A survey of the invertebrates of exposed riverine sediments on the Afon Tywi between Llandovery and Carmarthen in 2023

NRW Evidence Report no. 782

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Arolwg o'r ffawna di-asgwrn-cefn sy'n gysylltiedig â gwaddod afonol agored ar afon Tywi rhwng Mehefin a Medi 2023 oedd yr asesiad manwl cyntaf ers 1998. Gan ddefnyddio cyfuniad o chwilio â llaw, pydewau maglu, rhwydi sgubo a chloddiadau pyllau, cofnodwyd dros 300 o rywogaethau di-asgwrn-cefn o ddeuddeg safle samplu rhwng Caerfyrddin a Llanymddyfri, gan gynnwys 45 o arbenigwyr gwaddod afonol agored. Daethpwyd o hyd i un ar ddeg rhywogaeth gwaddod afonol agored am y tro cyntaf ar afon Tywi, gan gynnwys dwy sy'n newydd i Gymru – y pryf teiliwr *Rhabdomastix eugeni* a gwybedyn y dom *Rhegmoclemina lunensis*. Ychwanegwyd pedair rhywogaeth Gradd 2 a thair rhywogaeth Gradd 3 at y rhestr ffawna. O ganlyniad i'r arolwg, mae cyfanswm y rhywogaethau gwaddod afonol agored ar afon Tywi wedi codi i 106 o rywogaethau, gan gynnwys 91 rhywogaeth Gradd 1-3 a 79 o rywogaethau allweddol. Cofnodwyd 34 o'r 95 o rywogaethau gwaddod afonol agored a gofnodwyd cyn arolwg 2023, sef 35% o'r ffawna, gan gynnwys 31 o'r 72 o rywogaethau gwaddod afonol agored allweddol gwreiddiol (43%). O ystyried bod samplu wedi methu prif gyfnod y gwanwyn (Mai), y collwyd llawer o bydewau maglu i siltio, sathru gwartheg a lefelau afonydd uchel, a'r ffaith nad oedd mynediad i rai safleoedd allweddol yn bosibl oherwydd diffyg caniatâd i gael mynediad, mae'r canlyniadau'n amlygu bod ffawna gwaddod afonol agored afon Tywi yn dal i fod o bwysigrwydd cenedlaethol.

Gwnaethpwyd cofnodion pwysig o'r chwilen blymio leiaf *Bidessus minutissimus*, chwilen grwydr Newbery *Thinobius newberyi*, y pryfed *Athyroglossa ordinata*, *Dolichopus longicorn*, *Limnophora riparia*, *Myopina myopina*, *Rhaphium fractum*, *Rhaphium nasatum* a *Sciapus basilicus*, a'r chwilod *Carpelimus subtilis* a *Gnypeta carbonaria*. Dylid ystyried gwneud y chwilen blymio leiaf a chwilen grwydr Newbery yn nodweddion cymhwyso Safle o Ddiddordeb Gwyddonol Arbennig Afon Tywi. Mae gwaddod afonol agored afon Tywi yn cynnal poblogaethau pwysig o'r pryf copyn *Arctosa cinerea*, y trychfil *Cryptostem estronwm*, y fuwch goch gota pum smotyn *Coccinella quinquepunctata*, chwilen y ddaear *Perileptus areolatus* a'r chwilen grwydr *Hydrosmecta longula,* sydd i gyd yn weddol niferus ar afon Tywi. Mae cofnodion o'r heliwr corrod *Anoplius concinnus* a thrychfil y gwair *Monosynamma sabulicola* yn awgrymu y dylid ystyried cynnwys y ddau i fod yn gysylltiedig â gwaddod afonol agored o ystyried eu dosbarthiad presennol yng Nghymru.

Darganfuwyd y chwilen ddyfrol *Pomatinus substriatus* ar afon Tywi am y tro cyntaf ers 2003. Yn gysylltiedig â boncyffion a cherrig tanddwr neu wreiddiau coed agored mewn nentydd ac afonydd tir isel, mae'r boblogaeth yma'n haeddu bod yn nodwedd gymhwyso o Safle o Ddiddordeb Gwyddonol Arbennig Afon Tywi. Cafodd y gleren *Parapiophila flavipes* ei chofnodi yng Nghymru am y tro cyntaf o Lanymddyfri a Llanwrda.

Daethpwyd ar draws materion rheoli, i raddau uwch neu raddau llai, ar bob un o'r deuddeg safle samplu. Roedd jac y neidiwr a/neu glymog Japan yn broblem ar y rhan fwyaf o safleoedd, gyda gwartheg yn sathru a thail, tynnu graean ar raddfa fach, tynnu dŵr a gwaddodi silt hefyd wedi'u nodi mewn rhai o'r safleoedd. Dylid ceisio cael gwared â jac y neidiwr a chlymog Japan, a byddai eithrio da byw o waddod afonol agored allweddol drwy ddefnyddio ffensys o fudd i anifeiliaid di-asgwrn-cefn arbenigol ac adar magu a byddai'n helpu i leihau erydiad a siltio. Dylid atal echdynnu graean mewn mannau lleol.

Argymhellir bod samplu ychwanegol yn cael ei wneud rhwng Mai a Mehefin i gwmpasu cyfnod y gwanwyn a gollwyd.

Executive summary

A survey of the invertebrate fauna associated with exposed riverine sediment (ERS) on the Afon Tywi from June to September 2023 was the first detailed assessment since 1998. Using a combination of hand searching, pitfall trapping, sweep netting and pit excavations, over 300 invertebrate species were recorded from twelve sampling sites between Carmarthen and Llandovery, including 45 ERS specialists. Eleven ERS species were found for the first time on the Tywi including two which are new to Wales – Eugen's River-splay Cranefly *Rhabdomastix eugeni* and the scatopsid fly *Rhegmoclemina lunensis*. Four Grade 2 and three Grade 3 species were added to the faunal list. As a result of the survey, the total number of ERS species on the Tywi has been raised to 106 species including 91 Grade 1-3 species and 79 Key species. 34 of the pre-2023 survey 95 ERS species were recorded, representing 35% of the fauna, including 31 of the 72 original Key ERS species (43%). Given that sampling missed the main spring period (May), the loss of many pitfall traps to siltation, cattle trampling and high river levels, and that access to some key sites was not possible due to a lack of access permissions, the results highlight that the Tywi ERS fauna is still of national importance.

Important records were made of Minutest Diving Beetle *Bidessus minutissimus*, Newbery's Rove Beetle *Thinobius newberyi*, the flies *Athyroglossa ordinata*, *Dolichopus longicornis*, *Limnophora riparia*, *Myopina myopina*, *Rhaphium fractum*, *Rhaphium nasatum* and *Sciapus basilicus*, and the beetles *Carpelimus subtilis* and *Gnypeta carbonaria*. Consideration should be given to making Minutest Diving Beetle and Newbery's Rove Beetle qualifying features of Afon Tywi SSSI. Tywi ERS supports important populations of the spider *Arctosa cinerea*, the bug *Cryptostemma alienum*, Five-spot Ladybird *Coccinella quinquepunctata*, the ground beetle *Perileptus areolatus* and the rove beetle *Hydrosmecta longula,* all of which are relatively frequent on the Tywi. Records of the spider-hunting wasp *Anoplius concinnus* and the grass bug *Monosynamma sabulicola* suggest that both should be considered for inclusion as ERS associates given their current Welsh distributions.

The aquatic beetle *Pomatinus substriatus* was found on the Tywi for the first time since 2003. Associated with submerged logs and stone or exposed tree roots in lowland streams and rivers, the population here merits being a qualifying feature of Afon Tywi SSSI. The fly *Parapiophila flavipes* was recorded new to Wales from Llandovery and Llanwrda.

Management issues were encountered, to a greater or lesser extent, on all twelve sampling sites. Himalayan Balsam and/or Japanese Knotweed were a problem on most sites, with cattle trampling and dunging, small scale gravel abstraction, water abstraction and silt deposition also noted at some. The removal and eradication of Himalayan Balsam and Japanese Knotweed should be attempted, and the exclusion of livestock from key ERS using fencing would benefit specialist invertebrates and breeding birds and help to reduce erosion and siltation. Localised gravel extraction should be prevented.

It is recommended that additional sampling is undertaken in May to June to cover the missed spring period.

1. Introduction

River Shingle or Exposed Riverine Sediments (ERS) represents one of the last remaining natural habitats in the UK landscape. However, ERS has suffered major losses and on Welsh rivers there has been a halving in ERS since the 1940s and a decline in the number of ERS bars by 30% (Brewer *et al*., 2006; Howe, 2020b). This reduction has been attributed principally to the increase in the amount of vegetation on active and formerly active bars as a result of river engineering. ERS supports important invertebrate specialist faunas dominated by beetles and flies, with two hundred and fifty species recorded in the UK, which are reliant upon dynamic and open conditions (Howe, 2020b). Welsh rivers rank as some of the most important for ERS invertebrate assemblages in the UK, with eight having nationally important faunas – Mawddach, Monnow, Rheidol, Tywi, Upper Severn, Usk, Wye and Ystwyth. ERS invertebrate assemblages are SSSI qualifying features on six of these. Together, these rivers support two hundred and twenty-five UK and Welsh specialist ERS species including one hundred and fourteen beetles, one hundred flies, nine spiders and two bugs (Howe, 2020b).

Exposed Riverine Sediments (ERS) on the Afon Tywi between Llandovery and Carmarthen support a nationally important invertebrate assemblage, with a total of 95 ERS species of which 72 species form the core of the assemblage (Table 1; Appendix 1). Survey work in the 1980s and 1990s recorded the Five-spot Ladybird *Coccinella quinquepunctata* at Llanwrda in 1987, a first Welsh record and the first UK record since 1953 (Fowles & Morgan, 1987; Majerus & Fowles, 1989; Morgan, 1988). The rove beetle *Philonthus rubripennis* and the click beetle *Negastrius sabulicola* were found in 1990 (Morgan, 1991). The Tywi was ranked as the most important river in England and Wales by Sadler & Bell (2002), based on surveys undertaken in 1998, with thirty-one species of beetles and an ERS Quality Index (ERSQI) of 861. Important bars occurred at Fferm Typicca, Llanwrda & Llanwrda Station, Llwynjack and Penlan (Table 2). Further surveys have added additional species (Bates & Sadler, 2004) and the number of specialist beetles now exceeds sixty including Minutest Diving Beetle *Bidessus minutissimus* and Newbery's Rove Beetle *Thinobius newberyi*. Although they occupy muddy river margins rather than strictly ERS, the Scarce Four-dot Pin-palp *Bembidion quadripustulatum* (a Grade 2 ERS species) and the ground beetle *Bembidion inustum* (Bates *et al*., 2005; Levey & Pavett, 1999) occur on the Tywi at Llandovery and Llandeilo respectively.

Table 1. Exposed Riverine Sediment (ERS) invertebrates on the Afon Tywi.

Taxon	ERS species	Key ERS species	Grade 1 species	Grade 2 species	Grade 3 species
Beetles	65	58	33	24	-
Bugs	1	1	-	-	-
Flies	24	9	4	4	15
Spiders	5	4	2	2	-
Total	**95**	**72**	**39**	**30**	**15**

Table 2. ERS stations for invertebrates on the Afon Tywi.

Tywi ERS station	Grid reference	Key station for 2023 survey	Comment
Penlan (Cystanog)	SN448205	No	very silty
Whitemill	SN471212	Yes	-
Dryslwyn & Fferm Typicca	SN548206	Yes	gravel extraction; silty
Dinefwr Estate	SN603221	Yes	-
Llandeilo	SN636227	Yes	-
Bethlehem	SN675256	Yes	-
Llangadog	SN695289	No	little ERS
Llanwrda & Llanwrda Station	SN714307	Yes	-
Llwynjack, upstream of bridge	SN753334	Yes	-

The Tywi also supports a nationally important breeding population of the Common Clubtail (*Gomphus vulgatissimus*).

Natural Resources Wales requested an invertebrate survey of exposed river sediments on the Afon Tywi (River Towy) between Llandovery and Carmarthen, Carmarthenshire in 2023. Survey methods included hand searching, pitfall trapping, sweep netting and by pit excavation. This report provides the results of the survey.

1.1. Geology and ERS

The Tywi rises at 445m on the south-western flanks of the Cambrian Mountains and, with its three major tributaries (Bran, Cothi and Sawdde), drains an area of 1245 km^2. The catchment is underlain by Silurian mudstones and sandstones and Ordovician mudstones. The catchment is an important store of ERS, containing more ERS than any other Welsh catchment in both the 1940s and 1990s and 26-29% more than the Severn, the 2nd largest catchment (Brewer *et al.*, 2006). The Afon Tywi itself is the dominant store of ERS in the catchment as it contained 72.1% of the total ERS area in the 1940s and 69.5% in the 1990s. In1951, the Tywi had over 1 million m^2 of ERS, over 400,000m^2 more ERS than the Severn. It also had more ERS than any other river in 1992, although it had experienced a reduction in ERS area of 56% and a reduction in the number of bars of 263% (Tables 3 & 4). The mean area of bars declined by approximately 1,500 m^2 (40%), indicating that in the Tywi, decreasing bar size is a more important factor than a loss of whole bars. The Tywi supports a number of extremely large bars, with 12 bars having an area of over 20,000m^2 in 1951 and 6 bars with an area greater than 10,000m^2 (greater than the total area in 13 rivers in 1992). As a result of these large bars, the average size of bars is greater than in any other Welsh river.

Table 3. Changes in Exposed Riverine Sediment between 1940s and 1990s on the Afon Tywi. From: Brewer *et al*. (2006).

Date	No. bars	ERS area (m^2)	No. vegetated bars	Vegetated bar area (m^2)
1951	281	1,082,879	43	247,031
1992	207	476,857	30	117,255

Table 4. Changes in exposed riverine sediment (ERS) between 1940s and 1990s on the Afon Tywi. From: Brewer *et al*. (2006).

Date range	Change in bar no.	% Change	Change in ERS area (m^2)	% Change	Change in vegetated bar no.	% Change	Change in vegetated area (m^2)	% Change
1951–1992	-74	-26.3	-606,022	-55.9	-13	-30.2	-129,776	-52.5

The majority of ERS in the Tywi is stored in the middle and lower reaches, particularly after the confluence of the Afon Bran, and 43% was stored in the 10km reach between 40 and 50km downstream in 1951. Of the sixty-seven bars between forty and fifty km, fourteen have an area greater than 10,000m^2 with a total area of 337,867m^2. The 40 to 50km reach remained important in 1992 when it contained 38% of the total area of ERS. The size of bar material in the Afon Tywi decreases with distance downstream, although there is a degree of variability in this pattern.

Given the amount of ERS on the Tywi and the number of large bars, it is not surprising that the river supports an important ERS invertebrate fauna.

1.2. Survey work in 2023

The aim of the 2023 work was to survey Afon Tywi ERS, from Llandovery to Carmarthen, for invertebrates from April and September inclusive to determine the current fauna, the key bars for invertebrates and any threats. Whilst most of the focus was on ERS stations listed in Table 2, a reconnaissance of this section of the river was undertaken in case bars have shifted position or important ERS has been overlooked. Aerial images were used to identify these. Sampling used a variety of techniques including visual searches, stone-turning, pit-excavation & flooding and pitfall trapping.

2. Methods

2.1 Fieldwork methods

Excavations

Excavations (or holes) were dug in shingle close to the river edge with a sharp-pointed hand trowel. During this process, water flows into the excavation from the surrounding area. The water includes organic debris as well as beetles, aquatic invertebrates etc. and is periodically removed with a jug and poured through a 500micron sieve in order to retain any invertebrates. At the end of the excavation (30 minutes was employed on this survey), the contents of the sieve are removed to a sample pot using a wash bottle and preservative (70% alcohol) is added. The sample is later emptied into one or more petri dishes and examined under a binocular microscope. A number of minute and specialised beetles (mainly Staphylinidae) and some other invertebrates live in the interstices of ERS, and they are removed by this method.

An attempt was made to make the excavation with a spade, but this was less successful - a sharp pointed hand trowel is better for digging around and extracting buried cobbles and

large pebbles whereas a spade is too blunt for this (an entrenching tool might be effective). The technique is also known as the Karraman-Chappuis method after the zoologists who first perfected the method.

Hand searching

This mainly involved splashing or throwing river water using a bucket or jug onto the ERS at the river's edge. The method seems to work better if the ERS is dry. Some stone-turning was also employed although this is fairly ineffective on shingle with relatively small pebbles. Searching under driftwood was also undertaken and could prove profitable but driftwood was relatively scarce due, no doubt, to the dynamism of the river and weather.

Pitfall trapping

These comprised the usual disposable plastic drinking cups which were installed in holes in ERS in rows of nine on each site. Commercial antifreeze was added as a preservative. Flat stones were added as rain covers and to make the traps less visible to anglers or others who could disturb them.

Sweeping

Sweeping or sweep netting involved passing a fine meshed net mounted on a pole over ERS including bare and partly vegetated areas, the river's edge and over different substrates (notably sand, shingle, silt or mud). Invertebrate specimens were removed from the net with a pooter and dispatched using ethyl acetate. This method is the standard technique for flying and phytophagous insects such as mayflies, stoneflies, caddisflies, damselflies, bugs, beetles, flies, bees, wasps and allies.

Site locations

Suitable ERS deposits were suggested by NRW who arranged access. Figures showing the sampling locations have been provided in the report (Figures A to F; Figures 1 to 7 in Appendix 2). Red flags on the figures indicate where the surveyor was based when surveying each location and generally excavations were conducted within a few metres of these locations, pitfall traps and searches extended 10-20m from these and sweeping generally covered an area up to 30m from these centralised points.

2.2 Weather conditions

Weather have been noted under the Site Results. Weather conditions were measured using a Kestrel 3500 weather meter.

2.3 Identifications

The survey concentrated particularly on beetles (Coleoptera) and flies (Diptera), but included various Mollusca, Arachnida, Crustacea, small insects orders (Ephemeroptera, Orthoptera, Plecoptera, Megaloptera, Odonata), Trichoptera, Hemiptera and aculeate Hymenoptera. Any unidentified material (target groups or otherwise) has been retained.

Vouchers of rare and uncommon species have been retained. All material was collected by Andy Godfrey. The majority of the Coleoptera were identified by Mike Denton (Yorkshire Naturalist's Union Aleocharinae Recorder) whilst the Diptera and other material was identified by Andy Godfrey. Distinctive caddis cases, parts of invertebrates, shells and exuviae were also identified and recorded but obviously some of these could have been derived some distance upstream.

Figure A. Afon Tywi exposed riverine sediments (ERS) sampling sites in 2023.

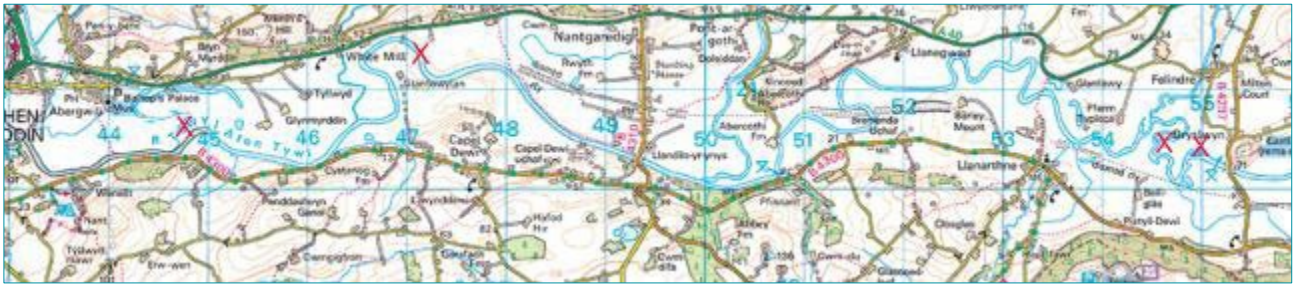
Figure B. Afon Tywi ERS sampling sites in 2023: Penlan, White Mill and Dryslwyn Sites 3 & 4.

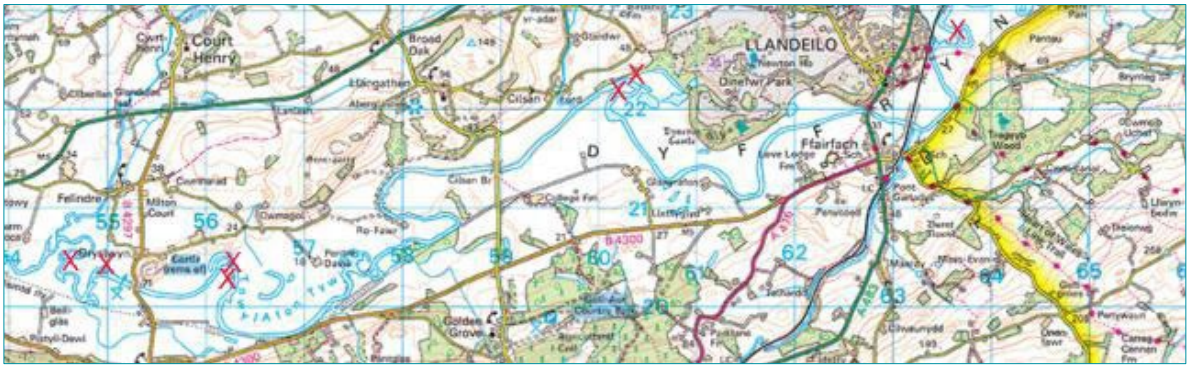

Figure C. Afon Tywi ERS sampling sites in 2023: Dryslwyn Sites 3, 4 & 5, Dinefwr Estate and Gelli Aur.

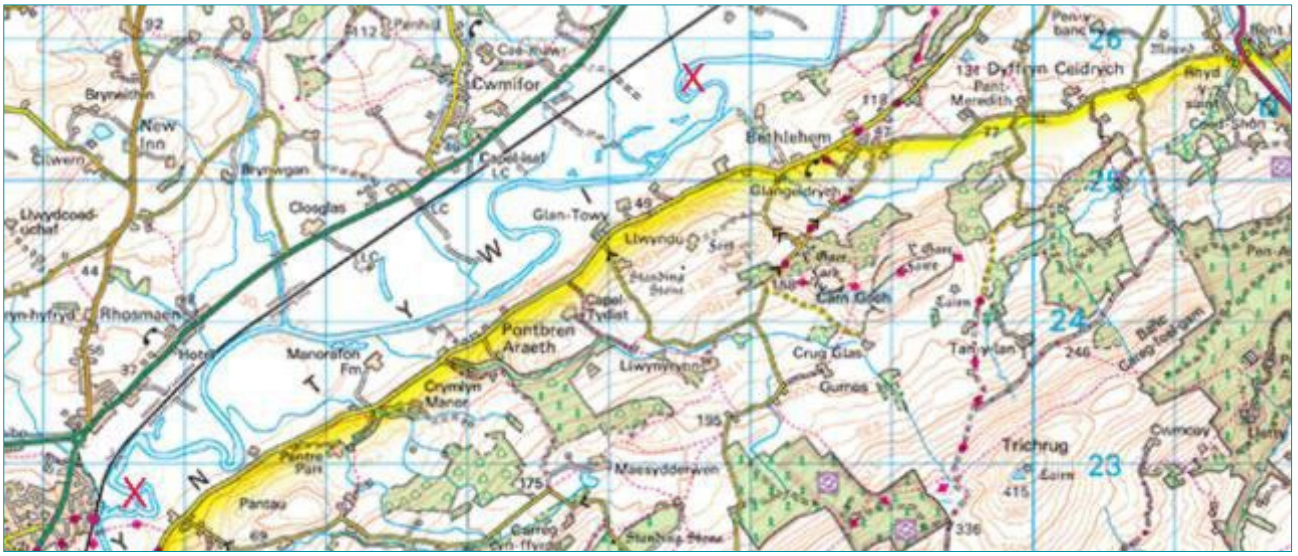

Figure D. Afon Tywi ERS sampling sites in 2023: Llandeilo (Railway Station) and Bethlehem.

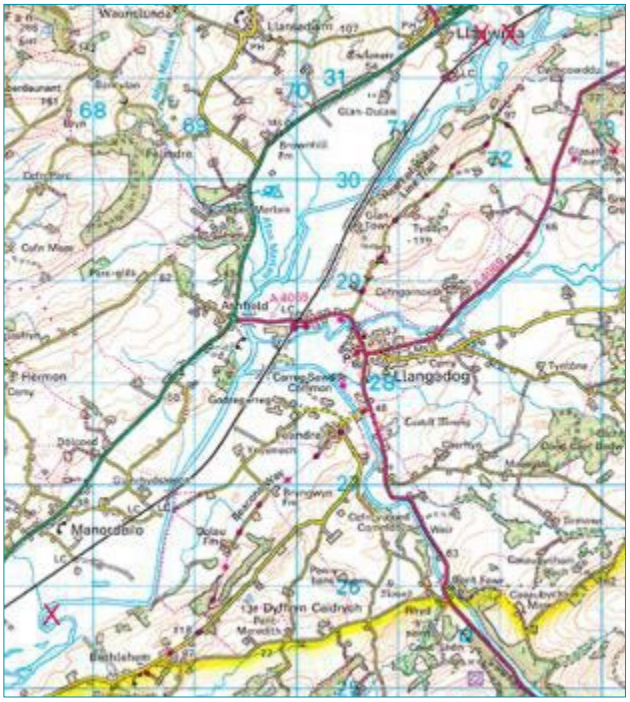

Figure E. Afon Tywi ERS sampling sites in 2023: Bethlehem, Llanwrda (Railway Station) and Llanwrda (East Bank).

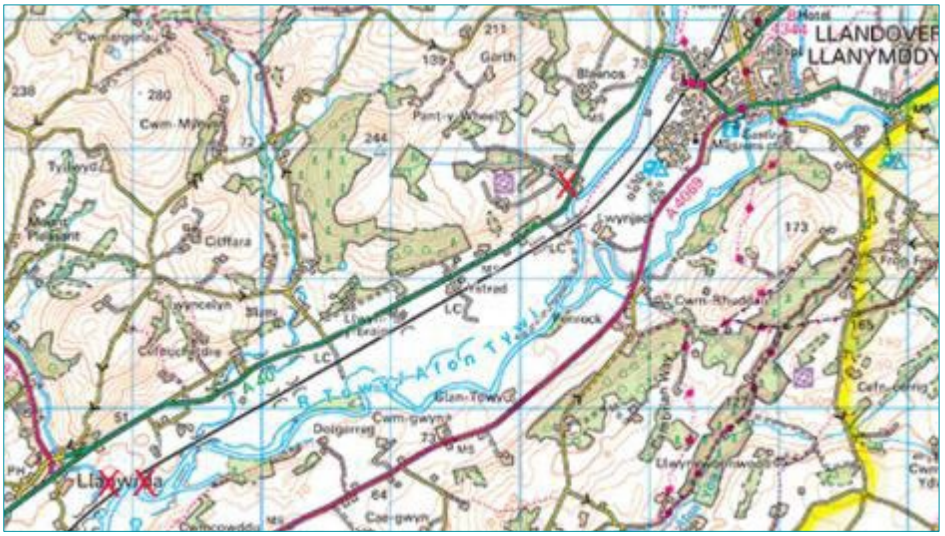

Figure F. Afon Tywi ERS sampling sites in 2023: Llanwrda (Railway Station), Llanwrda (East Bank) and Llandovery.

2.4 Definition of rarity statuses

There are 58 invertebrate species afforded special protection nationally on Schedule 5 of the Wildlife & Countryside Act 1981 (as amended), plus more than 300 species on Section 41 (England), and nearly 200 species on Section 42 (Wales) of the Natural Environment and Rural Communities Act (2006).

The UK spreadsheet of conservation designations lists UK species and their designations. The designations refer to species listed in international agreements, UK legislation, UK country lists, or which have a particular status (e.g. red list species, Nationally Rare or Scarce species). The Joint Nature Conservation Committee has collated several lists as a downloadable spreadsheet of species' designations. This is viewable at: Conservation designations for UK taxa | JNCC - Adviser to Government on Nature Conservation. These lists are not fully comprehensive. For example, the spreadsheet does not incorporate all marine species or all Schedules in The Wildlife and Countryside Act. Local Red List assessments are not included.

The JNCC website also lists up-to-date red lists for different taxonomic groups. Older examples cited in this report such Hyman and Parsons (1992, 1994) have gradually been replaced by newer versions each devoted to a family, and these are detailed on the JNCC website. More information is also available at: Conservation designations for UK taxa – updates | JNCC - Adviser to Government on Nature Conservation

2.5 Survey limitations

The weather was occasionally unpredictable, and this led to a few surveys being postponed. In general, suboptimum conditions were not too much of a problem since emptying and replacing pitfall traps and sampling by digging excavations are not generally

weather dependent and even some ground searching could be attempted in less than perfect weather.

The pitfall traps were almost completely washed-out and/or lost following installation. Some were also trampled by cattle and a small number may have been removed or interfered with by human agency. The traps were replaced on each of the three visits, but it was clear that the river was too dynamic, at least in 2023, which led to the reworking of exposed riverine sediments. This could have been mitigated at least partially by more frequent emptying, possibly leaving the traps only two weeks or possibly for three weeks.

3. Results

Over 300 taxa have been recorded from the survey of twelve ERS sites in 2023. The material sampled by hand searching the ERS, by excavation and by pitfall trapping are recorded in Appendix 3 whilst the swept material is recorded in Appendix 4.

3.1 ERS species recorded in 2023

A total of 45 ERS invertebrate species was recorded on Tywi ERS sites in 2023 (Table 5), of which eleven were found for the first time on the Tywi including two which are new to Wales – the cranefly *Rhabdomastix eugeni* and the scatopsid fly *Rhegmoclemina lunensis* (Table 6; see 3.2 below). Four Grade 2 and three Grade 3 species were added to the faunal list. As a result of the survey, the total number of ERS species on the Tywi has been raised to 106 species including 91 Grade 1-3 species and 79 Key species. 34 of the original 95 ERS species (see Appendix 1) were recorded, representing 35% of the fauna, including 31 of the 72 original Key ERS species (43%).

The distribution of the 45 ERS species recorded in 2023 on other Welsh ERS rivers is given in Table 7. Note that some of the species are known from additional Welsh localities.

In addition to the recognised ERS species, the spider-hunting wasp *Anoplius concinnus* was recorded from ERS at Dinefwr Estate and Llandeilo (Railway Station) and the grass bug *Monosynamma sabulicola* was found at Dryslwyn Site 4, Gelli Aur, Llandovery and Whitemill. Both should be considered for inclusion as ERS associates given their current Welsh distributions (see 3.2 below).

Table 5. Exposed Riverine Sediment (ERS) invertebrates on the Afon Tywi in 2023.

Taxon	ERS species	Key ERS species	Grade 1 species	Grade 2 species	Grade 3 species
Beetles	27	26	15	11	0
Bugs	1	1	0	0	0
Flies	15	9	1	4	5
Spiders	2	2	1	1	0
Total	**45**	**38**	**17**	**16**	**5**

Table 6. The 45 ERS invertebrate species recorded on Tywi ERS in 2023. Species in red are new to the Tywi.

Species	Order	ERS grade	Key ERS species	2023 survey
Aloconota cambrica	Coleoptera	1	x	x
Arctosa cinerea	Araneae	1	x	x
Atherix ibis	Diptera	-	x	x
Athyroglossa glabra	Diptera	2	x	x
Athyroglossa ordinata	Diptera	1	x	x
Bembidion atrocoeruleum	Coleoptera	1	x	x
Bembidion decorum	Coleoptera	1	x	x
Bembidion dentellum	Coleoptera	2	x	x
Bembidion femoratum	Coleoptera	2	x	x
Bembidion punctulatum	Coleoptera	1	x	x
Bembidion tibiale	Coleoptera	1	x	x
Bidessus minutissimus	Coleoptera	1	x	x
Carpelimus subtilis	Coleoptera	2	x	x
Clivina collaris	Coleoptera	2	x	x
Coccinella quinquepunctata	Coleoptera	1	x	x
Cryptostemma alienum	Hemiptera	-	x	x
Deleaster dichrous	Coleoptera	2	x	x
Dolichopus longicornis	Diptera	3	-	x
Elaphrus riparius	Coleoptera	-	-	x
Gnypeta carbonaria	Coleoptera	2	x	x
Helophorus arvernicus	Coleoptera	1	x	x
Hexatoma fuscipennis	Diptera	2	x	x
Hoplolabis areolata	Diptera	2	x	x
Hydrosmecta longula	Coleoptera	1	x	x
Hydrosmecta subtilissima	Coleoptera	1	x	x
Ibisia marginata	Diptera	3	-	x
Limnophora riparia	Diptera	3	-	x
Lionychus quadrillum	Coleoptera	2	x	x
Medon ripicola	Coleoptera	2	x	x
Myopina myopina	Diptera	-	-	x
Negastrius sabulicola	Coleoptera	1	x	x
Neobisnius prolixus	Coleoptera	2	x	x
Nephrotoma guestfalica	Diptera	3	-	x
Ochthephilus aureus	Coleoptera	2	x	x
Ochthephilus omalinus	Coleoptera	2	x	x
Oedothorax apicatus	Araneae	2	x	x
Perileptus areolatus	Coleoptera	1	x	x
Rhabdomastix eugeni	Diptera	-	x	x
Rhaphium fractum	Diptera	3	-	x
Rhaphium nasutum	Diptera	2	x	x

Species	Order	ERS grade	Key ERS species	2023 survey
Rhegmoclemina lunensis	Diptera	-	x	x
Sciapus basilicus	Diptera	-	x	x
Thinobius bicolor	Coleoptera	1	x	x
Thinobius newberyi	Coleoptera	1	x	x
Zorochros minimus	Coleoptera	1	x	x

Table 7. Distribution of the 45 ERS species on other major Welsh ERS rivers.

Species	Major Welsh ERS rivers
Aloconota cambrica	Mawddach, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth
Arctosa cinerea	Mawddach, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth
Atherix ibis	Monnow, Severn, Tywi, Usk, Wye
Athyroglossa glabra	Monnow, Severn, Tywi, Usk, Wye
Athyroglossa ordinata	Monnow, Tywi, Usk
Bembidion atrocoeruleum	Mawddach, Monnow, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth, Vyrnwy
Bembidion decorum	Mawddach, Monnow, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth, Vyrnwy
Bembidion dentellum	Rheidol, Severn, Tywi, Usk, Wye, Vyrnwy
Bembidion femoratum	Monnow, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth
Bembidion punctulatum	Mawddach, Monnow, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth, Vyrnwy
Bembidion tibiale	Mawddach, Monnow, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth
Bidessus minutissimus	Mawddach, Rheidol, Tywi, Wye, Ystwyth
Carpelimus subtilis	Severn, Tywi
Clivina collaris	Mawddach, Monnow, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth, Vyrnwy
Coccinella quinquepunctata	Monnow, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth, Vyrnwy
Cryptostemma alienum	Mawddach, Monnow, Rheidol, Severn, Tywi, Wye, Ystwyth
Deleaster dichrous	Mawddach, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth
Dolichopus longicornis	Monnow, Tywi, Usk, Wye
Elaphrus riparius	Monnow, Severn, Tywi, Usk, Wye
Gnypeta carbonaria	Severn, Tywi
Helophorus arvernicus	Mawddach, Monnow, Severn, Tywi, Usk, Wye, Ystwyth
Hexatoma fuscipennis	Rheidol, Severn, Tywi, Wye, Ystwyth
Hoplolabis areolata	Monnow, Severn, Tywi, Usk, Wye
Hydrosmecta longula	Mawddach, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth
Hydrosmecta subtilissima	Mawddach, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth
Ibisia marginata	Mawddach, Monnow, Tywi, Wye, Ystwyth
Limnophora riparia	Monnow, Tywi, Wye
Lionychus quadrillum	Rheidol, Tywi, Usk, Ystwyth
Medon ripicola	Rheidol, Tywi, Wye, Ystwyth, Vyrnwy
Myopina myopina	Monnow, Severn, Tywi
Negastrius sabulicola	Monnow, Severn, Tywi, Usk, Wye
Neobisnius prolixus	Rheidol, Severn, Tywi, Wye, Ystwyth
Nephrotoma guestfalica	Monnow, Tywi, Usk, Wye
Ochthephilus aureus	Monnow, Rheidol, Severn, Tywi, Wye
Ochthephilus omalinus	Mawddach, Monnow, Severn, Tywi, Usk, Wye, Ystwyth
Oedothorax apicatus	Rheidol, Severn, Tywi, Usk, Ystwyth
Perileptus areolatus	Mawddach, Rheidol, Severn, Tywi, Wye, Ystwyth, Vyrnwy
Rhabdomastix eugeni	Tywi

Species	Major Welsh ERS rivers
Rhaphium fractum	Monnow, Tywi, Usk, Wye
Rhaphium nasutum	Severn, Tywi
Rhegmoclemina lunensis	Tywi
Sciapus basilicus	Tywi, Usk
Thinobius bicolor	Rheidol, Severn, Tywi, Usk, Wye
Thinobius newberyi	Rheidol, Severn, Tywi, Ystwyth
Zorochros minimus	Mawddach, Monnow, Rheidol, Severn, Tywi, Usk, Wye, Ystwyth, Vyrnwy

Araneae

Arctosa cinerea (Lycosidae) – ERS Grade 1 / Nationally Scarce (NS)

This is one of the largest spiders in the UK, with females varying between 4.8 and 6.8cm. It occurs on riverbeds and lakesides where it builds a silk-lined burrow under stones. It occurs in Wales, Ireland, northern England, and Scotland but is absent from the south.

Coleoptera

Bidessus minutissimus (Dytiscidae) - Vulnerable (VU)
Carpelimus subtilis (Staphylinidae) – Nationally Scarce (NS)
Coccinella quinquepunctata (Coccinellidae) – Nationally Rare (RDB3)
Deleaster dichrous (Staphylinidae) – Nationally Scarce (Nb)
Hydrosmecta longula (Staphylinidae) - Nationally Scarce (Nb)
Hydrosmecta subtilissima (Staphylinidae) - Nationally Scarce (Nb)
Lionychus quadrillum (Carabidae) – Near Threatened (NT)
Medon ripicola (Staphylinidae) – Nationally Scarce (NS)
Negastrius sabulicola (Elateridae) – Nationally Rare (RDB2)
Neobisnius prolixus (Staphylinidae) – Nationally Rare (RDBK)
Perileptus areolatus (Carabidae) – Nationally Scarce (NS)
Thinobius bicolor (Staphylinidae) – Nationally Scarce (Na)
Thinobius newberyi (Staphylinidae) – Nationally Rare (RDB1)

The Minutest Diving Beetle *Bidessus minutissimus* is one of the smallest diving beetles in the UK at less than 2.5mm long. It occurs in both still and running water sites, and in the latter, it is usually found inside pools (Lott 2005, 2006). The habitat is generally regarded as being clean, fine silt at the edges of rivers near to their estuaries often amongst the roots of plants such as Reed Canary Grass *Phalaris arundinacea* (Foster *et al*., 2016). It was last recorded in England from a quarry near Presteigne, Herefordshire in 2009. Individuals were observed in an excavation pool at Dryslwyn Site 4 on 17th June 2023 and it was recorded from Dryslwyn Site 3 on 10th September 2023 by excavating.

The rove beetle *Carpelimus subtilis* is found at the margins of rivers, ditches and ponds, and wet sandy areas on cliffs. It has been recorded from a shingle bank by a river and from damp sand on the bank of a large pond.

The Five-spot Ladybird *Coccinella quinquepunctata* has been recorded on river shingle and stream margins. It is known to feed on aphids found on the leaf-axils of young Broom

Cytisus scoparius and has also been found on prostrate sallow bushes and other plants, and from rocks in streams. There are 900 records in the NBN Atlas with the largest clusters in Wales and the Scottish Highlands; records in England are much more sporadic. This distinctive proved to be relatively frequent on the present survey but it was only recorded by sweep netting.

The rove beetle *Deleaster dichrous* is found in wetland areas, on river shingle, stream beds, sandpits, sand dunes, and probably also in a variety of other situations.

The rove beetle *Hydrosmecta longula* has been recorded from river shingle, damp ground near water and also found in damp moss. The related *Hydrosmecta subtilissima* has been found in the drier areas of sand and fine shingle besides rivers and streams.

The ground beetle *Lionychus quadrillum* occurs on river shingle or sand. It has also been recorded on the coast above the high tide mark, and from a saltmarsh (Hyman & Parsons, 1992). There are 360 records on the NBN Atlas with most of the records located in Wales, the south coast of the southwest, a few slightly inland records in Kent and the coasts of Essex and Suffolk. It was recorded on the present survey from Llanwrda (near Railway Station) by searching on 11th August 2023.

The rove beetle *Medon ripicola* has been found in river shingle, coastal shingle, sandy areas at the bases of cliffs and in coastal debris.

The click beetle *Negastrius sabulicola* is associated with river shingle. Adults, and probably larvae, live in open areas of river shingle where there are no or few plants. The adults are found beneath larger pebbles, amongst finer particles and on the surface of the shingle. Wales seems to hold the most sites in the UK, followed by Cumbria and Northumberland and one site in southern Scotland on the NBN Atlas (which has 131 records). It was recorded on the present survey from Penlan by excavation on 7th August 2023.

The rove beetle *Neobisnius prolixus* has been recorded from river shingle, on damps and mud besides ponds or streams and has been found under stones. There are 227 records in the NBN Atlas with the majority in central or southern Wales, a second important cluster in the southwest peninsula and an outlier in Cumbria. It was recorded on the present survey from Llandovery on 12th August 2023.

The ground beetle *Perileptus areolatus* occurs on river shingle. Adults and probably larvae live in open areas of shingle near the water's edge, amongst fine sand and under larger pebbles.

The rove beetle *Thinobius bicolor* has been found in sand and in fine shingle, and also recorded under stones at the edge of water. It has also been found under large stones at the edge of water that two days earlier had been submerged.

Newbery's Rove Beetle *Thinobius newberyi* is associated with shingle and sand at river and stream margins, possibly living deep in stream-side gravel situations. It is apparently endemic according to Hyman & Parsons (1994). There are 26 records in the NBN Atlas,

with four sites all in Wales. It was recorded on the present survey from Llanwrda (Railway Station) by searching on 11th August 2023 and by excavation the next day at Llandovery.

Diptera

Athyroglossa ordinata (Ephydridae) – Nationally Scarce (pNS)
Ibisia marginata (Athericidae) – Nationally Scarce (NS)
Rhabdomastix eugeni (Limoniidae)
Rhaphium fractum (Dolichopodidae) – Nationally Scarce (NS)
Rhaphium micans (Dolichopodidae) - Nationally Scarce (NS)
Rhaphium nasutum (Dolichopodidae) - Nationally Scarce (NS)
Rhegmoclemina lunensis (Scatopsidae)
Sciapus basilicus (Dolichopodidae) – Nationally Rare (NR)

The shorefly *Athyroglossa ordinata* is known from old records from two nearby sites in Cornwall, Padstow (1902-1908) and St Merryn (1912, 1929); more recently from the Rivers Avon, Bovey, Otter, Teign and Torridge in Devon (2004); also, from Mordiford, Herefordshire (1913); recently from Dinefwr Deer Park (probably the Afon Tywi), Carmarthenshire (1996), the River Severn at Dolydd Hafren, Montgomeryshire (2004) and the Usk and Monnow rivers, Monmouthshire (2005). Members of this genus are usually associated with freshwater streams. The Cornish sites are coastal but were renowned in the past for the presence of freshwater streams running over dune or beach areas. The Devon and Monmouthshire records were swept from sandy or stony exposed sediment by small to medium-sized fast-flowing rivers (Bell *et al*., 2004, Drake, 2007). There are only seven records on the NBN Atlas, all in South Wales except for a single one in the Weald of Surrey or Sussex.

The Black-legged Water-snipefly *Ibisia marginata* has aquatic larvae that live in running water, usually where there is a stony or gravel bed and in unpolluted conditions. It has a definite western distribution in the UK, with strong populations in Wales, the southwest peninsula, Cumbria, and the south-west uplands (Stubbs *et al*., 2001).

Eugen's River-splay Cranefly *Rhabdomastix eugeni* was added to the British list by the author in 2006 from specimens found on ERS on the River Lune, near Holby, Cumbria and subsequently recorded elsewhere (Drake *et al*., 2007). It was the only *Rhabdomastix* species found on the Afon Tywi (others are associated with ERS) and is new to Wales based on these records (Mike Howe, pers. comm.). There are no records for this species in the NBN Atlas although the species has an entry.

The dolichopodid *Rhaphium fractum* has been recorded from riverbanks and from river shingle. There are only eighteen records in the NBN Atlas with the only accepted sites being in southwest Wales. *Rhaphium nasutum* was relegated from Notable status by Falk & Crossley (2005) due to it having been recorded from fifteen counties. Its habitat associations are unclear but include wetlands.

The scatopsid fly *Rhegmoclemina lunensis* was described as new to science in 2006 from specimens found by the author on ERS on the River Lune, near Holby, Cumbria (Haenni & Godfrey, 2009). It has subsequently been found elsewhere in Cumbria (Stephen Hewitt,

pers. comm.). On the Afon Tywi, it was recorded from Penlan and Whitemill in early August 2023. These records represent the first for Wales and the only UK site outside Cumbria. There are no records for this species in the NBN Atlas although the species has an entry.

The dolichopodid *Sciapus basilicus* was added to the British list from specimens collected in Wales by Cole (1998) but due to the fact its ecology, status and distribution were not known, it was not given an account in Falk & Crossley (2005). There are only nine records for this species in the NBN Atlas with only two sites, both in South Wales (Plant, 2006).

Hemiptera

Cryptostemma alienum (Dipsocoridae) – Nationally Scarce (NS)

Cryptostemma alienum is an obscure minute bug that lives amongst gravel or stones at the margins of fast streams in upland parts of the UK. It was relatively frequent in the ERS on the Afon Tywi.

3.2 Additional species of conservation interest

The following additional significant species were recorded:

Coleoptera

Bembidion bipunctatum (Carabidae) – Nationally Scarce (NS)
Ochthephilus andalusiacus (Staphylinidae) – Nationally Scarce (NS)
Platydomene angusticollis (Staphylinidae) – Nationally Scarce (Nb)
Pomatinus substriatus (Dryopidae) – Vulnerable (VU)

The ground beetle *Bembidion bipunctatum* is found near the margins of water, both inland and on the coast. Adults generally occur in sparsely vegetated or bare areas, such as gravel and shingle on the shoreline.

The rove beetle *Ochthephilus andalusiacus* has been recorded from the banks of rivers and streams. It has also been found in wet moss.

The rove beetle *Platydomene angusticollis* has been recorded from river shingle. It has been found on stream and river margins under flat stones, and in river shingle to a depth of about 10cm, in both wet and dry situations.

The dryopid *Pomatinus substriatus* was given Na status in Hyman & Parsons (1994) but is currently listed as VU by JNCC. This species is most often found beneath stones and debris, and amongst tree roots at the edges of fast rivers. It is typical of the less regulated river systems of Wales and south-west England but was too rare to feature as a species characterizing ERS (Sadler *et al*., 2004). It was recorded on the present survey from Penlan by searching on 7th August 2023.

Diptera

Dioxyna bidentis (Tephritidae) – Nationally Scarce
Drapetis infitialis (Hybotidae) – Nationally Rare (NR)
Hilara medeteriformis (Empididae) – Near Threatened (NT)
Platypalpus luteicornis (Hybotidae) – Nationally Scarce (NS)
Rhaphium micans (Dolichopodidae) - Nationally Scarce (NS)

The picture-winged fly *Dioxyna bidentis* has larvae that develop in the flowerheads of the local Trifid Bur-marigold *Bidens tripartita* and consequently records include marshes and wet areas on dunes.

The hybotid *Drapetis infitialis* is a little-known species with uncertain habitat affinities. The eight records in the NBN are widely scattered, with one Welsh site near Barmouth.

The empid *Hilara medeteriformis* is only known from three sites in Spey Valley (1935-1980), from Rannoch (1987) and from one isolated record from Chirk Castle Park, Denbighshire (1996) according to Falk & Crossley (2005). The habitat of this species is probably the margins of rivers, but one record is from broadleaved woodland on the shore of Loch Rannoch. The larvae probably develop as predators in mud.

The hybotid *Platypalpus luteicornis* has been recorded from damp woodland associated with wetlands and rivers but its precise habitat requirements are uncertain.

The dolichopodid *Rhaphium micans* is of uncertain habitat but sites include woodland, waterside and a gravel pit. There are only seventeen records on the NBN with the greatest along the Welsh borders.

Hemiptera

Aquarius najas (Gerridae) – Nationally Scarce (NS)
Micronecta griseola (Corixidae) – Nationally Rare (NR)
Monosynamma sabulicola (Miridae) – Nationally Scarce (Nb)

The river skater *Aquarius najas* typically forms flotillas in the slow stretches of rivers and streams that are often otherwise fast flowing, and this was how they were observed on the Afon Tywi. It appears to be more frequent in west Wales than east Wales or the Welsh borders, with other populations in the southwest of England, parts of southeast England and a few outliers in the Midlands and in southwest Scotland (Huxley, 2003).

Micronecta griseola was added to the British list in 2003 (Brooks & Nau, 2003). Male specimens from the Afon Tywi have been carefully dissected and all appear to be this species. There are only fourteen records on the National Biodiversity Network (NBN) Gateway with one site to the west of London, two around Oxford and the remaining six around Cambridgeshire. The current records therefore represent a significant extension in the distribution of this species in the UK although it has recently been recorded from Northern Ireland (Cuppen & Nelson, 2007) which is a far more significant range extension.

Monosynamma sabulicola was frequent at some sites on the present survey. The three species of *Monosynamma* in the UK have been confused but this species would appear to be the most likely species on ERS in South Wales. *M. sabulicola* occurs mainly on western sand dunes including several in Wales but has been found in gravel pits inland. The records should be treated as provisional until the specimens can be checked by a Hemipterist.

Hymenoptera

Anoplius concinnus (Pompilidae)
Symmorphus crassicornis (Eumenidae) – Nationally Rare (RDB3)
Tiphia minuta (Tiphidae) – Nationally Scarce (Nb)

In Wales, the spider-hunting wasp *Anoplius concinnus* is associated with coastal sand dunes and with sand quarries in the Wrexham area. Many of its inland localities elsewhere in Wales are ERS on the major river.

The eumenid wasp *Symmorphus crassicornis* was considered to be rather rare but there are 290 records in the NBN Atlas, and it is found throughout England as far as north Yorkshire and throughout Wales.

The solitary wasp *Tiphia minuta* has 292 records in the NBN Atlas and is found throughout England but is mainly coastal in Wales except for the southeast corner; there is one site in Scotland.

Other invertebrates

Several other significant invertebrates were recorded that do not have rarity categories mainly because they are too poorly known. Some of these are described below:

The chydorid *Disparalona rostrata* (Crustacea, Chydoridae) has 26 records on the NBN Atlas. All but one of the records are in East Anglia, the exception being a record south of Abergavenny, although there are old records for a Cumbrian tarn and a Yorkshire canal (Scourfield & Harding, 1966). The specimens were obtained on the Afon Tywi in an excavation and should be confirmed.

The blind cave shrimp *Niphargus aquilex* (Crustacea, Niphargellidae) has 763 records in the NBN Atlas but it is sparsely recorded throughout Wales. It is associated with caves, springs, wells, and interstitial gravels such as the submerged parts of ERS.

3.3 Site results

Sites are arranged from downstream (Carmarthen) to upstream (Llandovery) localities.

3.3.1 Penlan

Date: 7 August 2023

Weather: Very wet – recent period of heavy rain.

Habitat description: Low river level despite rain – see drawdown on banks – low level may be due to water abstraction. River has cut a channel through part of the bank resulting in an island. Extensive shingle and sandy ERS. Vegetation includes frequent osier on the inside of the ERS with Creeping Thistle (*Cirsium arvense*), Bush Vetch (*Vicia sepium*), Himalayan Balsam (*Impatiens glandulifera*), Redshank (*Persicaria maculosa*) and Soapwort (*Saponaria officinalis*).

Locations of samples: Figure 1 in Appendix 2.

Grid reference: SN4474720509.

Methods with start & finish times: Search 10.41-11.11am and sweeping 11.14-11.34am. Pitfalls reinstalled with rain covers.

Significant invertebrates recorded: *Arctosa cinerea* (one by searching), *Pomatinus substriatus* (two by searching), *Negastrius sabulicola* (one by excavation), *Medon ripicola* (four by searching), *Hydrosmecta subtilissima* (three by excavation), *Rhegmoclemina lunensis* (five by searching and one in excavation) and *Athyroglossa ordinata* (two swept),

Negative indicators: Possibly excessive water abstraction here resulting in lower-than-normal river levels. Japanese Knotweed (*Reynoutria japonica*) and Himalayan Balsam.

Image 1. Sandy ERS at Penlan on 7 August 2023. View is looking downstream on a bend that moves northwest then west.

Image 2. Sandy ERS at Penlan on 7 August 2023. View is looking upstream (southeast).

Date: 8 September 2023

Weather: Dry but misty. Vegetation wet at 9.30am. Maximum windspeed 1.1mph, average 0.8mph, 20.4°C (9.40am). 100% mist/fog but sunny and clearing.

Habitat description: Abstraction pipes still in place. Fringe of vegetation along river's edge. Osier (*Salix viminalis*) stand on shingle upstream. Trifid Bur-marigold (*Bidens tripartita*) present.

Locations of samples: Figure 1 in Appendix 2.

Grid reference: SN4474720509.

Methods with start & finish times: Excavation followed by search 10.30-11am and sweep 11.05-11.25. Four pitfalls found full of shingle and another full of sand. Elutriated sediment from pitfalls and retained organic fraction.

Significant invertebrates recorded: *Arctosa cinerea* (subadult), *Athyroglossa ordinata* (four swept) and *Dioxyna bidentis* (three swept).

Negative indicators: Japanese Knotweed and Himalayan Balsam.

3.3.2 Whitemill

Date: 16 June 2023

Weather: 1.9mph maximum wind speed, 0.8mph average wind speed, 24.6°C.

Habitat description: River with slow flow. Little vegetation (90% bare gravel and pebbles). More vegetation downstream and inland. Little Ringed Plover/Ringed Plover (*Charadrius hiaticula/dubius*) upstream so went downstream not to disturb them where there were finer pebbles. Sandy substrate in places. Vegetation included narrow leaved willows (*Salix* spp.), sallow (*Salix caprea*/*cinerea*) saplings, Broad-leaved Dock (*Rumex obtusifolius*) and Redshank. Cow pats and cattle tracks on the shingle.

Locations of samples: Figure 1 in Appendix 2.

Grid reference: SN4716321099 (central point). Excavation at SN4711321148

Methods with start & finish times: Excavation 10.10-10.30am, search 10.35-11pm., sweeping 11.10-11.40am. Installed nine pitfalls.

Significant invertebrates recorded: *Cryptostemma alienum* (one in excavation), *Monosynamma sabulicola* (forty-nine swept), *Bembidion bipunctatum* (in excavation), *Hydrosmecta longula* (seven by excavation), *Deleaster dichrous* (one by searching),

Coccinella quinquepunctata (one swept), *Rhaphium fractum* (one by searching) and *Rhabdomastix eugeni* (one swept).
Negative indicators: Vehicle tracks present on ERS. Japanese Knotweed where ERS meets the field inland.

Image 3. Whitemill looking upstream (east) on 16 June 2023.

Image 4. Whitemill looking downstream (west) on 16 June 2023.

Image 5. Excavation on Whitemill on 16 June 2023. Note the vehicle tracks on the shingle. View upstream (east).

Date: 7 August 2023

Weather: 100% cloud and slight breeze.

Habitat description: Pitfall traps washed away or covered up – part of shingle bar covered with mud and clearly reworked since June visit (Image 6). Abundant Redshank and frequent Osier saplings and mayweed (*Tripleurospermum*/*Matricaria* sp.). Spoke to anglers here. They informed me that the farmers used to lime their fields either here or along the river. Salmon (*Salmo salar*) was present in shallow water in the past. Anglers were of the opinion that water quality was poorer than in the past, possibly from silt upstream. Four anglers were present, and none had caught a fish here today – it was now quite difficult to catch fish here these days. The river level falls quickly according to the anglers. The importance of the river for Sea Trout (*Salmo trutta morpha trutta*) was mentioned.

Locations of samples: Figure 1 in Appendix 2.

Grid reference: SN4717621198.

Methods with start & finish times: Excavation, searching 1.52-2.22pm, sweep 2.22-2.42pm. Replaced pitfalls all with rain covers.

Significant invertebrates recorded: *Cryptostemma alienum* (one in excavation), *Perileptus areolatus* (three by searching), *Thinobius bicolor* (five by excavation), *Rhegmoclemina lunensis* (twenty by searching, one in excavation and one swept) and *Athyroglossa ordinata* (four swept).

Negative indicators: Japanese Knotweed and Himalayan Balsam where ERS borders field inland.

Image 6. Whitemill on 7 August 2023 showing mud and silt deposition on the ERS. View is looking downstream (west).

Date: 8 September 2023

Weather: Maximum windspeed 2.3mph, average windspeed 1.1mph, 26°C at 12.20am. 27-28°C at 1.30pm. One of the hottest days of the year.

Habitat description: Cattle on shingle and keeping cool in river.

Locations of samples: Figure 1 in Appendix 2.

Grid reference: SN4711321148.

Methods with start & finish times: Pitfalls full of shingle – seven found (Image 7 below). Elutriated sediment from pitfalls and retained organic fraction. Excavation 12.47-1.20, search 1.30-1.50pm, sweeping 1.50-2.10pm.

Significant invertebrates recorded: *Hydrosmecta longula* (one in excavation).

Negative indicators: Japanese Knotweed and Himalayan Balsam.

Image 7. Whitemill on 8 September 2023. Removed pitfalls full of substrate.

3.3.3 Dryslwyn Site 3B

Date: 17 June 2023

Weather: Small amount of rain overnight. 100% cloudy but warm, muggy, and dry. 0.8mph maximum windspeed, zero mph average windspeed, 21.3°C. Increasingly warm and sunny throughout the survey (24.5°C at 11.05am).

Habitat description: Some vegetation including regenerating osier with more osier inland. Redshank, Marsh Ragwort (*Senecio aquaticus*) and Creeping Cinquefoil (*Potentilla reptans*). Slow flow. Old cowpats on shingle and sand.

Locations of samples: Figure 2 in Appendix 2. For reasons that are unclear, but probably due to access or problems locating the site, the preferred location at Dryslwyn Site 3A was not sampled, and Site 3B was selected instead.

Grid reference: SN5463720374.

Methods with start & finish times: Excavation 10.25-10.55, sweep 11.05-11.35am, searching 11.35-12.05pm. Installed nine pitfalls.

Significant invertebrates recorded: *Carpelimus subtilis* (one in excavation), *Hydrosmecta longula* (two by excavation) and *Rhabdomastix eugeni* (one swept).

Negative indicators: None noted.

Image 8. Dryslwyn Site 3 on 17 June 2023. View looking east.

Image 9. Dryslwyn Site 3 excavation on 17 June 2023. Dryslwyn Castle in the distance. View looking upstream (east).

Date: 8 August 2023

Weather: Rain turning to drizzle by 10.30am. 19.6°C. Maximum windspeed 4.2mph, average 2.5mph. Rain largely stopped by 11am but light rain intermittently afterwards. Found plastic cups (pitfall traps out of ground) high up on bank.

Habitat description: Cattle grazing on the ERS.

Locations of samples: Figure 2 in Appendix 2. For reasons that are unclear, but probably due to access or problems locating the site, the preferred location at Dryslwyn Site 3A was not sampled, and Site 3B was selected instead.

Grid reference: SN5461520396.

Methods with start & finish times: Search 11-11.30am, excavation unsuccessful – water seeping into hole was murky – had same problem previous day. Wet sand and mud dumped on bar – evidence of reworking by the river. No sweeping due to wet weather.

Significant invertebrates recorded: *Arctosa cinerea* (one by searching), *Cryptostemma alienum* (one in excavation), *Perileptus areolatus* (three by searching) and *Hydrosmecta subtilissima* (four by excavation).

Negative indicators: Cattle significantly trampling ERS (and pitfalls?) here.

Image 10. Dryslwyn Site 3 on 8 August 2023. View is looking upstream on the inside of a tight meander.

Date: 10 September 2023

Weather: Drizzle turning to rain at 9.52am. Maximum windspeed 1mph, average 0.7mph, 22°C (9.53am). Still drizzling at 10.30am. Rain stopped towards end of survey.

Habitat description: Water Pepper (*Persicaria hydropiper*) present. No sign of cattle except for old cowpats. Flood debris present on ERS.

Locations of samples: Figure 2 in Appendix 2. For reasons that are unclear, but probably due to access or problems locating the site, the preferred location at Dryslwyn Site 3A was not sampled, and Site 3B was selected instead.

Grid reference: SN5463720374.

Methods with start & finish times: Four pitfalls out of ground – no beetles present in contents. Excavation 10.03-10.33, search 10.33-11.03 – beetles hard to find on wet ERS. Too wet to sweep.

Significant invertebrates recorded: *Arctosa cinerea* (over five by searching), *Cryptostemma alienum* (two by searching and in in excavation), *Perileptus areolatus* (one by searching), *Bidessus minutissimus* (one in excavation), *Hydrosmecta subtilissima* (one by searching) and *H. longula* (one in excavation).

Negative indicators: None.

3.3.4 Dryslwyn Site 4 (Fferm Typicca)

Date: 17 June 2023

Weather: 1.8mph maximum windspeed, 1.1mph average windspeed, 27.9°C, 70% cloud cover.

Habitat description: Slow flow. Shingle bare and part vegetated (cinquefoil, Silverweed *Potentilla anserina* and Reed Canary Grass *Phalaris arundinacea* inland). Dense Osier frequent inland. Grey Willow (*Salix cinerea*) saplings and redshank also recorded. Downstream was an area of reworked shingle with a shingle bar beyond – latter is probably where the sample should have been taken.

Locations of samples: Figure 2 in Appendix 2.

Grid reference: SN5501420307.

Methods with start & finish times: Excavation 1.50-2.20pm, searching 2.20-2.50pm, sweeping 2.55-3.25pm.

Significant invertebrates recorded: *Monosynamma sabulicola* (seventy-nine swept), *Bidessus minutissimus* colonised excavation pool after leaving it to clear for 10 minutes. *Perileptus areolatus* (3 in excavation), *Ochthephilus andalusiacus* (one by searching), *Hydrosmecta subtilisima* (four by searching), *Coccinella quinquepunctata* (four swept), *Rhaphium nasutum* (on swept), *R. micans* (three swept) and *Tiphia minuta* (one swept).

Negative indicators: Evidence of gravel extraction slightly downstream and inland.

Image 11. Dryslwyn Site 4 on 17 June 2023. Dryslwyn Castle in centre top. View is looking upstream (east). The nearside ERS had completely disappeared when the site was re-visited in August 2023.

Image 12. Dryslwyn Site 4 on 17 June 2023. View is downstream (west).

Image 13. Dryslwyn Site 4 excavation on 17 June 2023. Dryslwyn Castle in centre top. View is looking upstream (east).

Date: 8 August 2023

Weather: Rain at 12.50 after lull but had stopped by 1pm. 100% cloud cover, maximum windspeed 2.3mph, average 2mph. Drizzle at 1.30pm, search 1.30-2pm.

Habitat description: Area surveyed in June now flooded or covered in mud. No sign of pitfalls installed in June. Moved to area on map indicated by NRW (Image 11). Redshank by river's edge, Osier forming a belt behind the shingle. River level fairly high. No cattle present. Mayweed and Redshank present on upper beach. Otters (*Lutra lutra*) seen from the bridge on the B4297 upstream from the site in the past according to local birdwatcher.

Locations of samples: Figure 2 in Appendix 2.

Grid reference: SN5492020393.

Methods with start & finish times: No sweeping due to wet weather. Searching 1.30-2pm (beetles were scarce). Pitfalls put in along upper beach (i.e., away from the river's edge). Excavation unsuccessful – no beetles observed – water pouring into excavation was murky.

Significant invertebrates recorded: *Arctosa cinerea* – young spiders frequent on the shingle and *Hydrosmecta longula* (seven in excavation).

Negative indicators: Evidence of localised gravel extraction slightly inland.

Image 14. Dryslwyn Site 4 on 8 August 2023. View is looking downstream (west).

Date: 10 September 2023

Weather: Not raining, 100% cloud, vegetation wet. 22.2°C. Maximum windspeed 1.2mph, average 0.7mph. Sun appearing at 2.55pm.

Habitat description: Redshank frequent at rear of shingle bar and along the river's edge. Sheep's Sorrel (*Rumex acetosella*), Broad-leaved Dock, Common Reed (*Phragmites australis*) and Osier (occasional) recorded. Sandy areas on shingle bar.

Locations of samples: Figure 2 in Appendix 2.

Grid reference: SN5492020393.

Methods with start & finish times: Five pitfalls found – no beetles in washed-out contents. Excavation 2.25-2.55pm, search 2.57-3.27pm. Too wet to sweep.

Significant invertebrates recorded: *Arctosa cinerea* juveniles.

Negative indicators: None noted.

Image 15. *Arctosa cinerea* on Dryslwyn Site 4 on 8 August 2023.

3.3.5 Dryslwyn Site 5 (Golden Grove)

Date: 18 June 2023

Weather: Rain overnight (heavy in some parts of the UK). Dry, hot, 20% cloud cover (at 9.38am). Maximum wind 1.6mph, average 0.8mph, 22.4°C. 100% cloud cover at end

Habitat description: River with moderate flow. Cattle on shingle bar and fairly heavily grazed. Sand inland, shingle comprising middle and lower parts of bar. Sand on the upper parts of the bar. Short sparse vegetation. Some large driftwood present. Vegetation included Creeping Thistle (frequent), Broad-leaved Dock, Creeping Cinquefoil, regenerating willow (kept low due to grazing).

Locations of samples: Figure 2 in Appendix 2.

Grid reference: SN5625120216.

Methods with start & finish times: Excavation 9.43-10.13am, search 10.15-10.45am, sweep 10.45-11.15am. Installed pitfall traps.

Significant invertebrates recorded: *Bembidion bipunctatum* (in excavation), *Micronecta griseola* (six by excavation), *Hydrosmecta longula* (six by excavation), *Coccinella quinquepunctata* (two swept), *Sciapus basilicus* (five swept) and *Rhabdomastix eugeni* (two swept).

Negative indicators: Overgrazed and trampled by cattle?

Image 16. Dryslwyn Site 5 on 18 June 2023. View is downstream on the inside of a meander.

Date: 9 August 2024

Weather: 100% cloud, no detected windspeed and 17.4°C.

Habitat description: Cattle grazed shingle on inside of meander. Redshank on lower shore; creeping thistle also noted. Wet hollows present and ERS appears to have been reworked – not clear how but presumably by spates following heavy rain.

Locations of samples: Figure 2 in Appendix 2.

Grid rference: SN5629920300

Methods with start & finish times: Excavation 10-10.30am, search 10.30-11am, sweep 11.05-11.25am Searching included splashing river water onto lower shore and looking under stones. Installed pitfall traps – placed rain covers over the cups.

Significant invertebrates recorded: *Arctosa cinerea* (1), *Micronecta griseola* (12 individuals), *Hilara medeteriformis* (one dissected male).

Negative indicators: Not fenced off from field so cattle have access here and the ERS is poached and heavily grazed.

Date: 10 September 2024

Weather: No rain, 100% cloud cover, maximum wind 1.1mph, average wind 0.7mph, 21.3°C and humid (95.1% relative humidity). Heavy downpour halfway through sample hence no sweep netting.

Habitat description: Cow pats present on ERS and five sheep in field must also have access to the shingle bar. River margin vegetated as in August 2024.

Locations of samples: Figure 2 in Appendix 2.

Grid reference: SN5629920300.

Methods with start & finish times: Excavation 12.15-12.45am, search 12.45-13.15am, no sweeping due to heavy downpour. No sign of pitfall traps.

Significant invertebrates recorded: No significant invertebrates recorded.

Negative indicators: Sewage fungus in one stretch of the Afon Tywi on way back – evidence of pollution.

3.3.6 Dinefwr Estate

Date: 9 August 2023

Weather: 2.1mph maximum windspeed, 0.8mph average windspeed, 20°C, 100% cloud cover.

Habitat description: Frequent Redshank and Himalayan Balsam, also Broad-leaved Dock and Creeping Thistle. High river levels and strong flow. Took measurements of river (pH 8.5, conductivity µS 108, Total dissolved solids (TDS) = 13, water temperature = 14.2°C). Soapwort (*Saponaria officinalis*) recorded. ERS not grazed.

Locations of samples: Figure 2 in Appendix 2.

Grid reference: SN6009622044.

Methods with start & finish times: Excavation, search 1.35-2.05pm, sweeping 2-2.20pm. Installed pitfalls.

Significant invertebrates recorded: *Disparalona rostrata* (four in excavation), *Arctosa cinerea* (adults and juveniles). *Platydomene angusticollis* (one by searching), *Coccinella quinquepunctata* (two swept), and *Athyroglossa ordinata* (thirteen swept). *Anoplius concinnus* (Hym: Pompilidae) also present. This spider-hunting wasp seems to be present

wherever *Arctosa* is and maybe hunting the spider. The spider wasp is, however, less frequent.

Negative indicators: Japanese Knotweed (rare).

Image 17. Dinefwr Estate on 9 August 2023. View is looking downstream (north).

Date: 9 September 2023

Weather: Very hot (30-34°C), no cloud, maximum windspeed 1mph, average windspeed 0.5mph. Possibly hottest day of year.

Habitat description: Large stand of Himalayan Balsam behind shingle. Japanese Knotweed (occasional). Water Pepper, mayweed, and Broad-leaved Dock present. No grazing here.

Locations of samples: Figure 3 in Appendix 2.

Grid reference: SN6009622044.

Methods with start & finish times: All pitfalls in ground. Search 1.37-14.07pm, sweep 2.07-2.27. Few beetles during search (due to heat?).

Significant invertebrates recorded: *Arctosa cinerea* subadults present and *Athyroglossa ordinata* (five swept).

Negative indicators: Himalayan Balsam and Japanese Knotweed.

3.3.7 Gelli Aur

Date: 16 June 2023

Weather: 2.2 maximum windspeed, 0.7mph average windspeed, 29.5°C.

Habitat description: Osier and Crack Willow (*Salix fragilis*), Ox-eye Daisy (*Leucanthemum vulgare*), Creeping Thistle and Broad-leaved Dock. Sandy area present. Goose droppings. Bird-hide on opposite bank (Dinefwr Estate). Shingle islands and further shingle downstream on opposite bank.

Locations of samples: Figure 2 in Appendix 2.

Grid reference: SN6039322232.

Methods with start & finish times: Excavation 2.30-3.00pm, searching 3-3.30pm, sweeping 3.30-4pm. Installed nine pitfall traps.

Significant invertebrates recorded: *Cryptostemma alienum* (one in excavation), *Monosynamma sabulicola* (forty-nine swept), *Thinobius bicolor* (six in excavation), *Coccinella quinquepunctata* (four swept), *Dioxyna bidentis* (one swept), *Symmorphus crassicornis* (one swept) and *Rhabdomastix eugeni* (two swept),

Negative indicators: Japanese Knotweed and Himalayan Balsam.

Image 18. Gelli Aur on 16 June 2023. View looking upstream.

Date: 9 September 2023

Weather: No wind, 22.5°C (at 9.45am). 20% cloud – rest blue sky.

Habitat description: Cattle grazed on shingle and much dung and trampling at the river's edge. An island created since last visit. Vegetation included sapling Osiers, Broad-leaved Dock, mayweed, Knotweed, Soapwort, and frequent Water Pepper.

Locations of samples: Figure 3 in Appendix 2.

Grid reference: SN6041222217.

Methods with start & finish times: Search 10.25-10.55am, sweep 10.55-11.15am. Few beetles by searching – possibly because river edge is so heavily poached by cattle.

Significant invertebrates recorded: Juvenile *Arctosa cinerea* frequent, river skaters (*Aquarius najas*) in Afon Tywi near site and *Hydrosmecta subtilissima* (one by excavation).

Negative indicators: Excessive cattle trampling and dunging. Japanese knotweed and Himalayan balsam.

3.3.8 Llandeilo (Railway Station)

Date: 10 August 2023

Weather: 80% cloud cover with some dampness but drying out and with recent sun. Shingle dry. No wind, 23°C. Increasingly sunny. Sunny at 11.50am with 40% cloud cover.

Habitat description: Vegetation included Redshank, Osier (abundant to frequent), Common Nettle (*Urtica dioica*), Himalayan Balsam, Broad-leaved Dock, Creeping Thistle, Ribwort Plantain (*Plantago lanceolata*) and Colt's-foot (*Tussilago farfara*). Not grazed. Took measurements of river (pH 8.4, conductivity µS 110, Total dissolved solids (TDS) = 53, water temperature = 16.8°C).

Locations of samples: Figure 4 in Appendix 2.

Grid reference: SN6366322675.

Methods with start & finish times: Excavation, search 10.45-11.15am (very few beetles), sweep 11.12-11.22am. Pitfalls installed with rain covers.

Significant invertebrates recorded: *Anoplius concinnus. Arctosa cinerea* (adults and juveniles). *Cryptostemma alienum* (two in excavation), *Perileptus areolatus* (seven by searching), *Coccinella quinquepunctata* (two swept), *Rhabdomastix eugeni* (one swept) and *Athyroglossa ordinata* (one swept).

Negative indicators: Himalayan Balsam.

Image 19. Llandeilo on 10 August 2023. View is looking upstream (southeast).

Date: 11 September 2023

Weather: Heavy rain overnight – vegetation and shingle wet. 100% cloud cover. Maximum windspeed 1.5mph, average windspeed 0.9mph, 18.4°C (at 10am). Relative humidity (100%).

Habitat description: Botanically quite species rich. Water Pepper frequent. Redshank, bramble (*Rubus fruticosus* agg.), Marsh Yellow Cress (*Rorippa palustris*), buttercup (*Ranunculus* sp.), Himalayan Balsam, Monkey Flower (*Mimulus guttatus*) (rare), Broad-leaved Dock, Osier, Creeping Cinquefoil, Grey Willow, Common Nettle, Creeping Thistle, Greater Plantain (*Plantago major*), Knotted Pearlwort (*Sagina nodosa*) etc.

Locations of samples: Figure 4 in Appendix 2.

Grid reference: SN6366322675.

Methods with start & finish times: Excavation 11.05-11.35am, search 11.36-11.06am. Searching poor – only one carabid found – poor results possibly due to recent heavy rain (and large number of *Arctosa*?). All pitfalls found in the ground.

Significant invertebrates recorded: Juvenile *Arctosa cinerea* common and present in pitfalls, river skaters *Aquarius najas* in Afon Tywi, *Cryptostemma alienum* (one in pitfalls and one by excavation),

Negative indicators: Himalayan Balsam.

3.3.9 Bethlehem

Date: 10 August 2023

Weather: Maximum windspeed 1.8mph, average windspeed 1.2mph, 26.4°C, sunny with 40% cloud cover, breezy at times.

Habitat description: Vegetation included Colt's-foot, Himalayan Balsam (frequent), Japanese Knotweed (rare), Common Ragwort (*Jacobaea vulgaris*), Ribwort Plantain (occasional) and Redshank (occasional to frequent). Not grazed (fenced off from adjacent pasture) but old cowpats present and heavily used cattle track. Also, vehicle tracks. Vegetation included Yarrow (*Achillea millefolium*) and Knotgrass (*Polygonum aviculare* agg.).

Locations of samples: Figure 5 in Appendix 2.

Grid reference: SN6755925783.

Methods with start & finish times: Search 2.08-2.38pm, Sweep 2.35-2.55pm. Installed pitfalls.

Significant invertebrates recorded: Juvenile *Arctosa cinerea* and *Coccinella quinquepunctata* (one swept).

Negative indicators: Himalayan Balsam and Japanese Knotweed. Heavily used cattle track. Vehicle tracks.

Image 20. Bethlehem on 10 August 2023. View is looking upstream (northeast).

Date: 11 September 2023

Weather: 100% cloud cover, maximum windspeed 2.5mph, average windspeed 1.6mph, 18.6°C, relative humidity 98%.

Habitat description: Botanically shingle is quite species-rich – Colt's-foot, Creeping Thistle, Ribwort Plantain, Foxglove (*Digitalis purpurea*), Water Pepper, Sheep's Sorrel, Broad-leaved Dock, Common Knapweed (*Centaurea nigra*), Grey Willow, Japanese Knotweed, Yarrow, Knotted Pearlwort etc. Well-worn cattle track through shingle (used to access another field?).

Locations of samples: Figure 5 in Appendix 2.

Grid reference: SN6755925783.

Methods with start & finish times: Pitfalls all in ground with rain covers in place. Excavation 12.23-12.53, search 12.54-1.24pm. No beetles by splashing river water onto dry ERS (= hand searching). Sweeping 1.24-1.44pm. Cattle in neighbouring field.

Significant invertebrates recorded: One large *Arctosa cinerea* and also in pitfalls, *Hydrosmecta longula* (one by searching),

Negative indicators: Japanese Knotweed. Cattle have (restricted?) access to shingle.

3.3.10 Llanwrda (Railway Station)

Date: 11 August 2023

Weather: 90% cloud cover, cool and humid. Maximum windspeed 1.5mph, average windspeed 1mph. 19.2°C. 30% cloud at 11am.

Habitat description: Strong flow in river, very good water clarity. Vegetation on shingle included Redshank, Himalayan Balsam (inland), Creeping Thistle, Common Nettle, Grey Willow, and Foxglove (frequent). ERS fenced off from neighbouring sheep pasture, but sheep occasionally get access onto ERS through a hole in the fence. Defence works going on upstream on riverbanks to protect railway line.

Locations of samples: Figure 6 in Appendix 2.

Grid reference: SN7180231002.

Methods with start & finish times: Excavation. Search 11-11.30am, swept 11.30-11.50am. Installed pitfalls.

Significant invertebrates recorded: *Arctosa cinerea* (juveniles only), *Cryptostemma alienum* (one in excavation), *Lionychus quadrillum* (one by searching), *Thinobius newberyi* (two by searching), *Rhabdomastix eugeni* (one by searching) and *Athyroglossa ordinata* (one swept).

Negative indicators: None recorded.

Image 21. Llanwrda (Railway Station) on 11 August 2023. View is looking upstream (northeast).

Date: 12 September 2023

Weather: Maximum windspeed 0.9mph, average 0mph, 17.9°C and relative humidity 100% (at 10.07am). Sunny at 10.46am (23°C). Vegetation still wet in places.

Habitat description: Water Pepper, Redshank, Monkey Flower (rare), Himalayan Balsam (frequent), Japanese Knotweed (rare) and Creeping Thistle. Japanese Knotweed frequent on opposite bank with gorse (*Ulex* sp.).

Locations of samples: Figure 6 in Appendix 2.

Grid reference: SN7180231002.

Methods with start & finish times: All pitfalls in ground. Excavation 10.19-10.49am, Searching 10.49-11.19am, sweeping 11.19-11.39am. Only one carabid by splashing/searching.

Significant invertebrates recorded: *Arctosa cinerea* frequent and in pitfalls, *Cryptostemma alienum* (one by searching and two by excavation),

Negative indicators: Himalayan Balsam and Japanese Knotweed.

3.3.11 Llanwrda (East Bank)

Date: 11 August 2023

Weather: Maximum windspeed 3mph, average 0.7mph, 24.4°C. 25% cloud cover.

Habitat description: Vegetation included Redshank (frequent), Grey Willow (frequent), Himalayan Balsam (abundant) and Monkey Flower. River with strong flow and good water clarity. Long walk to site – no obvious footpaths. Took farm track to Cnwc and Glan-Towy from right-angled bend in road (farm track to Tylau-Hywell with 'Danger' signs and barbed wire so avoided this). Descended steep slopes but no access through wetlands so re-ascended to Glan-Towy then followed river downstream through rush-pasture and wetlands. Could possibly access this site far quicker by wading across the river from the last site? Works going on upstream on riverbanks to protect railway line.

Locations of samples: Figure 6 in Appendix 2.

Grid reference: SN7214331291.

Methods with start & finish times: Excavation failed to fill with water so abandoned. Search 2.35-2.55pm. Pitfalls installed.

Significant invertebrates recorded: *Arctosa cinerea* (juveniles only) and *Perileptus areolatus* (one by searching).

Negative indicators: Abundant Himalayan Balsam.

Image 22. Llanwrda (East Bank) on 11 August 2023. View is looking downstream (west).

Image 23. Llanwrda (East Bank) on 11 August 2023. View from hillside at Cnwc (disused farmhouse) looking northwest.

Date: 12 September 2023

Weather: 85% cloud cover but sunny and clearing. Vegetation still wet in marsh. Spots of rain at 1.35pm. Rain increased thereafter.

Habitat description: Vegetation included Himalayan Balsam (occasional), Broad-leaved dock (occasional), Sheep's Sorrell (rare), Knotted Pearlwort (rare), Water Pepper (occasional), Monkey Flower (rare) etc. A line of gorse and Himalayan Balsam blocks access to the shingle bar that is opposite Llanwrda (Railway Station).

Locations of samples: Figure 6 in Appendix 2.

Grid reference: SN7191931387. Maximum windspeed 3.5mph, average 1.8mph, 23°C, 30% cloud cover, rest blue sky (13.08pm).

Methods with start & finish times: All pitfalls in ground. Excavation 13.15-1.45pm, search 1.45-2.15. No beetles by splashing. Too wet to sweep.

Significant invertebrates recorded: *Arctosa cinerea* (one juvenile and one subadult).

Negative indicators: Himalayan Balsam – dense in parts.

3.3.12 Llandovery

Date: 18 June 2023

Weather: Maximum windspeed 1.5mph, average 0.7mph, 26.5°C, 100% cloud cover, muggy and warm.

Habitat description: Footpath through Llwynjack (farm) was closed so at the advice of the farmer, parked at lay-by on the A40(T) southwest of Pengeulan, went down the small road over the railway line, continued down the track then waded through the river and back up under the railway line to reach the site. Little Ringed/Ringed Plover downstream according to farmer and one seen below the railway bridge where the shingle had been heavily reworked in response to flooding. The survey was therefore conducted upstream of the railway bridge. Coarse shingle near the river – sandier inland. Vegetation included Broad-leaved Dock, Reed Canary Grass, water dropwort (*Oenanthe* sp.), Bittersweet (*Solanum dulcamara*), Figwort (*Scrophularia nodulosa*), Monkey Flower and Grey Willow saplings. Strong flow.

Locations of samples: Figure 7 in Appendix 2.

Grid reference: SN7535933464.

Methods with start & finish times: Excavation 1.33-2.03, search 2.05-2.35, sweep 2.31-3.01. Installed pitfall traps.

Significant invertebrates recorded: *Monosynamma sabulicola* (seventeen swept), *Coccinella quinquepunctata* (four swept), *Rhabdomastix eugeni* (two swept/pooted near river), *Ibisia marginata* (one swept) and *Hilara medeteriformis* (one swept).

Negative indicators: Japanese Knotweed and Himalayan Balsam. Gravel reworking downstream by neighbouring landowner.

Image 24. Llandovery on 18 June 2023. View is looking downstream (south) to the railway bridge and beyond.

Image 25. Llandovery excavation on 18 June 2023. View is looking upstream (north-east) in the direction of Llandovery.

Date: 12 August 2023

Weather: Rain until 10.10am. Maximum windspeed 2.5mph, average windspeed 0.8mph, 8.4°C. 90% cloud cover. Drizzle then 100% rain at 10.50am.

Habitat description: Vegetation included frequent Grey Willow, Himalayan Balsam (abundant to frequent) and Common Ragwort.

Locations of samples: Figure 7 in Appendix 2.

Grid reference: SN7539033493.

Methods with start & finish times: Excavation followed by search 10.50-11.20am. No sweeping due to rain. Installed pitfalls.

Significant invertebrates recorded: *Arctosa cinerea* (juveniles only), *Perileptus areolatus* (four by searching), *Thinobius newberyi* (three by excavation), *Neobisnius prolixus* (one by searching) and *Hydrosmecta longula* (three by excavation).

Negative indicators: Japanese Knotweed along footpath and occasional on site. Himalayan Balsam (abundant to frequent).

Date: 13 September 2023

Weather: Sunny with only 5% high cloud, rest blue sky. Maximum windspeed 2.5mph, average1.5mph, 18°C (at 9.44am).

Habitat description: As previously described.

Locations of samples: Figure 7 in Appendix 2.

Grid reference: SN7539033493.

Methods with start & finish times: Pitfalls all in ground but no beetles (contents washed-out?). Excavation 9.54-10.32am. Water did not fill excavation. Second excavation near to fast flow in river. Four old pitfalls found – possibly from June. Search 10.41-11.11am, sweep 11.11-11.31am.

Significant invertebrates recorded: None noted.

Negative indicators: Occasional Japanese Knotweed.

4. Discussion

4.1 Invertebrates

This is the first detailed assessment of the invertebrate fauna associated with exposed riverine sediment (ERS) on the Afon Tywi since 1998 (Sadler & Bell, 2002). As a consequence of the previous survey, the Tywi was ranked as the most important river in England and Wales, with 31 species of beetles and an ERS Quality Index (ERSQI) of 861. Key ERS bars at that time occurred at Fferm Typica, Llandovery, Llanwrda and Penlan. A recent review of the Tywi ERS fauna by Natural Resources Wales identified 95 specialist species including 84 Grade 1-3 species and 72 Key species to be used to determine the condition of the fauna (Howe, 2020b; Appendix 1).

The current survey of Afon Tywi ERS between Llandovery and Carmarthen from June to September 2023 inclusive has highlighted that it continues to support a nationally important specialist invertebrate fauna. A total of 45 ERS invertebrate species was recorded, of which eleven were found for the first time on the Tywi including two which are new to Wales – Eugen's River-splay Cranefly *Rhabdomastix eugeni* (Drake *et al*., 2007; Stubbs, 2021) and the scatopsid fly *Rhegmoclemina lunensis* (Haenni & Godfrey, 2009). Four Grade 2 and three Grade 3 species were added to the faunal list. As a result of the survey, the total number of ERS species on the Tywi has been raised to 106 species

including 91 Grade 1-3 species and 79 Key species. 34 of the original 95 ERS species were recorded, representing 35% of the fauna, including 31 of the 72 original Key ERS species (43%). Given that sampling missed the main spring period (May), some sites were excluded because of a lack of access permissions and that many of the pitfall traps were lost, the results highlight that the fauna is still of national importance.

Rhabdomastix eugeni was widespread on Tywi ERS, with records from Dryslwyn Sites 3B and 5, Gelli Aur, Llandeilo (Railway Station), Llandovery, Llanwrda (Railway Station) and Whitemill, whilst *Rhegmoclemina lunensis* was restricted to Whitemill.

Minutest Diving Beetle *Bidessus minutissimus* was recorded at Dryslwyn Sites 3B and 4 during the current survey. These are the first Welsh, and indeed UK, records since 2010, when it was recorded on the Afon Ystwyth, and the first on the Tywi since 2002/03 (Howe, 2023a). It is a qualifying feature on Afon Rheidol ger Capel Bangor SSSI and Rheidol Shingle & Backwaters SSSI (Howe, 2023a) and, on the basis of this survey it should be added as a feature of Afon Tywi SSSI.

Newbery's Rove Beetle *Thinobius newberyi* was recorded Llanwrda (Railway Station) and Llandovery during the current survey. This is the first record on the Tywi since 1998 (Sadler & Bell, 2002). It is a feature of Gro Ty'n yr Helyg SSSI and Rheidol Shingles & Backwaters SSSI (Howe, 2023b) and should be added as a feature of Afon Tywi SSSI.

The dolichopodid fly *Sciapus basilicus* was recorded at Dryslwyn Site 5. This species has previously been recorded only from the Usk (Cole, 1987; Drake *et al*., 2007). *Dolichopus longicornis* and *Rhaphium fractum* have otherwise only been recorded from ERS on the rivers Monnow, Usk & Wye, whilst *Rhaphium nasatum* was previously restricted to ERS on the upper Severn (Howe, 2020b). The flies *Limnophora riparia* and *Myopina myopina* have very restricted Welsh distributions, with the former known from the Monnow and Wye and the latter from the Monnow and Severn. *Athyroglossa ordinata*, otherwise restricted to ERS on the Monnow and Usk, proved to be widespread on the Tywi, with records from Dinefwr Estate, Llandeilo (Railway Station), Llanwrda (Railway Station), Penlan and Whitemill. The rove beetles *Carpelimus subtilis* and *Gnypeta carbonaria* are otherwise only known from the upper Severn.

The spider *Arctosa cinerea*, the bug *Cryptostemma alienum* and the Five-spot Ladybird *Coccinella quinquepunctata* are relatively frequent on Tywi ERS. Several of the shingle associated beetles were recorded in low numbers but a few were reasonably frequent (i.e. recorded on over five occasions) including the ground beetle *Perileptus areolatus* and the rove beetle *Hydrosmecta longula*.

In addition to the recognised ERS species, the spider-hunting wasp *Anoplius concinnus* was recorded from ERS at Dinefwr Estate and Llandeilo (Railway Station) and the grass bug *Monosynamma sabulicola* was found at Dryslwyn Site 4, Gelli Aur, Llandovery and Whitemill. Both should be considered for inclusion as ERS associates given their current Welsh distributions.

A record of the dryopid beetle *Pomatinus substriatus* at Penlan in August 2023 is the first on the Tywi since 2003 (Howe, 2020a). This aquatic beetle is associated with submerged logs and stone or exposed tree roots in lowland streams and rivers. Recorded from a handful of rivers in south and central Wales, it is a feature of River Usk (Lower Usk) SSSI, and consideration should be given to make it a feature of Afon Tywi SSSI.

Some taxa collected during the 2023 survey were not identified including most spiders, water mites, shorebugs belonging to the genus *Saldula*, some plant bugs (Miridae), certain more specialised Diptera (such as the Simuliidae, Ceratopogonidae, Phoridae and Sphaeroceridae) and the sawflies and parasitic Hymenoptera. Most of these have been retained and can be examined at a later date. The water mites sampled by extraction may be of particular interest since a number of specialised species have been recorded from interstitial gravels.

4.2 ERS management issues

Management issues were encountered, to a greater or lesser extent, on all twelve sampling sites. Himalayan Balsam and/or Japanese Knotweed were a problem on most sites, with cattle trampling, small scale gravel abstraction, water abstraction and silt deposition also noted at some (Table 8).

Table 8. Management issues at Tywi ERS sampling sites in 2023.

Site	Management issues
Penlan	Water abstraction; Himalayan Balsam & Japanese Knotweed
Whitemill	Gravel extraction; Silt deposition; Vehicle tracks; Himalayan Balsam & Japanese Knotweed
Dryslwyn Site 3B	Cattle trampling
Dryslwyn Site 4	Gravel extraction
Dryslwyn Site 5	Cattle trampling & dunging; Eutrophication; Sewage fungus; Silt deposition
Dinefwr Estate	Himalayan Balsam & Japanese Knotweed
Gelli Aur	Cattle trampling & dunging; Himalayan Balsam & Japanese Knotweed
Llandeilo (Railway Station)	Himalayan Balsam
Bethlehem	Cattle trampling; Vehicle tracks; Himalayan Balsam & Japanese Knotweed
Llanwrda (Railway Station)	Himalayan Balsam & Japanese Knotweed
Llanwrda (East Bank)	Himalayan Balsam
Llandovery	Gravel reworking downstream; Himalayan Balsam & Japanese Knotweed

The most consistent threats to the habitat and associated fauna noted during the survey were fairly small-scale evidence of gravel extraction at some sites (Whitemill, Dryslwyn Site 4), overgrazing and excessive poaching by cattle (for example Dryslwyn Sites 3 and 5 [Golden Grove]), the deposition of silt and mud on coarse ERS presumably following heavy rainfall (Whitemill, Dryslwyn Site 5 [Golden Grove]) and possible abstraction resulting in lower river levels (Penlan). Fencing off the ERS that was grazed would not only benefit invertebrates and plants but would allow little ringed plovers, ringed plovers and other birds to nest successfully. As it would also arrest erosion, fencing should be promoted to the landowners wherever possible. Localised eutrophication was observed at

Dryslwyn Site 5 (Golden Grove) in the form of sewage fungus in the Afon Tywi, but the source of the nutrients was not identified.

No other sources of pollution (algae, duckweed, noxious smells, oily scums, stagnant water, fish kills) were recorded but most of these are likely to be absent or difficult to identify on the moderate to fast-flowing Afon Tywi. A few chemical and physical measurements were taken of the river and wherever it was observed, water clarity appeared to be good to excellent, suggesting that pollution and eutrophication do not appear to be major issues. The paucity of fish alluded to by anglers at Whitemill in June 2023 does suggest there are issues with the river, and siltation was mentioned as a possible cause. However, river regulation as a result of the construction of the Llyn Brianne Dam in the late 1960s and 1970s to supply water to Carmarthen (Lillicrap, 1997) and acid rain (Edwards *et al*., 1990), which is a serious issue for running and standings waters in south and mid Wales, may have had long term impacts.

5. Conclusions and recommendations

The current survey of Afon Tywi ERS from June to September 2023 inclusive has highlighted that it continues to support a nationally important specialist invertebrate fauna, with 45 species recorded from twelve sites between Llandovery and Carmarthen. This is despite missing the spring sampling period, the loss of pitfall traps to flooding and a lack of access permission to some historically important ERS. Eugen's River-splay Cranefly *Rhabdomastix eugeni* and the scatopsid fly *Rhegmoclemina lunensis* were found new to Wales and important records were made of Minutest Diving Beetle *Bidessus minutissimus*, Newbery's Rove Beetle *Thinobius newberyi,* the flies *Athyroglossa ordinata*, *Dolichopus longicornis*, *Limnophora riparia*, *Myopina myopina*, *Rhaphium fractum*, *Rhaphium nasatum* and *Sciapus basilicus*, and the beetles *Carpelimus subtilis* and *Gnypeta carbonaria*.
It is recommended that additional sampling is undertaken in May to June to cover the spring period. Employing a Bou-Rouch pump to sample the fauna may be worth considering although this would require extra personnel since the equipment can be bulky and heavy.

The removal and eradication of Himalayan Balsam and Japanese Knotweed should be attempted, and the exclusion of livestock from key ERS using fencing would benefit specialist invertebrates and breeding birds and help to reduce erosion and siltation. Localised gravel extraction should be prevented.

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Appendix 1. The 95 species comprising the ERS invertebrate assemblage on Afon Tywi prior to the 2023 survey.

Species	Order	ERS grade	Key ERS species
Agonum albipes	Coleoptera	-	-
Aloconota cambrica	Coleoptera	1	x
Aloconota currax	Coleoptera	1	x
Aloconota insecta	Coleoptera	2	x
Aloconota sulcifrons	Coleoptera	2	x
Amara fulva	Coleoptera	2	x
Arctosa cinerea	Araneae	1	x
Atherix ibis	Diptera	-	x
Athyroglossa ordinata	Diptera	1	x
Bembidion andreae	Coleoptera	2	x
Bembidion atrocoeruleum	Coleoptera	1	x
Bembidion decorum	Coleoptera	1	x
Bembidion dentellum	Coleoptera	2	x
Bembidion femoratum	Coleoptera	2	x
Bembidion fluviatile	Coleoptera	2	x
Bembidion inustum	Coleoptera	-	x
Bembidion lunatum	Coleoptera	2	x
Bembidion prasinum	Coleoptera	1	x
Bembidion punctulatum	Coleoptera	1	x
Bembidion quadripustulatum	Coleoptera	2	x
Bembidion tibiale	Coleoptera	1	x
Bidessus minutissimus	Coleoptera	1	x
Brachygluta pandellei	Coleoptera	1	x
Campsicnemus marginatus	Diptera	3	-
Carpelimus bilineatus	Coleoptera	-	-
Carpelimus rivularis	Coleoptera	-	-
Carpelimus subtilis	Coleoptera	2	x
Caviphantes saxetorum	Araneae	-	-
Clivina collaris	Coleoptera	2	x
Coccinella quinquepunctata	Coleoptera	1	x
Cryptostemma alienum	Hemiptera	-	x
Deleaster dichrous	Coleoptera	2	x
Dixa dilatata	Diptera	3	-
Dixa nebulosa	Diptera	3	-
Dixa nubilipennis	Diptera	3	-
Dixa puberula	Diptera	3	-
Elaphropus parvulus	Coleoptera	2	x
Elaphrus riparius	Coleoptera	-	-
Esolus parallelepipedus	Coleoptera	-	-
Fleutiauxellus maritimus	Coleoptera	1	x
Gnypeta carbonaria	Coleoptera	2	x
Halorates distinctus	Araneae	2	x
Helophorus arvernicus	Coleoptera	1	x

Species	Order	ERS grade	Key ERS species
Hemerodromia oratoria	Diptera	3	-
Hexatoma bicolor	Diptera	2	x
Hexatoma fuscipennis	Diptera	2	x
Hydraena gracilis	Coleoptera	1	x
Hydraena nigrita	Coleoptera	1	x
Hydraena rufipes	Coleoptera	2	x
Hydrosmecta delicatula	Coleoptera	1	x
Hydrosmecta fragilis	Coleoptera	1	x
Hydrosmecta longula	Coleoptera	1	x
Hydrosmecta subtilissima	Coleoptera	1	x
Ibisia marginata	Diptera	3	-
Ischnopoda atra	Coleoptera	2	x
Ischnopoda constricta	Coleoptera	1	x
Ischnopoda leucopus	Coleoptera	1	x
Ischnopoda umbratica	Coleoptera	1	x
Lathrobium angusticolle	Coleoptera	1	x
Lionychus quadrillum	Coleoptera	2	x
Meotica anglica	Coleoptera	1	x
Negastrius sabulicola	Coleoptera	1	x
Neobisnius prolixus	Coleoptera	2	x
Neobisnius villosulus	Coleoptera		-
Nephrotoma guestfalica	Diptera	3	-
Ochthephilus aureus	Coleoptera	2	x
Ochthephilus omalinus	Coleoptera	2	x
Oedothorax apicatus	Araneae	2	x
Pardosa agricola	Araneae	1	x
Parocyusa longitarsis	Coleoptera	2	x
Perileptus areolatus	Coleoptera	1	x
Philhygra debilis	Coleoptera	2	x
Philonthus rubripennis	Coleoptera	1	x
Platypalpus niger	Diptera	3	-
Platystethus cornutus	Coleoptera	-	-
Ptenidium brenskei	Coleoptera	1	x
Rhabdomastix edwardsi	Diptera	2	x
Rhaphium penicillatum	Diptera	3	-
Spiriverpa lunulata	Diptera	1	x
Stenus asphaltinus	Coleoptera	2	x
Stenus biguttatus	Coleoptera	2	x
Stenus incanus	Coleoptera	1	x
Tabanus cordiger	Diptera	2	x
Tachydromia halidayi	Diptera	1	x
Tachydromia morio	Diptera	1	x
Teucophorus calcaratus	Diptera	3	-
Thalassophilus longicornis	Coleoptera	1	x
Thinobius bicolor	Coleoptera	1	x
Thinobius ciliatus	Coleoptera	1	x
Thinobius newberyi	Coleoptera	1	x
Tipula couckei	Diptera	3	-
Tipula montium	Diptera	3	-
Wiedemannia bistigma	Diptera	3	-

Species	Order	ERS grade	Key ERS species
Wiedemannia rhynchops	Diptera	3	-
Zorochros minimus	Coleoptera	1	x

Appendix 2. Afon Tywi ERS sampling locations in 2023.

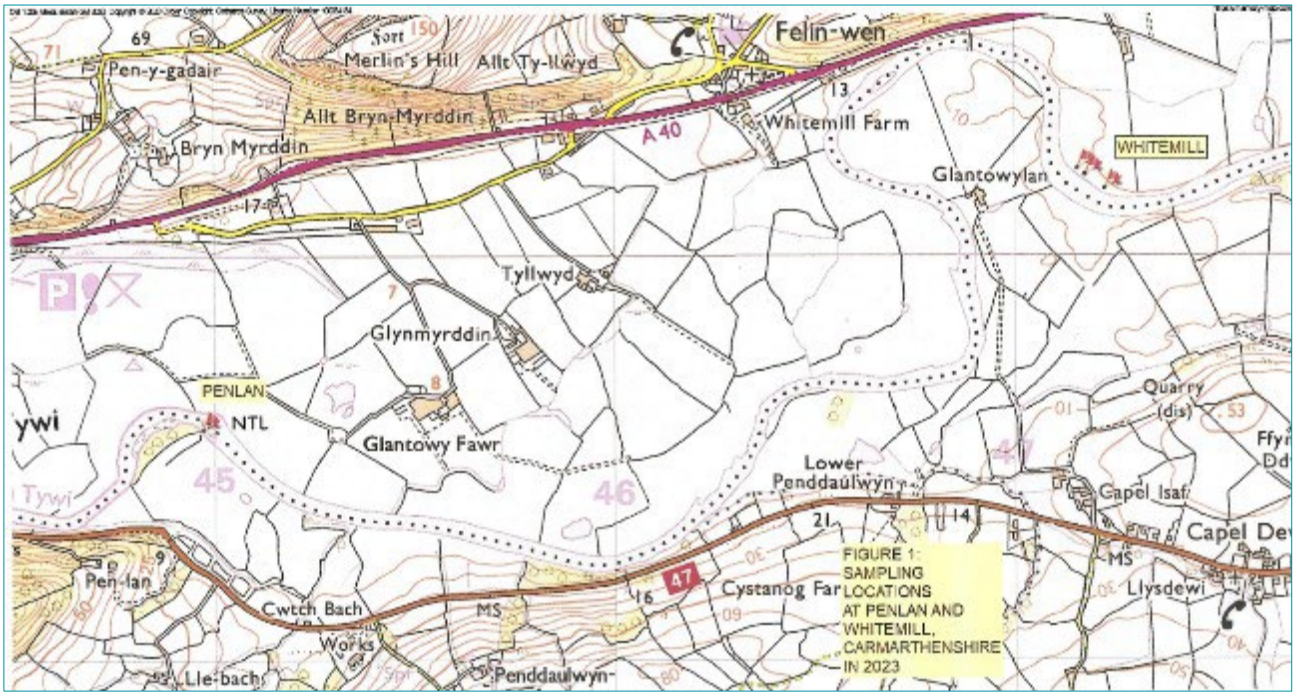

Figure 1. Sampling locations at Penlan and Whitemill.

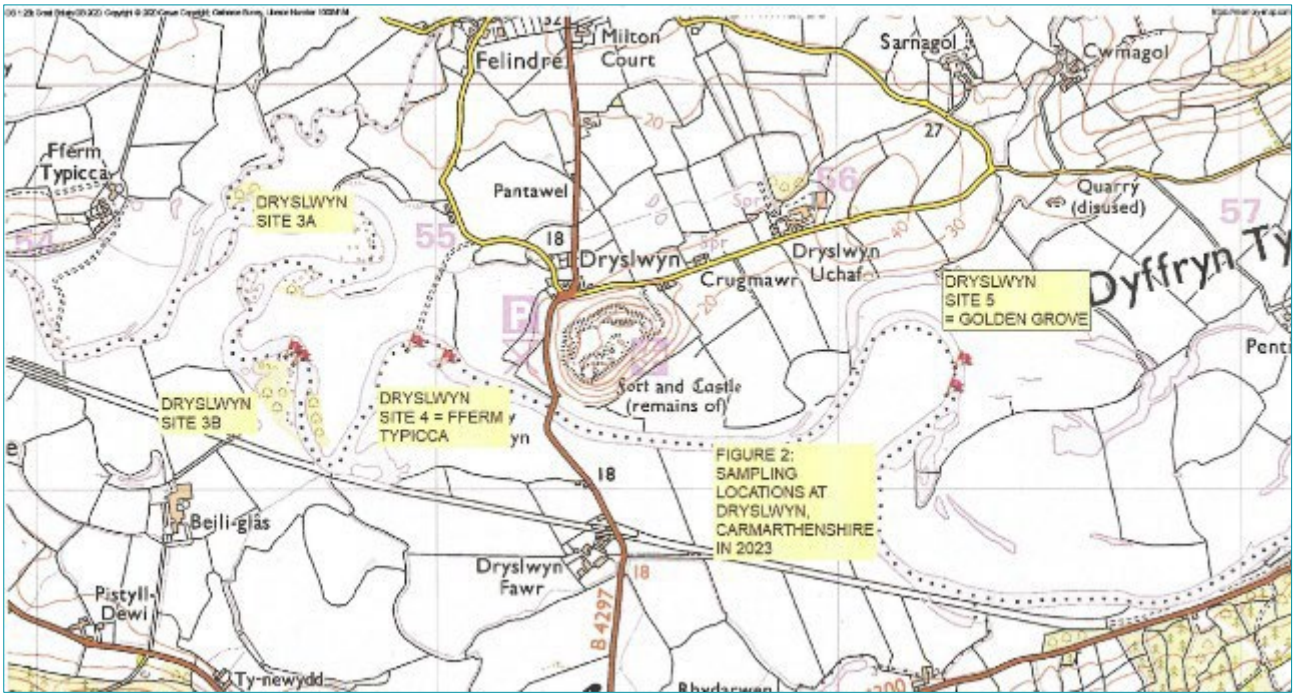

Figure 2. Sampling locations at Dryslwyn.

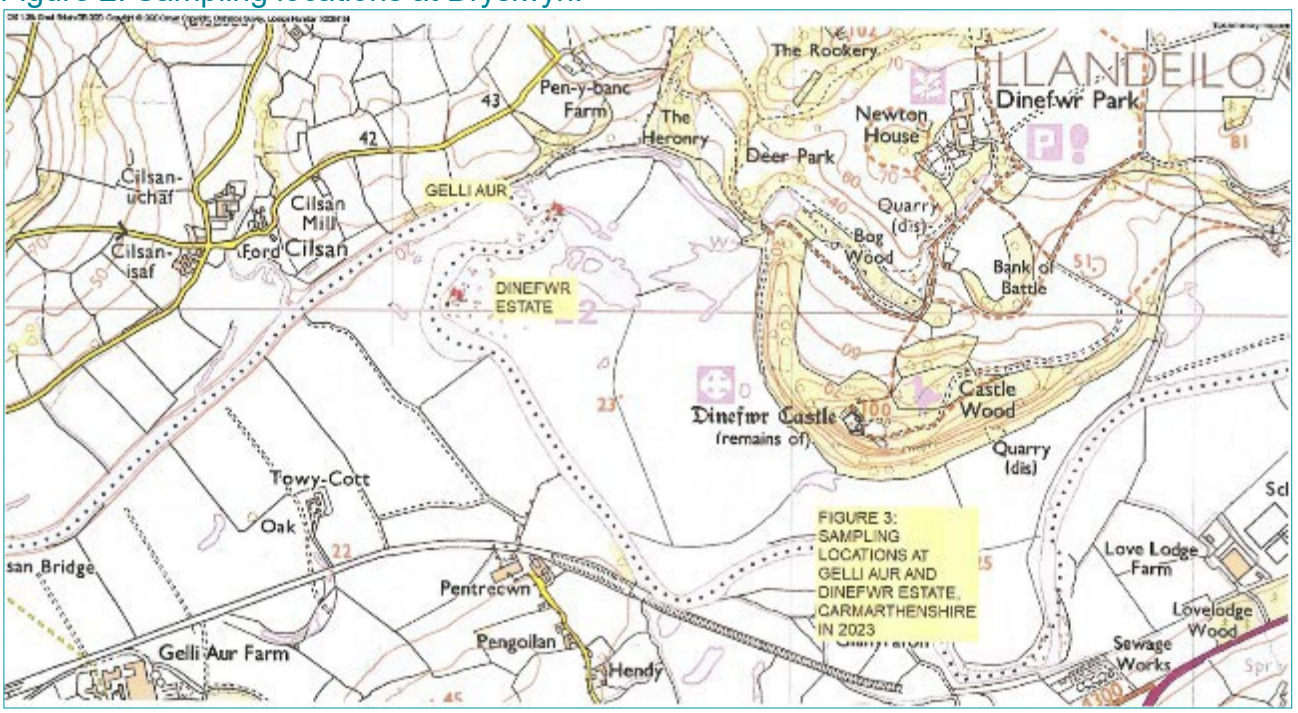

Figure 3. Sampling locations at Gelli Aur and Dinefwr Estate.

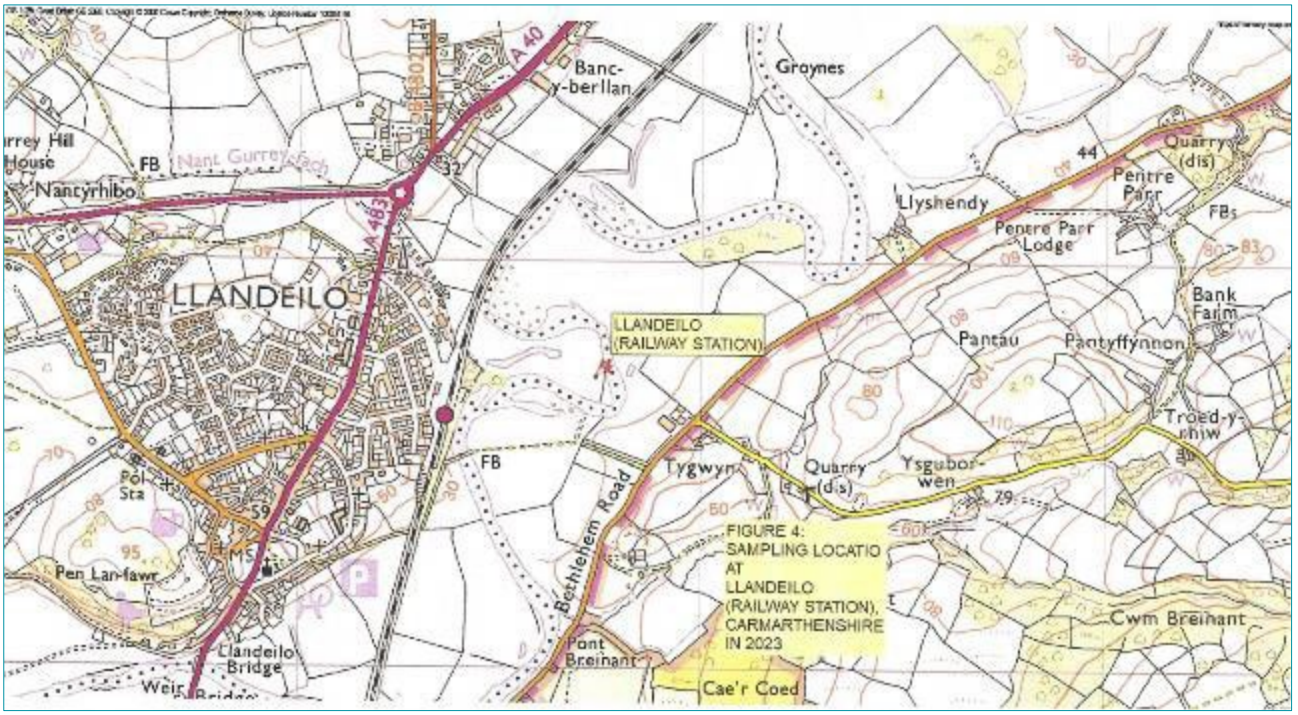

Figure 4. Sampling locations at Llandeilo (Railway Station).

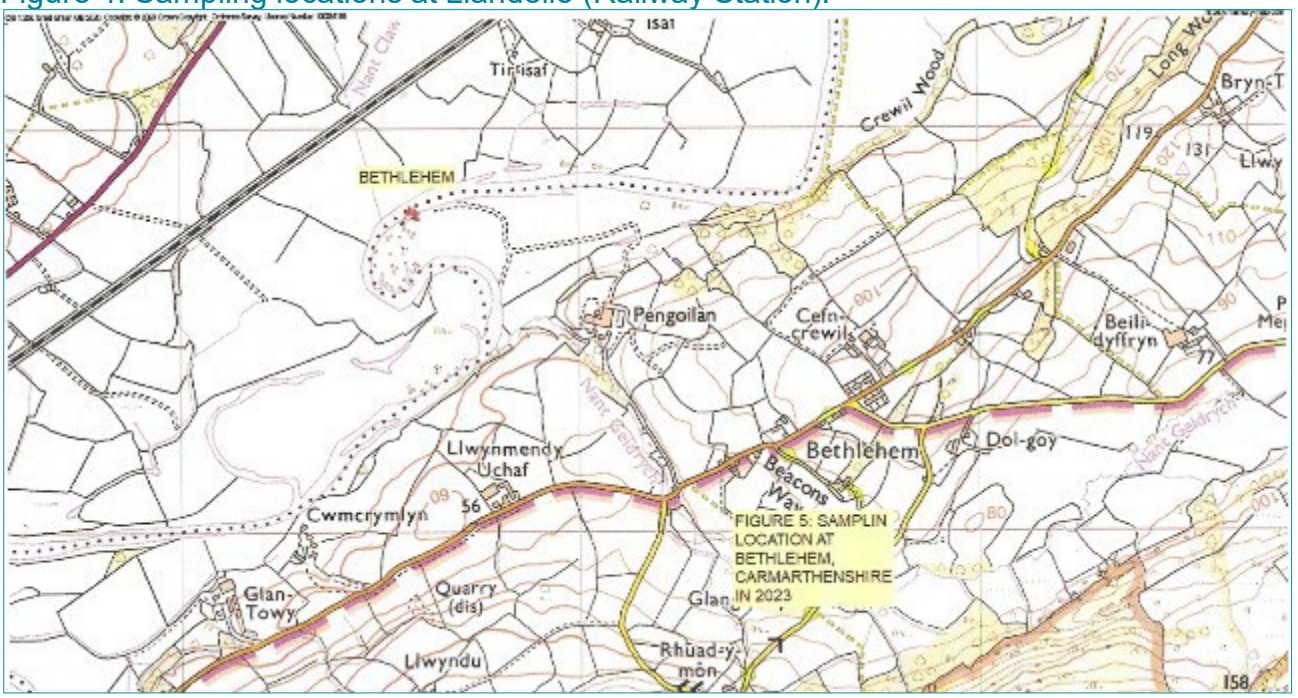

Figure 5. Sampling locations at Bethlehem.

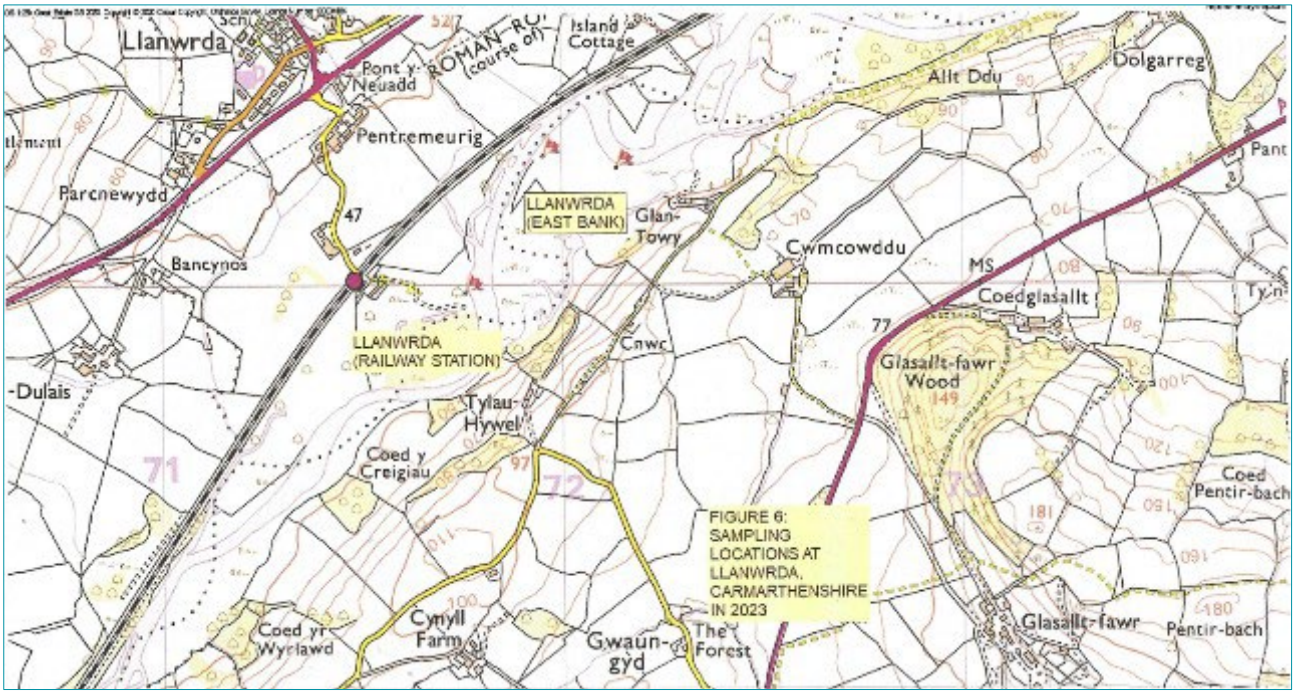

Figure 6. Sampling locations at Llanwrda.

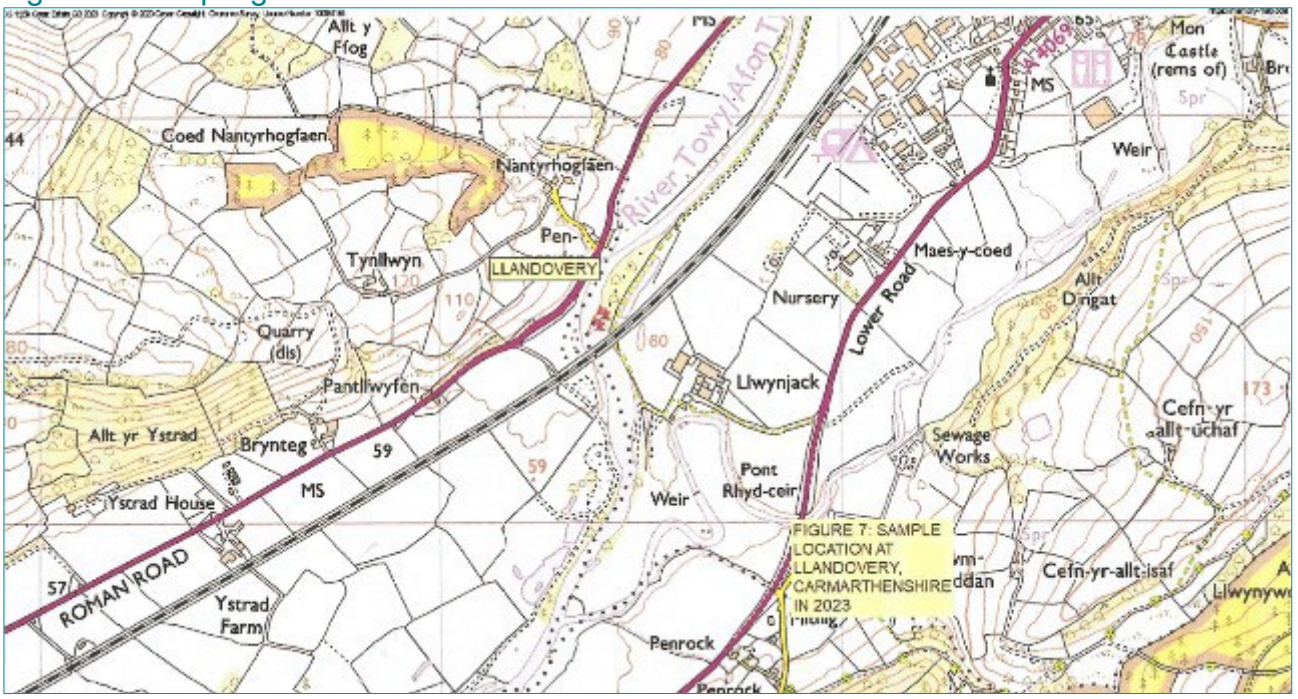

Figure 7. Sampling locations at Llandovery.

Data Archive Appendix

The data archive contains:

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

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

[C] ~~A series of GIS layers on which the maps in the report are based with a series of word documents detailing the data processing and structure of the GIS layers~~.

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

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

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

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

Metadata for this project is publicly accessible through Natural Resources Wales's Library Catalogue https://libcat.naturalresources.wales (English Version) and https://catllyfr.cyfoethnaturiol.cymru (Welsh Version) by searching 'Dataset Titles'. The metadata is held as record no. XXXXXX.