GWENT LEVELS
TRADITIONAL ORCHARD INVERTEBRATE STUDY
2019-2021

REPORT ON THE INVERTEBRATES

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TRADITIONAL ORCHARD INVERTEBRATE STUDY 2019-2021

INTRODUCTION AND BACKGROUND DETAILS

In April 2019 the author was invited by Gemma Bodé (Head of Nature Recovery) of Gwent Wildlife Trust to undertake invertebrate surveys in traditional orchards on the Gwent Levels and on the foreshore of the nearby River Severn, the latter specifically to target saproxylic invertebrates and invertebrate assemblages associated with rafted wood and to assess their relevance to the orchard biota. That part of the survey is covered in a distinct section of this report (page 34 *et seq.*).

THE SURVEY was conducted in late May 2019, early August 2020 and late May 2021. The location of the sites, all of which are listed below, is shown in Figs 1 and 2 and in tables 1, 2 and 3. The total number of orchards visited was 20 spread over 12 days of field work; it should therefore be accepted that some observations and intimations made in this report may require further substantiation.
The spring of 2021 was markedly untypical. The coldest April in 60 years had a sterilising effect on invertebrates, especially species that had become widely active. This retarded the normal periodicity of the developmental stages of many groups which in turn impacted on invertebrate biomass and on the performance of other groups, in particular passerine birds.
This report translates salient aspects the fieldwork into a meaningful synopsis; raw data were transmitted to Gwent Wildlife Trust prior to the production of this report.

ORCHARDS VISITED IN ALPHABETICAL ORDER BY SITE NAME

Blue House Farm Orchard, Wentlooge; **Brick House Farm Orchard**, Redwick; **Bryn House Orchard**, Redwick; **Bryn Road Orchard,** Redwick; **Cherry Orchard Farm Orchard,** Wentlooge; **Common Farm Orchard**, Nash; **Great Newra Farm Orchard**, Goldcliff; **Hawse Farm Orchard**, Wentlooge**; Little Cross Farm Orchard**, Nash; **Magor Community Orchard**, Magor with Undy; **Magor Pill Farm Orchard**, Magor with Undy; **Moorlands Orchard**, Goldcliff; **Myrtle Villa Orchard**, Goldcliff; **Porton Cottage Orchard**, Goldcliff; **Redwick House Orchard**, Redwick; **Rose Cottage North Orchard**, Magor with Undy; **Rose Cottage South Orchard**, Magor with Undy; **St Mary's Church Orchard**, Nash; **Samson Court Orchard**, Goldcliff**; The Willows Orchard**, Whitson, Goldcliff. Most subsequent site references in this report omit the word 'orchard.'

All of the sites visited are in private ownership and access to them was made with the full authorisation of all parties.

TRADITIONAL ORCHARDS ARE PRIORITY HABITATS
under the UK Biodiversity Action Plan (https://data.jncc.gov.uk/data/2829ce47-1ca5-41e7-bc1a-871c1cc0b3ae/UKBAP-BAPHabitats-56-TraditionalOrchards.pdf). The case for BAP status of traditional orchards was largely established by the work of Lush *et. al.* (2009) which supported BAP status through six key conclusions.

THE UK BIODIVERSITY ACTION PLAN defines traditional orchards in the following way:
"*Traditional orchards are structurally and ecologically similar to wood-pasture and parkland, with open-grown trees set in herbaceous vegetation, but are generally distinguished from these priority habitat complexes by the following characteristics: the species composition of the trees, these being primarily in the family Rosaceae; the usually denser arrangement of the trees; the small scale of individual habitat patches; the wider dispersion and greater frequency of occurrence of habitat patches in the countryside. Traditional orchards include plantings for nuts, principally hazel nuts, but also walnuts. Management of the trees is the other main feature distinguishing traditional orchards and wood-pasture and parkland. Trees in traditional orchards are, or were, grown for fruit and nut production, usually achieved through activities such as grafting and pruning*."

Traditional orchards are very much windows on the past supporting not only historic cultivars, but distinct phytoassociations, diverse niches and fastidious time-honoured species linked to the habitat. With alluviation of the Gwent Levels being a comparatively recent Holocene phenomenon and with the alluvium not infrequently transgressed by tidal surges the establishment of top fruit orchards was undoubtedly a challenge that evidently accelerated after 1850. The distinctive Gwent Levels landscape with its grid of functional watercourses meant that orchards required careful and at times strategic siting.

LAYOUT OF THIS REPORT

Sites are referred to by their site name; tables 1, 2 and 3 provide further details. Emphasis is placed on the provision of clear unambiguous details of species using current nomenclature so that, if required, records can be abstracted with confidence. Binomials are given in full at first citation after which they are usually cited without authorship. Vernacular names are rarely employed unless they are widely understood. Illustrations form a key complement to the text, the pagination of which is shown on the contents page.

THE LIVING LEVELS PARTNERSHIP (LLP)

This study was to satisfy the objectives of the Living Levels Partnership which have been defined at: https://static1.squarespace.com/static/5a1d5fb38a02c70db7c34f81/t/5b23a17a6d2a737c4e4253e0/1529061772336/LL_Part_5_Development+of+the+Living+Levels+programme+and+projects_reduced.pdf; https://static1.squarespace.com/static/5a1d5fb38a02c70db7c34f81/t/5b23a1a68a922dca387d127b/1529061825942/LL_Part_6_Scheme+Delivery+and+governance.pdf.

The LLP, supported by the National Lottery Heritage Fund, was established during 2014 following a two year developmental phase to deliver a sustainable vision for the Gwent Levels supported by evidence-based plans for the sustainable management of their distinctive landscape. Projects resulting from the LLP fell into one of three main programmes. Programme 1 covered active conservation and restoration of natural and historic assets. Programmes 2 and 3 determined mechanisms for increased public engagement with those assets. It is hoped that this report will effectively underpin those objectives.

The LLP is led by RSPB Cymru with the following partners: Buglife Cymru, Bumblebee Conservation Trust, Cardiff City Council, Cardiff Museum, Gwent Archives, Gwent Wildlife Trust, Monmouthshire County Council, Natural Resources Wales, Newport City Council, Sustrans and The National Trust.

The partnership covers a land area of 225km^2 extending from Cardiff and the River Rhymney in the west to Chepstow on the banks of the River Wye in Monmouthshire to the east. In addition to the low-lying agricultural land with its distinctive network of watercourses, the project also encompasses the intertidal zone of saltmarshes and littoral sediments that are revealed at low tide along the northern coastline of the Severn Estuary in Wales, hence the wider remit for this study.

THE GWENT LEVELS

The Gwent Levels are composed of two distinct land areas sometimes known as part of Severnside (Peterken, 2008). The Wentlooge Levels (Fig. 1) west of the River Usk extend over 8500 acres or 34 km^2. The Caldicot Levels to the east of the river Usk (Fig. 2) extend over 17,500 acres or 71 km^2. It includes the Newport Wetlands Reserve. This coastal plain is up to six kilometres wide and has eight distinct SSSI designations covering 5906 hectares (14594 acres) of land (Rippon, 1996) and 14500 kms of open land drains. The land covered by this Gwent Levels SSSI complex meets the Severn estuary foreshore at the overlapping boundaries of Ramsar, Special Protection Area and Special Area of Conservation designated sites, theoretically providing high levels of biotic and landscape safeguard. Maps of these designated areas can be viewed at https://magic.defra.gov.uk/MagicMap.aspx.

The landscape and biology of the Gwent Levels has been well documented and includes a number of in-depth studies (Bell & Neumann, 1997; Ferns *et al*., 1977, Peterken, 2008; Pickup, 2019; Rippon, 1996; Steers, 1948) which should be consulted for further information. Some of these authors outline in considerable detail the mechanisms whereby the levels were initiated, developed and constructed.

THE TRADITIONAL ORCHARDS OF THE GWENT LEVELS

Rippon (1996) regarded ecological diversity as a critical feature of landscape to which traditional orchards contributed significantly but were in marked decline. This decline occurred throughout Wales and was given as a 94% loss between 1958 and 1992 (TACP Environmental Consultants, 1994), a virtual elimination of that ecological diversity. That survey confirmed that Monmouthshire orchards suffered comparable declines but from a much higher original base-line thereby retaining proportionately more orchards. Tangible evidence of this decline can be observed readily on the Gwent Levels today and was observed during this study on many occasions, a matter that the LLP is seeking to counteract both through practical measures and the application of science.

Even in decline some orchards retain a sense of grandeur. At Cherry Orchard, Wentlooge, veteran pear trees probably >200 years old have lost many of their original cultivars to their out-grown rootstocks. This site confirms the wider benefits of a light human touch over time, which is quite distinct from abandonment.

THE CHARACTER OF THE TRADITIONAL ORCHARDS

Of the 20 orchards visited three are situated on the Wentlooge Levels (Fig. 1) and 17 are situated on the Caldicot Levels (Fig. 2). No single orchard resembles any of the others. Some orchards have been almost eradicated. The perry pear orchard at Brick House, Redwick (cover illustration), is reduced to two veteran trees, one of which is entomologically significant. At Bryn House, Redwick, only 'shadows' and stumps of traditional orchard trees remain following replanting to a more modern specification during 2004.

At Myrtle Villa (Fig. 8) the traditional orchard occupies an elongated triangle of land which was completely subsumed by scrub woodland with dense brambles and secondary tree growth, prior to its reclamation with heavy equipment. A similar situation pertained at Samson Court where a mixed top fruit orchard reverted to unmanaged woodland, clearance revealing a graveyard of agricultural equipment dating to the mid-1900s. Despite this there was, yet again, evidence of a rare specialised insect.

The veteran pear trees at Cherry Orchard (Fig. 11) exemplify faded grandeur in an orchard of great character. This site demonstrates interconnected sequences of habitat types including traditional hay meadows, reens, grips, helophytes and tall herbs contributing to high biodiversity. The ground flora defines a Hemlock Water-dropwort-dominated tall-herb mire variant of M28 phytoassociation (Rodwell, 1991) with abundant grasses *Phalaris* sp., Sorrel *Rumex acetosa* L., marginal Yellow Flag Iris *Iris pseudacorus* L. and occasional Marsh Fern *Thelypteris palustris* Schott all developed in maritime shelter on euhaline alluvium. Its pear trees harbour distinct assemblages of saproxylic invertebrates including little-known species and its adjacent traditional MG5 phytoassociation hay meadows support pollinating insects and butterflies such as the Dingy Skipper *Erynnis tages* (Linnaeus, 1758). Many orchards are circumscribed by reens and outgrown Crack Willows *Salix* x *fragilis* L. with their own attendant entomofauna (Figs 33, 34, 35). A fine Black Poplar *Populus nigra* L. at Porton Cottage almost certainly exemplifies traditional 'cottage' plant husbandry.

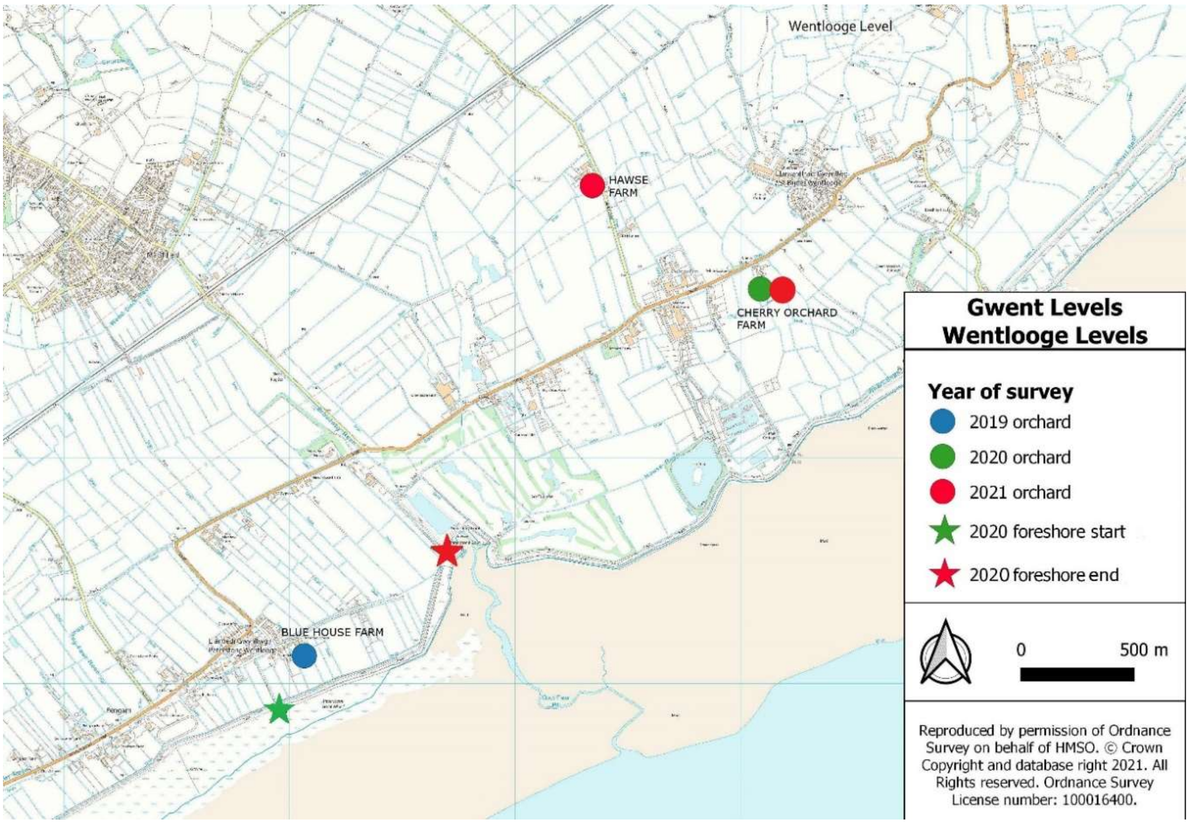


Fig. 1. Wentlooge Levels. Location of traditional orchards visited 2019-2021 and foreshore visited 2020. All of the orchards are located within the Gwent Levels SSSI complex of eight distinct designations.

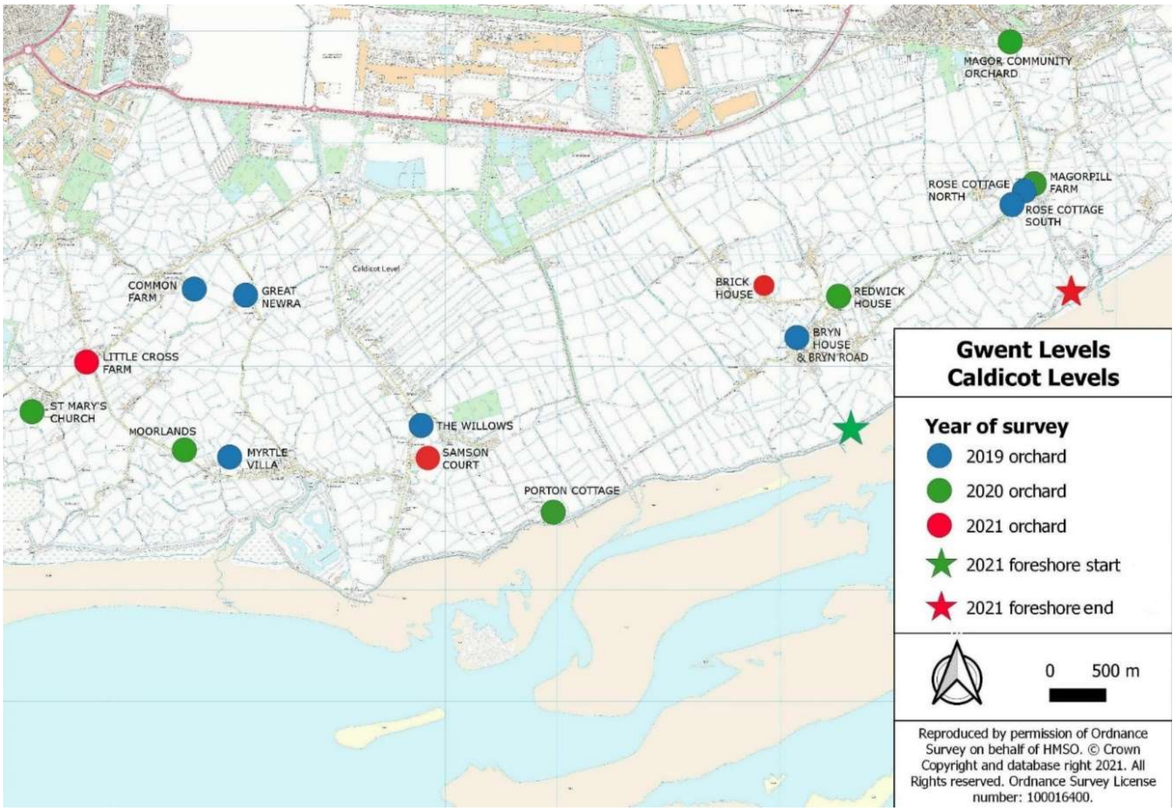


Fig. 2. Caldicot Levels. Location of traditional orchards visited 2019-2021 and foreshore visited 2021. All of the orchards are located within the Gwent Levels SSSI complex of eight distinct designations.

It seems that Cherry Orchard (several eponymous cultivated cherries exist near the farmhouse) may have been under-grazed seasonally, for all of the pear trees have been high-worked; grazing may have lapsed as noxious Hemlock Water-dropwort *Oenanthe crocata* L. proliferated. Although The Willows at Whitson (Fig. 10) has lost many of its veteran trees to wind-throw tose that remain demonstrate the benefits of grazing continuity, in this case by sheep, over almost three decades. This has created an open well-insolated relatively uniform environment resembling pasture-woodland.
Stocking orchards with horses is almost invariably counterproductive in relation to orchard fruit trees and some orchards have been somewhat degraded by horses over an extended period of time; the presence of horses also places constraints on orchard restoration success.
There is no available prescription for a 'perfect' invertebrate orchard. Like nature itself, invertebrates abhor a vacuum and are often highly adaptive to what an orchard offers. The cantharid beetles *Rhagonycha lignosa* (Müller, 1764) and *R. nigriventris* Motschulsky, 1860 are often associated with open woodlands or woodland edges and occurred only in the more neglected unmanaged orchards. The ideal traditional orchard is perhaps the one that delivers the largest number of options for all life to which invertebrates must succeed or fail through tested processes of accommodation (Fig. 3).

Fig. 3. Mouth-voided pellet of Jackdaw *Corvus monedula* L., The Willows, 28 May 2019. The following identifiable species of beetle are represented as part of the daily intake of a single bird: *Amara aenea* (De Geer, 1774); *Harpalus rufipes* (De Geer, 1774); *Poecilus cupreus* (Linnaeus, 1758); *Pterostichus madidus* (Fabricius, 1775); *Philonthus cognatus* Stephens, 1832; *Agriotes lineatus* (Linnaeus, 1767) all mostly terrestrial; *Onthophagus coenobita* (Herbst, 1783); *Agrilinus ater* (De Geer, 1774); *Acrossus rufipes* (Linnaeus, 1758); *Aphodius* sp. all mammalian dung specialists; the arboreal longhorn beetle A*naglyptus mysticus* (Linnaeus, 1758) and the weevil *Liophloeus tessulatus* (Müller, 1776). Other insects consumed are the arboreal bug *Acanthosoma haemorrhoidale* (Linnaeus, 1758), the grasshopper *Pseudochorthippus parallelus* (Zetterstedt, 1821) and the social wasp *Vespula vulgaris* (Linnaeus, 1758).

The land area occupied by the individual orchards varies but few exceed two acres in extent; the land areas of eight orchards are given in Figs 6-13. The Willows is a 'high value' orchard (Table 1) and extending over 0.97 ha or 2.4 acres is one of the largest. Smaller orchards such as Blue House Farm (0.27 ha or 0.66 acres) (Fig. 9) and Porton Cottage (0.24 ha or 0.59 acres) can make valuable contributions to landscape and biota (Tables 1, 2 and 3). Rose Cottage Orchard (Fig. 6) is effectively two compartments separated by buildings; this site occupies 0.76 ha or 2.6 acres overall. Magor Pill Farm Orchard is only a few metres distant from Rose Cottage so that together these orchards form an integrated complex providing significant ecological connectivity.

HISTORY AND ARCHAEOLOGY OF SURVEYED TRADITIONAL ORCHARDS

Some knowledge of the origins in time of the extant Gwent Levels traditional orchards may be gained from the documented history of the varieties, many of which have been confirmed by DNA-based cultivar naming programmes. Early historic apple varieties such as 'Costards' or 'Court Pendu Plat' are presently unrecorded from the Gwent Levels and the extant orchards appear to reflect the general upsurge in top fruit orcharding that hallmarked Victoriana (Twiss, 1999).

The known dates of introduction of particular top fruit varieties (Taylor, 1948; 1949) do not date the establishment of a particular orchard because many moderately old varieties are still planted now, for example 'Bramley's Seedling' which entered commerce during the 1870s. Dates of introduction have other significance, namely the possibility of establishing a varietal '*terminus post quem*' for particular orchards. Redwick House Orchard supports a wide range of cultivars including 14 varieties of apple and several varieties of plums and gages reflecting well on varietal diversity. Although it includes one or two long-favoured older varieties, such as 'Ashmead's Kernel' (*c*1740) and 'Bramley Seedling' (*c*1876), the origins in time of the vast majority of the varieties at Redwick House Orchard align in such a way that an establishment date of *c*1925 is feasible. Magor Pill Farm Orchard could have been established *c*1895 on the basis of dominance of 'Bramley Seedling' and 'Newton Wonder'. Great Newra Farm Orchard (Fig. 7) is evidently older since it includes the old Herefordshire cider apple 'Strawberry Norman', 'Tom Putt' a dual purpose apple dating to *c*1700 and 'Warner's King' another dual purpose apple thought to have been cultivated before 1780. Similarly the pear orchard at Cherry Orchard Farm (Fig. 11) with trees perhaps more than 200 years old includes the dessert pear 'Beurré D'Angleterre' thought to have been cultivated in western France as early as 1630.

Varietal information enables some comparison to be made of individual landowner's cultivar tastes, although there is an observable trend towards multi-purpose varieties, for example the indigenous 'Brithmawr' at The Willows which can be eaten, cooked, or pressed. This orchard demonstrates a wide spectrum of taste and includes the apples 'Bridstow Wasp' and the 'old' (Király *et al*., 2015) Hungarian 'Herceg Batthyanyi Alma'. Centres of varietal origin include Ireland, the Low Countries, and in the case of 'Striped Beefing' (Fig. 4), Norfolk. The overall range of varieties suggests that professional pomologists were engaged in their selection. John Basham (1845-1927) founded Fairoak Nurseries at Bassaleg in 1878 and as a Fellow of Royal Horticultural Society was influential in the management of Monmouthshire's orchards.

Fig. 4. Porton Cottage Orchard, 8 August 2020. The striking culinary apple 'Striped Beefing' discovered in Norfolk in 1794 is believed not to have been cultivated widely until about 1840, which together with other lines of evidence suggests that the parent tree and the orchard were established almost 200 years ago.

RELATIONSHIPS BETWEEN THE AGE AND THE SIZE OF VETERAN APPLE TREES

Although some orchard fruit trees may achieve large size, direct comparisons need to be made with care as size does not necessarily reflect the age of a tree. Factors to consider include declining annual wood increment into post-maturity, soil type and condition, and the extent of mistletoe load, which itself will vary with fruit tree variety. Whilst trunk girth increases with time, metrication is not, in the case of traditional orchard fruit trees, a definitive guide to age. Informed visual assessment of a fruit tree that takes account of its overall condition is a useful guide to its age. At St Mary's Church Orchard a veteran apple tree of the variety 'Mère de Ménage' (syn. 'Flanders Pippin') was found on 8 August 2020 to have a large fragment of a late 17th century black glass sack bottle embedded in the ground against its trunk. This variety was cultivated in France as early as 1740 but it is likely that the bottle identifies more closely with open field activities than with the existing orchard. The bole of this veteran tree, estimated to be not less than 90 years old, measured 132 cms in circumference 150 cms above the ground on 8 August 2020.

A healthy tree of the same variety growing in Worcestershire known to be 42 years old measured 136 cms in circumference 150 cms above the ground. Another 'Mère de Ménage' in Worcestershire was felled on 14 December 1980; the circumference at ground level was 148 cms and ring counts confirmed that the tree had been planted in 1883 making it 97 years old. These dimensions are exceeded by a living fallen apple tree at Magor with Undy Community Orchard which has a comparable circumference of 169 cms. According to census documents (Mrs B. Williams, *in litt.,* 20 August 2021) this site formed part of Undy Great Field in 1841 and records confirm that orcharding was practised then so that this particular tree could, theoretically, approach 150 years of age.

ARCHAEOLOGY AND CHRONOLOGY OF ORCHARD ESTABLISHMENT

At Porton Cottage Orchard the root plate of a fallen veteran apple tree yielded two ceramic sherds on 10 August 2020 (Fig. 5). One is a body sherd of north Devon lead glazed gravel-tempered ware dating to about 1600 noting that the fragmentation of it could have been later; the other a body sherd of a Mocha Ware vessel dating to about 1830. Incorporated into the original planting hole this would date the orchard and the planting to about that time. In broad terms the ceramic and varietal chronologies agree; that after about 1830 there was an upsurge, or possibly a resurgence of orchard practice on the Gwent Levels. It may be observed that an ability to purchase and trade in lead-glazed wares implies a certain level of economic stability such as may have existed in ecclesiastical contexts.

Fig. 5. Porton Cottage Orchard, 10 August 2020. Ceramic body sherds from root plate of fallen apple tree. Left: mid-19th century Mocha Ware. Right: unabraded 17th century North Devon lead glazed gravel-tempered ware.

Acknowledged saproxylic or ancient woodland invertebrates such as those cited here may have had only a century or so to colonise traditional orchards on the Gwent Levels. The question of their origins in space and time would require further research across what remains of the levels and their wider tree resources.

It may be appropriate here to issue a caveat. Ancient Woodland invertebrates presently regarded as maintaining fidelity to that habitat may in fact maintain fidelity to a very limited number, not only of tree species, but to specific conditions found in only one or a few trees in an entire woodland. The ptinid beetle *Gastrallus immarginatus* (Müller, 1821) may be such a species, which would, and evidently has, found suitable habitat relatively easily in the traditional farm orchards of the Gwent Levels and Lower Severn valley.

ASSIGNING COMPARATIVE LANDSCAPE AND INVERTEBRATE VALUES

Tables 1, 2 and 3 assign 'values' to each of the 20 orchards. Although subjective these have been applied previously (e.g. Whitehead, 1997) as simple but realistic tools to rapidly assist and inform future management options at these sites.

INVERTEBRATE VALUE

This may result from a variety of findings including the presence of one or a few habitat specialists or rare little-known species. It may also reflect assemblages of species benefitting from particular aspects of management or lack of management or from distinctive habitats or microhabitats within the wider orchard environment. The considerable biodiversity of the Gwent Levels traditional orchards *in toto* is reflected in the number of noteworthy invertebrates known from only one site (Table 4, Fig. 14). The entomofauna of the Gwent Levels traditional orchards is best understood as the entire sum of its parts.

LANDSCAPE VALUE

This is difficult to quantify and should take account of many sometimes interacting considerations. For example, orchards may make a strong positive contribution to visual amenity both on smaller (Fig. 9) or larger scales (Fig. 10). They may include rare or little-known top fruit varieties or may be intimately related to and complement outstanding architecture, for example Great Newra (Fig. 7) or Moorlands. In some cases the trees alone contribute strongly to historical or lost cultural tradition, declined expertise and a sense of place, notably at Cherry Orchard Farm (Fig. 11). Some orchards pose a particular challenge when attempting to assess their 'value' in this way. An example of this is Hawse Farm, where a traditional orchard remnant has been enhanced more recently with medlars and quinces, all set off by a spectacular plantsman's garden. Nonetheless, this site produced the saproxylic oedemerid beetle *Ischnomera cyanea* (Fabricius, 1792) at the flowers of a fine tamarisk *Tamarix tetrandra* Pall. ex M. Bieb.

INVERTEBRATE AND LANDSCAPE VALUE MAY INTERCONNECT

Invertebrate and landscape values may interconnect if an orchard is strategically located (Fig. 9) and acts as a biological oasis supporting or sheltering a diverse range of invertebrates whether resident or transient, or if an extended history of positive management (Fig. 10) sustains or favours such species, a circumstance not commonly observed. Some orchards clearly do form biological oases in otherwise open country, coastal orchards being especially important in this regard. A good example of this type of orchard which is also linked to a historic settlement still with resident Tree Sparrows *Parus montanus* (L.), is Porton Cottage Orchard located virtually on the open coast at Goldcliff. The management of such biological hotspots and their environs requires particular care and understanding.

Fig. 6.Rose Cottage south orchard, 27 May 2019. A largely unmanaged orchard that supports notable assemblages of saproxylic invertebrates. 0.386 ha or 0.97 acres.

Fig. 7. Great Newra, 19 May 2019. This ancient orchard accommodates ponies which impact widely on the fruit trees and herbage. 0.783 ha or 1.80 acres.

Fig. 8. Myrtle Villa Orchard, 25 May 2019. This orchard was almost lost to scrub and developing secondary woodland prior to its clearance during 2018. 0.739 ha or 1.82 acres.

Fig. 9. Blue House Orchard, Wentlooge Levels, 30 May 2019. This orchard exemplies the 'arboreal oasis' concept in a generally more open pastoral landscape. 0.66 acres.

Fig. 10. The Willows, 28 May 2019. Although subject to windblow and tree loss this large orchard has an extended history of positive management resulting in a strong contribution to visual amenity. 0.97ha or 2.4 acres.

Fig. 11. Cherry Orchard Farm, Wentlooge Levels, 27 May 2021. A fine but degrading pear orchard set in a wider matrix of extensive traditional agriculture. 1.1 acres.

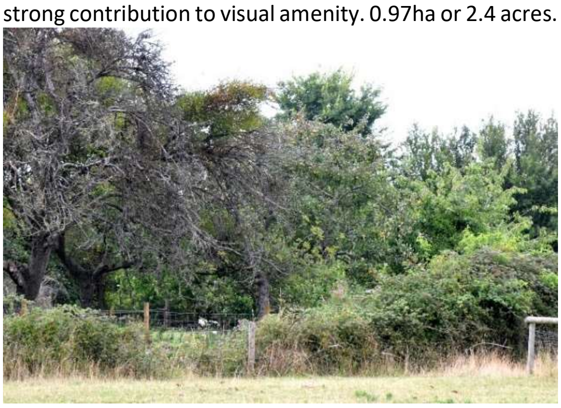


Fig. 12. Redwick House, 7 August 2020. A verdant orchard flanked by linear willow woodland with uniformly aged post-mature apple trees many subsumed by mistletoe. 0.456 ha or 1.12 acres.

Fig, 13. Common Farm, 29 May 2019. This orchard has been conserved by phased replanting. 0.723 ha or 1.78 acres.

Civil Parish	Site Name	Coordinates	Map ref.	Metres a.s.l.	Date of visit	Invertebrate Value (IV) 1-10	Landscape Value (LV) 1-10	IV + LV	Figure numbers this report
Magor with Undy	Rose Cottage North	51º56'N 02º82'W	ST431855	7	27 May	8	5	13	2
Magor with Undy	Rose Cottage South	51º56'N 02º82'W	ST430854	5	27 May	7	7	14	2, 6
Redwick	Bryn House	51º55'N 02º85'W	ST411842	6	27 May	3	4	7	2
Redwick	Bryn Road	51º55'N 02º85'W	ST412842	9	27 May	3	4	7	2
Goldcliff	Myrtle Villa	51º54'N 02º92'W	ST360829	6	28 May	8	9	17	2, 8
Goldcliff	The Willows	51º54'N 02º89'W	ST377834	5	28 May	9	10	19	2, 10
Nash	Common Farm	51º55'N 02º92'W	ST357847	6	29 May	6	7	13	2, 13
Goldcliff	Great Newra	51º55'N 02º92'W	ST362846	7	29 May	8	7	15	2, 7
Wentlooge	Blue House Farm	51º51'N 03º05'W	ST270801	6	30 May	8	7	15	1, 9

Table 1. Gwent Levels traditional orchard survey 2019-2021. 2019 site details and attributions (for further explanations see text).

Civil Parish	Site Name	Coordinates	Map ref.	Metres a.s.l.	Date of visit	Invertebrate Value (IV) 1-10	Landscape Value (LV) 1-10	II + LV	Figure numbers this report
Redwick	Redwick House	51º55'N 02º84'W	ST415846	5	7 August	8	5	13	2, 12
Magor with Undy	Magor Pill Farm	51º56'N 02º82'W	ST432856	7	7 August	8	6	14	2
Magor with Undy	Community Orchard	51º57'N 02º82'W	ST431868	9	7 August	8	6	14	2
Goldcliff	Moorlands	51º54'N 02º92'W	ST356832	7	8 August	4	7	11	2
Nash	St Mary's Church	51º54'N 02º94'W	ST342836	8	8 August	3	5	8	2
Goldcliff	Porton Cottage	51º53'N 02º88'W	ST389827	7	8 August	10	10	20	2
Wentlooge	Cherry Orchard Farm	51º53'N 03º02'W	ST290817	7	9 August	10	10	20	1

Table 2. Gwent Levels traditional orchard survey 2019-2021. 2020 site details and attributions (for further explanations see text).

Civil Parish	Site Name	Coordinates	Map ref.	Metres a.s.l.	Date of visit	Invertebrate Value (IV) 1-10	Landscape Value (LV) 1-10	II + LV	Figure numbers this report
Nash	Little Cross Farm	51º55'N 02º94'W	ST347841	7	25 May	7	7	14	2
Goldcliff	Samson Court	51º54'N 02º89'W	ST377831	8	25 May	4	6	10	2
Goldcliff	Porton Cottage	51º53'N 02º88'W	ST389827	7	26 May	10	10	20	2
Redwick	Brick House	51º55'N 02º85'W	ST409845	6	27 May	5	1	6	2
Wentlooge	Hawse Farm	51º53'N 03º03'W	ST283822	6	27 May	4	4	8	1
Wentlooge	Cherry Orchard Farm	51º53'N 03º02'W	ST290817	7	29 May	10	10	20	1, 11
Wentlooge	Cherry Orchard Farm	51º53'N 03º02'W	ST290817	7	9 June	10	10	20	1, 11

Table 3. Gwent Levels traditional orchard survey 2019-2021. 2021 site details and attributions (for further explanations see text).

Table 4. Randomised selection of 89 species of invertebrates of interest associated in a variety of ways with 20 Gwent Levels traditional orchards. The table cites UK national and Welsh statuses and in the final column the number of Welsh records based largely on data derived from NBN Atlas searches. The penultimate column shows the number of sites at which the species was observed and in parentheses the number of sightings of that species overall. NR status equates with a presence in up to 15 British Ordnance Survey map hectads since 1990. NS status equates with a presence in from 16 to 100 British Ordnance Survey map hectads since 1990.

Higher taxonomy	Family	Species	National Status	Subhabitat	Niche	Date	Notes	Number of sites (no. of individuals)	Welsh presence NBN Atlas 10.2021
Ant	Formicidae	Lasius brunneus (Latreille, 1798)	NS	orchard traditional	Pyrus communis	2021-05-27	foliage	8 (nests)	√ n=9
Ant	Formicidae	Lasius flavus (F., 1781)		orchard traditional		2021-05-25		1 (nests)	√ widely
Bee	Andrenidae	Andrena labialis (Kirby, 1802)		orchard traditional	herbage	2021-05-26	swept	1 (2)	√
Bee	Andrenidae	Andrena pilipes F., 1781		orchard traditional	herbage	2020-08-07	♀ localised coast	1 (1)	√ n=12
Bee	Apidae	Bombus sylvarum (L., 1761)		hay meadow	Trifolium pratense	2021-06-09	flower	1 (1)	√ Levels
Bee	Megachilidae	Megachile ligniseca (Kirby, 1802)		orchard traditional	Cirsium vulgare	2020-08-07	flower	1 (2)	√
Bee	Apidae	Osmia aurulenta (Panzer, 1799)		grassland rank	plastic bag puddle	2021-05-26	♂	1(1)	√
Beetle	Carabidae	Acupalpus exiguus Dejean, 1829		orchard traditional	herbage	2021-05-27	♀♀ gravid	2 (9)	√ n=4
Beetle	Aderidae	Aderus populneus (Creutzer, 1796)	NS	orchard traditional	Pyrus communis cv.	2020-08-09	twig	1 (1)	√ n=1
Beetle	Curculionidae	Amalus scortillum (Herbst, 1795)		orchard traditional	Myosotis	2021-05-26	foliage	1 (1)	√ n=11
Beetle	Cerambycidae	Anaglyptus mysticus (L., 1758)	NS	orchard traditional	pellet	2019-05-28	fragments	1 (1)	√ mostly
Beetle	Ptinidae	Anobium inexspectatum Lohse, 1954	NS	orchard traditional	Hedera helix	2020-08-08	foliage	1 (6)	√
Beetle	Malachiidae	Anthocomus fasciatus (L., 1758)	NS	orchard traditional	herbage	2021-05-27	swept	1 (7)	√
Beetle	Curculionidae	Anthonomus pomorum (L., 1758)		orchard traditional	herbage	2019-05-30	swept	(1) (1)	√
Beetle	Staphylinidae	Atheta palustris (Kiesenwetter, 1844)		orchard traditional	grassland orchard	2020-08-08	♂	(1) (1)	√ n=7
Beetle	Zopheridae	Bitoma crenata (F., 1775)		orchard traditional	Pyrus communis	2019-05-29	tree fallen	1 (2)	√
Beetle	Carabidae	Calathus rotundicollis Dejean, 1828		orchard traditional	Malus domestica	2020-08-07	woodmould	1 (1)	√
Beetle	Carabidae	Carabus granulatus L., 1758		orchard traditional	Malus domestica	2020-08-07	elytron	2 (3)	√
Beetle	Anthribidae	Choragus sheppardi Kirby, 1819	NR	orchard traditional	shrub Hedera helix	2020-08-08	rare	1 (1)	√ n=8
Beetle	Curculionidae	Coelositona cambricus (Stephens, 1831)		hay meadow	tussock	2020-08-09		1 (3)	√
Beetle	Chrysomelidae	Cryptocephalus pusillus F., 1777		orchard traditional	Malus domestica	2020-08-07	swept under	1 (1)	√
Beetle	Cryptophagidae	Cryptophagus populi Paykull, 1800	N	orchard traditional	Prunus domestica	2019-05-29	wood decayed	1 (1)	√ n=2
Beetle	Histeridae	Dendrophilus punctatus (Herbst, 1792)		orchard traditional	Malus domestica	2019-05-27	woodmould	1 (3)	√ n=3
Beetle	Ptinidae	Dryophilus pusillus (Gyllenhal, 1808)		garden rural	Picea abies	2021-05-27	foliage	1 (1)	√
Beetle	Eucnemidae	Epiphanis cornutus Eschscholtz, 1829 cfr		orchard traditional	Malus domestica	2021-05-25	galleries	1 (1)	√ n=5
Beetle	Ptinidae	Gastrallus immarginatus (Müller, 1821)	NS	orchard traditional	Pyrus communis	2021-05-27	exit holes	3 (13)	x
Beetle	Cerambycidae	Gracilia minuta (F., 1781)	NS	orchard traditional	Pyrus communis	2019-05-31	bole	1 (1)	√ south

Higher taxonomy	Family	Species	National Status	Subhabitat	Niche	Date	Notes	Number of sites (no. of individuals)	Welsh presence NBN Atlas 10.2021
Beetle	Curculionidae	Gymnetron villosulum Gyllenhal, 1836	NS	Orchard traditional	Malus domestica	2020-08-08	mostly on levels	1 (1)	√ n=5
Beetle	Tetratomidae	Hallomenus binotatus (Quensel, 1790)	NS	orchard traditional	Malus domestica	2019-05-30	stump Laetiporus	1 (8)	√
Beetle	Staphylinidae	Hapalaraea pygmaea (Paykull, 1800)		orchard traditional	Malus domestica	2019-05-27	in nest Erithacus	2 (5)	√ scarce
Beetle	Staphylinidae	Hypnogyra angularis Ganglbauer, 1896	NR	orchard traditional	Malus domestica	2019-05-27	larva AW indicator	1 (1)	√ n=6
Beetle	Oedemeridae	Ischnomera cyanea (F., 1792)		garden rural	Tamarix tetrandra	2021-05-27	flower	2 (3)	√ n=6
Beetle	Curculionidae	Isochnus sequensi (Stierlin, 1894)		orchard traditional	Salix fragilis.	2020-08-10	recent colonist	1 (1)	√ n=1
Beetle	Curculionidae	Kissophagus vicinus (Comolli, 1837)	NS	orchard traditional	Hedera helix	2020-08-08	stem	1 (4)	√ n=14
Beetle	Cerambycidae	Leiopus nebulosus (L., 1758)		orchard traditional	Juglans regia	2020-08-07	foliage	2 (2)	√
Beetle	Salpingidae	Lissodema denticollis (Gyllenhal, 1813)	NS	orchard traditional	Malus domestica	2019-05-29	foliage	1 (1)	√ n=11
Beetle	Curculionidae	Magdalis cerasi (L., 1758)	NS	orchard traditional	Malus domestica	2019-05-29	foliage	2 (2)	√ n=4
Beetle	Cantharidae	Malthodes pumilus (Brebisson, 1835)	NS	orchard traditional	herbage	2019-05-30	swept	1 (1)	√
Beetle	Latridiidae	Melanophthalma suturalis (Mann., 1844)		orchard traditional	herbage	2021-05-26	♂ dissected	2 (4)	x
Beetle	Mordellidae	Mordellochroa abdominalis (F., 1775)		orchard traditional	Malus domestica	2021-05-25	log under fungoid	1(1)	√
Beetle	Endomychidae	Mycetaea subterranea (F., 1801)		orchard traditional	Pyrus communis	2021-06-09	dead ptinid gallery	2 (5)	√
Beetle	Ptinidae	Ochina ptinoides (Marsham, 1802)		garden rural	Pyrus communis	2019-05-30	foliage	4 (8)	√
Beetle	Nitidulidae	Pocadius adustus Reitter, 1888		orchard traditional	fungus	2020-08-10	in Calvatia	1 (2)	√ n=10
Beetle	Tenebrionidae	Prionychus ater (F., 1775)		orchard traditional	Malus domestica	2019-05-30	larvae pupae	13 (144)	√ local
Beetle	Tenebrionidae	Pseudocistela ceramboides (L., 1758)	NS	orchard traditional	Malus domestica	2019-05-29	woodmould stump	1 (1)	√ VC35
Beetle	Ptiliidae	Ptinella taylorae Johnson, 1977		orchard traditional	Malus domestica	2019-05-28	rare introduced	1 (28)	√ rare
Beetle	Curculionidae	Rhamphus oxyacanthae (Marsham, 1802)		orchard traditional	Malus domestica	2019-05-30		3 (3)	√
Beetle	Coccinellidae	Rhyzobius chrysomeloides (Herbst, 1792)		orchard traditional	Malus domestica	2020-08-07	synanthropic	1 (1)	√ rare
Beetle	Staphylinidae	Scaphidium quadrimaculatum Ol., 1790		orchard traditional	Malus domestica	2021-05-25	log under fungoid	1 (1)	√
Beetle	Staphylinidae	Scaphisoma boleti (Panzer, 1793)	NS	orchard traditional	Crataegus monogyna	2019-05-31	wood red rotten	1 (1)	√
Beetle	Curculionidae	Scolytus mali (Bechstein, 1805)	NS	orchard traditional	Malus domestica	2020-08-07	bark under	1 (-)	√ n=4
Beetle	Staphylinidae	Sepedophilus immaculatus (Stephens, 1832)		orchard traditional	Crataegus monogyna	2019-05-31	wood red rotten	1 (1)	x
Beetle	Staphylinidae	Sepedophilus testaceus (F., 1792)	NS	orchard traditional	Malus domestica	2021-05-25	log under fungoid	2 (3)	√ VC35
Beetle	Lucanidae	Sinodendron cylindricum (L., 1758)		orchard traditional	Pyrus communis	2019-05-27	fragment	5 (16)	√
Beetle	Staphylinidae	Staphylinus dimidiaticornis Gemm., 1851		orchard traditional	Malus domestica	2019-05-28	cavity heads only	1 (4)	√
Beetle	Elateridae	Stenagostus rhombeus (Olivier, 1790)		orchard traditional	Prunus domestica	2019-05-29	larval exuviae	3 (6)	√
Beetle	Carabidae	Tachys bistriatus (Duftschmid, 1812)	NS	orchard traditional	herbage	2021-05-27	swept	1 (1)	√ n=8
Beetle	Staphylinidae	Tasgius ater (Gravenhorst, 1802)		orchard traditional	Pyrus communis	2019-05-27	woodmould	1 (1)	√
Beetle	Trogidae	Trox scaber (L., 1767)		orchard traditional	Malus domestica	2019-05-28	litter nest cavity	1 (1)	√
Beetle	Curculionidae	Tychius pusillus Germar, 1842	NS	Hay meadow	herbage	2021-06-09	swept	1 (3)	x

Higher taxonomy	Family	Species	National Status	Subhabitat	Niche	Date	Notes	Number of sites (no. of individuals)	Welsh presence NBN Atlas 10.2021
Bug	Anthocoridae	Anthocoris visci Douglas, 1889	NS	orchard traditional	Malus domestica	2020-08-07	Viscum album	3 (16)	√ n=4
Bug	Psyllidae	Cacopsylla visci (Curtis, 1835)	N?	orchard traditional	Malus domestica	2020-08-07	Viscum album	1 (3)	√ n=2
Bug	Rhopalidae	Corizus hyoscyami (L., 1758)		orchard traditional	Cirsium vulgare	2020-08-07	flower	1 (1)	√
Bug	Issidae	Issus coleoptratus (F., 1781)		wall	Hedera helix	2019-05-31	foliage	1 (1)	√
Bug	Miridae	Pinalitus viscicola (Puton, 1888)		orchard traditional	Malus domestica	2020-08-07	Viscum album	4 (12)	√ VC35
Butterfly	Lycaenidae	Celastrina argiolus (L., 1758)		orchard traditional		2020-08-07		1 (1)	√
Fly	Limoniidae	Achyrolimonia decemmmaculata (Loew)		orchard traditional	Malus domestica	2019-05-28	wood fallen	1 (3)	√
Fly	Keroplatidae	Cerotelion striatum (Gmelin, 1790)	N	orchard traditional	Malus domestica	2021-05-25	larvae fungoid log	1 (2)	√ scarce
Fly	Tipulidae	Dictenidia bimaculata (L., 1761)		orchard traditional	Malus domestica	2019-05-28	pupae cavity	2 (13)	√ local
Fly	Keroplatidae	Keroplatus testaceus (Dalman, 1818)	NS	orchard traditional	Malus domestica	2021-05-25	larvae under log	1 (5)	√
Fly	Mycetophilidae	Leptomorphus walkeri Curtis, 1831	NR	orchard traditional	Malus domestica	2019-05-28	larva + 3	1 (2)	√ n=7
Fly	Sciomyzidae	Limnia unguicornis (Scopoli, 1763)		orchard traditional		2021-05-26	metal trough	1(1)	√
Fly	Stratiomyidae	Odontomyia tigrina (F., 1775)		reen edge	herbage	2019-05-28	swept	1 (1)	√
Grasshopper	Acrididae	Chorthippus albomarginatus (De G., 1773)		haymeadoow	herbage	2020-08-09		4 (83)	√
Bush Cricket	Tettigoniidae	Conocephalus dorsalis (Latreille, 1804)		haymeadow	herbage	2020-08-09		3 (6)	√
Bush Cricket	Tettigoniidae	Conocephalus fuscus (F., 1793)		orchard traditional	herbage	2020-08-07		1 (1)	√ south
Harvestman	Leiobunidae	Nelima gothica Lohmander, 1945		orchard traditional	Malus domestica	2019-05-30	stump fungoid	1 (2)	√
Millipede	Craspedosomatidae	Nanogona polydesmoides (Leach, 1814)		orchard traditional	Malus domestica	2019-05-28	immature	2 (1)	√
Mite	Oribatida	Euphthiracaroidea cf Phthiracarus sp.		orchard traditional	Pyrus communis	2021-06-09	dead in galleries	1 (5)	√
Mollusc	Clausiliidae	Balea sarsii Pfeiffer, 1847		orchard traditional	Pyrus communis	2020-08-09	branch dead	4 (78)	√
Moth	Noctuidae	Acronicta leporina (L., 1758)		orchard traditional	Salix fragilis	2020-08-07	larva	1 (1)	√
Moth	Sphingidae	Smerinthus ocellata (L., 1758)		orchard traditional	Malus domestica	2019-05-29	pupa	2 (2)	√
Moth	Sesiidae	Synanthedon myopaeformis (Borkh., 1789)		orchard traditional	Malus domestica	2020-08-07	pupa exserted	4 (4)	x
Spider	Dictynidae	Nigma puella (Simon, 1870)	NS	orchard traditional	herbage	2019-05-30	swept	1 (1)	√ rare
Spider	Agelenidae	Tegenaria domestica (Clerck, 1757)		orchard traditional	Malus domestica	2019-05-28	♀ in cavity	1 (1)	√
Spider	Thomisidae	Xysticus kochi Thorell, 1872		orchard traditional	herbage	2021-05-26	♀ 1 VC35 record	1 (1)	√
Wasp	Chrysididae	Chrysis ignita (L., 1758)		orchard traditional	Crataegus monogyna	2019-05-28	♂ on log	1 (1)	√
Wasp	Pteromalidae	Cleonymus laticornis Walker, 1837		orchard traditional	Hedera helix	2021-05-26	stems dead	1 (11)	x
Wasp	Encyrtidae	Microterys seyon Guerrieri, 1996	?	orchard traditional	Hedera helix	2020-08-10	new to Wales	1 (1)	x

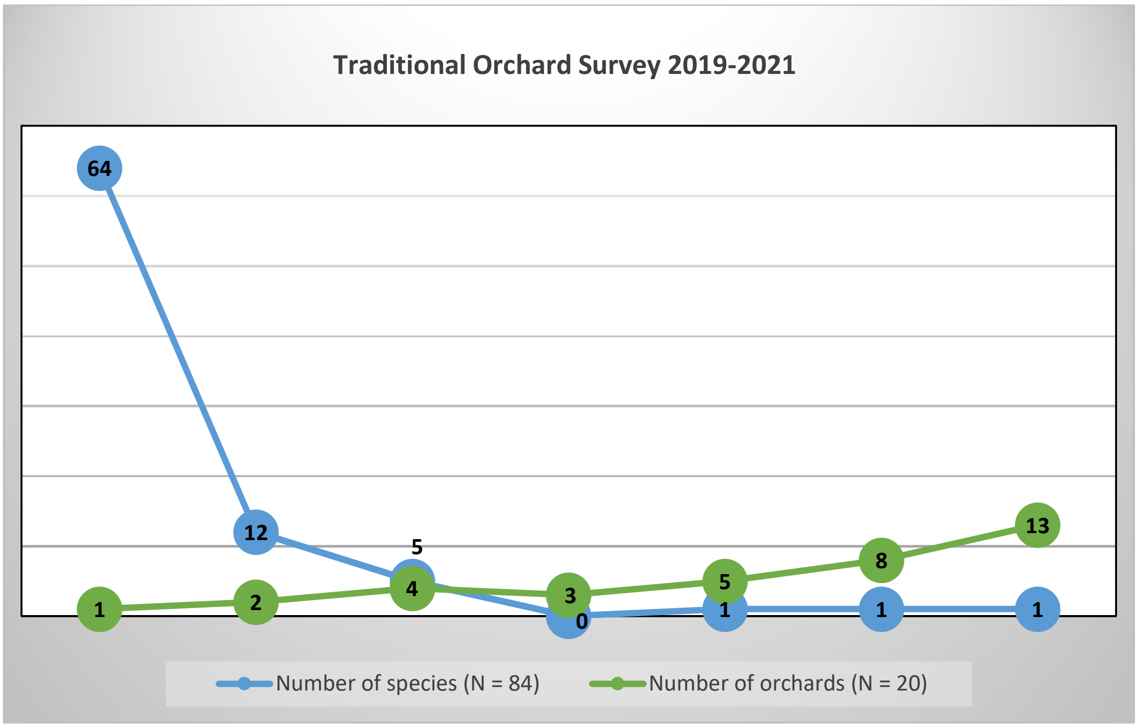


Fig. 14. The numbers of individuals of 84 species of invertebrates of interest listed in Table 4 plotted against the total number of orchards in which they occurred.

SPATIAL DISTRIBUTION OF ORCHARD INVERTEBRATES

An obvious conclusion from Fig. 14 is that 64 or 76% of the invertebrate species of interest are, observing the temporal limitations of the survey, confined to a single orchard and that only 12, 14% of the species, occurred in two orchards. Significantly, Hammond & Hine (1994) observed exactly the same phenomenon in 32 Welsh parklands; 37 species of saproxylic beetles were recorded at only one site. These authors argued for a biogeographical west to east reduction in saproxylic beetle diversity with attendant range edge fragmentation but one thing is clear from this comparison; the isolation of populations of invertebrates in the Gwent Levels traditional orchards cannot be explained by the impacts of historic flood events.

Other arguments can be introduced. It might be reasoned that the orchard invertebrates of the Gwent Levels have been, or still are, subject to negative selection pressures spanning an extended time period. Secondly it could be argued that across the entire spectrum of its traditional orchards the Gwent Levels are sustaining numerous distinct fragments of habitat. However the issue of spatial limitation could have an entirely different and more persuasive explanation. Reference to the final column of Table 4 confirms how many of these species are highly localised regionally and how many of them are known in Wales from a few records. Six species have not previously been recorded in Wales. It seems likely that the variety of orchards on the Gwent Levels, their varying management, and their locations provide specific niches for fastidious species or assemblages of species which have developed by chance colonisation, although the possibility of contracted relict historic faunules (Tables 5, 6) cannot be ruled out.

Porton Cottage Orchard, although relatively small in size, supports senile fruit trees with glade-like clearings, veteran ivy, shrouding marginal Crack Willows, a standard oak tree and a fine Black Poplar, a combination with no exact regional parallels. It is therefore a distinct, spatially constrained strongly circumscribed island of habitat, a biological hot-spot. Additionally this site is situated on what approximates to an open coast thus acting as an interception point for species both actively and passively dispersive, many of which must fail to colonise. To take another example, many orchard fruit trees develop cavities which over time acquire a distinctive invertebrate fauna. Cavities themselves vary greatly both in their physical content, moisture content, aspect and degree of exposure to shade and shelter. The majority of the traditional orchards on the Gwent Levels support some senile fruit trees many of which demonstrate such age-related features and in this sense, post-mature orchard fruit trees are no different from the idealised standardised 'perfect' veteran tree (Key, 1996) although the precise niche conditions may vary and thus may attract a limited number of species.

Invertebrates of interest occurring at more than four sites include the Tree Ant *Lasius brunneus* (Latreille, 1798) that also almost always requires dead or degraded wood and which uses apple, pear or hawthorn trees at eight sites; the wood-decay beetle *Sinodendron cylindricum* (Linnaeus, 1758) at five sites in both apple and pear wood and the tenebrionid beetle woodmould specialist *Prionychus ater* (Fabricius, 1775) at 13 sites. Nearly all of these will utilise bole cavities, dominantly in apple, *Malus domestica* (Suckow) Borkh. *Prionychus ater* is scarcely known in Wales beyond Monmouthshire and has undoubtedly benefitted from the past concentration of orchards in that county. *Pinalitus viscicola* (Puton, 1888) is a mistletoe-inhabiting mirid bug known from four sites and also geographically limited in Wales to Monmouthshire but is clearly also limited geographically by the presence of the host plant which prevails on ancient apple trees.

Occasionally the presence of a particular species of invertebrate will set one orchard apart from all the others, particularly if that species is elsewhere widespread generally. An example of this is the Yellow Meadow Ant *Lasius flavus* (Fabricius, 1781) which was proven to nest at only Little Cross Farm, perhaps due to vicissitudes of management. Elsewhere in Britain this widespread ant is content to colonise well structured, sometimes largely impervious sediments, such as occur on this part of the Gwent Levels. The key finding here is the need to maintain the overall number of orchards well-dispersed geographically and with trees of a variety of ages, structures and vigour.

ARBOREAL HABITATS

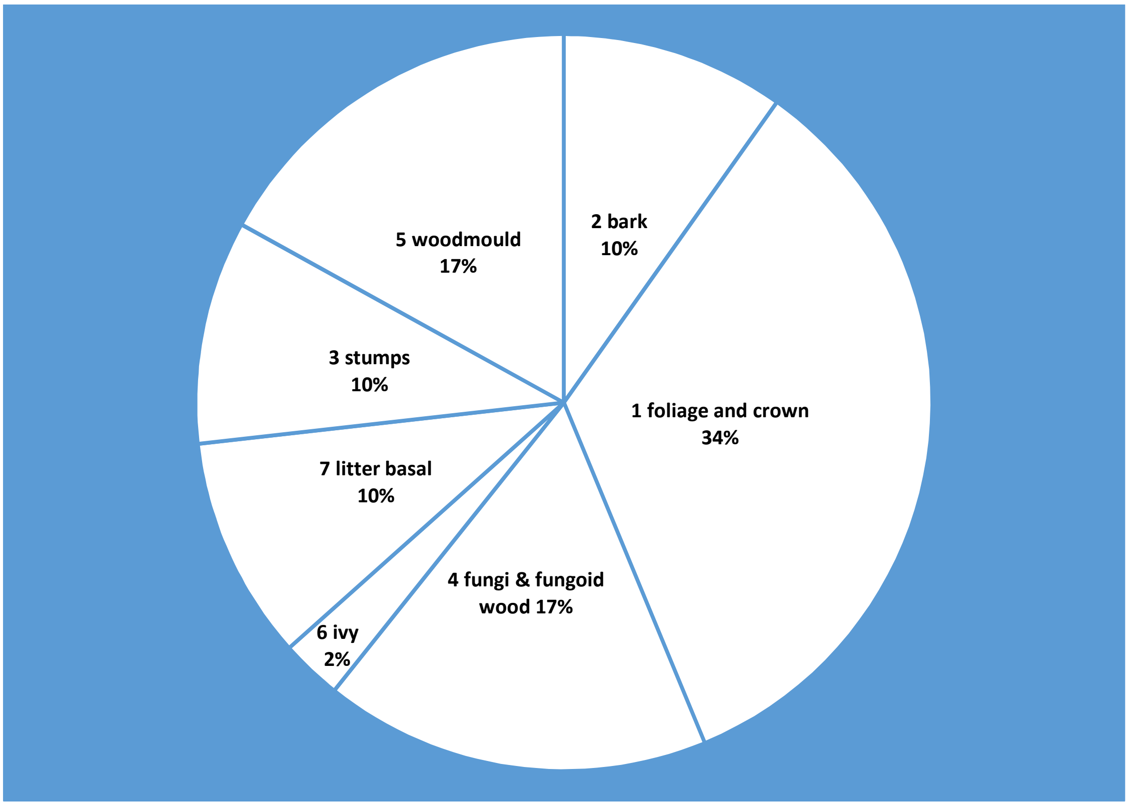


Fig. 15. Distribution of 125 species of arboreal beetles in seven areas of resource occupancy of veteran orchard trees of three genera, *Malus, Prunus* and *Pyrus*.

Traditional orchard invertebrates occupy a number of key habitats namely, tree crowns and foliage, branches and twigs, cavities, dead crown wood *in situ*, fallen wood, fungi, herbage and the ground; clearly theese are interconnected parts of a single habitat. Few niches in traditional orchards go unoccupied by invertebrates in one form or another.

This survey covered many taxonomic orders of invertebrates ranging over 172 taxonomic families of which the most speciose being beetles, Coleoptera, with 125 recorded species in 43 families followed by true bugs, Hemiptera, with 25 recorded species in 11 families. As beetles are the most speciose and are reasonably well understood in Wales (Fowles, 1995) their occupancy of niches across three genera of veteran orchard trees is given in Fig. 15 which analyses resource use of 125 species of arboreal beetles on the three principle genera of orchard fruit trees. It does not pinpoint the breeding sites of all of the beetles many of which will be elsewhere.

Foliage, crown and bark niches support 44% (n = 55) of the species; in the growing season these are usually the actively metabolising parts of the tree. The remainder of the habitats, with the exclusion of enshrouding ivy, are all quite different in the sense that they represent those products of tissue decay that may be expected to occur on or in a veteran fruit tree. These niches are occupied by 54% (n = 68) of the species which include the key saproxylic components of the fauna.

These data can be construed in a variety of ways. If one is primarily interested in conserving niche occupancy and biodiversity then the widest range of niches occurs on degraded senile veteran fruit trees. This survey recognises 18 species of Nationally Rare and Nationally Scarce insects on veteran fruit trees of which 12 (67%) are intimately connected to wood decay processes. The message is therefore clear, conserve senile veteran fruit trees!

THE WIDER INVERTEBRATE INTEREST of these seven areas of invertebrate occupancy is discussed in greater detail below.

1 FOLIAGE AND CROWN WOOD

Tree crowns are important for lichen-associated species, for foliicolous or leaf-feeding species (Stork & Hammond, 2013), and for species associated with fungoid or moribund peripheral branchlets. These include particular ciid beetles and some predatory salpingid beetles of which *Lissodema denticollis* (Gyllenhal, 1813) was recorded on apple at Great Newra on 29 May 2019; the related *Salpingus planirostris* (Fabricius, 1787) was also observed on apple at three orchards on the Caldicot Levels during August 2020.

The widespread longhorn beetle *Grammoptera ruficornis* (Fabricius, 1781) breeds in small diameter moribund crown wood (Lindhe, Jeppsson & Ehnström, 2010) and is one of many orchard insects that is evident as a flower visitor, especially at those of hawthorn *Crataegus* spp. Others include beetles of the genus *Anaspis* (Fig. 18), of which six species were recognised in this study. Although contributing significantly to the saproxylic fauna (Paviour-Smith & Elbourn, 1993) they are more commonly observed in their role as ‘flower beetles.’ Predatory arboreal rove beetles of the genus *Dropephylla* were especially evident in the veteran pear orchard at Cherry Orchard Farm.

The localised Tree Ant *Lasius brunneus* is recognised here as a key element of traditional orchard diversity on the Gwent Levels found at two orchards on the Wentlooge Levels and five on the Caldicot Levels. It may nest inside veteran fruit trees or close to them; workers often radiate over the entire crown of a tree. Nests were usually in or near woodmould on apple, pear or hawthorn trees and a remarkable situation at The Brick House, Redwick (cover illustration), was of a large colony somehow maintaining itself on one of only two large veteran pear trees that survived previous orchard clearance.

Some species, for example weevils of the genus *Magdalis*, feed on wood as larvae and on leaves as adults; clearly in such cases the two should go together! Other weevils such as *Polydrusus pterygomalis* Boheman, 1840, found only on plum at Porton Cottage on 26 May 2019, exist below ground as larvae and above ground as adults. Tree-crowns also act as flight interceptors for dispersing species, e.g. *Dorytomus taeniatus* (Fabricius, 1781) on plum at Little Cross Farm on 25 May 2021; *Gymnetron villosulum* Gyllenhal, 1836, a scarce wetland weevil on apple at Moorlands on 8 August 2020; the oak inhabiting weevil *Curculio glandium* Marsham, 1802 on pear at Myrtle Villa on 28 May 2019 and the throscid beetle *Trixagus obtusus* (Curtis, 1827) on plum at Porton Cottage on 26 May 2021, on ivy on 10 August 2021 and on pear at Cherry Orchard Farm on 9 August 2020.

At Blue House Farm 26 scirtid beetles *Contacyphon coarctatus* (Paykull, 1799) were on apple trees *Malus domestica* (Suckow) Borkh. cv. 'Bramley' on 26 May 2019. Discovered in Britain during 1996 (Hawkins, 2001) the ladybird *Rhyzobius chrysomeloides* (Herbst, 1792) was for long associated with human settlements and gardens; it has now penetrated into the wider landscape, especially in southern England and may overwinter on ivy *Hedera helix* L. and box *Buxus sempervirens* L. A single example was beaten from apple foliage at Magor Pill Farm on 7 August 2020.

Suites of Hemiptera or true bugs characteristic of the crown wood of veteran fruit trees are often associated with lichen-covered twigs with well-developed mite and psocid assemblages; these include anthocorids (five genera, e.g. *Anthocoris*, *Orius* and *Temnostethus* spp.) and microphysids (*Loricula* spp.). *Loricula pselaphiformis* Curtis, 1833 is a predator of mites and other small invertebrates and was commonly found; it proliferated on a dead apple tree at Rose Cottage south with a high biomass of small invertebrates. *Temnostethus gracilis* (Horváth, 1907) and *Temnosthethus pusillus* (Herrich-Schaeffer, 1835) are also mite-predators; it is possible that they compete with each other. Large numbers of *T. pusillus* occurred at Little Cross Farm on 25 May 2021 when *T. gracilis* was not observed. Conversely, large numbers of *T. gracilis* were at Magor Pill Farm on 7 August 2020 when *T. pusillus* was not observed. At Moorlands *T. gracilis* outnumbered *T. pusillus* by a factor of 28:1.

Although the Hawthorn Shieldbug *Acanthosoma haemorrhoidale* (Linnaeus, 1758) is not often perceived as an orchard inhabitant, a breeding population of L5 stage nymphs was observed on plum *Prunus domestica* cv. 'Victoria' at Porton Cottage on 8 August 2020. Species more characteristic of larger woodland trees were not observed commonly, certainly not as breeding populations. The mirid *Megacoelum infusum* (Herrich-Schaeffer, 1835) mostly usually on oak *Quercus* spp, was at Magor with Undy Community Orchard on apple on 7 August 2020 and the predatory Forest Bug *Pentatoma rufipes* (Linnaeus, 1758) was found breeding on plum at Porton Cottage on 26 May 2021, probably benefitting from the insect diversity at this site. These insects may benefit from nearby larger hardwood trees but they nevertheless demonstrate that in areas such as the Gwent Levels where high canopy mixed woodlands or mature specimen trees do not prevail, traditional orchards may sustain species associated with them. Little Cross Farm is also distinctive faunistically (Fig. 27, left) and may warrant further study; it supported large numbers of psyllid bugs including *Cacopsylla pyricola* (Förster, 1848) on pear on 25 May 2021.

Seven species of lichen and algae-feeding barkflies, Psocoptera, were recorded overall. *Loensia fasciata* (Fabricius, 1787) with black-banded forewings, somewhat localised in Wales, occurred on apple trees at Moorlands and on elm *Ulmus minor* Mill. cv. 'Atinia' at Myrtle Villa. The arboreal snail *Balea sarsii* Pfeiffer, 1847 [syn. *B. heydeni* (von Maltzan, 1881)] shares a similar diet but prefers the increased oceanicity of western Britain. It is well-represented in the Gwent Levels traditional orchards ascending into the high crowns of fruit trees especially in sheltered sites; strong populations occur at Porton Cottage. The localised theridiid spider *Sardinidion blackwalli* (O.-P. Cambridge, 1871) is most usually associated with built structures but 18 were on Bramley apple trees at Blue House on 30 May 2019.

Fig. 16. *Gibbaranea gibbosa* (Walckenaer, 1802), a characteristic and attractive foliicolous spider of Gwent Levels orchards. Myrtle Villa, 31 May 2019.

Fig. 17. *Amaurobius fenestralis* (Stroem, 1768), a widespread subcorticolous inhabitant of old broad-leaved trees. Myrtle Villa, 28 May 2019.

The specialist mistletoe fauna of the orchards is reasonably well-developed with the true bugs *Anthocoris visci* Douglas, 1889 at three sites and *Pinalitus viscicola* (Puton, 1888) at four sites on the Caldicot Levels. The mistletoe psyllid *Cacopsylla visci* (Curtis, 1835) was observed only at Magor with Undy on 7 August 2020 while the small ladybird *Stethorus pusillus* (Weise, 1891) was on mistletoe at Bryn Road Orchard on 27 May 2019.

2 BARK

Bark is an essential part of the tree, acting as a protectant for the vascular tissues beneath it. Comparatively few species of insect are dependent on living bark although many may colonise it if its integrity is compromised by bacteria, fungi, or other pathogens.

Some invertebrates such as Whirligig Mites, *Anystis* species, occur commonly on bark but are by no means tied to it. Snipeflies *Rhagio scolopaceus* (Linnaeus, 1758) routinely used glade tree bark as vantage points from which to launch aerial sorties. Tree Snails *Balea sarsii* are not infrequently found grazing algae on bark. At Porton Cottage the snail *Lauria cylindrica* (da Costa, 1778) used apple tree bark to find shelter beneath its appressed ivy stems. Larvae of the psychid Bagworm Moth *Luffia ferchaultella* (Stephens, 1850) with their lichen-dusted cases grazed the bark of apple trees at Little Cross Farm and Blue House Farm. It feeds on arboreal algae and lichens and is a widespread general scavenger on old fruit trees occurring also on rocks and tombstones.

A particularly interesting inhabitant of veteran fruit trees discovered in three orchards new to Wales is the rare ptinid beetle *Gastrallus*, a specialised occupant of galleries cut inside thick exfoliating bark, most usually of veteran pear trees (see page 40). Many insects that breed in decaying or fungoid wood of standing trees routinely perambulate on bark, often at night to minimise predation. This is often when pairing occurs. Some species (Fig. 18) lay their eggs in bark crevices from where their larvae can access subcortical tissues.

Fig. 18. A female *Anaspis regimbarti* Schilsky, 1895 ovipositing in bark crevice of pear *Pyrus communis*, Myrtle Villa, 28 May 2019.

A distinctive group of bark and phloem inhabitants are 'wood-boring' scolytine beetles of the genus *Scolytus* of which *Scolytus mali* (Bechstein, 1805) is not infrequently found in English traditional orchards. This species appears to be genuinely scarce in Wales and was observed only at Redwick House. *Scolytus rugulosus* (Müller, 1818) was also observed only once, on apple at Magor Pill Farm. Loosened bark is employed by many insects (Fig. 19) for purposes of overwintering or aestivation including wasps, bugs and many beetles. The mirid bug *Deraeocoris lutescens* (Schilling, 1837) occurs widely across the Gwent Levels orchards as a general predator on fruit trees and routinely winters under bark. A curious finding was of a live female social wasp *Vespula vulgaris* (Linnaeus, 1758) torpid under the bark of a plum tree at Great Newra on 29 May 2019. Why this wasp had not by then initiated a nest is unclear.

Fig.19. An apterous aphid *Melanaphis pyraria* (Passerini, 1862) in a failed attempt to overwinter in the subcortical larval gallery of a ptinid beetle *Gastrallus immarginatus*. Brick House Farm, Redwick, 27 May 2021.

The Tree Slug *Lehmannia marginata* (Müller, 1774) retreats beneath bark and wood during the day and appears at night to graze algae and lichen. In this study it occurred only at Common Farm on apple and at Myrtle Villa in decayed hawthorn. Although widespread in Britain and often commonly found in humid woodlands its patchy distribution on the Gwent Levels orchards invites questions. Similarly, subcortical myriapods (*Cylindroiulus, Nemasoma, Proteroiulus* spp.) proved hard to find and *Proteroiulus fuscus* (Am Stein, 1857) was observed only at Myrtle Villa on 28 May 2019. If these species are limited to spot populations or single trees in orchards of just a few trees, such as at St Mary's Church, notwithstanding their wider general distributions, then the refugial concept of such orchards would be highlighted. Native trees on the Gwent levels may be of interest in this regard and further research over a wider geographic area will throw further light on issues of range and distribution.

3 TREE STUMPS *IN SITU*

Live or moribund orchard tree stumps left *in situ* support an invertebrate fauna quite distinct from that of dead extirpated desiccated stumps that have been left with few or no fungal colonists. Live *In situ* stumps in varying stages of decay, sometimes advanced, were observed at The Willows and Blue House Farm. Trees in the process of forming stumps through extensive bole decay were noted at Great Newra and such trees may accommodate distinctive species of invertebrates influenced by the presence of fungi. The biota of fungoid stumps may resemble that of fallen crown wood. At The Willows one apple tree stump on 28 May 2019 supported 28 adult *Ptinella taylorae* Johnson, 1977 (Fig. 20) together with a mycophilous cecidomyiid fly (Fig. 21) that cannot yet be identified by sight.

Fig. 20. The naturalised subcortical apterous ptiliid beetle *Ptinella taylorae*, from under bark of apple tree stump, The Willows, Whitson, 28 May 2019.

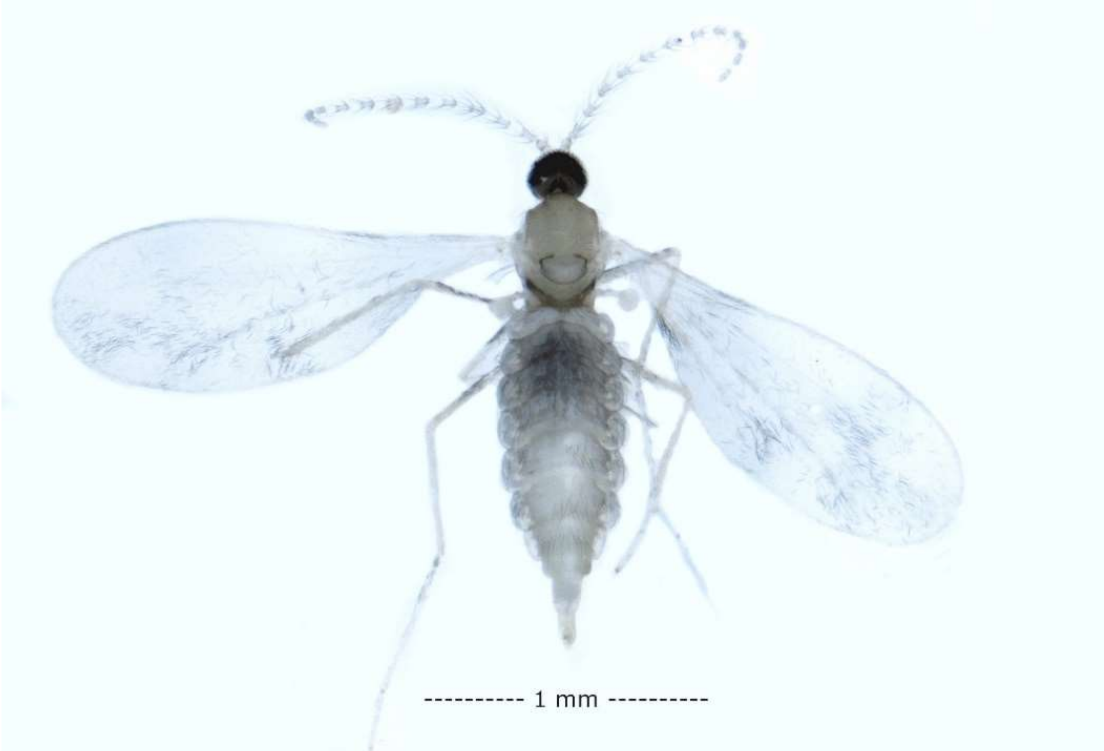


Fig. 21. Unidentified cecidomyiid fly, stump of apple tree, The Willows, 28 May 2019. This specimen has been submitted to the University of Ostrava in the Czech Republic for DNA analysis.

Stumps of fruit trees are often favoured by Lesser Stag Beetles *Dorcus parallelipipedus* (Linnaeus, 1758). Live examples were found at Rose Cottage South and Great Newra but evidence of past occurrence was noted at six other orchards. This demonstrates the well-known dispersive ability of a species that forms an important avian and mammalian prey item thereby supporting wider orchard ecology.

At Blue House Farm a large apple tree stump demonstrated the ancestral habitat of the slug *Limacus flavus* Linnaeus, 1758, a species now being actively usurped and genetically modified by interbreeding with the comparatively recent British colonist *Limacus maculatus* (Kaleniczenko, 1851). Apple tree stumps provided nest sites for ants of the genus *Myrmica* and at The Willows the Black Ant *Lasius niger* (Linnaeus, 1758) had thoroughly excavated the wood of one such hollow stump and drawn earth up into it to create a large aerial nest mound not unlike those of the Yellow Meadow Ant *Lasius flavus*. The craspedosomatid millipede *Nanogona polydesmoides* (Leach, 1814) was observed amongst piled apple tree stumps only at The Willows.

4 FUNGI AND FUNGOID WOOD

Many arboreal fungi have the ability to change the structure of wood by removing lignin, the material that confers strength on it. As the fungal hyphae penetrate the tree they disrupt its structural integrity rendering it favourable to colonisation by a wide range of invertebrates, some of which are unable to live elsewhere. Trees may fragment for a variety of reasons, for example drought, lightning strike or, in the case of trees such as elm, natural tendency. Wood exposed in this way is rapidly colonised by bacteria, protozoa and fungi. Fungal sporocarps, ascomycotine or basidiomycotine, are composed of modified hyphae and support a wide range of invertebrates.

Spore bodies of arboreal fungi frequently form large obvious features on the trunks or branches of trees although many species that are undetectable to the naked eye penetrate heartwood. Amongst the former, *Auricularia*, *Ganoderma*, *Laetiporus*, *Phellinus* and *Trametes* spp. all occur in the orchards although *Ganoderma australe* (Fr.) Pat. was recognised only at Myrtle Villa on hawthorn, while *Phellinus pomaceus* (Pers.) Maire appeared to be genuinely rare occurring only at Redwick House on

Damson, *Prunus domestica* ssp. *insititia* (L.) C. K. Schneid. All of these fungi have particular species of insect adapted to feed on them. *Orthocis alni* (Gyllenhal, 1813) occurred on *Auricularia* at Porton Cottage, *Cis bilamellatus* (Wood, 1884) on *Phellinus* at Redwick House (Fig. 22), *Cis boleti* (Scopoli, 1763) on *Trametes* at Redwick House, and *Eledona agricola* (Herbst, 1783), *Hallomenus binotatus* (Quensel, 1790) and *Mycetophagus quadripustulatus* (Linnaeus, 1761) on Chicken-of-the-woods *Laetiporus sulphureus* (Bull.) Murrill on plum at Little Cross Farm and on apple at Blue House Farm.
As life support systems (Boddy, 2021) fungi in their many manifestations occur in almost all the traditional orchards and they may support significant species of insect believed to characterise the ancient woodland environment (Table 4). Of the beetles recorded on orchard fruit trees, 44% of the species were linked to degraded wood in one form or another (Fig. 15) and did not occur elsewhere. Woodmould, the ultimate product of wood degradation, is discussed as a separate entity.

Fig. 22. Ciid beetles like this *Cis bilamellatus* (Wood, 1884) have the ability to completely recycle sporocarps of arboreal fungi. On *Phellinus pomaceus*, Redwick House, 7 August 2020.

Eucnemid beetles are generally regarded as being of conservation interest and include a number of species linked to the ancient woodland environment. *Epiphanis cornutus* Eschscholtz, 1829 has catholic tastes and is able to use both hard and softwood trees with a preference for fallen trees. Larval galleries in the outer wood of a fallen apple tree branch at Samson Court (Table 4) may have been caused by this species but no confirmatory fragments of beetles were found.
The Lesser Stag Beetle *Dorcus parallelipipedus* preferentially inhabits wood degraded by basidiomycotine fungi, frequently on standing trees as a potentially high-volume recycler in the woodland environment. The same comment applies to the related 'Rhinoceros' Beetle *Sinodendron cylindricum* (Linnaeus, 1758) which disperses by flight only on significantly warm summer days. This species readily accepts smaller diameter fungoid wood, mostly of apple, and was in fallen branch wood of pear at Myrtle Villa on 18 May 2019 (Fig. 23). Some insects are able to colonise hard dry exposed wood, notably ptinid beetles of which 'woodworm' is a well-known example. At Porton Cottage ptinid beetles *Ptilinus pectinicornis* (Linnaeus, 1758) were attended by the parasitic braconid wasp *Spathius exarator* (Linnaeus, 1758), a typical associate of such wood-boring beetles.

Fig. 23. The lucanid beetle *Sinodendron cylindricum* colonising pear *Pyrus communis* at Myrtle Villa, 28 May 2019.

The saproxylic cranefly *Dictenidia bimaculata* (Linnaeus, 1761) is widespread in Britain (Stubbs, 2021) but perhaps not commonly regarded as an orchard inhabitant. Breeding populations were observed in apple at Myrtle Villa and The Willows. The Red-belted Clearwing Moth *Synanthedon myopaeformis* (Borkhausen, 1789) has larvae that require the decaying wood of standing trees virtually exclusively in *Maloidea*: *Malus, Sorbus, Crataegus* and *Pyrus* spp. (Laštůvka & Laštůvka, 2001). The pupae of this localised species exsert themselves prior to emergence (Fig. 24) using their projecting adminicula, which usually render them fixed in the wood. *Synanthedon myopaeformis* has been found in four orchards *viz*. The Willows, Rose Cottage north, Magor with Undy and Magor Pill Farm and is likely to be more widespread. The Gwent Levels orchards are clearly important for the fortunes of this species.

Fig. 24. Exserted pupa of Red-belted Clearwing Moth *Synanthedon myopaeformis* on apple, Magor Pill Farm, 7 August 2020.

Larvae of the large crepuscular click beetle *Stenagostus rhombeus* (Olivier, 1790) were in decayed plum wood at Great Newra on 29 May 2019 and in decayed apple wood at Magor with Undy on 7 August 2020. *Cryptophagus populi* Paykull, 1800 is a genuinely rare species in Britain normally inhabiting bees nests (Leschen, 1999). British records have averaged about three a year during the past 150 years or so according to NBN Atlas accessed 1 December 2021; one was in the heartwood of a plum tree at Great Newra on 29 May 2019. A single example of the wood-boring beetle *Xyleborinus saxesenii* (Ratzeburg, 1837) (Fig. 25) was observed *in situ* in the wood of a fallen pear tree at Great Newra on 29 May 2019. According to NBN Atlas accessed 1 December 2021, there are 16 Welsh records of this beetle during the past 130 years. Modern records are from Dinefwr Deer Park and Llanover Park (Levey & Pavett, 2000a; 2000b) and Chirk Castle (Alexander, 2019); it is also recorded from the Bronze Age of the Somerset Levels (Girling, 1980).

Fig. 25. The scolytine wood-boring beetle *Xyleborinus saxesenii* in pear *Pyrus communis*, Great Newra, 29 May 2019.

4A FALLEN WOOD IN CONTACT WITH THE GROUND

This is effectively a sub-habitat of 4 above. Occasionally particular niches may be encountered that hallmark alluvial or 'wet' orchards such as those studied here, in particular the relationship between fallen crown wood, encrusting or resupinate fungi and hygrophilous invertebrates.

When crown wood falls it takes with it a range of saprophilous insects that may persist in it and complete their life cycles. These include a range of subcortical bugs and beetles that occupy the higher crown, for example carabid beetles *Caladromius* sp., various ptinid and elaterid beetles, and the flatbugs *Aneurus avenius* (Dufour, 1833) at The Willows and *Aneurus laevis* (Fabricius, 1775) at Blue House Farm, both on apple wood. A remarkable record of *Aneurus avenius* comes from Hawse Farm where an adult was found on a recently opened flower of a large Medlar *Mespilus germanica* Linnaeus, apparently attracted by the pollen; dispersal of flat bugs in flight is very rarely observed (Gossner, Engel & Blaschke, 2007). Eventually these saprophilous species reduce in number or disappear and the composition of the invertebrate fauna changes as the moisture content of the fallen wood and its mycobiota change. The localised cerambycid beetle *Gracilia minuta* (Fabricius, 1781) was found only at Myrtle Villa on dry fallen branch wood of pear held above the ground by surrounding plant growth; this species has a well-recognised preference for very dry wood in its growth position and would never occur on long-fallen wood on the ground.

Colonisation of fallen wood by poroid and other groups of polyporous fungi provide opportunities for the development of a distinctive entomofauna which is evidently well-supported on the Gwent Levels, in particular in sheltered environments at Blue House Farm, at Myrtle Villa where there was an abundance of decaying wood and at Little Cross Farm (Fig. 27, left). Although Boddy & Rayner (1984) showed that some fungi were present on crown wood prior to fall, contact with the ground is crucial for the sustenance of this mycobiota and its invertebrate associates. The presence of a wide variety of fungi and myxomycetes is a key determinant in the composition of a fallen wood invertebrate fauna. Encrusting fungi (Fig. 27) such as *Byssomerulius corium* (Pers.) Parmasto (Polyporales, Irpicaceae) are of frequent occurrence.

This association includes staphylinid and scaphidiine beetles and tipulid, keroplatid and mycetophilid flies and their larvae (Figs 26, 27). The faunule was well-developed at The Willows and at Little Cross Farm where fallen apple tree limbs bedded in the ground supported well-developed communities of keroplatid flies, including the fungus gnat *Cerotelion striatum* (Gmelin, 1790), staphylinid beetles including *Sepedophilus testaceus* (Fabricius, 1792) which, together with *Scaphidium quadrimaculatum* Olivier, 1790 and *Scaphisoma agaricinum* (Linnaeus, 1758) have a particular affinity for poroid fungi. Further work may clarify whether these specialised stenotopic species occur more widely but they clearly highlight the wider ecological benefit of retaining fallen wood *in situ.* This community was best expressed in orchards that were reasonably well-maintained and not overgrown, suggesting that temperature is a further factor. In other words, the exact condition and position of the wood on the ground may be a determinant for the community which is evidently delicately attuned.

Fig. 26. Larva of the fungus gnat *Leptomorphus walkeri* Curtis, 1831 on fallen apple wood, The Willows, 28 May 2019.

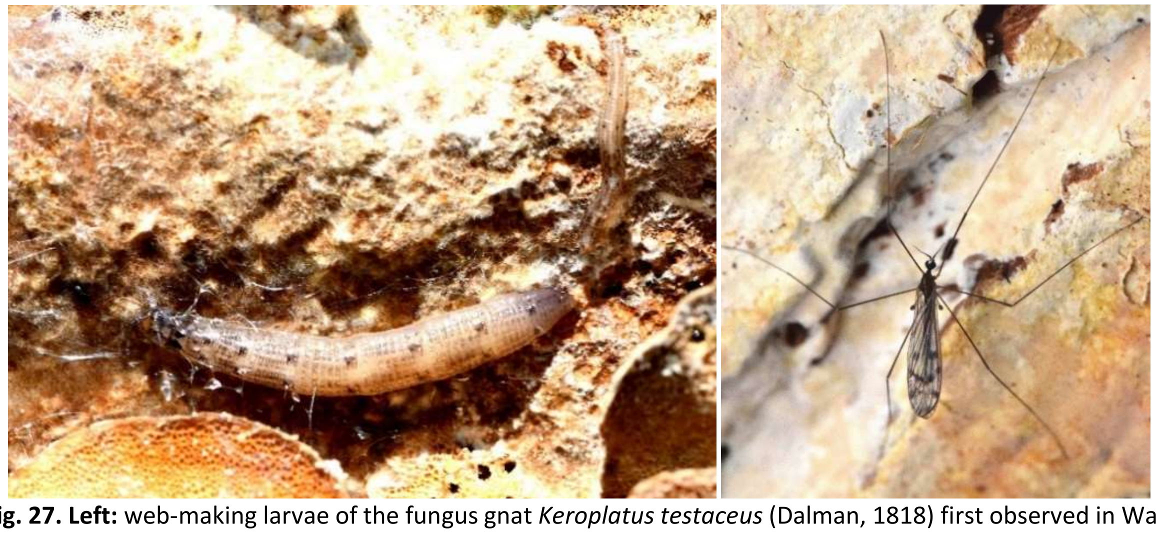


Fig. 27. Left: web-making larvae of the fungus gnat *Keroplatus testaceus* (Dalman, 1818) first observed in Wales during 1996 (Levey & Pavett, 2000), Little Cross Farm, 25 May 2021 on encrusting fungus probably *Byssomerulius corium* on a fallen apple tree branch. **Fig. 27. Right:** *Achyrolimonia decemmaculata* (Loew, 1873) a mycosaproxylic cranefly amongst encrusting fungus on fallen cordwood of apple tree, The Willows, 28 May 2019.

At Blue House Farm, a significant range of mycophilous insects at the fungus *Laetiporus sulphureus* (Bull.) Murrill on sawn apple logs included the rather rare melandryid beetle *Hallomenus binotatus* (Quensel, 1790) which was added to the Welsh entomofauna relatively recently (Hammond & Hine, 1994). At Myrtle Villa sawn logs of elm *Ulmus minor* Mill. cv 'Atinia' supported breeding click beetles *Stenagostus rhombeus* (Olivier, 1790) and Cardinal Beetles *Pyrochroa serraticornis* (Scopoli, 1763); live elm trees around the curtilage of the site sustained the now localised weevil *Orchestes alni* (Linnaeus, 1758). According to the NBN Atlas accessed 28 November 2021, the most recent Monmouthshire record of this species was in 1999.

5 WOODMOULD

Woodmould is a critically important pabulum for many invertebrates. It is the finest product of wood diminution occurring both as seams in standing trees and in their cavities. In large veteran trees it may form substantial beds contained entirely within their boles. Containment is therefore critical in maintaining the condition and existence of woodmould within a tree in the absence of which it may be subject to gravitational descent and biotic loss; for invertebrates life in woodmould brings risks.
Woodmould varies in its moisture content and cannot therefore be defined uniformly. Fine dry cavity woodmould may have the appearance of talc; a limited number of invertebrates colonise this including some whose larvae 'swim' in it (Whitehead, 2007a). It may contain abundant invertebrate faeces, in particular of isopods, together with fragmentary invertebrate skeletal material. For the invertebrate ecologist such fragments can unravel historical detail.

Fig. 28. Nest of Tree Ant *Lasius brunneus* in hawthorn wood delignified by *Ganoderma australe*, Myrtle Villa, 28 May 2019.

A well-developed woodmould fauna contained in a veteran apple tree at Rose Cottage south must have existed for decades. Initially the cavity had been subject to the ingress of rainwater and a sludge bed developed in it. Over time ivy *Hedera helix* L. enveloped the tree, the wet basal sediments contracted and were buried in fine powdery woodmould containing a typical maloid woodmould insect fauna including the beetles *Hypnogyra angularis* Ganglbauer, 1895 and *Dendrophilus punctatus* (Herbst, 1792). This complex of orchards was the only site to reveal a significant population of the rove beetle *Hapalaraea pygmaea* Paykull, 1800, a widespread scarce saproxylic species most usually associated with fungoid trees or the flowers of spring-flowering trees nearby. At Rose Cottage they bred in a tree cavity in which Robins nested and evidently predated some of the beetles.
At Myrtle Villa so-called 'red-rotten' wood developed in senile moribund hawthorns was further comminuted by nesting Tree Ants *Lasius brunneus* (Fig. 28). They created conditions accepted by the millipede *Proteroiulus fuscus* (Am Stein, 1857), the slugs *Lehmannia marginata* (Müller, 1774) and *Limacus flavus* Linnaeus, 1758 in its 'wild' ancestral niche, the wasp *Pemphredon lugubris* (Fabricius, 1793) and the rove beetles *Scaphisoma boleti* (Panzer, 1793) and *Sepedophilus immaculatus* (Stephens, 1832).

A key woodmould species in this study is the large tenebrionid beetle *Prionychus ater* (Fabricius, 1775) which favours dry maloid woodmould in Britain; it is a curiosity that the rare *Prionychus melanarius* Germar, 1813 that occurs elsewhere in Severn estuary orchards seems not to occur on the Gwent Levels. *Prionychus ater* is capable of flight and occurred in 13 of the 20 orchards visited; with two exceptions all were on apple trees. One exception was at Bryn House where larvae were in a veteran pear tree stump, the other was at Samson Court where the remains of beetles were in a plum tree cavity. The more colourful *Pseudocistela ceramboides* (Linnaeus, 1758) prefers decayed wood and woodmould near the ground and occurred only at Great Newra on 29 May 2019 in the stump of an apple tree.

Cavity-contained woodmould tells many stories and is utilised by a wide range of species as retreats (Fig. 29). An apple tree cavity at The Willows contained the heads of four *Staphylinus dimidiaticornis* Gemminger, 1851 on 28 May 2019, a large, colourful wetland rove beetle which, without the aid of a presumed Wood Mouse, would have gone unrecorded. Fragments of the related *Tasgius ater* (Gravenhorst, 1802) were in woodmould of pear at Bryn House on 27 May 2019; this isopod predator was strictly coastal until relatively recently (Whitehead, 1999a).

Fragments of the small ground beetle *Ocys tachysoides* (Antoine, 1933) were in woodmould in a hollow fallen apple tree at Magor with Undy on 27 May 2019 together with a live *Carabus granulatus* Linnaeus, 1758 and a single *Calathus rotundicollis* Dejean, 1828, a reasonably widespread ground beetle (Luff, 2007) that is evidently localised on the Gwent Levels and may be declining generally. Tree cavities are routinely used as hibernacula or refugia particularly by 'high-value' female bees and wasps; these may not survive and the remains of a female Buff-tailed Bumblebee *Bombus terrestris* (Linnaeus, 1758) were in a plum tree cavity at Samson Court on 25 May 2021. A dark morph Tree Bumblebee *Bombus hypnorum* Linnaeus, 1758, a recent British colonist, was more successful and was hibernating in apple tree woodmould at Myrtle Villa on the late date of 28 May 2019 (Fig. 29).

Fig. 29. Cavity fill in apple tree *Malus domestica*, Myrtle Villa, 28 May 2019. **Left,** dark female Tree Bumblebee *Bombus hypnorum*. **Top right**, cocoon of Oak Eggar Moth *Lasiocampa quercus*. **Bottom right,** a carcass beetle *Trox scaber*.

The carcass beetle *Trox scaber* (Linnaeus, 1767) (Fig. 29) is one of a group of beetles which prefer arid open conditions which has adapted to dry woodmould in tree cavities, especially in veteran orchard apple trees; it also occurs amongst dry litter in bird's nests, especially those of the Jackdaw *Corvus monedula* L. Larvae of the Oak Eggar Moth *Lasiocampa quercus* (Linnaeus, 1758) that successfully pupated in apple tree cavity woodmould at Myrtle Villa (Fig. 29) probably fed on nearby willows. At Magor with Undy the cocoon of a campoplegine ichneumonid wasp was in woodmould on a fallen apple tree on 7 August 2020.

6 IVY *Hedera helix* L.

Ivy serves a variety of functions in orchards. It is a host plant for a range of small invertebrates that attract predatory species, it provides both winter shelter and sunning platforms for species that have developed elsewhere or between stem and bark where the ivy ascends a tree. At some sites veteran willows may be overrun by arborescent ivy, the flowers of which provide nectar for numerous flies, wasps, and bees. Ivy also sustains a number of wood-boring beetles.

These relationships were seen especially well in sun-spots at Porton Cottage during 2020. Here the frequently synanthropic snail *Lauria cylindracea* da Costa has adapted to conditions between ivy stems and tree bark. The rare anthribid beetle *Choragus sheppardi* Kirby, 1819 was found only here on arborescent ivy beneath which it probably bred in decaying apple wood. A number of wood-boring beetles typify ivy namely *Anobium inexspectatum* Lohse, 1954 and the related *Ochina ptinoides* (Marsham, 1802). *Kissophagus vicinus* (Comolli, 1837) breeds in older often dry ivy stems and at Porton Cottage was attended by the parasitic pteromalid wasp *Cleonymus laticornis* Walker, 1837.

A significant finding on ivy, also at Porton Cottage, was the rare encyrtid wasp *Microterys seyon* Guerrieri, 1996 which is discussed in more detail on page 42. The distinctive issid bug *Issus coleoptratus* (Fabricius, 1781) uses ivy as one of its host plants; a breeding population was at Myrtle Villa on 31 May 2019.

7 LITTER AND ARBOREAL DETRITUS

Litter in the orchard environment is defined here as an accumulation of generally slowly decomposing plant-derived organic matter. This covers a range of pabula, for example dry cavity-protected bird's nests, accumulations of wood-derived or other material around the bases of fruit trees, fallen desiccated fruit or drying hay. The term as it is used here is therefore a somewhat abstract generality. Accumulations of litter tend to hallmark the more neglected orchards; well-managed systematically grazed orchards such as The Willows have more limited mostly peripheral accumulations of litter. Litter provides breeding sites for many invertebrates and attracts numerous predators to its populations of springtails, mites and other small invertebrates.

Litter in the form of foliage accumulations or dried herbage is a key habitat for overwintering insects such as *Sehirus luctuosus* Mulsant & Rey, 1864 the Forget-me-not cydnid bug. This was an unexpected discovery at Porton Cottage on 10 August 2020 where new generation adults rely on the shelter of orchard litter for overwintering. The recent antipodean colonist, *Nysius huttoni* F. B. White, 1878 (Cuming, 2008; Smit, Reemer & Aukema, 2007; Zielińska & Lis, 2020) is another true bug that overwinters as an adult; one was swept from tussocky herbage at Blue House Farm on 30 May 2019.

Litter also supports insects that are usually arboreal or both arboreal and terrestrial. An Eyed Hawk Moth pupa *Smerinthus ocellata* (Linnaeus, 1758), presumably moribund, was recovered from apple tree litter at Great Newra on 29 May 2019 and another was observed beneath bedded timber at Porton Cottage on 10 August 2020. The localised southern ground beetle *Syntomus obscuroguttatus* (Duftschmid, 1812) was hunting amongst pear tree litter at Cherry Orchard Farm on 9 August 2020, a site which also provided evidence of the small rove beetle *Geostiba circellaris* (Gravenhorst, 1806). Cryptophagid beetles are often associated with sporulating fungi; *Cryptophagus scanicus* (Linnaeus, 1758) was at Cherry Orchard Farm on 9 August 2020 and *Cryptophagus reflexus* Rey, 1889 was in an old Robin's nest at Rose Cottage north on 27 May 2019, a habitat shared by the pseudoscorpion *Chernes cimicoides* (Fabricius, 1793) and the rove beetle *Hapalaraea pygmaea* (Paykull, 1800).

SAPROXYLIC BEETLES AND THE IMPACT OF TIME

Table 5 lists 11 species of orchard-inhabiting beetle to which Ancient Woodland Indicator (AW) status may be applied. Most of these inhabit degraded or fungoid wood. The first two species, *Gastrallus immarginatus* (Müller, 1821) and *Vanonus brevicornis* (Perris, 1869) were unknown in Wales prior to this study, and being AW Grade 1 listed species are particularly sensitive indicators. It is observed that both of these species coexist at one site, Cherry Orchard Farm. This species list provides further evidence of the role of traditional orchards in perpetuating not only the exact conditions required by fastidious species but also their existence in space where they may otherwise be absent. Some of these species are discussed individually elsewhere in this report.

Confirmation of the role of Gwent Levels traditional orchards in supporting sensitive saproxylic species can also be gleaned from the work of Hammond and Hine (1994). They reported that from 20 Welsh Parklands the beetles *Hypnogyra angularis* Ganglbauer, 1895, *Hallomenus binotatus* (Quensel, 1790), and *Sepedophilus testaceus* (Fabricius, 1792) were, together with the Tree Ant *Lasius brunneus*, new to the entomofauna of Wales. Indirect faunistic links in time are therefore forged between existing traditional orchards and what are mostly early post-medieval Welsh deer parks.

Table 5. Gwent Levels traditional orchard survey 2019-2021. Habitat, status and affinities of 11 species of beetle regarded as Ancient Woodland Indicators (Alexander, 2004) in traditional orchards.

Beetle	Habitat	National Status	Ancient Woodland Indicator Grade	Number of orchards
Hypnogyra angularis Ganglbauer, 1895	woodmould	NR	2	1
Stenagostus rhombeus (Olivier, 1790)	subcortical	-	3	3
Gastrallus immarginatus (Müller, 1821)	cortical	NS	1	3
Hallomenus binotatus (Quensel, 1790)	fungi	NS	3	1
Bitoma crenata (Fabricius, 1775)	subcortical	-	3	1
Eledona agricola (Herbst, 1783)	fungi	NS	3	2
Prionychus ater (Fabricius, 1775)	woodmould	-	3	13
Pseudocistela ceramboides (L., 1758)	wood	NR	2	1
Ischnomera cyanea (Fabricius, 1792)	wood	-	3	1
Vanonus brevicornis (Perris, 1869)	Fungi	NR	1	1
Xyleborinus saxesenii (Ratzeburg, 1837)	wood	-	3	1

NON-ARBOREAL HABITATS

TERRESTRIAL SPECIES

These species were observed incidentally as an adjunct to the defined key objectives and were not targeted. In the case of two orchards, Myrtle Villa and Samson Court, both recently reclaimed from enveloping secondary woodland, terrestrial assemblages were destabilised and undeveloped.

Although this group of species can be treated in a general sense the composition of the terrestrial invertebrate fauna varies with site characteristics, identifiable phytoassociations (*sensu* Rodwell, 1991, 1992) and the extent of management practice. Top end predators such as the ground beetle *Carabus granulatus* Linnaeus, 1758 may occur widely. Larval and adult stages of this species were observed at Myrtle Villa during May 2019. Sites such as Cherry Orchard Farm are both close to the coast and to major reens and this site yielded a significant population of the localised ground beetle *Acupalpus exiguus* Dejean, 1829 and two examples of the scarce *Tachys bistriatus* (Duftschmid, 1812) on 27 May 2021, a species that was not seen elsewhere but which occurs rarely in orchards further upstream in the Severn estuary. The pselaphine rove beetle *Rybaxis longicornis* (Leach, 1817) also occurred here; this is a hygrophilous species of floodplain grasslands, marshes and the upper reaches of salt marshes.

The small rove beetle *Platystethus nitens* (Sahlberg, 1832), characteristic of seasonally inundated grasslands, was at Blue House Farm on 30 May 2019; similarly, the hygrophilous rove beetle *Atheta palustris* (Kiesenwetter, 1844) was at Porton Cottage on 8 August 2020. Examples of the rove beetle *Stenus subaeneus* Erichson, 1840 were in herbage at Blue House Farm on 30 May 2019. The ecological preferences of this species are somewhat varied and complex; large numbers have been observed in a Worcestershire gravel pit and even larger numbers in montane woodlands in Western Greece. At the same site *Stenus cicindeloides* (Schaller, 1783), in contrast, has a recognised preference for wetlands. The wetland limoniid fly *Symplecta stictica* (Meigen, 1818) was commonly encountered in ranker orchard grassland together with the commoner species of dolichopodid flies. Mown orchard grassland attracts transient beetle faunas associated with cut and drying hay and this was observed at Cherry Orchard Farm on 9 June 2021 when predatory carabid and staphylinid beetles, and characteristically large numbers of latridiid, corylophid and cryptophagid beetles assembled.

Some terrestrial species use orchard trees in a variety of ways as adults. They include cantharid beetles such as *Rhagonycha fulva* (Scopoli, 1763), *Rhagonycha lignosa* (Müller, 1764) (Hawse Farm, 27 May 2021) and *Rhagonycha nigriventris* Motschulsky, 1860 (Rose Cottage south, 27 May 2019). Although their larvae are terrestrial predators adult beetles require flowering plants and foliage. The leaf beetle *Oulema obscura* (Stephens, 1831) at Blue House Farm on 30 May 2019 shows a similar duality. Larvae feed on the foliage of coarse grasses during the spring and summer while adults utilise loosened bark for overwintering. Figure 3 illustrates how effective birds at The Willows are at assembling data on terricolous invertebrates; a Jackdaw demonstrated that this somewhat drier site supported a relatively mesophilous pastoral assemblage of insects.

Fig. 30. One of two examples known from Monmouthshire of the terrestrial spider *Xysticus kochi* Thorell, 1872. Penallt, 18 June 2012.

Amongst spiders the localised thomisid *Xysticus kochi* Thorell, 1872 (Fig. 30) was at Porton Cottage on 26 May 2021 and the Nationally Scarce *Nigma puella* (Simon, 1870) was swept from herbage at Blue House Farm on 30 May 2019. It is clear that the grasslands of the Gwent Levels orchards support a diverse range of sometimes localised terrestrial insects some of which may be limited to one or a few sites.

PHYTOPHAGOUS SPECIES OF ORCHARD HERBAGE

Traditional orchard herb-dominated biotopes support a diverse range of invertebrates that may form part of the diverse wider grassland assemblages of the Gwent Levels. Until more work is undertaken on grassland insects of the levels, the contribution made by its orchard grassland species is here given without wider context. Critically important examples of MG5 phytoassociation grasslands (Rodwell, 1992) were identified on the Wentlooge Levels, for example, around Cherry Orchard Farm, which support characteristic insects largely dependent on them.

All traditional orchards support phytophagous invertebrates but the species, the number of species and the assemblages vary enormously; no two Gwent Levels orchards are the same in this regard. Well distributed common elements of phytophagous faunas can be discerned, often linked to particular wetland herbs, such as weevils associated with Polygonaceae. The entomofauna of Magor with Undy Community Orchard herbage is especially rich. This may due to a range of factors including its sheltered location on the 'back fen' and its history of cultivation as part of Undy Great Field which have created diverse herb and tall herb associations of Rosaceae, Fabaceae, Asteraceae, Apiaceae, Polygonaceae, Plantaginaceae, Rubiaceae and Cyperaceae.

This association supported an equally diverse resident fauna of leaf beetles and weevils on 7 August 2020 including *Gastrophysa* spp., *Chaetocnema* spp., *Longitarsus* spp., *Perapion curtirostre* (Germar, 1817), *Perapion hydrolapathi* (Marsham, 1802), *Perapion violaceum* (Kirby, 1808), and *Trichosirocalus troglodytes* (Fabricius, 1787). The carrying capacity of this site was also considerable and a count of 335 *Longitarsus pratensis* (Panzer, 1794), a leaf beetle associated with plantains, Plantaginaceae, was rapidly achieved on 7 August 2020 when there were large numbers of grass bugs *Nabis ferus* (Linnaeus, 1758), *Notostira elongata* (Geoffroy in Fourcroy, 1785) and *Stenodema laevigata* (Linnaeus, 1758) amongst 13 species of terrestrial true bugs including *Coreus marginatus* (Linnaeus, 1758), the striking *Corizus hyoscyami* (Linnaeus, 1758), a recently expansive species (Whitehead, 2008), and breeding populations of the widespread *Dolycoris baccarum* (Linnaeus, 1758).

Auchenorrhyncha (Fig. 31) or planthoppers comprise a distinct group of phytophagous Hemiptera that typically imbibe sugar solutions from plants. The Magor with Undy fauna included the generally widespread *Anoscopus albifrons* (Linnaeus, 1758), *Aphrodes makarovi* Zakhvatkin, 1948, *Conosanus obsoletus* (Kirschbaum, 1858), *Arthaldeus pascuellus* (Fallén, 1826) and *Philaenus spumarius* (Linnaeus, 1758).

Cercopis vulnerata Illiger in Rossi, 1807 (Fig. 31) is a distinctive auchenorrhychan which was not commonly observed although a remarkable concentration of 330 adults was found reen-side at Myrtle Villa environs on 31 May 2019. Like other groups, the Orthoptera, grasshoppers and bush crickets, tended to form somewhat discrete populations overall with Short-winged Conehead *Conocephalus dorsalis* (Latreille, 1804) focussing closer to the coast. Long-winged Conehead *Conocephalus fuscus* (Fabricius, 1793) was observed only at Magor with Undy where Lesser Marsh Grasshopper *Chorthippus albomarginatus* (De Geer, 1773) also occurred. This species was also at Redwick House which also had notably high numbers of Meadow Grasshopper *Pseudochorthippus parallelus* (Zetterstedt, 1821). The Speckled Bush-cricket *Leptophyes punctatissima* (Bosc, 1792) was observed at Magor with Undy and Porton Cottage.

Photo © Dr J.A. Whitehead

Fig. 31. *Cercopis vulnerata* expelling a fluid bubble, Folly Farm, Somerset, 18 June 2006.

Fig. 32. Male *Conocephalus fuscus*, Magor with Undy Community Orchard, 7 August 2020.

WINGED ORCHARD VISITORS

The orchards and their environs support the more usual butterflies although Small Copper *Lycaena phlaeas* (Linnaeus, 1761) was observed only at Blue House Farm. An incidental sighting came in the form of an Ox-tongue Conch tortricid moth *Cochylis molliculana* Zeller, 1847 (Fig. 40) on 30 May 2019 evidently new to Wales. In the wider orchard context winged visitors are not confined to fruit trees. The insect fauna of sallows and willows fell somewhat outside the remit of this study but they are undoubtedly important in sustaining a wide range of Lepidoptera (Figs 33, 34, 35) and other insects. Mention should be made of the weevil *Isochnus sequensi* (Stierlin, 1894) that occurred on Crack Willow *Salix x fragilis* L. at Porton Cottage on 10 August 2020. This recently expansive species, hitherto largely unknown in Wales, has a clear preference for riparian willows in midland England and may well become, or be, more widespread on the Gwent Levels.

Amongst Hymenoptera, the Shrill Carder Bee *Bombus sylvarum* (Linnaeus, 1761) is a seriously-declined speciality of Gwent Levels grasslands (Howe, 2012), especially of Fabaceae-rich M5 phytoassociation grasslands (Rodwell, 1992). A single example was observed in such a situation at Cherry Orchard Farm on 9 June 2021. A worn female Lobe-spurred Furrow Bee *Lasioglossum pauxillum* (Schenck, 1853) swept at Redwick House on 7 August 2020 was ultimately recognised by the metatibial internal spur characters. This species is usually regarded as very rare in Wales but with a wider distribution in southern England where it is Nationally Scarce. The Large Sallow Mining Bee *Andrena apicata* Smith, 1847 was at Little Cross Farm and Porton Cottage on consecutive days in May 2021. Although Nationally Scarce it is probably more widespread on the Gwent Levels than these records imply, especially when sallows and willows are in flower. *Andrena labialis* (Kirby, 1802) is a rather localised mining bee which also favours forb-rich meadows; it was observed only at Porton Cottage on 26 May 2021. Small diapriid Hymenoptera remain little-known generally but a single *Basalys parva* Thomson, 1858, a parasitoid of fly pupae (Notton, 1991), was on the foliage of walnut *Juglans regia* L. at Redwick House on 7 August 2020.

Although ants of the genus *Myrmica* were often abundant across the orchards some ants had a restricted distribution for reasons which are not immediately apparent. The Yellow Meadow Ant *Lasius flavus* (Fabricius, 1781) is impacted on by grassland management practice and nests of this species occurred only at Little Cross Farm which also yielded *Myrmica lobicornis* Nylander, 1846 at its only site. At the same site the widespread *Lasius niger* (Linnaeus, 1758) drew columns of soil >30 cms upwards inside the hollow bole of a small apple tree, possibly as a flood-alleviation strategy. *Leptothorax acervorum* (Fabricius, 1793) nested around the bases of veteran apple trees at both Magor Pill Farm and Porton Cottage, examples from the latter site showing some distinctive skeletal features that may require further study.

Amongst the mobile dung beetles *Onthophagus coenobita* (Herbst, 1783) is one of the more widespread onthophagines; it occurred in horse dung at Magor Pill Farm on 7 August 2020 and in a Jackdaw pellet (Fig. 3) at The Willows on 28 May 2019.

During the course of this survey arrangements were made to survey the environs of Porton Cottage. This is a fine example of a vernacular farm cottage with linked outbuildings. The construction uses ashlar, brick, sandstone and limestone rubble, the latter including reclaimed beach boulders. The east-facing wall is rendered with lime mortar. The house may date to about AD1750 but its fabric may well contain materials recycled from earlier buildings nearby or evidence of older structures. An unabraded fragment of Old Red Sandstone roofing tile from the adjacent orchard is of a type known to have been used in Roman vernacular architecture. The garden at Porton Cottage is equally vernacular, its corners demarcated by ancient plants of the Duke of Argyll's Tea Tree *Lycium barbarum* L.

On 26 May 2021 the flowers of a garden hawthorn *Crataegus monogyna* Jacq. attracted five species of beetle known to occur in the nearby orchard and the lime mortar provided nesting sites for the mining bee *Lasioglossum smeathmanellum* (Kirby, 1802) (Fig. 33) that regularly forages in the orchard. The localised Mason Bee *Osmia aurulenta* (Panzer, 1799) (Fig. 34) usually nests in the empty shells of larger terrestrial molluscs which abound around the cottage. The number of water-retaining containers situated around the cottage, one of which supports the invasive snail *Physella acuta* (Draparnaud, 1805), provide a challenge for flying insects; the *Osmia aurulenta* shown in Fig. 34 was recovered from one.

The sympathetic management of Porton Cottage enable it to shelter a range of species which would otherwise find coastal existence problematic and at the same time to establish clear faunistic links with the biology of the adjacent orchard making for a highly desirable combination of circumstances in which the human fingerprint has been lightly impressed.

Fig. 33. *Lasioglossum smeathmanellum*, Porton Cottage house wall, 26 May 2021.

Fig. 34. *Osmia aurulenta*, Porton Cottage environs, 26 May 2021.

Fig. 35. The spectacular larva of The Miller *Acronicta leporina* (L., 1758) on Crack Willow, Redwick House, 7 August 2020.

Fig. 36. Larva of the Clouded Border *Lomaspilis marginata* (L., 1758) on Crack Willow, Porton Cottage, 10 August 2020.

Fig. 37. Larvae of Buff-tip *Phalera bucephala* (Linnaeus, 1758) on Crack Willow, Porton Cottage, 10 August 2020.

DRIFTWOOD INVERTEBRATES OF THE RIVER SEVERN FORESHORE

Examination of tidal driftwood was a stated requirement of this study. Saproxylic and other invertebrates associated with driftwood were searched for at:

i) Wentlooge Levels foreshore extending over 1.3 kms on 9 August 2020 (Fig. 1)
ii) Caldicot Levels foreshore, Portland Grounds-Cold Harbour Pill-Magor Pill extending over 2.5 kms on 24 May 2021 (Fig. 2)

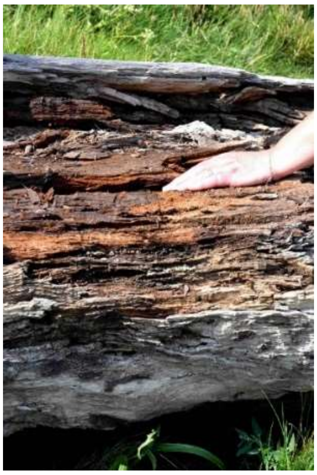
At the conclusion of day work additional cursory studies were made during evening strolls at:
i) Wentlooge Levels foreshore on 30 May 2019 **ii)** Caldicot Levels foreshore at Magor Pill on 8 August 2020

Examination of driftwood on the Severnside foreshores was undertaken with the key objective of determining whether rafted cordwood and complete trees provided a significant habitat for saproxylic invertebrates, what those invertebrates might be, and what their relationship might be with the saproxylic invertebrates of the traditional orchards. It may also be that rafted insects include representatives of documented later prehistoric/early historic entomofaunas (Table 6) (Girling, 1984,

1985) which may have long extant counterparts inland. This matter is not a simple one and the establishment of such relationships is somewhat fraught.

Prior to the alluviation of the levels and the deposition of the Wentlooge Formation, estuarine woodlands at their lowest levels of descent would have contained an intimate admixture of living, rafted and collapsed trees which was the haunt of a fairly specific biota (Girling, 1984; 1985). Any such admixture is now broken by an extended history of land management resulting in fabricated flood defences, principally the Newport Seawall, with the implication that drift-transported insects require wings if they are to colonise orchards directly. A saproxylic beetle *Ptilinus pectinicornis* was resting on an exposed coastal wall at Goldcliff (51°53'N 02°90'W, ST3781) on 31 May 2019. The saproxylic elaterid beetle *Melanotus castanipes* (Paykull, 1800) (Fig. 42) flies readily; it occurred in either elm, apple, pear or plum in nine orchards and was distributed along both foreshores in rafted trees. The wasp *Pemphredon lugubris* (Fabricius, 1793) was identified at two orchards and active at rafted willow trees at Magor Pill (51°55'N 02°81'W ST4384) on 8 August 2020, in which provisioned galleries of another fossorial wasp, *Ectemnius* sp., were observed. The ease with which these species can access easily excavated softened wood is a clear foreshore attraction.

Fig. 38. Extensive grazing marsh looking west towards Cardiff from Peterstone Wentlooge, 30 May 2019. The flood embankment creates a barrier to the inland penetration of tide-rafted trees some of which sustain saproxylic invertebrates.



The Tree Ant *Lasius brunneus* is a key species in the traditional orchards of the Gwent Levels with nesting proven at eight sites. A very large nest of this species was found between the annual rings of a damp tide-rafted tree on the Wentlooge foreshore (51°31'N 03°04'W, ST2780) on 9 August 2020 (Fig. 39). The nearest orchard nesting site on the Wentlooge Levels is at Blue House Farm which is only 700 metres west of this rafted tree; direct connectivity would therefore be a simple matter. Entire nests of *Lasius brunneus* can be fluvially transported in wood *in situ* (PFW, personal observation) and passive dispersion in this way is a significant factor in the range consolidation of this species, especially in western Britain.

Fig. 39. Nest of the Tree Ant *Lasius brunneus* in tide-rafted tree, Wentlooge foreshore, 9 August 2020.

If rare stenotopic species are recognised only in rafted trees, further complexities arise which may require further research. Is the condition, structure or mycobiota of such trees attractive exclusively to those species, as it markedly is with beetles such as *Nacerdes melanura* (Linnaeus, 1758), a species commonly found in tide-rafted wood? An example of such extreme localisation is the Nationally Rare NR elaterid beetle *Ischnodes sanguinicollis* (Panzer, 1793) found breeding in *Acer* sp. on the Wentlooge foreshore on 30 May 2019. This species, which curiously has no fossil record, is here new to Wales; it readily accepts riparian trees and woodlands and as such occurs upstream on the River Severn (PFW, personal observation). Similarly the cerambycid beetle *Phymatodes testaceus* (Linnaeus, 1758) was observed breeding in rafted willow *Salix* sp., on the upper saltmarsh of Wentlooge on 30 May 2019. It was not recognised in the orchards but is known from six Welsh Parklands (Hammond & Hine, 1994). *Phymatodes testaceus* often maintains site-fidelity on small spatial scales where host-tree wood is profuse.

The Nationally Scarce NS eucnemid beetle *Epiphanis cornutus* Eschscholtz, 1829 was observed breeding in a tide-rafted tree at Cold Harbour Pill on 24 May 2021. This has relevance to suggested past breeding at Samson Court orchard, noting that *E. cornutus* is usually weakly dispersive and was unrecorded from Welsh parklands by Hammond & Hine (1994). According to the NBN Atlas accessed 30 December 2021 *E. cornutus* has occurred in Wales on five occasions and in Britain on 51 occasions.

The more widespread subcortical zopherid beetle *Bitoma crenata* (Fabricius, 1775) was observed breeding on dry rafted willow *Salix* sp. at Wentlooge foreshore (51°31'N 03°04'W, ST2780) on 9 August 2020; in the orchards an example was on pear *Pyrus communis* at Great Newra on 19 May 2019.

The dominantly littoral weevil *Pseudophloeophagus truncorum* (Stephens, 1831) is strongly linked to rafted wood and timber but will extend inland into coastal woodlands where it breeds in the decayed wood of standing trees and shrubs. An example was found in rafted willow *Salix* sp. at Redwick coastal embankment (51°55'N 02°82'W, ST4384) on 24 May 2021. According to the NBN Atlas accessed 30 December 2021 there are 11 Welsh records, dominantly in the littoral and 37 British records of *P. truncorum*. A presence in supra-littoral orchards such as Porton Cottage cannot be ruled out.

The small originally antipodean weevil *Euophryum confine* (Broun, 1881) accepts a wide range of host tree species and is routinely dispersed by fluvial processes; it has become widespread in Britain as a result of such passive dispersion. On the Severnside coast it was observed breeding in willow *Salix* sp., at Magor Pill on 8 August 2020 and was associated with pear *Pyrus communis* at Bryn House Orchard and with apple *Malus domestica* at Rose Cottage south, both on 27 May 2019.

Two species of elm-associated scolytine weevils were identified in rafted elm trees on the foreshore of which *Scolytus multistriatus* (Marsham, 1802) was also observed breeding on elm at Myrtle Villa on 31 May 2019. It is a point of interest that *S. multistriatus* is able to maintain a viable perennial breeding population in tide-washed driftwood. The second more localised scolytine, *Pteleobius vittatus* (Fabricius, 1787), was observed as a solitary individual in elm at Cold Harbour Pill (51°55'N 02°81'W, ST4384) on 24 May 2021. According to the NBN Atlas accessed 30 December 2021 there are 11 mostly old Welsh records from three vice-counties the most recent from Livox Wood, Monmouthshire (Whitehead, 2013) and it was unrecorded from 32 Welsh parklands by Hammond & Hine (1994).

The normally saproxylic rove beetle *Atheta basicornis* (Mulsant & Rey, 1852) has a strong but by no means exclusive affinity with fluvial drift and is often linked to rafted or floating willow. Scarcely known in Wales, two examples were under the bark of rafted willow *Salix* sp. at Magor Pill (51°55'N 02°81'W, ST4384) on 8 August 2020. The NBN Atlas accessed on 30 December 2021 records two Welsh and 61 British examples of this species.

The taxonomic status of the carabid beetles *Ocys harpaloides* (Audinet-Serville, 1821) and *Ocys tachysoides* (Antoine, 1933) was recently clarified by Maddison & Anderson (2016), the former being generally but not exclusively (Whitehead, 2019) coastal. *Ocys harpaloides* was amongst rafted cordwood on the Wentlooge foreshore (51°31'N 03°04'W, ST2780) on 9 August 2020. *Ocys tachysoides* was recognised from fragments in the cavity of an apple tree at Rose Cottage south on 27 May 2019.

INVERTEBRATES AND DRIFTWOOD - CONCLUDING COMMENTS

In this study on the Gwent Levels foreshore we have seen that:

i) Driftwood is able to sustain a significant resource of saproxylic insects.
ii) Driftwood can support a diverse range of insect species linked to it with varying degrees of fidelity.
iii) A number of species such as *Nacerdes melanura* (Linnaeus, 1758) are intimately tied to driftwood. Some rare discriminating Ancient Woodland Indicator (AWI) species that utilise driftwood have not yet been identified in Gwent Levels orchards. The condition of driftwood and the continuity of that condition over time is critical in the fortunes of particular species, especially Hymenoptera and some beetles.
iv) The quantity, variety and spatial distribution of driftwood is important if it is to satisfy the requirements of discriminating sensitive species.
v) The physical condition of Severnside driftwood is largely determined by its position in relation to a sea-wall or sea-bank. Driftwood generally exists in a more or less constant regime of open exposure, insolation, and saturation all in varying extent. Wood may be artificially conserved and its life extended by eipsodic saturation by seawater (Fig. 38) which creates challenges for some insect and fungal colonists. At the highest levels of flood strand, for example in embayments or on floodplains at the mouths of watercourses, there is evidence to suggest that populations of some species e.g. the Tree Ant *Lasius brunneus* (Fig. 39) may achieve large size and persist indefinitely.
vi) There is no doubt, certainly for species able to fly, that the insect fauna of littoral driftwood has the ability to supplement the fauna of the Gwent Levels traditional orchards especially those near the coast. See also the discussion on the littoral weevil *Rhopalomesites tardii* on page 44.
vii) Littoral driftwood should not be removed or disposed of other than by pre-determined strategy.

TERRESTRIAL FORESHORE INVERTEBRATES

During the course of this study a limited number of incidental observations were made on terrestrial foreshore invertebrates a selection of which is given here.

Scolopostethus pictus (Schilling, 1829) (Hemiptera, Lygaeidae)
This Nationally Rare NR ground bug has not been observed in Wales since 1970 (Howe, 2004) a view supported by the NBN Atlas accessed 30 December 2021 which confirmed eight British records. Examples were observed in tidal flood strand at Peterstone Wentlooge (51°51'N 03°05'W, ST2779) on 30 May 2019 and at Cold Harbour Pill (51°55'N 02°81'W, ST4384) on 24 May 2021. The Gwent Levels foreshore is clearly a stronghold for this rare species often associated with fluvial environments (Whitehead 1991a, 1991b).
Melanophthalma suturalis (Mannerheim, 1844) (Coleoptera, Latridiidae)
This is a widespread localised mycophilous beetle found in a range of wetlands including carr, swamps and reed beds. Examples were swept from the back of the salt marsh at Magor Pill (51°55'N 02°81'W, ST4384) on 8 August 2020. Others were noted in the environs of Myrtle Villa on 28 May 2019 and in the coastal orchard at Porton Cottage on 8 August 2020. Data from the NBN Atlas accessed 30 December 2021 showed no previous Welsh records and 25 British records.
Atomaria gutta Newman, 1834 (Coleoptera, Cryptophagidae)
This mycophilous beetle is most frequently encountered in Britain in lowland river catchments but also extends to estuary mouths and strandlines, for example in Bridgewater Bay. Breeding populations are uncommonly observed so that 50, including teneral adults, packed amongst a white resupinate fungus beneath rafted driftwood at Magor Pill on 8 August 2020 is unusual.
Finally, in a year when Clouded Yellow butterflies ***Colias croceus*** (Fourcroy, 1785) were infrequently seen, two were observed *in copula* on a foreshore boulder at Wentlooge (51°31'N 03°04'W, ST2780) on 9 August 2020.

COMMENTS ON SELECTED INVERTEBRATES

PSYLLIDS, HEMIPTERA

Cacopsylla visci (Curtis, 1835) (Psyllidae)

Although the NBN Atlas accessed 10 January 2022 showed no Welsh records of the Mistletoe Psyllid the present writer has a number of records in Monmouthshire's traditional orchards since as far back as 2011 as extensions of the English midland Mistletoe 'province'. Clearly rare in Wales, three were on Mistletoe *Viscum album* L. at Magor with Undy Community Orchard on 7 August 2020.

MOTHS, LEPIDOPTERA

Cochylis molliculana Zeller, 1847 (Tortricidae)

Known as the Ox-tongue Conch after its host-plant *Picris echioides* L., this fairly recent British colonist was first observed in Dorset during 1992 since when it has extended its range northwards and westwards around the coast. An example attracted to light at Brick House, Redwick on 30 May 2019 is likely to be new to Wales. It was not cited by Horton (1994).

Fig. 40. *Cochylis molliculana* Zeller, 1847. The Brick House, Redwick, 30 May 2019.

BEETLES, COLEOPTERA

Tachys bistriatus (Duftschmid, 1812) (Carabidae)

This Nationally Scarce NS thermophilous wetland habitat indicator species was active in a M28 tall herb mire phytoassociation at Cherry Orchard Farm on 27 May 2021 together with other wetland species. It has a scattered distribution across southern England and may be increasing as a consequence of climate change. It was absent from an east Anglian fen survey that identified 2187 species of invertebrates (Lott, Procter and Foster, 2002). In Wales there are two old Glamorganshire records and on the Gwent Levels there are 1988 records for Magor Marsh Nature Reserve. These records are more reflective of an indigenous Gwent Levels/Severn Estuary relict than records at artificial water bodies such as gravel pits (Atty, 1983). An example was in the basal woodmould of a plum tree Pru*nus domestica* cv. 'Rivers' Early Prolific' in Gloucestershire on 20 September 2001 (Whitehead, 2005). Lott (2003) stated that *T. bistriatus* occurred on exposed soft sediment but this was based on evidence from a single sample only.

Acupalpus exiguus Dejean, 1829 (Carabidae)

This localised Nationally Scarce NS wetland ground beetle is rare in Wales with four records on the NBN Atlas accessed on 10 January 2022. It has a strong riparian presence in the primary drainage of the River Severn, River Avon and doubtless elsewhere (Easton, 1947); it can fly (Whitehead, 2020) and in winter may migrate short distances away from wet catchment fringes. According to Drake (2004) *A. exiguus* demonstrates some fidelity to grazing marshes. Examples in the M28 tall herb mire phytoassociation at Cherry Orchard Farm on 27 May 2021 appear to be associated with the environs of canalised reens developed on the Upper Wentlooge Formation; the same comment on habitat applies to examples by Porton Cottage on 26 May 2021. A male example from Porton Cottage (Fig. 41) presented an identification problem. Dr Bernd Jaeger was consulted in an attempt to clarify the matter. The view prevailed that this was an unusually pale colour form of a species that is more usually black as a mature adult.

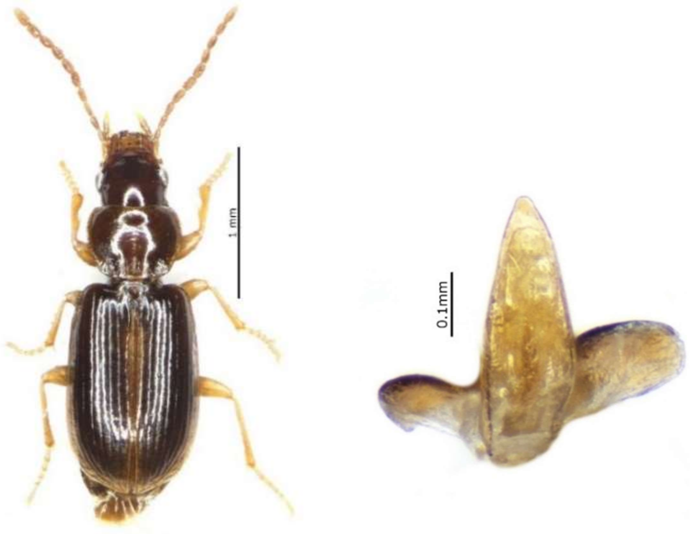


Fig. 41. *Acupalpus exiguus*, male, Porton Cottage, 26 May 2021. Left: an unusually pale adult reminiscent of other species of *Acupalpus*. Right: male genitalia or aedeagus, dorsal aspect.

Hypnogyra angularis Ganglbauer, 1896 (Staphylinidae)

This Nationally Rare NR saproxylic species has a particular predilection for maloid woodmould where the life cycle is completed. A larva was in apple tree cavity woodmould at Rose Cottage south on 27 May 2019. This species is generally regarded as a strong indicator of the ancient woodland environment but one that is now characteristic of traditional orchards (Whitehead, 2006) where the quality and aeration of the woodmould is critical. The writer has records from cherry, ash, and beech in other time-patinated landscapes.

Melanotus castanipes (Paykull, 1800) (Elateridae)

This widely distributed click beetle has catholic tastes breeding in woodmould, under bark, in wood, in cavities and even in peat (Whitehead, 2007b) and railway sleepers (Fig. 42). It was recorded as 36 adult beetles and larvae from 10 orchards breeding in four tree genera, *Malus, Prunus, Pyrus,* and *Ulmus*. It readily disperses in flight, especially at night. Published records are no doubt confused with the closely similar *Melanotus villosus* (Geoffroy in Fourcroy, 1785) which is evidently more discriminating and much scarcer, especially in Wales.

Fig. 42. Pupa and larval exuvia of the saproxylic click beetle *Melanotus castanipes* removed from softwood railway sleeper bedded in the ground. Magor Pill Farm, 7 August 2020.

Pocadius adustus Reitter, 1888 (Nitidulidae)

According to the NBN atlas accessed 10 January 2022 there are six Welsh records of this species widely dispersed in Anglesey, Denbighshire and Monmouthshire. Two adults were observed in the sporophore of a Giant Puffball *Calvatia gigantea* (Batsch) Lloyd at Porton Cottage on 10 August 2020. Extensive galleries indicated that these represented a breeding population. This species utilises a range of related species of puffball fungi.

Gastrallus immarginatus (Müller, 1821)(Ptinidae) UK Biodiversity Group (1999) Biodiversity Action Plan species.

This is a Nationally Rare NR bark-inhabiting beetle with an especially exacting ecology. Until 2000 it was strictly associated with Field Maple *Acer campestre* L. in Britain, although in continental Europe it colonises oak *Quercus* spp. (Lohse, 1969) and the present writer has breeding records on Turkey Oak *Quercus cerris* L. in east central Europe. In 2000 it was discovered breeding on apple *Malus domestica* at Gotherington on the Cotswold Hills, in traditional orchards on pear *Pyrus communis* at Blaisdon, Gloucestershire, on apple and pear at Aston-on-Carrant, Worcestershire and in 2001 on pear at Minsterworth, Gloucestershire (Whitehead, 2004).

Fig. 43. Cherry Orchard Farm, Wentlooge. 9 June 2021. Left, subcortical faecal-filled larval galleries of *Gastrallus immarginatus* showing dead pupa and larval exuvia of omaliine staphylinid beetle in galleries. Right, enlarged view of same omaliine staphylinid pupa and larval exuvia believed to be *Dropephylla cf. ioptera* (Stephens, 1834).

On the Gwent Levels *G. immarginatus* breeding activity was observed for the first time in Wales on pear at Samson Court on 25 May 2021, at Brick House, Redwick on 27 May 2021 and at Cherry Orchard Farm on 27 May 2021. A return visit to Cherry Orchard on 9 June 2021 enabled further evidence to be gleaned (Fig. 43). The results of this investigation proved to be of some interest. A ramifying network of larval *G. immarginatus* galleries were found to be packed with faeces of typical ptinid form. Several species of mite were observed in the galleries including numbers of large adult euphthiracaroid mites amongst desiccated sporocarps of ascomycotine fungi. Some of the ptinid faeces were being recycled by fungal hyphae and unusually small pale examples of the beetle *Mycetaea subterranea* (Fabricius, 1801) (Coleoptera, Endomychidae) had become entrapped in the galleries. Fragments of larval exuviae apparently represent this species which is believed to complete its entire life cycle within the tree. Of particular interest was a dead pupa colonised by a fungus to which a larval exuvia remained attached (Fig. 43). Microscopic examination of the exuvia confirmed its staphylinimorph affinity and examination of the pupa pointed clearly to Omaliinae; further observation led me to conclude that the species involved was likely to be *Dropephylla ioptera* (Stephens, 1834), a genus for long recognised as including subcortical predators (Luze, 1906). Dr Margaret Thayer, a foremost authority on Staphylinidae (Thayer, 2005) lent her support to these assertions, pointing out there is evidence of a related species predating wood-boring beetles (Coleoptera, Scolytinae) in the New World (Furniss, 1995).

At the same site the predatory melyrid beetle *Anthocomus fasciatus* (Linnaeus, 1758) was found to be abundant, and although no direct relationship was established in this instance, it would seem that *G. immarginatus* may be subject to significant predation, at least on orchard fruit trees. Whitehead

(1999, 2004) suggested that range-edge populations of *G. immarginatus* may be small and short-lived. In continental Europe populations may be substantial. The arboretum at Banská Štiavnica, Slovakia was established about 1860. On 19 June 1999, one of three Field Maple trunks was found to be peppered on all aspects with >10,000 exit holes attributable to *G. immarginatus* and as far as could be discerned not a single larva remained in the tree (Whitehead, 1999b). The second tree revealed in excess of 200 exit holes with no larvae present, while the third tree revealed no exit holes attributable to *G. immarginatus*. Predation and fungal impacts are other clear considerations; knowledge of these matters remain largely embryonic.

There are temporal precursors for the 'alluvial' populations of *G. immarginatus* on the Gwent Levels which are of considerable interest as they imply that in prehistory *G. immarginatus* was a species of fen woods or carr. These subfossil records cover the Neolithic Shapwick Sweet Track on the Somerset Levels (Coles, Hibbert & Orme, 1973; Girling, 1984), the Bronze Age of Stileway in Somerset (Girling, 1985) and the Bronze Age of Thorne Waste in the Thorne Moors complex of the Yorkshire and Lincolnshire River Ouse (Buckland, 1979; Skidmore, Limbert & Eversham, 1985). At Thorne Waste *G. immarginatus* was recovered from peat embedded in a timber trackway traversing fen wood and raised mire; the great pear trees at Cherry Orchard Farm, Wentlooge would surely provide a close analogue for this! It would indeed be of interest if *G. immarginatus* had colonised traditional orchards as relictual inhabitants of those woodlands. It may be that in prehistory *G. immarginatus* had a wider host range; on the footsclopes of Bredon Hill in Worcestershire the writer observed on 11 November 1999 a small breeding population in Hazel *Corylus avellana* L. which abounded in prehistoric riparian woodland (Buckland, 1979).

Anaglyptus mysticus (Linnaeus, 1758) (Cerambycidae).

This attractive longhorn beetle has a predilection for somewhat insolated open grown trees and is a well-known inhabitant of ancient woodland fringes and traditional orchards in England. The Welsh population is concentrated along its eastern fringes. Fragments of this species were found in a corvid bird pellet at The Willows (Fig. 1).

Prionychus ater (Fabricius, 1775) (Tenebrionidae)

This large tenebrionid beetle has developed a particular affinity for apple tree woodmould. According to NBN atlas accessed 12 January 2022 it has been observed in Wales on 34 occasions, so that the 144 larvae, pupae, beetles and fragments of beetles here scattered across 13 traditional orchards enlarges the Welsh population significantly. It also demonstrates the amount of support this Ancient Woodland Indicator species receives from Monmouthshire orchards in which county most Welsh records are concentrated. The present writer has British records from 12 species of native tree but breeding populations are always greater in orchards. The apparent absence from the Gwent Levels of the scarcer *Prionychus melanarius* (Germar, 1813) requires some explanation given its presence in traditional orchards on the east side of the River Severn and higher upstream on the west side.

Choragus sheppardi Kirby, 1819 (Anthribidae)

According to NBN Atlas accessed 12 January 2022 there are nine mostly very old Welsh records of this declining Nationally Rare NR species but none from Monmouthshire. This is almost certainly a candidate for inclusion in the saproxylic beetle-based Index of Ecological Continuity (Alexander, 2004). The finding of an adult at Porton Cottage on 8 August 2020 associated with a moribund apple tree *Malus domestica* makes a clear statement for the conservation interest of that site. Like *Gastrallus immaculatus* this species favours moribund Field Maple *Acer campestre* in parts of its British range.

Vanonus brevicornis (Perris, 1869) (Aderidae)

There are no previous Welsh records of this Nationally Rare NR discriminating mycophilous Ancient Woodland Indicator species. For long considered one of the rarest British beetles (Buckland, 1979) it has recently shown a slight resurgence (Washington, 2019). It has a predilection for terrestrial fungi linked to trees or tree-decay processes, and like *Gastrallus immarginatus* may hallmark riparian woodlands or fen woods (Buckland, 1979; Whitehead, in press b). The example from Cherry Orchard Farm on 9 August 2020 was associated with the fungus *Gymnopilus junonius* (Fr.) P.D. Orton, 1960 (Agaricales, Cortinariaceae) which may prove attractive to it (Washington, 2019).

BEES, WASPS AND ANTS, HYMENOPTERA

Microterys seyon Guerrieri, 1996 (Encyrtidae)

A female example of this rare little-known parasitoid of soft scale insects was on arborescent ivy *Hedera helix* L. at Porton Cottage Orchard on 10 August 2020 (Whitehead, in press a). This species is rarely observed in Britain (Painter, 2020) but a female from the Isle of Man was associated with the soft scale *Coccus hesperidum* Linnaeus, 1758 on ivy (Painter, 2020); if there are other Welsh records I cannot trace them. The known range of this species suggests an oceanic west-European type of distribution. When handled the Porton Cottage wasp readily jumped up to 320 mm, an ability which appears to have been seldom recorded.

Lasius brunneus (Latreille, 1798) Tree Ant (Formicidae)

In recent decades this ant, first recorded in Britain in 1923, has increased and consolidated its British range and it can no longer be regarded as a national rarity. Despite this it remains scarce in Wales with only about nine pubished records since its discovery there less than 30 years ago (Hammond & Hine, 1994). The finding here of large breeding populations on the Caldicot Levels at Brick House and on the Wentlooge Levels at Cherry Orchard Farm and of breeding in at least eight other orchards confirms how important the Gwent Levels orchards are for this key indicator species of orchard biological vigour. Foreshore populations (Fig. 39) interfinger with orchard populations.

FLIES, DIPTERA

Achyrolimonia decemmmaculata (Loew, 1873) (Limoniidae)

This is a rather specialised cranefly associated with fungoid wood (Buxton, 1960) which according to Stubbs (2021) is a somewhat localised widespread species of lowland woods. Recorded from The Willows on fallen crown wood of apple *Malus domestica* on 28 May 2019 (Fig. 27). Scattered throughout Wales north to Merionethshire and Caernarvonshire.

Dictenidia bimaculata (Linnaeus, 1761) (Tipulidae)

This is a widespread saproxylic inhabitant of a range of broadleaved trees. Although extending north to the Scottish Highlands there is a curious scarcity of Welsh records. Breeding was confirmed in good numbers at Myrtle Villa and The Willows on 28 May 2019 in apple *Malus domestica*.

SNAILS, MOLLUSCA

Physella acuta (Draparnaud, 1805) (Physidae)

This adventive North American aquatic snail has an ability to rapidly colonise new areas (Vinarski, 2017). It is strongly synanthropic and able to breed in garden water-butts in sheltered areas, in old allotment water-baths and in ornamental fountains. Populations were found in only one of several water-butts at Porton Cottage on 26 May 2021.

GWENT LEVELS BEETLES - SURVIVORS IN TIME AND SPACE

During 1990 storms exposed structures and features in intertidal sediments at Goldcliff. These became the subject of archaeological investigation and insect remains recovered from trackways, ditches and the insides of houses were subsequently dated to the Iron Age, about BC300 in round terms (Smith, Osborne & Barrett, 1997; 2000). Table 6 lists Iron Age taxa from Goldcliff which have congeners in common with those found during the present survey. No species included in these lists might be termed sensitive ecological indicators apart from *Porotachys bisulcatus* discussed below and *Tachys bistriatus* discussed here on p. 38. Both time periods share numerous generalist species that reflect human activity often associated with managed or agrarian landscapes. The Iron Age presence of four species of scarabaeid beetles associated with mammalian dung indicates that open grassland, pasture or grazing marsh was available in Iron Age Goldcliff with *Calamosternus granarius* often using cattle dung and *Aphodius ater* often using sheep dung.

Table 6. Beetle genera and species recorded both from the Goldcliff Iron Age occupation site (Smith, Osborne & Barrett, 1997) and the present study.

Family	Iron Age – later prehistoric	This study - modern extant
Apionidae	*Apion* spp.	*Apion* 12 spp. identified
Cantharidae	*Cantharis* spp.	*Cantharis* five spp. identified
	Rhagonycha spp.	*Rhagonycha* three spp. identified
Carabidae	*Acupalpus* spp. one identified	*Acupalpus* two different spp. identified
	Bembidion obtusum Serville, 1821	*Bembidion obtusum* Serville 1821
	Calathus spp.	*Calathus rotundicollis* Dejean, 1828
	Dromius spp. identified	*Dromius* two arboreal spp. identified
	Harpalus spp.	*Harpalus rufipes* (DeGeer, 1774)
	Leistus spp.	*Leistus fulvibarbis* Dejean, 1826
	Paradromius linearis (Olivier, 1795)	*Paradromius linearis* (Olivier, 1795)
	Porotachys bisulcatus (Nicolai, 1822)	*Tachys bistriatus* (Duftschmid, 1812)
Chrysomelidae	*Bruchus/Bruchidius* spp.	*Bruchus/Bruchidius* two spp. identified
	Chaetocnema spp.	*Chaetocnema concinna* (Msh., 1802)
	Cassida spp.	*Cassida* two spp. identified
	Psylliodes spp.	*Psylliodes affinis* (Paykull, 1799)
Coccinellidae	*Tytthaspis sedecimpunctata* (L., 1758)	*Tytthaspis sedecimpunctata* (L., 1758)
Cryptophagidae	*Atomaria* spp.	*Atomaria* six spp. identified
	Cryptophagus scanicus (L., 1758)	*Cryptophagus scanicus* (L., 1758)
Curculionidae	*Ceutorhynchus* spp.	*Ceutorhynchus obstrictus* (Msh., 1802)
	Curculio spp.	*Curculio glandium* Marsham, 1802
	Dorytomus spp.	*Dorytomus* two spp. identified
	Hypera spp.	*Hypera postica* (Gyllenhal, 1813)
	Mecinus collaris Germar, 1821	*Mecinus collaris* Germar, 1821
	Polydrusus spp.	*Polydrusus pterygomalis* Boheman, 1840
	Sitona lineatus (L., 1758)	*Sitona lineatus* (L., 1758)
Dytiscidae	*Hydroporus* four spp. identified	*Hydroporus planus* (Fabricius, 1781)
	Illybius spp.	*Illybius montanus* (Stephens, 1828)
Erirhinidae	*Notaris* spp.	*Notaris acridulus* (L., 1758)
Geotrupidae	*Geotrupes* spp.	*Geotrupes spiniger* (Marsham, 1802)
Hydrophilidae	*Cercyon* six spp. identified	*Cercyon melanocephalus* (L., 1758)
	Helophorus spp.	*Helophorus aequalis* Thomson, 1874
	Megasternum concinnum (Msh., 1802)	*Megasternum concinnum* (Msh., 1802)
Latridiidae	*Corticaria/Corticarina* spp.	*Corticaria/Corticarina* two spp.
Nitidulidae	*'Meligethes' sensu lato* spp.	*'Meligethes' sensu lato* two spp.
Oedemeridae	*Oedemera nobilis* (Scopoli, 1763)	*Oedemera nobilis* (Scopoli, 1763)
Ptiliidae	*Acrotrichis* spp.	*Acrotrichis sitkaensis* (Motschulsky, 1845)
Ptinidae	*Anobium punctatum* (DeGeer, 1774)	*Anobium punctatum* (DeGeer, 1774)
Scarabaeidae	*Aphodius ater* (De Geer, 1774)	*Aphodius ater* (De Geer, 1774)
	Calamosternus granarius (L., 1767)	*Calamosternus granarius* (L., 1767)
	Melinopterus prodromus (Brahm, 1790)	*Melinopterus prodromus* (Brahm, 1790)
	Melinopterus sphacelatus (Panzer, 1798)	*Melinopterus sphacelatus* (Panzer, 1798)
Staphylinidae	*Anotylus rugosus* (Fabricius, 1775)	*Anotylus rugosus* (Fabricius, 1775)
	Carpelimus bilineatus Stephens, 1835	*Carpelimus bilineatus* Stephens, 1835
	Lesteva spp.	*Lesteva punctata* Erichson, 1839
	Paederus spp.	*Paederus* two spp. identified
	Philonthus spp.	*Philonthus* three spp. identified
	Quedius spp.	*Quedius* two spp. identified
	Rugilus spp.	*Rugilus rufipes* Germar, 1835
	Stenus spp.	*Stenus* six spp. identified
	Tachyporus spp.	*Tachyporus* three spp. identified
	Xantholinus spp.	*Xantholinus linearis* (Olivier, 1795)

Porotachys bisulcatus (Nicolai, 1822) (Coleoptera, Carabidae)

This is the only British fossil record of a species that was last seen as a vagrant in Britain in 1863 (Bold, 1865) until it appeared in a quasi-synanthropic context in Essex during June 2020 (Hardy, 2020). Widely dispersed in Europe and North Africa, *P. bisulcatus* in the wild is usually associated with humid woodlands and at Goldcliff may have been a relict of alluvial or fen woodland.

The weevil ***Rhopalomesites tardii*** (Curtis, 1825) cited by Smith, Osborne & Barrett (1997) from prehistoric Goldcliff but not found during the present survey requires some consideration. This weevil is of particular interest as a saproxylic species strongly linked to driftwood around British coasts. Smith, Osborne & Barrett (1997) recorded *R. tardii* from a subfossil community of salt-marsh insects in a palaeochannel fill believed to be contemporaneous with an adjacent Iron Age dwelling. In Wales, and elsewhere in Britain, this species rarely occurs inland, for example at Dinefwr Deer Park (Hammond & Hine, 1994). Smith, Osborne & Barrett (1997) make reference to the relationship between driftwood and coastal woodland and it is likely that passive dispersion has for long been an important mechanism of colonisation of such woodland (Read, 1987) by this species.

MANAGEMENT RECOMMENDATIONS FOR TRADITIONAL ORCHARDS

The management of traditional orchards is not a simple matter; there is no 'one size fits all' approach and each site will require its own specific 'user's manual.' Management may require to be fine-tuned to accommodate specific aspects of orchard biology or particular species, of historical fruit tree cultivars or wider considerations of landscape and landscape matrix. A prudent manager will always be mindful of Sir Isaac Newton's Third Law of Motion *viz.* "*For every action there is an equal and opposite reaction*" and understand that there is no perfect system of management.

MANAGEMENT OF A TYPICAL LOWLAND FARM ORCHARD

A typical lowland farm orchard in England or Wales will today contain post-mature or senile trees, a proportion, or sometimes the majority of which will have been lost to fungi, windblow or deliberate clearance. Typically the trees will conform to some form of geometric layout at wide spacings and the scions will have been worked onto vigorous seedlings or old vigorous varieties. Traditional orchards therefore resemble pasture woodlands and this hints at historic management in which orchard grassland was grazed, often by sheep but sometimes by other livestock, including pigs. They are entirely distinct from post-1940s intensive or semi-intensive commercial orchards using modern rootstocks.

However lowland farm orchards are managed they benefit from care and attention and from **consistency of management**. Once a realistic management plan is emplaced and adhered to, the biology of the orchard adapts to that plan and the invertebrate and wider biota tends to stabilise in line with the plan. A good example of this is The Willows at Whitson where three decades of sheep grazing has created a stable, pleasant environment and landscape. The Moorlands at Goldcliff is another site where landowners have taken a constructive interest in the amenity value of their orchard. A well-managed larger orchard will contain many senile trees, may attract a significant avifauna, there will be good light admission and any replantings well protected and guarded where necessary. Adjacent watercourses and related linear woodlands will be schematically managed, perhaps sequentially in time and space, to sustain wildlife generally.

THE MANAGEMENT PLAN

For each orchard the management plan should be produced, written down and agreed (Kirby, 1992). The benefits of any such scheme produce results that have wider regional impacts.

The benefits of planned management are:

i) To assist and support landowners looking ahead
ii) To provide clarity and stability
iii) To maintain the amenity value of orchards which may vary significantly
iv) To maintain or complement distinctive historic varieties of pome fruit in their original contexts
v) To maintain the overarching ecology of the site
vi) To maintain key or target species of plants or animals or assemblages of them

During the course of this study it was clear that some orchards had been abandoned and subsumed within a canopy of secondary or scrub woodland. Far from having any kind of management plan in place they had become almost archaeological. Gwent Wildlife Trust through its Living Levels Partnership has achieved positive results in efforts to reclaim some of these orchards and have worked with landowners in a variety of practical ways to restore traditional orchards and their fruit trees. The effects of this are already apparent but will require to be sustained.

THE MANAGEMENT OF ORCHARD FRUIT TREES

It has been made clear in this report that all parts of a mature orchard fruit tree support assemblages of invertebrates and that post-mature or senile trees have particular features that attract them and other wildlife. Fallen crown wood and moribund trees and stumps are also attractive to small mammals and birds such as the smaller woodpeckers; these should be retained where possible. The last nest of a Lesser Spotted Woodpecker found by the present writer was in a traditional orchard.

Young maiden trees require to be pruned occasionally for crown form, structure and symmetry over a short period of say, eight years, after when support stakes may be removed. Theoretically, orchard fruit trees require no further detailed attention; they should not normally be sprayed with any chemical controlling agents.

The habit of the fruit tree is predetermined by the variety. For example the apple ‘Grenadier’ forms a large untidy mass while ‘Mère de Ménage’ spreads widely developing robust secondary branches. Pears such as ‘Malvern Hills’ may form enormous wide spires. Trees left to their own devices gradually develop their own distinctive biology, although there is no reason why some ‘arboricultural’ attention should not be applied on occasion to orchard trees.

Simple actions may include the cutting back of wind-sheared branches cleanly to their points of origin or the removal of a little crown weight or the provision of additional support if required. A modicum of crown-raising may be required to assist ground management but such work should be undertaken cautiously.

Horses in traditional orchards are incompatible with them. Where horses are kept in or near traditional orchards they are likely to accelerate the decline of the fruit trees; all such trees should be individually guarded with reasonably wide tree guards of rubust construction. The management of fruit trees closely resembles the management of any other veteran broadleaved tree which has been outlined by many authors, including, for example, Read (1996; 2000).

MANAGEMENT FOR INVERTEBRATES

There are two key elements in the management of orchards for invertebrates *viz*.

i) the management of the orchard
ii) the management of the trees

These two matters, as mentioned earlier, may require fine-tuning on a site-by-site basis. A list of key or target species in all biological groups will be provided to relevant parties for each orchard when enough is known about them. Rare or indicator species will be stated and any specific actions documented. Positive management aimed at fruit trees should indirectly conserve a good spectrum of invertebrates. Deadwood is widely recognised as an important resource for many species and should be retained wherever possible. Fallen wood should be retained on site, ideally not in full insolation. As we have observed, fungi and slime moulds are key elements of orchard and fruit tree biology and they should be conserved wherever possible. The important matter here is to understand that conservation management is not simply about rejuvenation.

Any ‘idealised’ or conceptualised format for an ‘invertebrate orchard’ may change dramatically according to its position in relation to other landscape features, or for example, its proximity to the coast. The tall-herb mire community of the Upper Wentlooge Formation at Cherry Orchard Farm that invaded from marginal unmanaged reens contains abundant noxious Hemlock Water Dropwort which would initially limit grazing options. One may envisage an orchard with its herbage well managed either for hay or simply by a regime of regular cutting or planned livestock grazing. The timing of mowing or other operations may be highly site-dependant and require careful timing. Peripheral shrubs or trees such as over-shrouding willows should be mapped and listed and their management, where necessary, prescribed. Some orchards or their curtilages supported veteran Crack Willows with large boles and long-outgrown pollard limbs which are intrinsically important for a wide range of species. For some orchards recognised as biological hotspots (e.g. this report, Table 3) or strategically located, management may need to be exacting.

We may hark back to page five of this report and the statement that: "*The ideal traditional orchard is one that delivers the widest cross-section of options for all life and to which all invertebrates must adapt by processes of accommodation*." Achieving this ideal is never simple and it will be more difficult for some landowners than for others. Inevitably the matter becomes political and support systems may be required. With the European's Union's Common Agricultural Policy now defunct in Britain the British governments will be looking to its successor. As a replacement scheme DEFRA has recently proposed to introduce a Local Nature Recovery plan, an equivalent of which could form a basis for real progress with Gwent Levels traditional orchards, landscapes and species.

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Whitehead, P.F., 2022. *Gwent Levels traditional orchard invertebrate study 2019-2021. Report on the invertebrates,* pp. 1-54, appendix 1: *The crevasse splay at Porton House, Goldcliff*. Report for Gwent Wildlife Trust.

APPENDIX 1
THE CREVASSE SPLAY AT PORTON HOUSE, GOLDCLIFF

On 26 May 2021 excavations at Porton House (51º53'N 02º88'W ST388826 *c*6m a.s.l. Fig. 1) revealed a series of graded current-bedded sediments under the modern land surface immediately landward of the built sea-wall. The total visible thickness of the sediments at their deepest point was 87 cms; the base was slumped (Fig. 2). The sediments were entirely minerogenic. Two key lithologies were represented *viz*., Jurassic or Liassic Limestone pebbles up to 10 cms across, some containing shells of the bivalve mollusc *Gryphaea* spp., a group presently under taxonomic review, and seams of coarse, gritty, angular sand grains. The section has been divided into five numbered levels (Fig. 3) based on lithology, sediment size and artefact content, noting that their boundaries are sometimes diffuse.

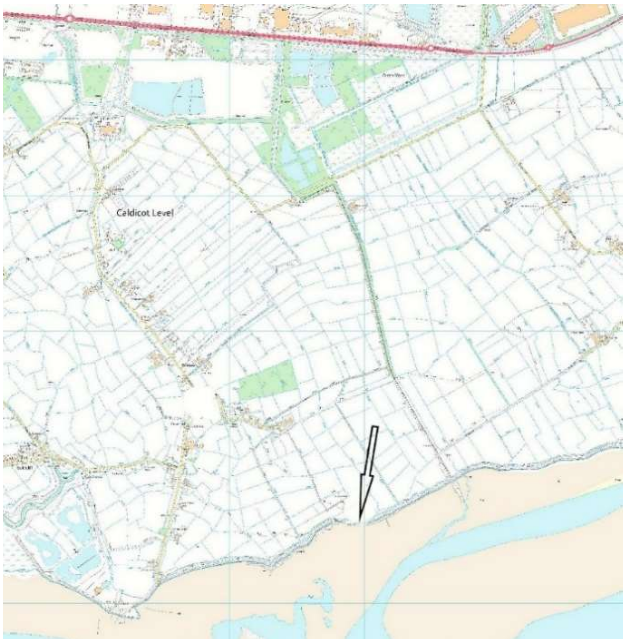

Fig. 1. Porton House crevasse splay 26 May 2021. Geographic location.

Fig. 2. Porton House crevasse splay 26 May 2021. Section immediately below seawall embankment.

The initial interpretation of this feature and its geomorphologic relationship with adjacent modern land surfaces proved problematical until discussion with Dr M. J. Simms brought to mind dramatic crevasse splays observed by the writer on the Somerset coast. A crevasse splay explains any geomorphological unconformity between it and existing land surfaces inland of it. Sediments are splayed inland from the coast when storms or storm surges breach shingle ridges. In this instance, the variable sedimentology may represent the vagaries of tidal movement or more probably the impacts of rising sea levels.

DATING THE CREVASSE SPLAY

A flint blade in good unpatinated condition was found *in situ* at the visible base of level five (Fig. 3) which, in the present writer's view, can be dated within broad limits. Higher in the section levels three and four may represent elements of a single event, the sediments fining downwards. Level four contained valves of the marine bivalve mollusc *Arcopagia crassa* (Pennant, 1777) (Tellinoidea, Tellinidae), an intertidal inhabitant of sediments similar to those in which it was found in the splay, together with numerous sherds of fluvially worn Roman ceramic. The presence of these fragile shells, of which one is intact, in current-bedded sand, is important in discounting any possibility that the crevasse splay was formed by the breach and subsequent resorting of the sediments of any humanly-constructed sea-defence. Given that historic sea-walls were simple earthen embankments (Rippon, 1996) such a notion cannot be countenanced. The current-bedded well-stratified superimposed sediments and their clast lithology supports the reworking of Jurassic flood debris introduced to the River Severn by its catchment rivers eroding Jurassic outcrops, some of which occur to the east of Newport.

Allen & Rippon (1997) sought to explain the changing position of the coastline at Magor Pill over time; however the shingle ridge that enabled this splay would be an aggradational, not erosional feature. The work of Allen & Rippon (1997) is of considerable assistance here. On page 351 they state that: "*Isolated sheets and patches of semi-mobile gravel erosively seal the western palaeochannel on the lower foreshore and lie across beds of the Wentlooge Formation. They consist of rounded pebbles and cobbles, derived from the local Pleistocene gravels, set tightly and firmly in a compact matrix of muddy shelly sand the surfaces of most patches and sheets having the appearance of a smooth even pavement. The clasts seem to experience transport, **a few at a time only during storms or the strongest tides.** These lag gravels are important because they trap and incorporate artefacts transposed from stratified contexts in older deposits as the foreshore continues to be eroded vertically."*

This statement needs to be read carefully. Although the origin of these 'semi-mobile gravels' is not explained by Allen & Rippon (1997) I believe they hold the key to explaining the Porton House sediment splay. These 'lag gravels' almost certainly represent the remnants of a naturally constructed shingle ridge that may have developed in later prehistory, perhaps in relation to storm surges and rising sea-levels which are well documented at that time. How such gravel bars came to degrade is a different matter; this may have happened during later marine transgressions. The Porton House crevasse splay is believed to be the furthest visible inland evidence of what was a larger splay with the shingle ridge, its structural integrity changing with time, being positioned some distance beyond the present built seawall. Essentially the Porton House splay documents sequential tidal ingress over the Caldicot Levels.

THE CHRONOLOGY OF THE CREVASSE SPLAY

The artefacts contained within the section are limited in number but they age progressively downwards. Weight must be attached to the flint artefact found *in situ* in its original sediment impression at the visible base of level five beneath which the sediments had slumped (Fig. 3). As all the artefacts must predate their moment of deposition by an unknown amount of time they cannot be used to date the splay but they can allow a hypothetical chronostratigraphic framework to be created.

The flint blade (Figs 4, 5) is in an excellent state of preservation and importantly, although there are edge micro-removals, all are identically patinated and may be due to deliberate blunting to support an index finger; there are no post-fabrication removals or other effects consistent with abrasion in a body of gravel. On this basis it can be argued that **a)** the flint artefact is not far travelled and **b)** that a shingle ridge or natural sea-bank existed at Porton, in broad conjectural terms, say *c*4250 years ago. The flint blade is unlikely to fall within a time period much more recent than this; it was presumably originally entrained from a land surface which may have included vegetated semi-stable shingle.

Level five was devoid of ceramic but sherds occurred commonly in level three and especially in level four; these levels effectively interdigitate and may represent a single event. The distinctive angular sand grain matrix of levels three and four was surprising in a fluvial context, the sand evidently not being far-transported. The ceramic in level three was almost exclusively of mid to late Roman type. An indurated body sherd of a straight-sided cooking pot with quartz and feldspar temper provisionally assigned to the 14th century AD was not found *in situ.* All of the ceramic was edge-rounded attesting to prolonged fluvial action. The Roman wares included Severn Valley Ware, Grey Ware and fragments of mortaria indicating the nearby existence of a significant settlement. The presence of intertidal mollusc shells in level four sands could be explained in a variety of ways, one being that it represents tidal ingress during a phase of rising sea-levels. Level one is post-medieval containing coal, Iron-glazed ware, stoneware and shells of extant terrestrial snails often in 'made-up' ground, perhaps reflecting significant coastal activity at Porton in post-medieval time.

Fig. 3. Porton House crevasse splay vertical section, 26 May 2021, broken into five numbered levels, arrow pinpointing a flint blade. Measurements of thicknesses are for guidance only; the thickness of each level and the degree of intergrading varies. The levels are: **1.** Up to 24 cms of disturbed made-up ground. Post-dating AD1700. **2.** Up to 10 cms rounded to subangular Jurassic Lias Limestone pebbles, aceramic ?AD1607. **3.** *Circa* four cms pebbles in fine gravel and sand matrix, clasts up to one cm diameter diffusing downwards into **4.** Coarse gritty sand, weakly bedded, with occasional pebbles of flint, Roman ceramic. **5.** Roughly bedded rolled rounded to subangular limestone gravel with Lias Limestone and *Gryphaea* sp. averaging seven cms (up to 13 cms) diameter in matrix of similar finer gravel base not visible, *Gryphaea* sp. also as isolated fossils.

It is therefore hypothesised that a tide-assembled shingle ridge did exist and was composed largely of Jurassic rocks introduced to the River Severn by flood events higher in its catchment. This ridge was breached in a single massive prehistoric storm surge followed by sequential flood events with varying impacts. It is well-known that shingle bar breaches may occur literally over the course of one night at locations where they may have survived intact for hundreds of years. Not all subsequent flood events or storm surges would impact equally on the entire structure of the splay, its internal sediments receiving some protection. A distinct flood event (levels three and four) scoured intertidal mollusc shells and Roman pottery and drove them inland possibly during early historic or medieval time; Pickup (2019) cites major flood events in AD1097 and AD1116. There is then evidence of a far more powerful inundation (level two), perhaps more powerful then the surge that initiated the splay, which could, hypothetically, be ascribed to the AD1607 flood which may also have recycled sediments from the splay itself. It should be mentioned in passing that notional tsunami events at that time (Hall, 2013; Haslett, 2011) are now more or less universally discounted (https://www.surgewatch.org/about/). It would seem that the Porton House section represents the landward edge of the splay but it is impossible to say how much of it has been removed historically by any mechanism.

LANDSCAPE IMPACTS OF CREVASSE SPLAYS

The initiation of a crevasse splay and subsequent ingress of tides and seawater creates enormous impacts on landforms and land use inland. As tides and surges force their first ingress the protected hinterland is immediately exposed to saltmarsh conversion and such saltmarshes may develop within a couple of decades. The land surface is dissected by evolving sequences of developing tidal creeks and gutters, the so-called dendritic drainage of Rippon (1996). It is no wonder that the Romans required sea-defences. According to Allen & Rippon (1997, p. 340): "*Late Iron Age rubbish would have been discarded from an occupation, no longer surviving, on a marsh lying significantly higher (c2.85m) judging from the thickness of the Upper Wentlooge formation at the borehole site and the most plausible date for land claim in the Roman period*."

Level three yielded a right upper molar of an adult domestic ox of a type resembling what was historically termed Celtic Shorthorn *Bos longifrons* Owen. This tooth shows an unusual occlusal surface wear pattern indicating that it grazed for an extended period of time on minerogenic sediments on the coast or within coastal influence; there is a significant wear differential between the enamel and the dentine.

THE FLINT BLADE

The subparallel crested blade (Figs 3, 4, 5) is 48 mm long and 12 mm wide at the widest point and is triangular in cross section. It has been struck from a core of high quality Cretaceous chalk flint evidently for the purpose of rejuvenating the core. Edge blunting (Fig. 4) is contemporaneous with fabrication. The dorsal surface has some small encrustations of secondary Calcium Carbonate.

Fig. 4. Proximal half of Neolithic flint blade. Left: dorsal surface. Right: main flake surface showing bulbar scar and concave scraper to right.

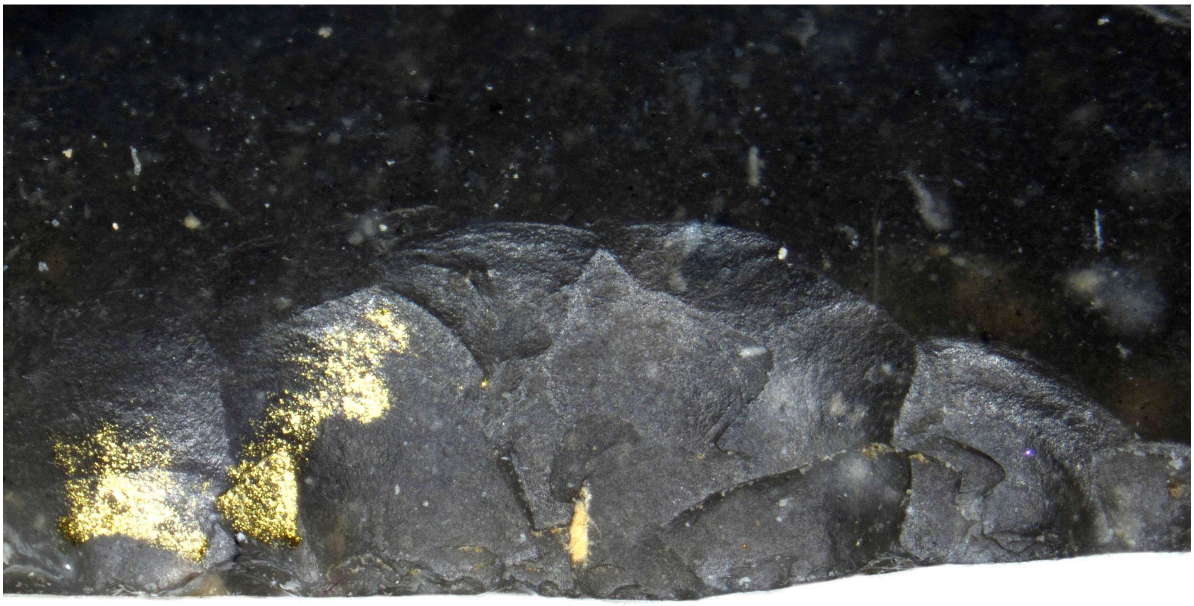

Fig. 5. Microphotograph of flakelet removals and utilisation traces on concave scraping face shown at Fig. 4 right. Metallic flecks, visible from *in situ*, are plainly visible to the left.

In describing potential utilisation impacts the present writer is unaware of any parallels for the adhered burnish of bright metallic microparticles (Fig. 5) which can be removed by a steel blade. This may have occurred had the blade once worked gold but any such flight of fancy would require substantiation by a highly-skilled specialist. The fact that this metallic shimmer survives at all is further testimony to the artefact not having undergone distant or prolonged transportation.

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REPORT GLOSSARY

Basidiomycotine: relating to bracket fungi and mushrooms; **biota**: assemblage of life forms; **biotic**: relating to the biota; **biotope:** definable ecological association; **euhaline**: salinity approaching that of seawater; **foliicolous**: preference for foliage; **Holocene**: the present interglacial period; **hyphae**: growth web of fungi and some bacteria often forming mycelial wefts; ***in copula***: mating; **Isopoda**: woodlice; **maloid**: pertaining to fruit trees of the genera *Malus, Pyrus, Sorbus, Mespilus*; **mesophilous**: consistently equable environmental state; **mycobiota**: assemblage of fungi; **mycophilous**: preference for fungi; **phytophagous**: plant-eating; **resupinate**: apparently inverted, often appressed; **saprophilous**: preference for decaying organic tissues; **saproxylic**: relating to dead or decaying wood; **Severnside**: marginal regions of the Severn estuary; **subcorticolous**: under bark; **supra-littoral**: positioned above and close to the coastal fringe.