on a cycle of say 20-25 years, to ensure recruitment of age class cohorts, and to respond to any problems which may be detected – the advice of a suitably-experienced arborist should ideally be sought on this point.

The present tree tagging dates from about 1981 and relies on aluminium tags which are readily and constantly damaged by grey squirrels. The tags have been replaced as they are lost (Carl Green, pers. comm.) but a more resilient tag design would be more sustainable. The Latschbacher numbered tags have been found elsewhere to provide the best solution. These can be attached to the trees using a nail, leaving the tag loose, and allowing for expansion of the tree trunk.

Monitoring of the biological communities is more problematic as it could be labour intensive. A good option is to carry out repeat specialist surveys periodically, in order to detect any major changes that may be occurring and to consider their causes and any practical remedies which might be advisable. This work would most usefully be tied in with the tree health and recruitment monitoring programme as the one will inform the other.

As the Coleoptera are the best known and understood group at Chirk Castle Park, a case could be made to focus on them. However, knowledge of other saproxylic groups should ideally be built up too, and site assessment protocols developed for them. Further specialist Diptera surveys involving flight trapping should be a priority.

The 2018 survey supplemented the hand survey techniques by the operation of six flight interception traps strategically placed on tree trunks close to extensive wood-decay habitats. While some key saproxylic beetles were only detected by targeted hand search, the majority of species with conservation status were detected by the traps. Indeed, the flight interception traps employed in 2018 proved to be more productive than the entire array of approaches adopted by the very detailed 1996 survey (Judd, 1999). It is therefore recommended that flight interception trapping - using the four-bottle design - should be adopted as the standard for future common standards monitoring of saproxylic invertebrates in wood pasture and parkland habitat. It is suggested that nine or ten traps should be employed as the standard, to increase the trapping effort but without creating too challenging a project. Operation of a small number of flight traps can readily be combined with hand search techniques to provide a more rounded condition assessment.

There are a number of potential approaches available to the interpretation of the data from monitoring surveys. The basic approach taken in 2018 was to do IEC and SQI analyses to provide baseline data for comparison with future monitoring episodes. This approach has been found to provide a simple assessment of change over time for the saproxylic beetles (Alexander, 2014).

This could be supplemented by breaking down the fauna into assemblage groups and determining threshold levels for favourable representation. This could be trialled during the next monitoring episode – little experience is available for guiding such an approach at present. Assemblage groups which might lend themselves to more targeted favourable condition assessment are:

- the red-, or brown-rot succession of beetles, which is currently known to include *Dorcatoma chrysomelina*, *D. flavicornis*, *Mycetophagus piceus* and *Euglenes oculatus;* the presence of at least three of these species could be the trial threshold for favourable condition;
- the advanced heartwood-decay and wood-mould assemblage, which currently includes *Abraeus granulum, Plegaderus dissectus, Quedius maurus, Q. scitus. Q. truncicola and Prionychus ater*; these are more difficult to detect on demand and so a threshold of three species is suggested;
- the large bracket fungus assemblage, which currently includes *Pseudotriphyllus suturalis, Triphyllus bicolor, Hallomenus binotatus* and *Eledona agricola*; three out of four should be a workable threshold;

- lower canopy aerial dead branch assemblage, which currently includes *Phloiophilus edwardsii, Tetratoma desmaresti, Anisoxya fuscula, Abdera quadrifasciata* and *Conopalpus testaceus*; a threshold of three species is suggested;
- rot-hole Diptera – five specialist rot-hole Diptera with conservation status were found in 2018 and this might provide a threshold for future monitoring;
- species-richness of fungus gnats might provide another workable target group; 54 species were found in 2018, and a threshold of 50 species is suggested as a trial figure;
- hoverflies appear not to be a species-rich group here but two key species were present – *Brachypalpus laphriformis* and *Ferdinandea ruficornis* – and could be used as another threshold for favourable condition.

These assemblage groups and thresholds could then be examined in a simple table format with results from each monitoring episode:

Saproxylic assemblage	Threshold	2018 results
Red-rot specialist beetles	3 out of 4	4
Advanced heartwood decay beetles	3 out of 6	3
Large bracket fungus beetles	3 out of 4	3
Aerial dead branch beetles	3 out of 5	5
Rot-hole Diptera	5	5
Fungus gnat species total	50	54
Key hoverfly species	2	2
Total number of thresholds	**7**	**7**

The 2018 survey results meet all seven thresholds – the thresholds are based on these results of course - and so would be assessed as indicating favourable conservation status for saproxylic invertebrates in Chirk Castle Park SSSI at that time.

The adoption of a wide range of assemblages for monitoring purposes would provide a stronger approach and would focus on some of the key saproxylic features in Chirk Castle Park and thereby inform site management. The suggested thresholds could be modified according to experience and would need periodic review anyway as additional key species are detected within the site. These should of course be used along with the veteran trees themselves being in good condition.

7.5. Educational aspects

It is important that the nature conservation interests and management implications at Chirk Castle Park 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.

8. Acknowledgements

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9. References

Alexander, K.N.A. 2002. The invertebrates of living and decaying timber in Britain and Ireland – a provisional annotated checklist. *English Nature Research Report No*. **467**.

Alexander, K.N.A. 2004. Revision of the Index of Ecological Continuity as used for saproxylic beetles. *English Nature Research Report No*. **574**.

Alexander, K.N.A. 2008. Tree biology and saproxylic Coleoptera: issues of definitions and conservation language. Pp 9-13 in: Vignon, V. & Asmodé, J.-F. (eds) Proceedings of the 4th Symposium and Workshop on the Conservation of Saproxylic Beetles, held in Vivoin, Sarthe Department – France 27-29 June 2006*. Revue D'Écologie (La Terre et la Vie)* Supplément **10**.

Alexander, K.N.A. 2014. Saproxylic Coleoptera from Calke, Hardwick and Kedleston Parks, Derbyshire: additional records including two species new to the county list and reassessment of site quality and condition. *The Coleopterist* **23**: 72-77.

Alexander, K.N.A. 2015. What do we really know about oak jewel beetle and acute oak decline? *Arboricultural Magazine* **169**: 50-53.

Alexander, K.N.A. 2018. Tree abundance, density and age structure: The key factors which determine species-richness in saproxylic (wood-decay) invertebrates. Chapter 9: 124-133, in: Çolak AH, Kirca S & Rotherham ID (eds) *Ancient Woodlands and Trees: A Guide for Landscape Planners and Forest Managers*. IUFRO World Series Volume 37. Vienna.

Alexander, K.N.A., Dodd, S. & Denton, J.S. 2014. A review of the scarce and threatened beetles of Great Britain. The darkling beetles and their allies. Aderidae, Anthicidae, Colydiidae, Melandryidae, Meloidae, Mordellidae, Mycetophagidae, Mycteridae, Oedemeridae, Pyrochroidae, Pythidae, Ripiphoridae, Salpingidae, Scraptiidae, Tenebrionidae & Tetratomidae (Tenebrionoidea less Ciidae). Species Status No. **18**. *Natural England Commissioned Report* **NECR148**.

Barker, S.R.J, & Foster, A.P. 2009. *Chirk Castle, Wrexham*. Nature Conservation Evaluation. National Trust Conservation Directorate, Swindon (unpublished).

Cox, J. & Sanderson, N. 2001. *Livestock grazing in National Trust parklands – its impact on tree health and habitat.* Unpublished contract report to National Trust Estates Department, Cirencester.

Drake, C.M., Lott, D.A., Alexander, K.N.A. & Webb, J. 2007. Surveying terrestrial and freshwater invertebrates for conservation evaluation. *Natural England Research Report* **NERR005**.

Fowles, A.P., Alexander, K.N.A. & Key, R.S. 1999. The Saproxylic Quality Index: evaluating wooded habitats for the conservation of dead-wood Coleoptera. *The Coleopterist* **8**: 121-141.

Hyman, P.S. (Revised and updated by Parsons, M.S.) 1992. A review of the scarce and threatened Coleoptera of Great Britain. Part 1. UK Nature Conservation No.**3**. Joint Nature Conservation Committee, Peterborough.

Hyman, P.S. (Revised and updated by Parsons, M.S.) 1994. A review of the scarce and threatened Coleoptera of Great Britain. Part 2. UK Nature Conservation No.**12**. Joint Nature Conservation Committee, Peterborough.

Judd, S. 1999. Wales Parkland Survey (Stage 5 – 1996) Chirk Castle Park Saproxylic Invertebrates. *CCW Contract Science Report No*. **352**.

Lane, S.A. 2017. A review of the status of beetles of Great Britain. The clown beetles and the false clown beetles (Histeridae and Sphaeritidae). Species Status No.**32**. *Natural England Commissioned Research* **NECR235**.

Lonsdale, D. (ed). 2013. *Ancient and other veteran trees: further guidance on management.* The Tree Council, London.

Nieto, A. & Alexander, K.N.A. 2010. *European Red List of Saproxylic Beetles.* Luxembourg: Publications Office of the European Union.

Read, H.J. (ed). 2000. *Veteran Trees: A guide to good management*. English Nature, Peterborough.

10.1. Appendix 1. Cumulative list of wood-decay Coleoptera (beetles) known from Chirk Castle Park, with SQI and IEC analysis.

Species shown as scoring xero are saproxylic species present at Chirk but which were not acknowledged as saproxylic when the list used by Fowles *et al*. (1999) was compiled. Some of these species are established introductions but others are long-term natives.

Family	Species	GB status	SQI score	IEC score	1993	1996	2018
Histeridae	*Abraeus granulum*	NS (Lane 2017)	8	3		8	
	Abraeus perpusillus (globosus)		4			4	
	Plegaderus dissectus		8	2		8	
	Gnathoncus buyssoni	NS (Lane 2017)				0	
	Paromalus flavicornis		2			2	2
Ptliidae	*Nossidium pilosellum*	NS (Hyman 1994)	8			8	
	Ptenidium gressneri	NS (Hyman 1994)	8	2		8	
	Ptinella aptera		2			2	
	Pteryx suturalis		2			2	
Leiodidae	*Anisotoma humeralis*		2			2	2
	Anisotoma orbicularis		2			2	
	Agathidium confusum	RDBi (Hyman 1994)	24			24	
	Agathidium nigrinum		2			2	
	Agathidium nigripenne		2			2	
	Agathidium varians		2			2	
Staphylinidae	*Phyllodrepoidea crenata*	NS (Hyman 1994)	8			8	
	Coryphium angusticolle		2			2	
	Acrulia inflata		2			2	
	Dropephylla devillei		2			2	
	Dropephylla gracilicornis	NS (Hyman 1994)				0	
	Dropephylla ioptera		1			1	
	Dropephylla koltzei (vilis)		1			1	
	Hapalaraea pygmaea		2			2	
	Phloeonomus punctipennis		2			2	
	Xylostiba monilicornis	NS (Hyman 1994)	8			8	
Pselaphinae	*Batrisodes venustus*	NS (Hyman 1994)	8	3		8	
	Euplectus karstenii		2			2	
	Euplectus piceus		2			2	
	Bibloporus bicolor		2			2	
	Bibloporus minutus	NS (Hyman 1994)	8	2		8	
Staphylinidae	*Sepedophilus littoreus*		2			2	
	Atheta liturata		2			2	
	Dinaraea aequata		1			1	
	Bolitochara lucida		2			2	
	Bolitochara pulchra	NS (Hyman 1994)	8			8	
	Leptusa fumida		1			1	
	Leptusa pulchella		2			2	
	Leptusa ruficollis		1			1	
	Agaricochara latissima		2			2	
	Anomognathus cuspidatus		2			2	
	Homalota plana		2			2	
	Ischnoglossa prolixa		2			2	

Family	Species	GB status	SQI score	IEC score	1993	1996	2018
	Phloeopora bernhaueri		2			2	
	Phloeopora testacea		1			1	
	Placusa pumilio		2			2	
Scaphidiidae	*Scaphidium quadrimaculatum*		2		2	2	
	Scaphisoma boleti	NS (Hyman 1992)	8			8	
Staphylinidae	*Siagonium quadricorne*		2			2	
Scydmaenidae	*Microscydmus nanus*	NS (Hyman 1994)		2		0	
	Stenichnus bicolor		4	1		4	
Staphylinidae	*Atrecus affinis*		1			1	1
	Gabrius splendidulus		1			1	
	Quedius maurus		4	1		4	4
	Quedius plagiatus		2			2	
	Quedius scitus	NS (Hyman 1994)	8	2	8	8	
	Quedius truncicola	NS (Hyman 1994)	8	3			8
	Nudobius lentus		2			2	
Lucanidae	*Dorcus parallelipipedus*		2			2	2
	Sinodendron cylindricum		2			2	2
Scirtidae	*Prionocyphon serricornis*	NS (Hyman 1992)	8	1			8
Buprestidae	*Agrilus biguttatus*		8				0
Eucnemidae	*Melasis buprestoides*	NS (Hyman 1992)	4	1		4	
	Epiphanis cornutus		8				8
Elateridae	*Denticollis linearis*		1			1	1
	Stenagostus rhombeus		4	1		4	4
	Melanotus castanipes		1		1	1	1
Cantharidae	*Malthinus flaveolus*		1			1	
	Malthodes marginatus		1			1	1
	Malthodes maurus	NS (Alexander 2014)	16			16	
	Malthodes minimus		1			1	
	Malthodes mysticus		2			1	
	Malthodes pumilus	NS (Alexander 2014)	2				2
Dermestidae	*Ctesias serra*		4		4	4	4
Ptinidae	*Ptinomorphus imperialis*		8			8	
	Ptinus subpilosus	NS (Alexander 2017)	8	2		8	
	Grynobius planus		2			2	2
	Xestobium rufovillosum		4	1	4		4
	Hemicoelus fulvicornis		1			1	1
	Anobium inexspectum		8			8	
	Anobium punctatum		1			1	1
	Ptilinus pectinicornis		1		1	1	1
	Dorcatoma chrysomelina		4	1			4
	Dorcatoma flavicornis	NS (Alexander 2017)	8	1		8	8
	Dorcatoma substriata (serra)	NS (Alexander 2017)	16	2	16		16
Lymexylidae	*Hylecoetus dermestoides*		4	1		4	4
Phloiophilidae	*Phloiophilus edwardsii*	NS (Alexander 2014)	8	1			8
Trogosittidae	*Thymalus limbatus*	NS (Alexander 2014)	8	2		8	
Melyridae	*Dasytes aeratus*		2			2	
	Malachius bipustulatus		1			1	1
	Anthocomus fasciatus	NS (Alexander 2014)	4				4
Sphindidae	*Sphindus dubius*	NS (Hyman 1992)	8			8	
	Aspidiphorus orbiculatus		2			2	

Family	Species	GB status	SQI score	IEC score	1993	1996	2018
Nitidulidae	*Epuraea limbata*		2				2
	Epuraea longula	NS (Hyman 1994)	8			8	
	Epuraea marseuli		1			1	
	Epuraea pallescens (florea)		2			2	
	Epuraea silacea (deleta)		1		1		
	Cryptarcha strigata	NS (Hyman 1994)	8		8	8	
	Cryptarcha undata	NS (Hyman 1994)	8			8	
	Glischrochilus hortensis				0		
Monotomidae	*Rhizophagus bipustulatus*		1			1	
	Rhizophagus cribratus		2			2	
	Rhizophagus dispar		1			1	1
	Rhizophagus ferrugineus		2			2	
	Rhizophagus nitidulus	NS (Hyman 1992)	4	1		4	
	Rhizophagus perforatus		2			2	
Silvanidae	*Uleiota planatus*						0
	Silvanus bidentatus	NS (Hyman 1992)	8		8		
Cucujidae	*Pediacus dermestoides*		4	1	4	4	4
Cryptophagidae	*Henoticus serratus*		2			2	
	Cryptophagus dentatus		1			1	
	Cryptophagus micaceus	RDBK (Hyman 1992)	16	3		16	
	Atomaria pulchra		2			2	
Erotylidae	*Dacne bipustulata*		2		2	2	2
	Dacne rufifrons		2		2	2	2
	Triplax aenea		2			2	2
Biphyllidae	*Diplocoelus fagi*	NS (Hyman 1992)	8	2		8	
Cerylonidae	*Cerylon ferrugineum*		2		2	2	2
	Cerylon histeroides		4			4	
Endomychidae	*Endomychus coccineus*		2			2	
	Mycetaea subterranea		2			2	
	Symbioles latus	NS (Hyman 1992)	8	1			8
Latridiidae	*Cartodere constricta*		4			4	
	Enicmus brevicornis	NS (Hyman 1992)	8	1		8	
	Enicmus rugosus	NS (Hyman 1992)	8	2		8	
	Enicmus testaceus		2			2	
Mycetophagidae	*Pseudotriphyllus suturalis*	NS (Alexander *et al* 2014)	4	1		4	4
	Triphyllus bicolor	NS (Alexander *et al* 2014)	4	2		4	4
	Litargus connexus		2			2	2
	Mycetophagus atomarius		2	1		2	
	Mycetophagus multipunctatus		2			2	2
	Mycetophagus piceus		4	2		4	4
	Mycetophagus quadripustulatus		2		2	2	2
Ciidae	*Octotemnus glabriculus*		1			1	1
	Sulcacis nitidus (affinis)		2			2	
	Orthocis alni		2			2	
	Cis bidentatus		2		2	2	2
	Cis bilamellatus						0
	Cis boleti		1			1	1
	Cis castaneus (nitidus)		2			2	2
	Cis fagi		2			2	

Family	Species	GB status	SQI score	IEC score	1993	1996	2018
	Cis festivus	NS (Hyman 1992)	2			2	
	Cis pygmaeus		2			2	2
	Cis submicans (micans)		4				4
	Cis vestitus		2			2	2
	Cis villosulus (setiger)		2			2	
	Ennearthron cornutum		2				2
Tetratomidae	*Hallomenus binotatus*	NS (Alexander *et al* 2014)	8	1		8	
	Tetratoma desmaresti	NS (Alexander *et al* 2014)	16	1			16
	Tetratoma fungorum		2				2
Melandryidae	*Orchesia minor*	NS (Alexander *et al* 2014)	8			8	
	Orchesia undulata		4	1		4	
	Anisoxya fuscula	NS (Alexander *et al* 2014)	16	1			16
	Abdera quadrifasciata	NS (Alexander *et al* 2014)	16	3	16	16	16
	Hypulus quercinus	NR & NT (Alexander *et al* 2014)	16	3		16	
	Melandrya caraboides		4	1		4	
	Conopalpus testaceus		8	1		8	8
Mordellidae	*Mordellistena neuwaldeggiana*	NS (Alexander *et al* 2014)	16	1			16
Colydiidae	*Pycnomerus fuliginosus*						0
	Bitoma crenata		4	1		4	
Tenebrionidae	*Eledona agricola*		4	1	4	4	4
	Scaphidema metallicum					0	
	Prionychus ater		8	1	8	8	8
Oedemeridae	*Ischnomera cinerascens*	NS (Alexander *et al* 2014)	32	1			32
	Ischnomera cyanea		4	1		4	
	Ischnomera sanguinicollis	NS (Alexander *et al* 2014)	8	3		8	
Pyrochroidae	*Pyrochroa coccinea*		4	1	4	4	4
	Pyrochroa serraticornis		1			1	
Salpingidae	*Vincenzellus ruficollis*		2		2	2	
	Salpingus planirostris		1			1	1
	Salpingus ruficollis		1			1	
Aderidae	*Aderus populneus*	NS (Alexander *et al* 2014)	8				8
	Euglenes oculatus	NS (Alexander *et al* 2014)	8	1			8
Scraptiidae	*Anaspis fasciata (humeralis)*		2			2	2
	Anaspis frontalis		1			1	1
	Anaspis garneysi						0
	Anaspis lurida		2				2
	Anaspis maculata						0
	Anaspis pulicaria		1				0
	Anaspis rufilabris		1			1	
	Anaspis thoracica	NS (Alexander *et al* 2014)	8	1		8	8
Cerambycidae	*Rhagium bifasciatum*		1			1	
	Rhagium mordax		1			1	
	Grammoptera ruficornis		1			1	1
	Pachytodes cerambyciformis		2			2	
	Alosterna tabacicolor		2			2	

Family	Species	GB status	SQI score	IEC score	1993	1996	2018
	Rutpela maculata		1			1	
	Phymatodes testaceus		4	1			4
	Clytus arietis		1			1	1
	Anaglyptus mysticus	NS (Hyman 1992)	4			4	
	Pogonocherus hispidulus		2			2	2
	Pogonocherus hispidus		2			2	
	Leiopus nebulosus		2			2	
	Saperda scalaris	NS (Hyman 1992)	8	1		8	
	Tetrops praeustus		2			2	
Curculionidae	*Euophryum confine*						0
	Phloeophagus lignarius		2			2	
	Trachodes hispidus	NS (Hyman 1992)	8	1		8	
Scolytinae	*Scolytus intricatus*		2		2	2	2
	Scolytus rugulosus		2			2	
	Ernoporicus fagi	NS (Hyman 1992)	8	1		8	
	Dryocoetes villosus		2		2	2	2
	Xyleborinus saxesini		4	1		4	
	Trypodendron domesticum		2	1		2	
	Trypodendron signatum	NS (Hyman 1992)	8	1		8	
	Hylesinus crenatus		2			2	
	Hylesinus varius		1			1	
	TOTALS		**SQS**		**105**	**625**	**325**
			SPP		**23**	**170**	**74**
			SQI		**456**	**368**	**439**
			IEC			**62**	**75**
			No. spp		**24**	**173**	**80**

10.2. Appendix 2. Cumulative list of wood-decay Diptera (flies) known from Chirk Castle Park.

Family	Species	Saproxylic	GB status	1996	2018
Tipulidae	*Tipula flavolineata*	yes		1996	2018
	Tipula irrorata	yes		1996	
Limoniidae	*Austrolimnophila ochracea*	yes			2018
	Neolimonia dumetorum	yes		1996	2018
	Epiphragma ocellaris	yes		1996	
	Rhipidia ctenophora	yes	VU		2018
Bolitophilidae	*Bolitophila saundersii*	yes			2018
Diadocidiidae	*Diadocidia ferruginosa*	yes		1996	
	Diadocidia spinosula	yes		1996	
Ditomyiidae	*Symmerus annulatus*	yes		1996	
Keroplatidae	*Cerotelion striatum*	yes			2018
	Macrocera parva	probable		1996	2018
	Macrorrhyncha flava	yes		1996	
	Orfelia nemoralis	yes		1996	
	Orfelia nigricornis	yes			2018
	Orfelia unicolor	yes		1996	
	Platyura marginata	yes		1996	
Mycetophilidae	*Acnemia amoena*	probable	NT	1996	2018
	Alloctocera pulchella	yes		1996	
	Apolephthisa subincana	yes		1996	
	Brevicornu sericoma	yes		1996	2018
	Dynatosoma fuscicorne	yes		1996	2018
	Ectrepesthoneura colyeri	yes	NS	1996	
	Ectrepesthoneura hirta	yes		1996	2018
	Exechiopsis intersecta	possible			2018
	Monoclona rufilatera	yes		1996	2018
	Mycetophila autumnalis	yes			2018
	Mycetophila cingulum	yes		1996	2018
	Mycetophila formosa	yes			2018
	Mycetophila lunata	yes		1996	
	Mycetophila marginata	probable			2018
	Mycetophila ocellus	probable		1996	2018
	Mycetophila ornata	yes			2018
	Mycetophila pumila	yes			2018
	Mycetophila tridentata	yes			2018
	Mycomya annulata	yes		1996	
	Mycomya cinerascens	yes		1996	
	Mycomya circumdata	yes		1996	
	Mycomya marginata	yes		1996	
	Mycomya sigma	yes		1996	
	Mycomya wankowiczii	yes		1996	
	Neoempheria pictipennis	yes		1996	
	Phronia biarcuata	yes		1996	2018

Family	Species	Saproxylic	GB status	1996	2018
	Phronia conformis	yes		1996	2018
	Phronia forcipata	probable		1996	2018
	Phronia humeralis	yes			2018
	Phronia nigricornis	probable		1996	2018
	Phronia notata	probable			2018
	Phronia triangularis	probable			2018
	Platurocypta testata	yes		1996	
	Saigusaia flaviventris	yes		1996	
	Tetragoneura sylvatica	yes		1996	2018
	Trichonta foeda	yes		1996	
	Trichonta melanura	yes			2018
	Trichonta vitta	yes		1996	2018
	Zygomyia humeralis	yes		1996	2018
Psychodidae	*Trichomyia urbica*	yes			2018
	Vaillantodes miksici	probable			2018
Mycetobiidae	*Mycetobia pallipes*	yes			2018
Anisopodidae	*Sylvicola cinctus*	yes			2018
Trichoceridae	*Cladoneura hirtipennis*	yes	NS		2018
	Apiloscatopse scutellata	yes			2018
Xylophagidae	*Xylophagus ater*	yes		1996	
Scenopinidae	*Scenopinus niger*	yes	NS		2018
Hybotidae	*Anthalia beatricella*	probable	NT		2018
	Euthyneura myrtilli	yes		1996	
	Oedalea holmgreni	probable		1996	2018
	Oedalea stigmatella	yes		1996	
	Tachypeza nubila	yes			2018
Dolichopodidae	*Australachalcus melanotrichus*	yes	NS		2018
	Medetera impigra	yes		1996	
	Medetera tristis	yes		1996	
	Medetera truncorum	yes		1996	
	Sciapus platypterus	yes		1996	2018
Phoridae	*Anevrina thoracica*	probable			2018
Syrphidae	*Brachyopa scutellaris*	yes		1996	
	Brachypalpoides lenta	yes		1996	
	Brachypalpus laphriformis	yes			2018
	Criorhina berberina	yes		1996	
	Ferdinandea ruficornis	yes	NS		2018
	Myathropa florea	yes		1996	
	Xylota segnis	yes		1996	
Megamerinidae	*Megamerina dolium*	yes		1996	
Lonchaeidae	*Lonchaea caucasica*	yes			2018
Lauxaniidae	*Pseudolyciella stylata*	probable			2018
Clusiidae	*Clusiodes sp*	yes			2018
Odiniidae	*Odinia boletina*	yes			2018
Chloropidae	*Lasiambia brevibucca*	yes	NS		2018
Drosophilidae	*Drosophila obscura*	yes			2018
Anthomyiidae	*Eustalomyia festiva*	yes			2018

Family	Species	Saproxylic	GB status	1996	2018
	Pegomya testacea	possible	NT		2018
Fanniidae	*Fannia aequilineata*	yes	NS		2018
Muscidae	*Helina abdominalis*	yes	NS		2018
	Helina pertusa	yes			2018

10.3. Appendix 3. Diptera (flies) from flight traps in Chirk Castle Park. Those marked * were also recorded in 1996 by Judd (1999).

Family	Species	Trap 183	Trap 195	Trap 200	Trap 544	Trap 565	Trap 576	Assemblage	Status
Tipulidae	*Nephrotoma quadrifaria*				1m 2f		f		
	**Tipula flavolineata*			f				saproxylic	
	**Tipula fascipennis*						2m 1f		
	**Tipula paludosa*	mf			several mf	f	mf		
Limoniidae	*Austrolimnophila ochracea*		f			2m		saproxylic	
	**Limonia nubeculosa*		mf						
	**Neolimonia dumetorum*	m				2m 1f	mf	saproxylic	
	Ormosia hederae						mf		
	**Ormosia nodulosa*					m			
	Rhipidia ctenophora						1m 1f	saproxylic	Vulnerable
Bolitophilidae	*Bolitophila saundersii*	1m						saproxylic	
Keroplatidae	**Macrocera parva*						f	saproxylic	
	Cerotelion striatum	1f				1m		saproxylic	
	Orfelia discoloria			1m					
	Orfelia nigricornis						1f	saproxylic	
Mycetophilidae	**Acnemia amoena*					1f		saproxylic	Near Threatened
	**Acnemia nitidicollis*					1m			
	Allodia alternans		1m						
	**Apolephthisa subincana*					3m 2f			
	**Boletina gripha*	1m							
	**Boletina trivittata*					1m			
	Brachypeza bisignata					1f			
	**Brevicornu griseicolle*	1m				2m			
	**Brevicornu sericoma*	2m	1m			2m		saproxylic	
	Coelosia tenella						1f		
	**Docosia gilvipes*					3m	1m		
	**Dynatosoma fuscicorne*					1f		saproxylic	
	**Ectrepesthoneura hirta*						1m	saproxylic	
	Exechia bicincta					1f			
	Exechia festiva					1m			
	Exechia fusca	f				1f	1f		
	Exechiopsis intersecta	2f					1m 1f		
	Leia cylindrica					1m			
	**Leia fascipennis*	2m				1m	1f		
	**Leia winthemii*					1m			
	**Monoclona rufilatera*					3m		saproxylic	
	Mycetophila autumnalis						1m	saproxylic	

Family	Species	Trap 183	Trap 195	Trap 200	Trap 544	Trap 565	Trap 576	Assemblage	Status
	**Mycetophila cingulum*					1m 1f	2f	saproxylic	
	**Mycetophila edwardsi*					3m 2f			
	Mycetophila formosa					1f		saproxylic	
	Mycetophila fungorum					1m			
	Mycetophila marginata	2m			3m	4m		saproxylic	
	**Mycetophila ocellus*		2f			several m 1f		saproxylic	
	Mycetophila ornata	1m					1m	saproxylic	
	Mycetophila perpallida					1m			
	Mycetophila pumila					1m 1f		saproxylic	
	Mycetophila signatoides					1m			
	Mycetophila tridentata	2f		1f	1m 1f	numerous mf	1m	saproxylic	
	**Phronia biarcuata*					1m 1f		saproxylic	
	**Phronia conformis*					4m		saproxylic	
	**Phronia forcipata*					1m 1f		saproxylic	
	Phronia humeralis						1m	saproxylic	
	**Phronia nigricornis*	2m 1f				4m 1f	2m 1f	saproxylic	
	Phronia notata					1m		saproxylic	
	Phronia triangularis					1m			
	Rymosia fasciata					1m			
	Sciophila geniculata		2m 1f					saproxylic	Nationally Scarce
	Sciophila interrupta			1m 1f					Nationally Scarce
	**Synapha fasciata*					1f			
	**Synapha vitripennis*					5m			
	Tetragoneura sylvatica					1m		saproxylic	
	Trichonta melanura					1m		saproxylic	
	**Trichonta vitta*		1m			1m		saproxylic	
	**Zygomyia humeralis*					1m		saproxylic	
Sciaridae	*Lycoriella ingenua*				m		m		
Psychodidae	*Psychoda phalaenoides*	m	m			m			
	Trichomyia urbica	m	m					saproxylic	
	Vaillantodes miksici		m	m				saproxylic	
Mycetobiidae	*Mycetobia pallipes*					m [+ several f]		saproxylic	
Anisopodidae	*Sylvicola cinctus*		mf		m	2m		saproxylic	
	Sylvicola punctatus						m		
Trichoceridae	*Cladoneura hirtipennis*	m						saproxylic	Nationally Scarce
Scatopsidae	*Apiloscatopse flavicollis*						f		
	Apiloscatopse scutellata					f		saproxylic	
Ceratopogonidae	*Serromyia femorata*						f		
Rhagionidae	**Rhagio lineola*					m			

Family	Species	Trap 183	Trap 195	Trap 200	Trap 544	Trap 565	Trap 576	Assemblage	Status
	**Rhagio scolopaceus*				m	m			
Stratiomyidae	**Beris chalybata*					f			
	Beris vallata						f		
	**Chorisops tibialis*		m				f		
Scenopinidae	*Scenopinus niger*			1f		1f		saproxylic	Nationally Scarce
Hybotidae	*Anthalia beatricella*			1f				saproxylic	Near Threatened
	**Hybos culiciformis*			mf					
	**Oedalea holmgreni*					1m 2f		saproxylic	
	Platypalpus luteus					mf			
	**Platypalpus pallidiventris*	m				f			
	**Platypalpus pectoralis*						f		
	Tachypeza nubila	m						saproxylic	
	Trichinomyia flavipes					m			
Empididae	*Empis albinervis*					m			
	**Empis longipes*				f				
	Empis lutea					m			
	**Empis punctata*		6f	3f		mf	f		
	**Empis stercorea*					f			
	**Rhamphomyia erythrophthalma*				m				
Dolichopodidae	*Australachalcus melanotrichus*		m					saproxylic	Nationally Scarce
	Chrysotimus molliculus	f			mf				
	Chrysotus cilipes				2f				
	**Chrysotus gramineus*	m		m	m 2f	m			
	Dolichopus festivus			m					
	Rhaphium appendicuatum				m				
	**Sciapus platypterus*	f	f	f	f	mf	f		
	Xanthochlorus galbanus		m			mf			
Phoridae	*Anevrina thoracica*			f				saproxylic	
Syrphidae	*Brachypalpus laphriformis*			1f				saproxylic	
	Ferdinandea ruficornis		f		4f			saproxylic	Nationally Scarce
	**Syrphus ribesii*				f				
Lonchaeidae	*Lonchaea caucasica*					2f		saproxylic	
Sciomyzidae	**Pherbellia scutellaris*					f			
Sepsidae	**Sepsis cynipsea*			m	m				
Lauxaniidae	*Homoneura interstincta*			2f		f			
	Meiosimyza platycephala	f							
	Pseudolyciella stylata				m	2m		saproxylic	
	Tricholauxania praeusta					mf			
Clusiidae	*Clusiodes sp*					f		saproxylic	
Odiniidae	*Odinia boletina*						f	saproxylic	

Family	Species	Trap 183	Trap 195	Trap 200	Trap 544	Trap 565	Trap 576	Assemblage	Status
Heleomyzidae	*Morpholeria ruficornis*					3m			
	Tephrochlamys flavipes				f	1f			
	Tephrochlamys rufiventris					6m	f		
Chloropidae	*Chlorops hypostigma*						f		
	Lasiambia brevibucca		1m 22f			mf		saproxylic	pNationally Scarce
Drosophilidae	*Drosophila obscura*				f			saproxylic	
	Scaptomyza pallida					mf			
Scathophagidae	*Scathophaga furcata*						m		
	Scathophaga stercoraria				f	f			
Anthomyiidae	*Anthomyia procellaris*	m			f				
	Delia criniventris	m							
	Delia florilega	m							
	Delia platura	m			m		2m 1f		
	Eustalomyia festiva				2f			saproxylic	
	Hylemya vagans	mf		mf		1m 2f	f		
	Hylemya variata	m		mf	m		m		
	Lasiomma strigilatum					m			
	Paradelia intersecta					m			
	Pegomya testacea			m					pNear Threatened
Fanniidae	*Fannia aequilineata*			f	f	f	mf	saproxylic	pNationally Scarce
Muscidae	*Coenosia intermedia*						m		
	Eudasyphora cyanella					f	m		
	Helina abdominalis					4f		saproxylic	pNationally Scarce
	Helina celsa			m					
	Helina depuncta		f			mf			
	Helina impuncta	mf	f	f	mf		f		
	Helina pertusa		f		2f	f	m	saproxylic	
	Muscina levida			f					
	Phaonia errans					f	mf		
	Phaonia pallida	f				f			
	Phaonia subventa								
	Phaonia tuguriorum		f						
	Phaonia valida					f	f		
	Polietes meridionalis			m					
Rhinophoridae	*Melanophora roralis*				1m				
	Paykullia maculata	f				f			
Calliphoridae	*Calliphora vicina*		f			f			
	Pollenia angustigena				**f**				
	Pollenia rudis				mf				

10.4. Appendix 4. Invertebrates other than Diptera taken in flight traps in Chirk Castle Park. Those marked * were also recorded in 1996 by Judd (1999).

Group & Family	Species Identification	183 ok	195 hb	200 ok	544 ok	565 ok	576 ok	Status	Assemblage
Coleoptera									
Aderidae	*Aderus populneus*		1					NS	saproxylic
	Euglenes oculatus	7		45		8	2	NS	saproxylic
Cantharidae	**Malthodes marginatus*			1f					saproxylic
	Malthodes pumilus			1			1	NS	saproxylic
Carabidae	*Dromius quadrimaculatus*					1			epiphyte
	Pterostichus niger				1				field layer
Cerambycidae	**Pogonocherus hispidulus*					1			saproxylic
Cerylonidae	**Cerylon ferrugineum*			1					saproxylic
Ciidae	*Cis bilamellatus*		1f				2ff		saproxylic
	**Cis pygmaeus*						1		saproxylic
	Cis submicans (micans)						2		saproxylic
	Ennearthron cornutum			2					saproxylic
Coccinellidae	*Harmonia axyridis*		6						
Colydiidae	*Pycnomerus fuliginosus*	2		1		2			saproxylic
Cucujidae	**Pediacus dermestoides*				2			Euro RL	saproxylic
Curculionidae	*Euophryum confine*		1	1		3	1		saproxylic
	Orchestes rusci						1		arboreal
	Phyllobius argentatus					1			arboreal
	Phyllobius pyri						4		arboreal
Dermestidae	**Ctesias serra*	1	2			1	1		saproxylic
Elateridae	*Athous haemorrhoidalis*	1				3	1		field layer
	**Denticollis linearis*						1		saproxylic
	**Melanotus castanipes*	1		4	1	2			saproxylic
Endomychidae	*Symbiotes latus*			2				NS	saproxylic
Eucnemidae	*Epiphanis cornutus*			1				Euro RL	saproxylic
Histeridae	**Paromalus flavicornis*			1					saproxylic
Latridiidae	*Aridius nodifer*					2			
Leiodidae	**Anisotoma humeralis*		1				1		saproxylic
Lucanidae	**Sinodendron cylindricum*		1						saproxylic
Lymexylidae	**Hylecoetus dermestoides*		1m 1f		1f				saproxylic
Melandryidae	*Anisoxya fuscula*		1					NS	saproxylic
	**Conopalpus testaceus*	1							saproxylic
Mordellidae	*Mordellistena neuwaldeggiana*	1						NS	saproxylic
Mycetophagidae	**Mycetophagus piceus*			1				NS	saproxylic
	**Triphyllus bicolor*			1				NS	saproxylic
Nitidulidae	*Epuraea limbata*						1		saproxylic
Oedemeridae	*Ischnomera cinerascens*						2	NS	saproxylic
Phloiophilidae	*Phloiophilus edwardsii*				1			NS	saproxylic
Ptinidae	**Anobium fulvicorne*	1							saproxylic
	**Anobium punctatum*	9	3	13	3	12	1		saproxylic
	Dorcatoma chrysomelina	1		abundant	4	3	10		saproxylic
	**Dorcatoma flavicornis*					abundant		NS	saproxylic
	**Grynobius excavatus*	2	6				2		saproxylic
	**Ptilinus pectinicornis*					3			saproxylic
Salpingidae	**Salpingus planirostris*					1			saproxylic

Group & Family	Species Identification	183 ok	195 hb	200 ok	544 ok	565 ok	576 ok	Status	Assemblage
Scirtidae	*Prionocyphon serricornis*		2					NS	saproxylic
Scolytinae	**Dryocoetes villosus*			2	4	16	10		saproxylic
	**Scolytus intricatus*				2				saproxylic
Scraptiidae	**Anaspis fasciata*			2	1				saproxylic
	Anaspis garneysi		3ff	2ff		3ff	1f		saproxylic
	Anaspis lurida					1f	4ff		saproxylic
	Anaspis maculata			2					saproxylic
	Anaspis pulicaria			2			1		saproxylic
	**Anaspis thoracica*		1f					NS	saproxylic
Staphylinidae	**Quedius maurus*		1						saproxylic
	Quedius truncicola					8		NS	saproxylic
Tenebrionidae	**Prionychus ater*	1							saproxylic
Hemiptera									
Anthocoridae	*Temnostethus pusillus*						1m		epiphyte
Issidae	*Issus coleoptratus*					2			arboreal
Miridae	*Calocoris quadripustulatus*				1				arboreal
	Dryophilocoris flavoquadrimaculatus				1				arboreal
Hymenoptera									
Vespidae	*Vespa crabro*		1						
Psocoptera									
Caeciliusidae	*Valenzuela flavidus*	1							arboreal
Ectopsocidae	*Ectopsocus briggsi*	1							arboreal
Elipsocidae	*Elipsocus hyalinus*					1			epiphyte
Lachesillidae	*Lachesilla pedicularia*					1			epiphyte
Psocidae	*Atlantopsocus adustus*					1f			epiphyte
	Loensia fasciata					1			epiphyte
	Loensia variegata	1				1			epiphyte
	Trichadenotecnum sexpunctatum					1			epiphyte

10.5. Appendix 5. Invertebrates recorded by hand search techniques in Chirk Castle Park. Those marked * were also recorded in 1996 by Judd (1999).

Family	Species Identification	Status	Assemblage	Locator
Coleoptera				
Buprestidae	*Agrilus biguttatus*		saproxylic	
Cantharidae	*Cantharis decipiens*			
	Cantharis nigricans			
	Cantharis pellucida			
	**Malthodes marginatus*		saproxylic	
	Rhagonycha fulva			
	Rhagonycha lignosa			
Carabidae	*Calodromius spilotus*		epiphyte	
	Dromius meridionalis		epiphyte	
	Dromius quadrimaculatus		epiphyte	
	Laemostenus terricola			
Cerambycidae	**Clytus arietis*		saproxylic	
	**Grammoptera ruficornis*		saproxylic	
	Phymatodes testaceus		saproxylic	
Cerylonidae	**Cerylon ferrugineum*		saproxylic	
Ciidae	**Cis bidentatus*		saproxylic	
	Cis bilamellatus		saproxylic	
	**Cis boleti*		saproxylic	
	**Cis castaneus*		saproxylic	
	**Cis pygmaeus*		saproxylic	
	**Cis vestitus*		saproxylic	
	Ennearthron cornutum		saproxylic	
	**Octotemnus glabriculus*		saproxylic	
Coccinellidae	*Coccinella septempunctata*			
Colydiidae	**Bitoma crenata*		saproxylic	
	Pycnomerus fuliginosus		saproxylic	
Cucujidae	**Pediacus dermestoides*	Euro RL	saproxylic	
Curculionidae	*Euophryum confine*		saproxylic	
	Phyllobius pyri			
Dermestidae	**Ctesias serra*		saproxylic	
Elateridae	*Agriotes pallidulus*			
	Athous haemorrhoidale			
	Kibunea minuta			
	**Melanotus castanipes*		saproxylic	
	**Stenagostus rhombeus*		saproxylic	
Erotylidae	**Dacne bipustulata*		saproxylic	
	**Dacne rufifrons*	Euro RL	saproxylic	
	**Triplax aenea*		saproxylic	
Histeridae	**Paromalus flavicornis*		saproxylic	
Latridiidae	*Aridius nodifer*			
Lucanidae	**Dorcus parallelepipedus*		saproxylic	
	**Sinodendron cylindricum*		saproxylic	
Lymexylidae	**Hylecoetus dermestoides*		saproxylic	
Melandryidae	**Abdera quadrifasciata*	NS	saproxylic	by Myddleton Lake only

Family	Species Identification	Status	Assemblage	Locator
Melyridae	*Anthocomus fasciatus*	NS	saproxylic	by Home Farm Cottage
	**Malachius bipustulatus*		saproxylic	
Monotomidae	**Rhizophagus dispar*		saproxylic	
Mycetophagidae	**Litargus connexus*		saproxylic	
	**Mycetophagus multipunctatus*		saproxylic	
	**Mycetophagus quadripustulatus*		saproxylic	
	**Pseudotriphyllus suturalis*	NS	saproxylic	
Phloiophilidae	*Phloiophilus edwardsii*	NS	saproxylic	
Ptinidae	**Anobium punctatum*		saproxylic	
	**Dorcatoma flavicornis*		saproxylic	
	Dorcatoma substriata	NS	saproxylic	Tree tag nos. 230, 368, 566
	Xestobium rufovillosum		saproxylic	
Pyrochroidae	**Pyrochroa coccinea*		saproxylic	
Salpingidae	**Salpingus planirostris*		saproxylic	
Scolytinae	**Dryocoetes villosus*		saproxylic	
	**Scolytus intricatus*		saproxylic	
Scraptiidae	**Anaspis frontalis*		saproxylic	
	Anaspis maculata		saproxylic	
	Anaspis regimbarti		saproxylic	
Silvanidae	*Uleiota planata*		saproxylic	
Staphylinidae	**Atrecus affinis*		saproxylic	
Tenebrionidae	**Eledona agricola*		saproxylic	
Tetratomidae	*Tetratoma desmaresti*		saproxylic	Upper park
	Tetratoma fungorum		saproxylic	
Dermaptera				
Forficulidae	*Forficula auricularia*			
Diptera				
Hybotidae	*Tachypeza nubila*		saproxylic	
Rhagionidae	*Rhagio scolopaceus*			
Stratiomyidae	*Chorisops tibialis*			
Syrphidae	*Brachypalpus laphriformis*		saproxylic	
Hemiptera				
Anthocoridae	*Cardiastethus faciiventris*		epiphyte	
	Temnostethus gracilis		epiphyte	
	**Xylocoris cursitans*		saproxylic	
Cicadellidae	*Iassus lanio*			
Microphysidae	*Loricula elegantula*		epiphyte	
Miridae	*Calocoris quadripustulatus*			
	Harpocera thoracica			
	Phylus melanocephalus			
Pentatomidae	*Pentatoma rufipes*			
Tingidae	*Tingis cardui*			
Hymenoptera				
Vespidae	*Vespa crabro*			
Orthoptera				
Tettigoniidae	*Meconema thalassinum*			
Raphidioptera				
Raphidiidae	*Phaeostigma notata*		saproxylic	

Family	Species Identification	Status	Assemblage	Locator
Araneae				
	Salticus scenicus		epiphyte	
	Nuctenea umbratical		epiphyte	
Opiliones				
	Paroligolophus agrestis		epiphyte	

10.6. Data Archive Appendix

The data archive contains:

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

[B] Species records, which are held on the NRW Recorder 6 database.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue http://libcat.naturalresources.wales or http://catllyfr.cyfoethnaturiol.cymru by searching 'Dataset Titles'. The metadata is held as record no 122401.

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