

Terrestrial and Freshwater *Species* *in Peril* in Wales

Sam Bosanquet, Mike Howe, Sam Dyer, Elisabeth Halliwell, Tristan Hatton-Ellis, Patrick Lindley & Julian Woodman

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Clockwise: Callilepis nocturna, Down-looking Moss Catoscopium nigritum, Arctic Charr/ Torgoch Salvelinus alpinus and Radnor Lily Gagea bohemica © Richard Gallon, Hermann Schachner, B. Shields & Pat O'Reilly

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Rhagair

Mae'r adroddiad manwl a thrylwyr hwn sydd wedi'i osod yng nghyd-destun yr argyfwng natur yn gwneud cyfraniad hollbwysig am dri rheswm trawiadol.

Y rheswm cyntaf yw cyfoeth y data – a gafodd ei gasglu a'i gydosod gan amaturiaid a gweithwyr proffesiynol ymroddedig fel ei gilydd – sy'n datgelu cymaint am ba mor fregus yw ein bioamrywiaeth. Er enghraifft, mae'r data'n dangos sut y mae rhywogaethau sydd mewn perygl yn amgylcheddau dŵr croyw a thiriogaethol Cymru yn bennaf yn bryfed neu'n infertebratau eraill, ffyngau a chennau. Serch hynny, mae 155 o blanhigion fasgwlaidd ar y rhestr, 25 o rywogaethau adar, 5 o bysgod, 6 mamal ac un amffibiad – ym mhob achos cyfran sylweddol iawn o'n hamrywiaeth o rywogaethau o blanhigion fasgwlaidd neu fertebratau. Mae'r data hyn yn ei gwneud hi'n glir bod ein cyfrifoldebau cadwraethol dros rywogaethau bregus yn ymestyn yn eang iawn ar draws teyrnasodd planhigion, ffyngau ac anifeiliaid.

Yr ail reswm, yw'r cysylltiad â rhwydwaith Cymru o safleoedd gwarchodedig. O'r rhywogaethau sy'n cael eu cynnwys yn yr adroddiad, mae 35% ar ein Gwarchodfeydd Natur Cenedlaethol, 75% ar ein Safleoedd o Ddiddordeb Gwyddonol Arbennig (SoDdGAau), ac yn fwy trawiadol fyth mae 47% i'w cael **yn unig** ar SoDdGAau. Mae'r lleoliadau hyn sydd wedi'u gwasgaru ar draws 12% o Gymru, ac sy'n cynnwys yr holl brif gynefinoedd, yn amlwg yn hanfodol i gadwraeth natur yng Nghymru. Wrth gwrs, mae hyn yn atgyfnerthu'r heriau adnabyddus o reoli, cynnal ac adfer cyflwr ein SoDdGAau. Mae'r adroddiad hefyd yn dangos pam y mae angen i ni ehangu gwarchodaeth natur yng Nghymru i gynnwys y 25% o rywogaethau nad ydynt ar SoDdGAau ar hyn o bryd naill ai trwy ehangu'r rhwydwaith hwn neu drwy fentrau cadwraethol eraill. Un enghraifft o'r fath yw'r ffordd y mae Cymru'n cyflawni ein cyfrifoldebau o dan y Fframwaith Bioamrywiaeth Byd-eang.

Y trydydd rheswm, yw bod yr adroddiad yn dangos i ni i ba raddau y mae natur yng Nghymru dan bwysau. Mae tua 25%, neu 743, o'r rhywogaethau a restrir wedi'u dosbarthu fel rhai sydd mewn perygl difrifol, mewn perygl neu mewn sefyllfa fregus, ac mae dros 300 o rywogaethau wedi diflannu yng Nghymru ers y 1800au. Unwaith eto, infertebratau yw'r rhain yn bennaf ond rydym hefyd wedi colli infertebratau a oedd unwaith yn gyffredin fel y Durtur, Rhegen yr ŷd a'r Cigydd Cefngoch. Er bod dwysáu amaethyddol neu newid hinsawdd yn bwysau allweddol yn yr amgylchedd ehangach, yn achos rhywogaethau â dosbarthiadau mor gyfyngedig â'r rhai yma, mae'r pwysau'n aml yn fwy lleol: er enghraifft rheoli coetiroedd, lle mae coed neu bren marw yn cael eu colli. Olyniaeth llystyfiant neu drawsnewid yn goetiroedd ar laswelltiroedd a oedd unwaith yn llawn rhywogaethau. Newid hydrolegol mewn mawndiroedd neu lygredd mewn pyllau, llynnoedd a dyfroedd rhedegog. Addasiadau neu golledion cynefinoedd arfordirol ac afonol. Un o wersi cadwraeth erioed fu'r angen i gadw pethau i fynd ar sawl ffrynt ar yr un pryd – o'r lefel fyd-eang i lefel leol iawn. Mae'r adroddiad hwn yn dangos unwaith eto fod anghenion cadwraeth natur yn amlochrog.

Yn y pen draw, mae'r adroddiad hwn yn ein hatgoffa'n glir bod natur yng Nghymru mewn sefyllfa ansicr - o ran y nifer fawr o rywogaethau sydd mewn perygl, ac o ran y tueddiadau maen nhw'n eu harddangos. Ac eto, gallwn hefyd weld ychydig o obaith drwy'r camau cadwraethol sydd ar y gweill: clirio prysgwydd, ailsefydlu twyni tywod, rheoli cynefinoedd cadarnhaol ar gyfer infertebratau, magu a rhyddhau mewn caethiwed, bioddiogelwch gwell

ar ynysoedd. Mae llawer i'w wneud o hyd – o wella ein gwybodaeth am rywogaethau nad ydynt wedi'u cofnodi'n ddigonol a chymhell y camau gweithredu sydd eu hangen i alluogi neu i berswadio'r rhai sydd â'r pŵer i wneud gwahaniaeth cadarnhaol.

Efallai bod natur yng Nghymru mewn perygl – ond ni ddylid anobeithio.



Steve Ormerod

Prifysgol Caerdydd a Cyfoeth Naturiol Cymru

Foreword

Set in the context of the nature emergency, this meticulous report makes a critical contribution for three striking reasons.

The first is the richness of the data – collected and assembled by dedicated amateurs professionals alike – that reveals so much about the vulnerability of our biodiversity. For example, the data show how species in peril in Wales' freshwater and terrestrial environments are dominantly insects or other invertebrates, fungi and lichens. There are, nevertheless, 155 vascular plants on the list, 25 bird species, five fishes, six mammals and one amphibian – in each case a very significant proportion of our vascular plant or vertebrate diversity. These data make it clear that our conservation responsibilities for vulnerable species extend very widely across the Plant, Fungal and Animal Kingdoms.

Second, is the link with Wales' network of protected sites. Of the species covered in the report, 35% are on our National Nature Reserves, 75% are on our Sites and Special Scientific Interest (SSSIs), and even more strikingly, 47% **only** occur on SSSIs. Spread across 12% of Wales, and covering all major habitats these locations are clearly vital to the conservation of nature in Wales. Of course, this reinforces the well-known challenges of managing, maintaining and restoring the condition of our SSSIs. And further still, the report illustrates why we need to expand the protection of nature in Wales to cover the 25% of species that are not currently on SSSIs either by expanding this network or through other conservation initiatives. One such is in the way that Wales is delivering our responsibilities under the Global Biodiversity Framework.

Third, the report shows us the extent to which nature in Wales is under pressure. Around 25%, or 743, of the species listed are classified as critically endangered, endangered or vulnerable, and over 300 species have become extinct in Wales since the 1800s. Again, these are mostly invertebrates but we've also lost once widespread vertebrates such as Turtle Doves, Corncrake and Red-backed Shrike. Whereas agricultural intensification or climate change are key pressures in the wider environment, in the case of species with such restricted distributions as the ones here, the pressures are often more local: woodland management, for example, where trees or deadwood are lost. Vegetation succession or conversion to woodlands on once species-rich grasslands. Hydrological

change in peatlands or pollution in ponds, lakes and running waters. Modifications or losses of coastal and riverine habitats. One of the lessons of conservation has always been in the need to hold the line on multiple fronts simultaneously – from the truly global to the very local. This report shows us once more that the needs of nature conservation are multi-faceted.

In the end, this report is a stark reminder that nature in Wales is in a precarious position - both in the large number of species in peril, and in the trajectories they display. Yet, we can also glimpse hope through the conservation actions underway: scrub clearance, the remobilisation of sand dunes, positive habitat management for invertebrates, captive rearing and release, enhanced biosecurity on islands. There is still much to do – from improving our knowledge of under-recorded species and incentivising the actions needed to enabling or persuading those with the power to make a positive difference.

Nature in Wales might be in peril – but hope is not lost.

A handwritten signature in black ink, reading "S. Ormerod", with a long horizontal stroke extending to the right.

Steve Ormerod
Wales

Cardiff University and Natural Resources

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1. Crynodeb gweithredol

Mae bioamrywiaeth dan fygythiad yng Nghymru. Cyhoeddodd y Senedd argyfwng natur yn 2021, ac mae Llywodraeth Cymru wedi ymrwymo i'r Fframwaith Bioamrywiaeth Fyd-eang. Wedi'i ddatblygu mewn ymateb i'r argyfwng bioamrywiaeth fyd-eang, mae'r Fframwaith Bioamrywiaeth Fyd-eang yn nodi cynllun uchelgeisiol i atal a gwrthdroi dirywiad bioamrywiaeth erbyn 2030 (Fframwaith Bioamrywiaeth Fyd-eang Kunming-Montreal).

Er bod llawer o ddadansoddiadau o bwysau a phrinder megis Rhestrau Coch yr Undeb Rhyngwladol dros Gadwraeth Natur, ac asesiadau ehangach o'r amgylchedd megis yr Adroddiad ar Sefyllfa Adnoddau Naturiol, yn aml nid oes digon o'r dadansoddiad ar lefel Cymru y mae ei angen i gymryd camau gweithredu. Nod yr adroddiad hwn yw mynd i'r afael â'r bwlch hwn mewn tystiolaeth drwy nodi'r rhywogaethau daearol a dŵr croyw sydd fwyaf mewn perygl o ddiflannu yng Nghymru a'u lleoliadau allweddol, fel y gellir blaenoriaethu safleoedd pwysig a chamau rheoli perthnasol i'w gwarchod.

Mae'r adroddiad hwn yn darparu asesiad cynhwysfawr o'r rhywogaethau daearol a dŵr croyw mwyaf agored i niwed yng Nghymru fel y'u deallwyd yn 2024. At ddibenion y gwaith hwn, rydym wedi canolbwyntio ar **brinder gofodol** fel y mesur o fregusrwydd, gyda phob rhywogaeth sy'n digwydd mewn pum safle neu lai yng Nghymru wedi'i chynnwys. Gelwir y rhain yn *rhywogaethau mewn perygl* drwy gydol yr adroddiad hwn. Mae pob rhywogaeth wedi'i phriodoli i un o bum categori cyfyngu:

- rhywogaethau sydd wedi dirywio'n gyflym (*yn mynd yn brin*);
- rhywogaethau sydd wastad wedi bod yn brin (*yn brin yn naturiol*);
- rhywogaethau lle credir bod prinder yn fwyaf tebygol o ddeillio o dan-gofnodi / data annigonol (*wedi'u tan-gofnodi*);
- rhywogaethau sy'n brin yng Nghymru ond yn gyffredin yn Lloegr (*ar ymylon y gwasgariad*); a
- rhywogaethau sydd wedi lledu i Gymru o Loegr yn ddiweddar, ond sydd wedi ymsefydlu mewn llond llaw o safleoedd yn unig hyd yma (*cytrefwyr*).

Casglwyd data o amrywiaeth o ffynonellau, ac maent yn cynrychioli ein dealltwriaeth orau o ddosbarthiad rhywogaethau yng Nghymru. Er bod mwy o ymdrech cofnodi ar safleoedd gwarchodedig, mae yna hefyd gofnodi helaeth ehangach gan wirfoddolwyr i ddarparu cofnodion ar gyfer cynlluniau cofnodi cenedlaethol cydlynol, y mae llawer ohonynt yn cynnwys samplu strwythuredig ledled Cymru. Mae dadansoddiad o'r data rhywogaethau hyn, a gasglwyd dros lawer o ddegawdau, yn dangos bod 2955 *rhywogaeth mewn perygl* yng Nghymru, gan gynnwys 309 ffwng, 321 cen, 107 mwsogl a llysiau'r afu, 7 rhawn yr ebol, 155 planhigyn fasgwlaidd, 2017 infertebrat, 5 pysgodyn a llysywen pendoll, 1 amffibiad, 6 mamal a 27 poblogaeth adar (sy'n bridio, rhai nad ydynt yn bridio, neu rai sy'n pasio heibio). Yn ogystal, mae cyfanswm o 304 o rywogaethau wedi diflannu o Gymru ers dechrau cofnodi biolegol systematig yn y bedwaredd ganrif ar bymtheg, gyda 114 wedi'u gweld ddiwethaf yn y 1950au neu'n ddiweddarach. Mae 11 o rywogaethau wedi diflannu ers dechrau'r mileniwm, gan gynnwys cen y llyngyren wen *Thamnotia vermicularis*, y bryum aflwm *Bryum calophyllum*, y bliwlys *Daphne mezereum*, rhisglyn y morfa *Lycia zonaria*, bras yr yd *Emberiza calandra* a'r Turtur *Streptopelia turtur*.

O'r 2955 o *rywogaethau mewn perygl*, mae 1262 yn hysbys o un lleoliad yn unig. Mae'r dosbarthiad cyfyngedig hwn yn golygu bod y rhywogaethau hyn yn eithriadol o agored i ddigwyddiadau stocastig, yn ogystal ag i newid yn yr hinsawdd. Ystyrir bod ychydig o dan hanner y *rhywogaethau mewn perygl* (1433 o rywogaethau) wedi'u *tan-gofnodi*, ond ystyrir bod dosbarthiad 52% ohonynt wedi'i gofnodi'n gywir. Mae gan y rhan fwyaf o'r 52% hwnnw ddosbarthiadau cymharol sefydlog (gan gynnwys 1389 o'r rhai sy'n *brin yn naturiol* a 23 ar *ymylon y gwasgariad*), o leiaf dros y degawdau diwethaf, ond roedd 77 o rywogaethau (y rhai sy'n *mynd yn brin*) yn fwy cyffredin o'r blaen ac maent wedi dioddef gostyngiadau sylweddol yn ddiweddar. Mae 33 o rywogaethau wedi'u categorio fel *cytrefwyr*.

Mae rhai *rhywogaethau mewn perygl* yn anifeiliaid a phlanhigion proffil uchel sy'n destun camau cadwraeth, fel y grugiar ddu *Lyrurus tetrix* a'r fritheg frown *Fabriciana adippe*. Mae eraill wedi dirywio hyd at ymyl difodiant yng Nghymru, gyda llai o gydnabyddiaeth ac ymwybyddiaeth, gan gynnwys pryf y bendro *Oestrus ovis*, mwsogl y darian frown *Buxbaumia aphylla* a'r cen *Cetraria sepincola*. Mae 56 o rywogaethau wedi'u cyfyngu i Gymru yn y DU, ac mae cyfrifoldeb arbennig i ddiogelu eu poblogaethau.

Mae dadansoddiad yn dangos mai *coetir*, *parcdir* a *phrysgwydd* yw'r pwysicaf o'r 13 ecosystem ar gyfer *rhywogaethau mewn perygl*, gyda bron i draean o'r holl rywogaethau (1,076 o rywogaethau) wedi'u cyfyngu i'r ecosystem hon, ac yna *glaswelltir* (531), *mawndir* (356), *mynydd-dir* (203), *twyni a morfa heli* (201), *afonydd*, *nentydd a ffosydd* (196) ac *arfodir a chlogwyn arfordirol* (168). Mae'r chwe ecosystem sy'n weddill yn cynnal rhwng 15 (*amaethyddol*) a 52 (*llyn a phwll*) o rywogaethau. Mae pwysigrwydd *coetir*, *parcdir* a *phrysgwydd* yn cael ei amlygu gan golli coed fel y prif fygythiad a nodwyd yn dilyn dadansoddiad o fygythiadau a phwysau. Fodd bynnag, mae'n hanfodol cydnabod bod nifer fawr o'r rhywogaethau sy'n gysylltiedig â'r ecosystem hon yn dibynnu ar goed hynafol mewn cyd-destun parcdir neu borfa goedwig, ac na fydd plannu coed o gymorth iddynt yn y tymor byr, nac hyd yn oed yn y tymor canolig. Mae plannu coed hefyd wedi'i nodi fel bygythiad lle mae'n disodli cynefinoedd sy'n bwysig i rywogaethau prin, yn enwedig i ecosystemau glaswelltir, er mai olyniaeth llystyfiant yw'r bygythiad pwysicaf i ecosystemau nad ydynt yn goediog. Mae hyn yn bennaf o ganlyniad i gael gwared ar bori da byw o laswelltiroedd a gwlyptiroedd, ac yn aml mae llygredd aer yn gwaethgu.

Nodwyd mwy na 2000 o safleoedd fel rhai sy'n cynnal *rhywogaethau mewn perygl*, ond mae gan nifer fach gyfrifiadau anghymesur o uchel o rywogaethau sydd â chyfyngiadau o ran gwasgariad. Systemau twyni arfordirol, parcdiroedd neu ardaloedd mynyddig yw'r rhan fwyaf o'r rhain, ac mae'r rhai cyfoethocaf yn cynnal amrywiaeth o gynefinoedd gwahanol. Mae enghreifftiau nodedig yn cynnwys Tywyn a Choedwig Niwbwrch, sydd â 130 o *rywogaethau mewn perygl*, Twyni Whiteford (94), Arfordir Pen-bre (86), Yr Wyddfa (85), Parc y Waun (82) a Pharc Dinefwr (81). Mae Tywyn a Choedwig Niwbwrch yn cynnal amrywiaeth o dacsonau, gan gynnwys ffwng, mwsoglau, llysiau'r afu, planhigion blodeuol, rhawn yr ebol, corynnod a phryfed, tra bod Parc Dinefwr yn cynnal cennau coed hynafol, chwilod a phryfed saprotylig, a chwilod sy'n gysylltiedig â gro afonydd. Mae 17 safle yn cynnal 50 neu ragor o *rywogaethau mewn perygl*, gyda'r 50 safle gorau yn cynnal 19 neu ragor o *rywogaethau mewn perygl*.

Mae safleoedd o ddiddordeb gwyddonol arbennig yn hanfodol i ddiogelu rhywogaethau prinnaf Cymru. Mae 2222 (75%) o *rywogaethau mewn perygl* yn digwydd ar o leiaf un safle o ddiddordeb gwyddonol arbennig yng Nghymru, ac mae 1402 (47%) i'w cael ar safleoedd o ddiddordeb gwyddonol arbennig yn unig. Dim ond 721 (24%) o

rywogaethau sydd wedi'u hysbysu neu'n nodweddion safleoedd o ddiddordeb gwyddonol arbennig cymwys ar hyn o bryd, gan gynnwys 185 wedi'u hysbysu, 282 yn gymwys, a 255 sy'n gydrannau cydosodiad safleoedd o ddiddordeb gwyddonol arbennig. Mae 1047 (35%) o *rywogaethau mewn perygl* yn digwydd ar o leiaf un warchodfa natur genedlaethol, ac mae 353 (12%) ohonynt wedi'u cyfyngu i warchodfeydd natur cenedlaethol, ac o'r herwydd, mae eu statws o dan reolaeth uniongyrchol Cyfoeth Naturiol Cymru neu sefydliad partner agos. **Mae'r canlyniadau hyn yn tynnu sylw at bwysigrwydd rhwydwaith o safleoedd gwarchodedig sy'n cael ei reoli'n effeithiol gydag ymyriadau wedi'u targedu i atal difodiant rhywogaethau ac i wella statws rhywogaethau.**

O'r 733 o *rywogaethau mewn perygl* nad ydynt i'w cael ar safleoedd gwarchodedig, mae 479 (65%) wedi'u cyfyngu i un safle. Mae safleoedd anstatudol allweddol ar gyfer *rhywogaethau mewn perygl* yn cynnwys Parc C, Parc E, Safle 38, Afon A ac Afon B, ac mae rhai ohonynt yn cael eu rheoli gan berchnogion cydymdeimladol, gan gynnwys Cyfoeth Naturiol Cymru. Mae mwyafrif y safleoedd anstatudol yn cynnal llai o *rywogaethau mewn perygl*, er bod y niferoedd ar Safle 1, Safle 23 a Safle 52 yn sylweddol.

Mae gan 2570 (87%) o *rywogaethau mewn perygl* statws dan fygythiad, gan gynnwys 743 (25%) â statws Prydain Fawr neu Gymru o fod mewn perygl difrifol (CR), mewn perygl (EN) neu dan fygythiad (VU). Fodd bynnag, dim ond 549 (19%) o rywogaethau sydd wedi'u rhestru ar restr adran 7 ddiwygiedig Deddf yr Amgylchedd (Cymru).

Mae gweithredu cadwraethol sydd wedi'i dargedu at rywogaethau prin wedi parhau ers blynyddoedd lawer ar safleoedd o ddiddordeb gwyddonol arbennig, ardaloedd cadwraeth arbennig, ac yn enwedig gwarchodfeydd natur cenedlaethol. Mae hyn wedi cael ei wella yn ystod y blynyddoedd diwethaf gan raglenni penodol, gan gynnwys Twyni Byw LIFE a *Natur am Byth!*, er bod angen llawer mwy o weithredu wedi'i dargedu at *rywogaethau mewn perygl*. Mae'r adroddiad hwn yn disgrifio camau rheoli a gymerwyd ar wahanol raddfeydd gofodol ar gyfer amrywiaeth o rywogaethau ar draws gwahanol grwpiau tacsonomig.

I'r rhan fwyaf o *rywogaethau mewn perygl*, **mae diogelu a gwella poblogaethau yn dod am gost cymharol fach yn ariannol.** Yn aml, gellir ei gyflawni drwy addasu'r rheolaeth bresennol, strimio llystyfiant i ddarparu amodau mwy agored i'r rhai sydd angen cynefinoedd olyniaethol cynnar, neu reoli prysgwydd sy'n ymledu. I'r nifer o rywogaethau sy'n gysylltiedig â choed hynafol, mae'n gwestiwn o ddiogelu'r adnodd presennol, mabwysiadu arferion rheoli cydymdeimladol i leihau effeithiau niweidiol a sicrhau cenhedlaeth nesaf o goed hynafol.

Argymhellir datblygu cynllun gweithredu blaenoriaethol ar gyfer safleoedd o ddiddordeb gwyddonol arbennig, gwarchodfeydd natur cenedlaethol a safleoedd eraill i gynorthwyo rheolaeth gydymdeimladol ar gyfer *rhywogaethau mewn perygl*, a thrwy hynny lleihau'r risg o ddifodiant a dinistr lleol. Dylid ystyried hefyd ddarparu amddiffyniad a sicrhau rheolaeth briodol trwy ddynodi safleoedd o ddiddordeb gwyddonol arbennig pellach fel rhan o fframwaith blaenoriaeth yng Nghymru. Gall canllawiau helpu CNC ac eraill i gymryd camau priodol ar lefel rhywogaethau ac ecosystemau i leihau'r risg o ddifodiant rhywogaethau. Bydd arolygon wedi'u targedu a chynnal cofnodion, gan gynnwys diweddariadau parhaus o'r dadansoddiadau *rhywogaethau mewn perygl*, yn helpu i bennu eu statws a'u dosbarthiad presennol. Gyda chamau gweithredu sydd â'r adnoddau priodol ac wedi'u

blaenoriaethu'n briodol, mae gennym gyfle i wrthdroi dirywiad *rhywogaethau mewn perygl* a chyfrannu at wytnwch ein hamgylchedd naturiol.

2. Executive summary

Biodiversity is under threat in Wales. The Senedd declared a nature emergency in 2021, and Welsh Government has committed to the Global Biodiversity Framework (GBF). Developed in response to the global biodiversity crisis, the GBF sets out an ambitious plan to halt and reverse the decline of biodiversity by 2030 (the Kunming-Montreal Global Biodiversity Framework).

Although there are many analyses of pressures and rarity such as the International Union for Conservation of Nature (IUCN) Red Lists, and wider assessments of the environment such as the State of Natural Resources Report (SoNaRR), these often lack analysis at a Wales level required to take action. This report aims to address this evidence gap by identifying terrestrial and freshwater species most at risk of extinction in Wales and their key locations, so that important sites and relevant management actions to conserve them can be prioritised.

This report provides a comprehensive assessment of the most vulnerable terrestrial and freshwater species in Wales as it was understood in 2024. For the purposes of this work, we have focussed on **spatial rarity** as the measure of vulnerability with all species occurring at five or fewer sites in Wales included. These are termed *Species in Peril* throughout this report. All species have been attributed to one of five restriction categories:

- species that have declined rapidly (*Decliners*);
- species that have always been rare (*Naturally Rare*);
- species where rarity is thought most likely to result from under-recording / inadequate data (*Under-Recorded*);
- species that are rare in Wales but common in England (*Edge of Range*); and
- species that have recently spread into Wales from England but are only established at a handful of sites so far (*Colonisers*).

Data were collected from a variety of sources and represent our best understanding of species distribution in Wales. Whilst there is more recording effort on protected sites, there is also extensive wider recording by volunteers to provide records for coordinated national recording schemes, many of which involve structured sampling across Wales. Analysis of these species data, collected over many decades, shows that there are 2955 *Species in Peril* in Wales, including 309 fungi, 321 lichens, 107 mosses & liverworts, seven stoneworts, 155 vascular plants, 2017 invertebrates, five fish & lampreys, one amphibian, six mammals and 27 bird populations (breeding, non-breeding or passage). In addition, a total of 304 species have been lost from Wales since systematic biological recording began in the 1800s, with 114 last seen in the 1950s or later. Eleven species have been lost since the beginning of the millennium, including Whiteworm Lichen *Thamnolia vermicularis*, Blunt Bryum *Bryum calophyllum*, Mezereon *Daphne mezereum*, Belted Beauty *Lycia zonaria*, Corn Bunting *Emberiza calandra* and Turtle Dove *Streptopelia turtur*.

Of the 2955 *Species in Peril*, 1262 are known from just a single location. This restricted distribution means that these species are exceptionally vulnerable to stochastic events as well as to climate change. Just under half of *Species in Peril* (1433 species) are

considered *Under-Recorded*, but 52% are considered to have accurately recorded distributions. Most of that 52% have roughly stable distributions (including 1389 *Naturally Rare* and 23 *Edge of Range*), at least over recent decades, but 77 species (*Decliners*) were previously more widespread and have suffered significant recent declines. 33 species are categorised as *Colonisers*.

Some *Species in Peril* are high profile animals and plants that are subject to conservation action such as Black Grouse *Lyrurus tetrix* and High Brown Fritillary *Fabriciana adippe*. Others have declined to the verge of extinction in Wales with less recognition and awareness, including Sheep Nostril Fly *Oestrus ovis*, Brown Shield-moss *Buxbaumia aphylla* and the lichen *Cetraria sepincola*. 56 species are restricted to Wales in the UK and there is a special responsibility to safeguard their populations.

Analysis shows that *Woodland, Parkland & Scrub* is the most important of the 13 ecosystems for *Species in Peril*, with nearly a third of all species (1076 species) restricted to this ecosystem, followed by *Grassland* (531), *Peatland* (356), *Montane* (203), *Dune & Saltmarsh* (201), *River, Stream & Ditch* (196) and *Coast & Coastal Cliff* (168). The remaining six ecosystems support between 15 (*Agricultural*) and 52 (*Lake & Pond*) species. The importance of *Woodland, Parkland & Scrub* is highlighted by tree loss being the primary threat identified following analysis of threats and pressures. However, it is critical to recognise that a large number of the species associated with this ecosystem rely on ancient trees in a parkland or wood pasture context, and that tree planting will not help them in the short or even medium terms. Tree planting is also identified as a threat where it replaces habitats important for rare species, especially to grassland ecosystems, although vegetation succession is much the most important threat to non-wooded ecosystems. This is mostly the result of the removal of livestock grazing from grasslands and wetlands, and is often exacerbated by air pollution.

More than 2000 sites were identified as supporting *Species in Peril*, but a small number hold disproportionately high counts of range-restricted species. Most of these are coastal dune systems, parklands or montane areas, and the richest support a range of different habitats. Outstanding examples include Newborough Warren & Forest, which holds 130 *Species in Peril*, Whiteford Burrows (94), Pembrey Coast (86), Yr Wyddfa (85), Chirk Park (82) and Dinefwr Park (81). Newborough Warren & Forest supports a range of taxa including fungi, mosses, liverworts, flowering plants, stoneworts, spiders and insects, whilst Dinefwr Park supports ancient tree lichens, saproxylic beetles and flies, and a beetle associated with river shingles. Seventeen sites support 50 or more *Species in Peril*, with the top 50 sites supporting 19 or more *Species in Peril*.

SSSIs are crucial to the protection of the rarest Welsh species. 2222 (75%) *Species in Peril* occur on at least one SSSI in Wales, and 1402 (47%) are found only on SSSIs. Only 721 species (24%) are currently notified or qualifying SSSI features including 184 notified, 282 qualifying and 255 which are SSSI assemblage components. 1047 (35%) *Species in Peril* occur on at least one NNR, of which 353 (12%) are restricted to NNRs, and as such, their status is under the direct control of Natural Resources Wales or a close partner organisation. **These results highlight the importance of an effectively managed network of protected sites with targeted interventions to prevent species extinctions and to improve species statuses.**

Of the 733 *Species in Peril* not found on protected sites, 479 (65%) are restricted to single sites. Key non-statutory sites for *Species in Peril* include Parkland C, Parkland E, Site 38, River A and River B, some of which are managed by sympathetic owners including NRW. The majority of non-statutory sites support fewer *Species in Peril*, although numbers on Site 1, Site 23 and Site 52 are significant.

2570 *Species in Peril* (87%) have a threat status including 743 (25%) with a GB or Wales status of Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). However, only 549 species (19%) are listed on the revised Environment (Wales) Act Section 7 list.

Conservation action targeted at rare species has continued for many years on SSSI, SAC and especially NNRs. This has been enhanced in recent years by specific programmes, including Sands of LIFE and *Natur am Byth!*, although considerably more action targeted at *Species in Peril* is required. This report describes management actions undertaken at various spatial scales for a wide range of species across different taxonomic groups.

For most *Species in Peril*, **safeguarding and enhancing populations comes at relatively little financial cost**. Often, it can be achieved by tweaking existing management, strimming vegetation to provide more open conditions for those requiring early-successional habitats or controlling encroaching scrub. For the many species associated with veteran trees, it is a question of safeguarding the current resource, adopting sympathetic management practices to diminish deleterious impacts and ensuring a next generation of veterans.

It is recommended that a prioritised action plan is developed for SSSIs and NNRs and other sites to support sympathetic management for *Species in Peril*, thereby reducing the risk of extinctions and localised extirpations. Consideration should also be given to providing protection and securing appropriate management through further SSSI designations as part of a prioritised framework in Wales. Guidance can help NRW and others take appropriate action at both species and ecosystem level to reduce the risk of species extinctions. Targeted surveys and maintenance of records, including ongoing updates of the *Species in Peril* analyses, will help to determine their current status and distribution. With appropriately resourced and prioritised action, we have the opportunity to reverse the decline of *Species in Peril* and contribute to the resilience of our natural environment.

3. Introduction

We face a nature crisis. The Convention on Biological Diversity (CBD) (UN Environment Programme, 2022a) states that *“biodiversity is in decline globally and is declining more rapidly than at any other time in human history. This is occurring in all regions and is happening at the level of genes, species and ecosystems. Despite projections of some local increases in species richness and ecosystem productivity, the overall effect of global changes on biodiversity is projected to be negative, with adverse impacts on human socioeconomic well-being and health.”* One million of Earth’s estimated 8 million species of animals and plants are threatened with extinction, and 75% of the Earth’s land surface has been significantly altered by human actions including 85% of wetlands. A recent study has calculated that more than 9000 Australian non-marine invertebrate species have become extinct over the last 230 years with ongoing extinctions of between 1 to 3 species every week (Woinarski *et al.*, 2024). Many common, widespread plants and animals are declining, both in terms of number and range, whilst historically localised species have been lost from a significant proportion of their sites. Unless urgent action is taken there will be further acceleration in the rate of global species extinctions. The Kunming-Montreal Global Biodiversity Framework, building on the CBD’s Strategic Plan for Biodiversity 2011-2020, sets out an ambitious plan with four long-term goals and 23 associated global targets for urgent actions over the decade to 2030 (UN Environment Programme, 2022b).

The loss of species matters. *“Biodiversity is fundamental to human well-being, a healthy planet, and economic prosperity for all people, including for living well in balance and in harmony with Mother Earth. We depend on it for food, medicine, energy, clean air and water, security from natural disasters as well as recreation and cultural inspiration, and it supports all systems of life on Earth”* (UN Environment Programme, 2022b). Ecosystems with their full complement of biodiversity are both more resilient and productive, providing greater benefits for people and underpinning sustainable economic prosperity and rare species have been shown to disproportionately contribute to vulnerable functions in ecosystems (Mouillot *et al.*, 2013).

A shift in narrative from ‘business as usual’ to a strategic and focused approach to prioritised species recovery will require a fundamental change to our current approaches for the following reasons:

- i) the UK is one of the most nature depleted nations in the world (Newbold *et al.*, 2016);
- ii) the twin crises of biodiversity loss and climate change are inextricably linked (UN Environment Programme, 2020b);
- iii) multiple reports have documented the ongoing decline of species in the UK (Burns *et al.*, 2023; Johnstone *et al.*, 2022; Smith *et al.* 2023) and
- iv) the UK has a commitment to adopt the 30 by 30 target by applying policy and legislation measures and novel thinking to maximise opportunities.

This situation is mirrored both in the UK (Burns *et al.*, 2023) and in Wales specifically (Natural Resources Wales, 2020; Smith *et al.*, 2023). The latest State of Nature report (Burns *et al.*, 2023; Smith *et al.*, 2023) gives some alarming overall figures demonstrating the decline in Welsh wildlife:

- on average a decline in species of 20% since 1994;
- one in six (18%) Welsh species are threatened with extinction
- 42% of Wales' plant species are found in fewer places than previously.

The State of Nature report also states that 95 species have gone extinct in Wales. Some examples include the Whiteworm Lichen *Thamnolia vermicularis* (Figures 1) which has been lost from all four of its montane sites due to a combination of climate change and air pollution (Turner, 2023), and both Blunt Bryum *Bryum calophyllum* and Broad-nerved Hump-moss *Meesia uliginosa* which have gone from their last Welsh dune system (Holyoak, 2015). Oysterplant *Mertensia maritima* was last seen at its final locality on the Welsh coast in 1989 (Dines, 2008) and the Barred Green Colonel *Odontomyia hydroleon* (Figures 1) has not been seen in Wales since 2006 (Howe, 2020q). Several birds have been lost as breeding species since 1980 including Corn Bunting *Emberiza calandra* and Turtle Dove *Streptopelia turtur* (Pritchard *et al.*, 2021). The current report provides more details of these extinctions and highlights a much higher number of species that have been lost in Wales.



Figures 1 & 2. Barred Green Colonel *Odontomyia hydroleon* © Mike Hammett and Whiteworm Lichen *Thamnolia vermicularis* © Wikimedia Commons

In response to these losses and declines, the Welsh Government declared a 'Nature Emergency' in 2021. This led to a Biodiversity Deep Dive in October 2022 (Welsh Government, 2022), which recommended transforming the protected sites series so that it is better, bigger, and more effectively connected, as well as looking at how OECMs (Other Effective Area-based Conservation Measures) can deliver biodiversity outcomes, reforming land management and planning, and unlocking public and private finance to deliver for nature at far greater scale and pace.

The Nature Networks Programme, funded by Welsh Government since 2022, aims to address the nature emergency in Wales through increasing biodiversity, improving the condition of protected sites and enhancing the resilience and connectivity of our habitats and species. Some of its projects are species-focussed but many are more broadly habitat-based, considering protected site condition and general connectivity rather than the needs of individual species. At the same time, the *Natur Am Byth!* programme, funded by

the National Lottery Heritage Fund, Natural Resources Wales and Welsh Government, is more directly species-focused, with nine environmental NGOs working with Natural Resources Wales to deliver projects that will reverse the population losses of a suite of key species across many taxonomic groups.

Whilst reports such *State of Nature* and *SoNaRR* clearly demonstrate the need for action, much of the data presented is based on published Red Lists and threat statuses, and many Welsh species have not been assessed using such criteria. This is particularly pertinent to invertebrates and most non-lichenised fungi. Furthermore, these reports do not provide policy makers, managers and conservation practitioners with the detail needed to understand and prioritise management actions. It is crucial that the right actions are taken in the right places, especially as the funds available to tackle it are finite.

This is a particular issue for rarer species, where generic actions that are not spatially targeted are unlikely to deliver benefits. Many species are restricted to a handful of sites meaning that stochastic events could render them extinct in Wales. Until now there has been no attempt to evaluate the number of species that are under such threat.

This report seeks to:

- determine how many species have a very restricted distribution in Wales, defined here as five or fewer sites and termed *Species in Peril*, and how many of those are truly in peril;
- create an inventory of these species;
- identify key sites for these species, and key pressures affecting them, and
- provide a series of case studies of effective species conservation.

More specifically, the intention is to encourage and enable more effective and targeted management actions.

The focus of this report is on terrestrial and freshwater species and excludes those found in the marine environment other than breeding seabirds.

4. Methods

Wales level data were analysed from 19 different higher taxonomic groups of macrofauna and macroflora (fungi, lichens, mosses, liverworts, stoneworts, vascular plants, moss animals, gastropod molluscs, bivalve molluscs, crustaceans, spiders & allies, springtails, centipedes, millipedes, insects, fish & lampreys, amphibians & reptiles, mammals and birds). Complete analysis for some taxonomic groups was not possible due to a lack of data. This is particularly pertinent to several insect and other invertebrate groups such as aphids, lice, mites & ticks, parasitic wasps, springtails, thrips and free-living & parasitic worms. Microbes could not be included in the assessment due to the inadequacy of the available data. In total, 7000 to 10,000 species across all taxonomic groups were assessed. Where possible, datasets from published GB or Wales level Red Lists and published atlases were used to make the assessment.

Data were collated from a variety of sources including the NBN Atlas Wales, Aderyn (the Biodiversity Information & Reporting Database of the Welsh Local Environmental Records

Centres), databases of the Botanical Society of the British Isles (BSBI), British Bryological Society (BBS), British Lichen Society (BLS), British Mycological Society, Association of British Fungus Groups, NRW's Welsh Invertebrate Database (WID) and reports of surveys commissioned by the Countryside Council for Wales and NRW. Together, these provide the most comprehensive repository of species records covering most taxonomic groups and particularly those that are most valued in wildlife conservation. As stated above, the recording of species in more obscure taxa is more piecemeal and are not well represented in databases, making evaluation for this project much more difficult. As such, these taxa are not covered comprehensively by *Species in Peril*. However, it is recognised that the UK has one of the world's most comprehensive biological recording systems (Cooke *et al.*, 2023).

It should be noted that there is a bias in recording towards protected sites, and particularly National Nature Reserves, which both attract wildlife recorders and provide a focus for surveys commissioned by NRW and its predecessor bodies. However, many naturalists record species for national recording schemes which encourage recording in areas which have previously received little attention. For example, the British Bryological Society organises its annual field meetings in under-recorded parts of Britain and Ireland with the aim of recording in as many areas as possible, whilst every Welsh county has a designated County Recorder who aims to record as widely as they can. As a result, bryophyte recording has taken place in every hectad (10x10km square) in Wales and in almost every tetrad (2x2km square), such that bryophytes recorded from a handful of sites are genuinely rare. The same is true for flowering plants, butterflies, moths and several other invertebrate groups. This wider recording effort helps to evaluate species that are more widespread and common and puts records from protected sites into context. Whilst recorder bias cannot easily be adjusted for, records from both statutory and non-statutory sites were utilised when collating the data for *Species in Peril*.

It has also been demonstrated that protected sites do support significantly more rare species than the wider countryside, with double the number in selected invertebrate groups (Cooke *et al.*, 2023) and, to a lesser extent, in a wider range of taxonomic groups (Cunningham *et al.*, 2021; Watson *et al.*, 2014).

Analysis of several thousand species from diverse taxonomic groups inevitably reveals differences between those groups, and a degree of standardisation was attempted prior to the data gathering phase of the project. The standard approaches taken are discussed in section 4.1. Despite this, some differences in approach were necessary, particularly when it came to deciding which groups of fungi and invertebrates to consider in detail. Taxon-specific approaches are discussed in section 4.2.

4.1. Definitions

4.1.1. Sites

To ensure consistency of approach, a suitable definition of a site is important. This is problematic because identifying a single unified ecological scale across taxon groups is not possible: a pond may support a single pair of ducks, a small population of great diving beetles, or thousands of water snails. It would be legitimate to consider a pond as a site for the water snails, the diving beetles would likely need connection to other similar ponds to maintain a viable population, and the ducks would need a much larger habitat area that possibly included wintering grounds elsewhere. Thus, appropriate spatial and temporal scales are needed, as per Principle 7 of the Ecosystem Approach.

Defining a site was not always straightforward and a degree of pragmatism was needed. For some habitat specialist species, sites are clearly separated by unsuitable habitat: for example, several saproxylic invertebrates and ancient bark lichens are restricted to widely separated parklands such as Chirk Castle, Carn Gafallt, Gregynog and Dinefwr Estate and have no or few known areas of potential habitat between those sites. Dune systems, lakes and lowland raised bogs are similarly isolated habitat types. For other species, the ecological separation may be more blurred: the Welsh Thread-moss *Bryum gemmiparum* and the River Stippled Lichen *Endocarpon adscendens* are restricted to well-lit, rocky sections of the River Usk and each section could be considered as a different site. However, one catastrophic flooding or pollution event could potentially affect the entire river, and these species were therefore considered to be restricted to a single site rather than a series of subsites.

The approach when defining a site was further complicated when accounting for highly mobile species. For example, some taxa require large geographic areas to satisfy their full ecological needs at critical stages of breeding or over wintering. This is particularly pertinent to birds for three reasons: i) some species are resident or sedentary (i.e. non migratory) and tend to remain in the same localities year-round, and where that site sufficiently meets the species full ecological requirements within its home range (e.g. House Sparrow *Passer domesticus*); ii) for other residents, some species show dispersive migration that involves moving from breeding to geographically separated wintering sites (e.g. Peregrine *Falco peregrinus*), and iii) some avian species are migratory that signify a regular movement each year between breeding and wintering sites (e.g. Greenland White-fronted Goose *Anser albifrons flavirostris*). Migratory birds therefore occupy different ecological spaces that are bio-geographically separated by hundreds or thousands of kilometres between breeding and non-breeding seasons. For simplicity we identified sites that are occupied by bird species for those species that are determined: resident, dispersive migrant or migrant.

Montane sites can be difficult to separate because they often fall within single management units, but if the ecology of a species is well known it may be possible to separate sites. For example, the lichen *Coccoltrema citrinescens* is restricted to base-rich igneous rock, so its colonies in Cwm Uchaf and on Clogwyn y Garnedd were initially considered to be separate sites because there is no suitable habitat in the intervening 1.5 km and limited recolonisation potential if one colony was lost. However, the richness of certain massifs in Eryri and the difficulty of consistently splitting records led eventually to the larger areas of Yr Wyddfa, Glyderau (including Cwm Idwal) and Carneddau being used.

Site names have been used as consistently as possible, although some fungus records only say “Eryri” so it was not possible to treat them at the same level as those lichens, mosses and liverworts which are recorded from specific massifs in Eryri. A very small minority of species only have a record at the county level, so were included in the table as VC41, VC43 etc.

4.1.2. Taxa in scope

Only native, terrestrial and freshwater species have been included in the study, although ‘archaeophyte’ plants – non-native taxa that were introduced by humans, either intentionally or unintentionally, and became naturalised in Britain and Ireland between the start of the Neolithic period and AD1500 – have been included because many botanists treat them as honorary natives.

The nativeness of some fungi and invertebrates is questionable, especially when a non-native foodplant or host plant is used, and some fungi that are exclusively associated with non-native conifers have been excluded from analyses despite there being no suggestion that they were deliberately introduced.

4.1.3. Timescale of data

Setting cut-off dates for records also requires case-by-case consideration, although most sites where the last record was from more than 50 years ago have not been listed as currently occupied. For well-recorded taxa, such as vascular plants or butterflies, it is relatively straightforward to determine when a colony has been lost, so a shorter period since the last record can be used, but for more obscure species the lack of a record since the 1980s may just reflect the lack of a recent visit by an expert.

This can have implications for whether a species is listed as being restricted to five or fewer sites or not. For example, the Broad-leaved Brook-moss *Hygrohypnum duriusculum* has been recorded recently on five rivers in Eryri, but there are also early 20th century records from Cwm Idwal and Ysgolion Duon; these records are considered too old to count as extant sites, not least because they are both relatively well explored by bryologists, but if they dated from the late 20th century *Hygrohypnum duriusculum* would be considered likely to be present at seven sites.

4.1.4. Restriction, ecosystem and pressures categories

For the purpose of this project, *Species in Peril* have been assigned to one of five restriction categories depending upon whether they are declining, static or even increasing, or may actually be widely overlooked (Table 1).

Some species restricted to sunny limestone may only ever have been found in five or fewer Welsh sites because their substrate is of limited extent, but their populations could be thriving. In contrast, some upland species might have been more widespread in the distant past, retreating to montane ‘refugia’ over the last few thousand years but with currently (and historically) stable populations.

Table 1. The five restriction categories used for *Species in Peril*.

Restriction category	Criteria
1. <i>Decliners</i>	Species that were formerly more widespread but are now restricted to five or fewer sites. These are considered to be in the most peril.
2. <i>Naturally rare</i>	Species that have only been known on five or fewer Welsh sites, are not declining, but remain vulnerable to loss.
3. <i>Under-recorded</i>	Species that have been recorded from five or fewer sites but that are from poorly recorded taxa (mostly certain invertebrate groups and most fungi) or are difficult to sample. These species are likely to be a little more widespread.
4. <i>Edge of range</i>	Species which have a limited distribution in Wales but are more widespread in the rest of GB.
5. <i>Colonisers</i>	Species with expanding ranges that have recently colonised Wales.

Each *Species in Peril* has been assigned to one of 13 broad ecosystems, approximately following the Phase 1 habitat codes, and these were subsequently converted to the seven SoNaRR ecosystems (Table 2).

Table 2. Ecosystems used for assessing *Species in Peril*, and their SoNaRR equivalents.

Ecosystem	SoNaRR ecosystem
<i>Agricultural</i>	Enclosed farmland
<i>Cave & Subterranean</i>	n/a as cross-cutting in several ecosystems
<i>Coast & Coastal Cliff</i>	Coastal margins
<i>Dune & Saltmarsh</i>	Coastal margins
<i>Grassland</i>	Semi-natural grassland
<i>Heathland</i>	Mountain, moorland & heath
<i>Lake & Pond</i>	Freshwater
<i>Lowland Rock Exposure</i>	Mountain, moorland & heath
<i>Montane</i>	Mountain, moorland & heath
<i>Peatland</i>	Freshwater
<i>River, Stream & Ditch</i>	Freshwater
<i>Urban & Synanthropic</i>	Urban
<i>Woodland, Parkland & Scrub</i>	Woodlands

For each *Species in Peril*, the primary pressure acting on its status was assigned using the standardised list in Table 3, although it is recognised that most species will be subject to multiple pressures.

Species in Peril were also considered by their GB and/or Welsh threat status. IUCN Red List status was applied where available, using GB or Welsh Red Lists. The latter have been published for mammals, vascular plants, stoneworts, mosses & liverworts, lichens and some fungi, but have not been produced for any invertebrate group. Although birds have not been determined by a Welsh IUCN Red List assessment, they have been assessed at both a GB level (Stanbury et al., 2021) and by standardised criteria of Birds of Conservation Concern (Johnstone et al., 2022). Where there is no threat status, a GB national spatial status is given - Nationally Rare species are found in 15 or fewer hectads (10x10km squares) and Nationally Scarce species are found in 16 to 100 hectads. Some fungi are assigned an 'uncertain' status, and a few species are neither Red Listed nor Nationally Rare/Scarce leaving them with a LC (Least Concern) or Local entry.

Table 3. Pressures assigned to *Species in Peril*, based on those categories used for Habitats Regulations reporting.

Pressures	Comment
Agricultural change	Includes ploughing, fertiliser, dung treatments, loss of arable etc.
Air pollution	n/a
Climate change	n/a
Coastal change	n/a
Collection, hunting or harvesting	n/a
Construction	n/a
Deadwood loss	n/a
Human disturbance	Includes recreation
Hydrological change	n/a
Invasive Non-Native Species (INNS)	n/a
Quarrying/Mining	n/a
River modification	Includes hydropower, exposed riverine sediment (ERS) loss etc.
Tree loss	n/a
Tree planting	n/a
Vegetation succession	n/a
Water pollution	n/a
Uncertain	n/a

Any species only recorded in Wales before 1940 is considered **extinct**; any species recorded between the 1940s and 1970s but not since is considered **potentially extinct**, but perhaps also overlooked; species recorded since 1980 are considered **extant** unless there has been an unsuccessful effort to re-find them in which case they can be officially listed as extinct.

4.2. Taxon-specific approaches

Each taxonomic group was considered in a slightly different way, but with similar methods, as outlined below using relevant taxon-group specific datasets.

4.2.1. Non-lichenised fungi

The analysis for fungi is as complete as possible but is known to be imperfect. The sheer number of fungi recorded from Wales coupled with the relative difficulty of scrutinising the two national fungus databases – FRDBI and CATE2 – meant that repeating the approach taken for mosses, liverworts and lichens was not possible. Red Lists were therefore used to select a subset of species for examination, and this subset was then added to using data on the well-recorded habitats of grassland (Mitchell, 2023) and sand dunes (Evans & Roberts, 2015a).

The number of records of Red Listed fungi from recorders' gardens, urban areas and Country Parks is in stark contrast to the records of Red Listed lichens, mosses and liverworts, which are largely restricted to SSSIs, and this gives the impression that many fungus species are severely under-recorded in Wales. This renders the threshold of five sites relatively meaningless for fungi, and it is highly likely both that many of the species currently recorded from five or fewer sites are much more widespread and that many other non-Red List species currently have records from five or fewer sites.

4.2.2. Lichens & lichenicolous fungi

A spreadsheet of records of all Red List, Nationally Rare and Nationally Scarce lichens and lichenicolous fungi was generated from the British Lichen Society database. This was examined in combination with GB lichen distribution maps on the British Lichen Society website and species with five or fewer occupied hectads were scrutinised in more detail.

4.2.3. Mosses & liverworts

A spreadsheet of records of all Red List, Nationally Rare and Nationally Scarce mosses, liverworts and hornworts was generated from the British Bryological Society database. The number of occupied Welsh hectads was calculated for each species, and any with five or fewer occupied hectads were scrutinised more carefully to determine how many occupied sites there are.

4.2.4. Vascular plants & stoneworts

A list of native or archaeophyte vascular plants from five or fewer sites, post 1987, was derived from the Botanical Society of Britain and Ireland (BSBI) Distribution Database (DDB). Subsequent definitions of threat and rarity were derived from the GB Red List (Cheffings *et al.*, 2005) and Welsh Red List (Dines, 2008). The DDB was then scrutinised for locations for the selected species. The taxa analysis included two critical apomictic groups (whitebeams *Sorbus* and sea-lavenders *Limonium*) but not the larger apomictic complexes in the genera *Hieracium* (hawkweeds), *Taraxacum* (dandelions) and *Rubus* (brambles). Currently, 33 hawkweed species are restricted to Wales: many of these are Welsh or GB endemics and some occur in five or fewer sites (latest working GB red list, unpublished). Brief accounts of Welsh and GB endemic *Hieracium* are given in Appendix 3 & 4. Only two *Taraxacum* spp. are restricted to Wales (latest working GB red list unpublished). Currently, no data for *Rubus* are readily available.

Stoneworts were predominantly assessed using the recent review of their Welsh status (Stewart & Hatton-Ellis, 2020), together with more recent data where relevant. Five taxa, Bearded Stonewort *Chara canescens*, Coral Stonewort *Chara tomentosa*, Slimy-fruited Stonewort *Nitella capillaris*, Many-branched Stonewort *Nitella hyalina* and Tassel Stonewort *Tolypella intricata*, have old records but no recent records on the BSBI database, and would therefore be potential candidates for extinct taxa. However, examination of preserved specimens has shown all of these to be misidentifications (N.F. Stewart, pers. comm.).

4.2.5. Terrestrial & freshwater invertebrates

All published GB Status Reviews, both recent IUCN threat assessments and older Red Lists (some dating to the 1980s), were consulted. All published GB atlases were also used. The results of commissioned surveys were considered using relevant NRW Evidence Reports as were recent internal NRW unpublished accounts for SSSI qualifying invertebrate species and assemblages. Welsh records for relevant species were collated from NRW's Welsh Invertebrate Database (WID), the NBN Atlas Wales and Aderyn to identify those with 5 or fewer localities. In addition, the Spider Recording Scheme, Glamorgan Moth Recording Group and Monmouthshire Moth and Butterfly Group websites were used, and expert opinions from Richard Gallon (spiders) and George Tordoff (moths) were sought.

Given the number of species involved, it was not possible to undertake an exhaustive assessment of species classed as Least Concern or Local. It is highly likely that a significant number of species which have a restricted distribution in Wales but are more widespread elsewhere in GB have been overlooked for inclusion in *Species in Peril*.

4.2.6. Freshwater fish & lampreys

The status of freshwater fish used data from the recently published GB Red List (Nunn *et al.*, 2023), which includes a Wales level assessment. Species-specific reviews include Arctic Charr *Salvelinus alpinus* (McCarthy, 2007; Winfield *et al.*, 2010), Gwyniad *Coregonus lavaretus* (Winfield *et al.*, 2008; Natural Resources Wales, 2019c), Allis Shad *Alosa alosa* and Twaite Shad *Alosa fallax* (Aprahamian *et al.*, 1999; Natural Resources Wales, 2019a&b).

Following Nunn *et al.* (2023), Sturgeon *Acipenser sturio* and Baltic Sturgeon *Acipenser oxyrinchus* were not assessed because their status as breeding species in Welsh freshwaters is unconfirmed. Further analysis of 19th Century records by the UK Sturgeon Alliance may help to clarify this situation.

4.2.7. Amphibians & reptiles

The Amphibian and Reptile Conservation Trust (ARC) Red List assessment for GB was utilised to provide status assessments of amphibians and reptiles in Wales (Foster *et al.*, 2021). Species specific reports were also used where additional information was needed, such as confirmation that Sand Lizard *Lacerta agilis* is now found at more than five sites in Wales (Owens *et al.*, 2022).

4.2.8. Mammals

The primary source of information for mammals was the Mammal Society population and conservation status assessment (Mathews *et al.*, 2018) and the subsequent State of Mammals in Wales report (Mathews *et al.*, 2020). Supplementary information for individual species to update these reports was also utilised, such as additional survey work for Barbastelle Bat *Barbastella barbastellus* (Rush & Billington, 2020), Bechstein's Bat *Myotis bechsteinii* (Whitby & Binet, 2020) and the National Bat Monitoring Program Reports ([NBMP](#)) for the horseshoe bat *Rhinolophus* species.

4.2.9. Birds

Due to the migratory nature of some species, breeding, regularly occurring wintering and passage birds were considered separately. In some cases, just a single stage of the lifecycle is relevant to Wales. For example, Bewick's Swan *Cygnus columbianus* and Greenland White-fronted Goose *Anser albifrons flavirostris* breed elsewhere but winter here, whilst Dunlin *Calidris alpina* and European Golden Plover *Pluvialis apricaria* breed in Wales in declining numbers but are much more numerous in winter. Other species, such as Black Grouse *Lyrurus tetrix* and Black Guillemot *Cepphus grylle*, are resident and their small populations are not split into 'breeding' and 'wintering'. Two resident species: Common Crane *Grus grus* and Avocet *Recurvirostra avosetta*, were assessed for both their breeding and wintering populations.

The monitoring of bird populations in Wales is good for most species due to the many skilled and enthusiastic volunteer bird watchers. The principal data sources used for the bird aspect of this report were Wetland Bird Surveys (WeBS), Seabird Census data (Seabirds Count 2015-21), species specific surveys such as the Statutory Conservation Agency and RSPB Annual Breeding Bird Scheme (SCARABBS), Rare Breeding Birds Panel (RBBP) and *The Birds of Wales* (Pritchard *et al.*, 2021). In some cases, unstructured records that provide the only information on some rare passage species, such as Aquatic Warbler *Acrocephalus paludicola*, need to be interpreted more cautiously owing to their lack of rigour and survey effort.

The second IUCN Red List assessment for Great Britain (Stanbury *et al.*, 2021) was used to determine birds at risk of extinction, and the fourth assessment of Birds of Conservation Concern for Wales (Johnstone *et al.*, 2022) was applied to determine birds that are of conservation priority in a broader sense. The benefit of undertaking the internationally standardised IUCN Red List process, in addition to Birds of Conservation Concern (BoCC), is that it allows a comparison between the status of bird populations with other geographical areas as well as with other taxonomic groups, plus it allows birds to be incorporated into multi-taxa assessments and higher-level biodiversity indicators (Stanbury *et al.*, 2021).

5. Results

5.1. Site counts by taxonomic group

Almost 3000 species were found to have records from five or fewer Welsh sites (Table 4). These *Species in Peril* comprised more than 1900 invertebrates, in excess of 300 fungi, over 300 lichens, 155 vascular plants and over 100 mosses & liverworts. The numbers of range-restricted vertebrates were much lower, with 27 birds, five freshwater fish, six native mammals and one amphibian. No reptiles are restricted to five or fewer sites. The full data are available on request in an Excel spreadsheet and is stored as metadata in NRW archives (NRW_DS161307).

Table 4. Number of *Species in Peril* by taxonomic group.

Group	1 site	2 sites	3 sites	4 sites	5 sites	Total
Fungi	145	87	43	22	12	309
Lichens	187	76	39	16	3	321
Mosses & liverworts	41	24	22	14	6	107
Stoneworts	3	2	2	0	0	7
Vascular plants	44	48	25	18	20	155
Moss animals	1	0	0	0	0	1
Gastropod molluscs	8	0	4	1	0	13
Bivalve molluscs	4	1	2	0	0	7
Spiders and allies	31	25	20	18	15	109
Crustaceans	2	2	2	2	0	8
Springtails	5	0	0	1	0	6
Centipedes	1	1	0	2	1	5
Millipedes	4	1	1	2	0	8

Group	1 site	2 sites	3 sites	4 sites	5 sites	Total
Insects	774	419	307	230	130	1860
Fish & lampreys	1	1	2	0	1	5
Amphibians & reptiles	0	1	0	0	0	1
Mammals	3	0	1	1	1	6
Birds	8	4	10	3	2	27
Grand total	1262	692	480	330	191	2955

There is a higher proportion of species known from a single site than from two sites in every major taxonomic group with the exception of vascular plants. There are then fewer species restricted to three sites, four sites and five sites (Figure 3). For lichens, over half of all species in the analysis are known from just a single site. Although less marked for other taxon groups, this pattern is universal for all taxon groups with a large enough sample size to analyse (Figure 4). This highlights the precarious nature of *Species in Peril*, with the majority occurring on just one site in Wales.

Site definition might play a role in this because some of the single sites are large upland blocks such as the Yr Wyddfa and Carneddau massifs, but the pattern is remarkably consistent. The total of 1262 species restricted to single Welsh sites is far larger than anticipated, highlighting the vulnerability of our flora, fauna and mycota.

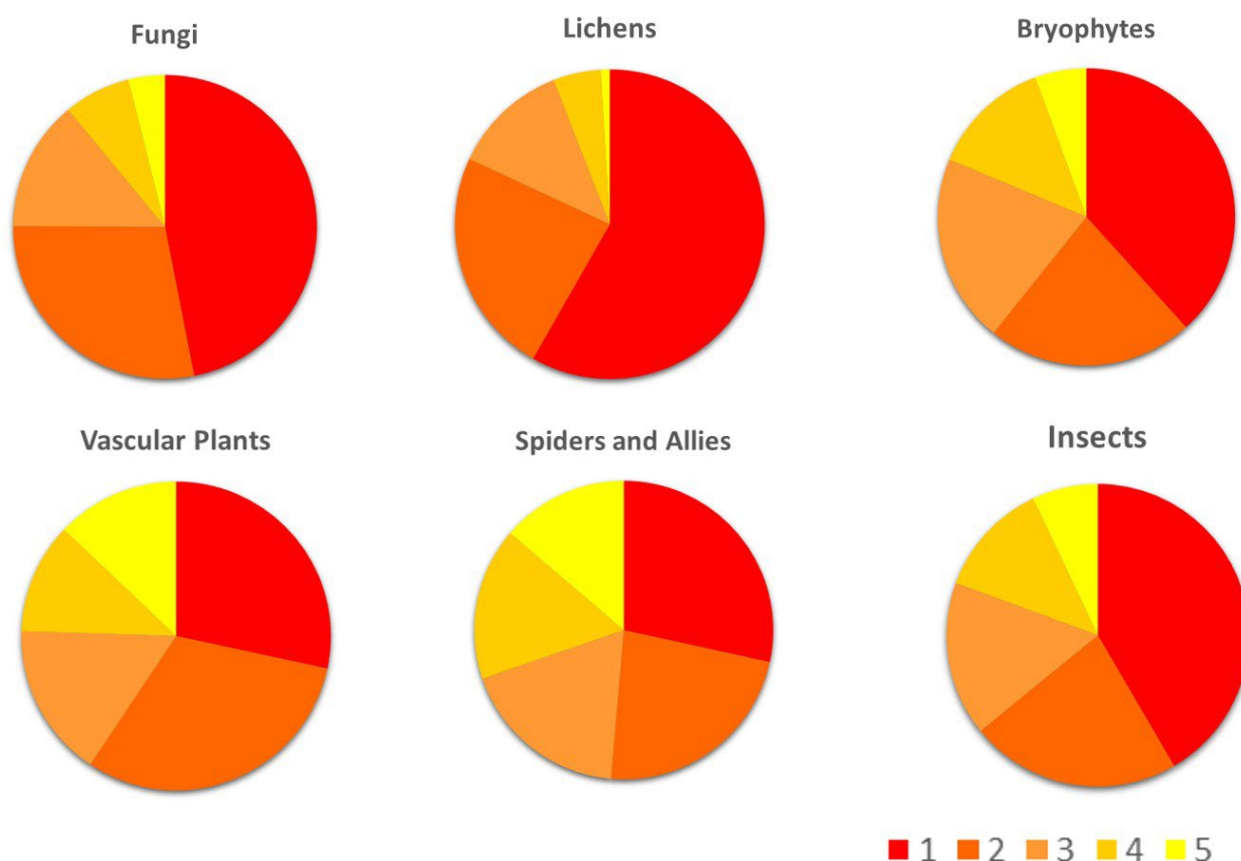


Figure 3. Proportion of *Species in Peril* on different numbers of sites for each of the six most species-rich groups.

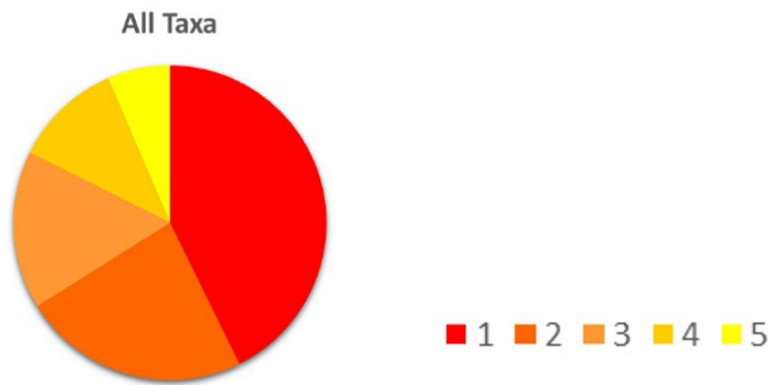


Figure 4. Proportion of *Species in Peril* found on 1, 2, 3, 4 and 5 sites.

5.2. Restriction category

Different taxonomic groups show different patterns of representation within the five restriction categories (Figure 5; Table 5).

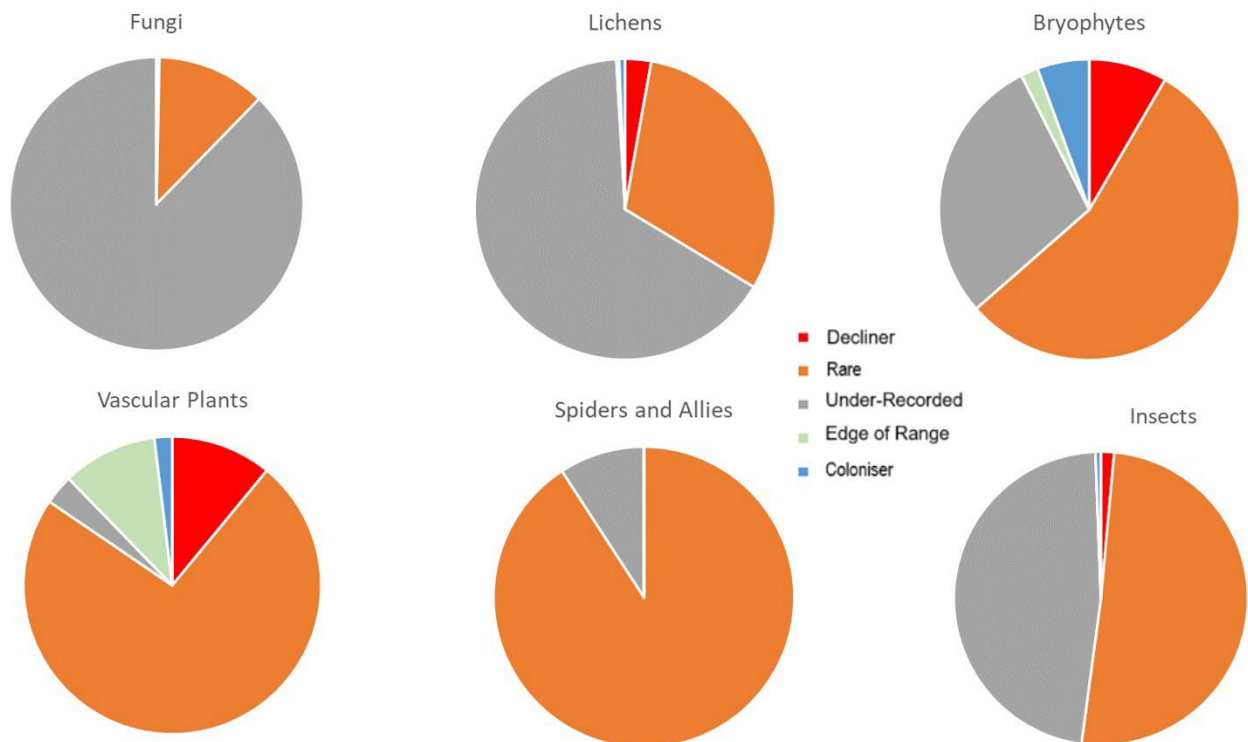


Figure 5. Representation of different restriction categories among six taxonomic groups.

Seventy-seven *Species in Peril* were identified as *Decliners* (Table 5). These species were formerly more widespread but now occur at five or fewer sites. Over half of these are insects and vascular plants (26 and 17 species respectively). Ten bird species were also identified in this category, a disproportionately large number for a relatively species-poor group, though this may also reflect the relatively good data on bird numbers compared to most other taxonomic groups.

1,389 species were identified as *Naturally Rare* (Table 5; Figure 6). These species have always been rare in Wales and there is no reason to suspect that most of them are under immediate threat of extinction here. However, species found at a small number of sites are inherently at greater risk than more widespread taxa (IUCN, 2012), so they still require conservation action to maintain populations.

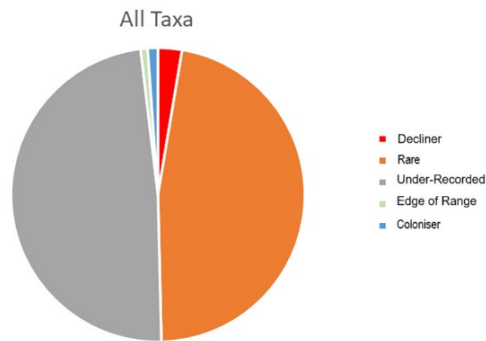


Figure 6. Representation of different restriction categories across all taxonomic groups.

Table 5. Number of *Species in Peril* in each restriction category by taxonomic group.

Group	<i>Decliners</i>	<i>Naturally rare</i>	<i>Under-recorded</i>	<i>Edge of range</i>	<i>Colonisers</i>	Total
Fungi	1	37	271	0	0	309
Lichens	9	99	210	1	2	321
Mosses & liverworts	9	59	31	2	6	107
Stoneworts	0	6	0	0	1	7
Vascular plants	17	114	5	16	3	155
Moss animals	0	1	0	0	0	1
Gastropod molluscs	2	9	2	0	0	13
Bivalve molluscs	2	4	1	0	0	7
Spiders and allies	0	99	10	0	0	109
Crustaceans	0	6	2	0	0	8
Springtails	0	0	6	0	0	6
Centipedes	0	0	5	0	0	5
Millipedes	0	0	8	0	0	8
Insects	26	943	880	0	11	1860
Fish & lampreys	1	3	0	1	0	5
Amphibians & reptiles	0	1	0	0	0	1
Mammals	0	2	2	2	0	6
Birds	10	6	0	1	10	27
Grand total	77	1389	1433	23	33	2955

Taxonomically complex groups such as fungi, springtails and millipedes are significantly represented as *Under-Recorded* because misidentifications abound and many species are likely to be substantially under-recorded. In contrast, the distributions of most vertebrates except for a few bats are well known, as are those of vascular plants and stoneworts, so very few of these are *Under-Recorded*. Some insect orders are very well-recorded, so the restricted range of more than 50% is considered to be genuine, but other orders are more likely to be overlooked and the apparent restriction of 880 insect species to five or fewer sites might be the result of under-recording. The same is true for lichens, with a large

number of tiny, often parasitic ‘lichenicolous’ species potentially overlooked but roughly a third genuinely restricted in range.

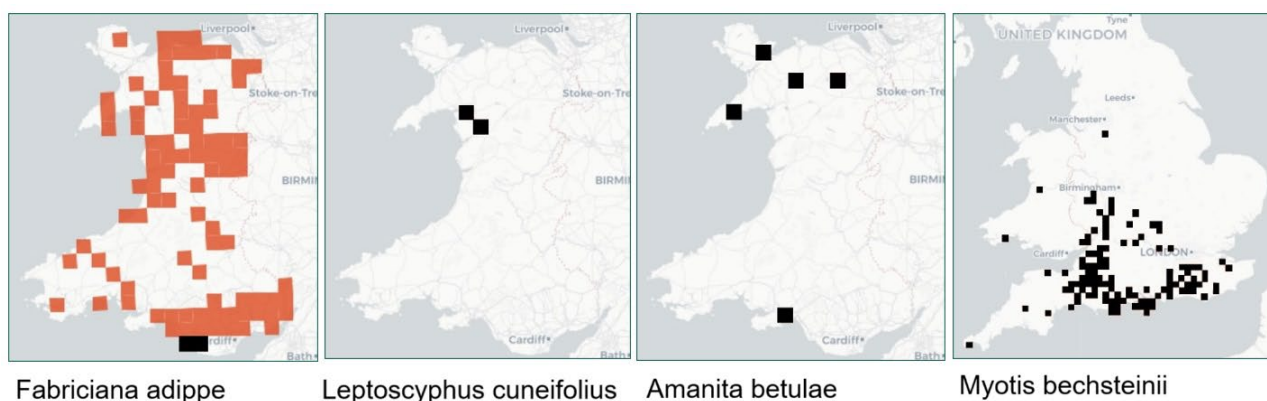
Edge of Range and *Colonisers* categories were used less often, because relatively few species are more common in England but rare in Wales and most increasing species have already colonised more than five sites. Four contrasting distributions are presented in Figures 7 to 10.

There were marked differences in allocation of restriction categories to different groups, reflecting different levels of available information. The significant knowledge gaps already identified for fungi, lichens and to a lesser extent invertebrates resulted in a high proportion of *Under-Recorded* in these groups (Figure 5). Where the available information was considered adequate to assess threat, by far the most frequent category was *Naturally Rare* (Figure 5 & Figure 6). *Edge of Range* and *Coloniser* species were most likely to be identified in mosses, liverworts and vascular plants (Figure 5).

The 77 *Decliners* are arguably the most threatened in Wales. They were formerly widespread but have declined to such an extent that they are now known from five or fewer Welsh sites. Some of these are already high-profile conservation priorities, including Black Grouse *Lyrurus tetrix*, Freshwater Pearl Mussel *Margaritifera margaritifera*, High Brown Fritillary *Fabriciana adippe*, Strandline Beetle *Eurynebria complanata* and Fen Orchid *Liparis loeselii*. However, others have declined without much note being taken, for example Yellow Wagtail *Motacilla flava*, Plain Clay *Eugnorisma depuncta*, Sheep Nostril Fly *Oestrus ovis*, Grass-wrack Pondweed *Potamogeton compressus*, Brown Shield-moss *Buxbaumia aphylla* and the lichen *Cetraria sepincola*. Appendix 5 (p.194) provides the full list of *Decliners*.

Twelve of these 77 species are covered by actions under the *Natur am Byth!* programme (of a total of 67 species targeted by that programme of which 39 are *Species in Peril*) – Eagle-claw Lichen *Anaptychia ciliaris* subsp. *ciliaris*, Arctic-Alpine Pea Clam *Conventus conventus*, Strandline Beetle *Eurynebria complanata*, High Brown Fritillary *Fabriciana adippe*, Scarce Speckled Lichen *Lecanographa amylacea*, Fen Orchid *Liparis loeselii*, Burnt-tip Orchid *Neotinea ustulata*, Large Mason Bee *Osmia xanthomelana*, Dog Screw-moss *Tortula canescens*, Broad-fruited Cornsalad *Valerianella rimosa*, Narrow-mouthed Whorl Snail *Vertigo angustior* and Geyer's Whorl Snail *Vertigo geyeri* – but targeted species-specific conservation action is needed for all 77, both to ensure that existing sites are suitably managed and to increase the number of sites so that they have greater resilience.

More details of key species are found in Appendices 3 & 4 (pp.176 & 186).



Figures 7, 8, 9 & 10. Distribution of four species in Wales, showing contrasting distributions. High Brown Fritillary *Fabriciana adippe* has declined from being widespread (pre-2000 records in red) to occupying a single site in the Vale of Glamorgan (post-2000 records in black); Wedge Flapwort *Leptoscyphus cuneifolius* has only ever been known in Wales from a small area of Meirionnydd with a Hyperoceanic climate; the fungus *Amanita betulae* has five scattered Welsh populations and is probably somewhat overlooked albeit far from ubiquitous; Bechstein's Bat *Myotis bechsteinii* is frequent in England but has a very restricted Welsh range, including just a single Welsh breeding site. Maps from www.nbnatlas.org.uk.

5.3. Key ecosystems

The Habitats of Wales Survey provides statistics for all terrestrial and freshwater habitats in Wales (Blackstock *et al.*, 2010; Table 6). These habitats have been translated to 11 of the 13 ecosystems used for *Species in Peril*, thereby giving relative quantities for each. Note that Blackstock *et al.* (2010) provides no statistics for cave, subterranean, urban and synanthropic habitats.

The 13 ecosystems support variable numbers of *Species in Peril*, with *Woodland*, *Parkland* & *Scrub* supporting most species (1076 = 36%) (Table 7). This is in large part due to the number of saproxylic insects included in the analysis whose range is limited by the very small number of Welsh sites where ancient trees are present in sufficient numbers to support viable insect populations. *Woodland*, *Parkland* & *Scrub* is also the most important ecosystem for rare Welsh fungi, lichens, insects and spiders but only supports three vertebrates, all bats. Other key ecosystems include *Grassland* (18% of *Species in Peril*), *Peatland* (12%), *Montane* (7%) and *Dune & Saltmarsh* (7%).

The importance of each ecosystem varies with the different species groups. *Montane* is the key ecosystem for vascular plants and mosses and liverworts, but supports relatively low numbers of insects and spiders. The small number of *Species in Peril* associated with the *Agricultural* ecosystem are dominated by vascular plants, and similar small numbers restricted to *Cave & Subterranean* are all invertebrates. The *Grassland* ecosystem is important for insects, fungi and, to a much lesser extent, vascular plants and lichens. Some taxa such as mosses & liverworts, vascular plants and spiders & allies are relatively evenly spread through several ecosystems.

The use of ecosystems by *Species in Peril* is broadly similar if only *Decliners* and *Naturally Rare* are considered (Table 8). However, the importance of the *Dune & Saltmarsh* ecosystem for fungi is more pronounced.

The *Species in Peril* associated with each ecosystem are discussed in the following sections (5.3.1 to 5.3.13).

Table 6. Habitats of Wales and their equivalent *Species in Peril* ecosystem.

Habitat	Area (ha)	Ecosystem
Saltmarsh	5,800	<i>Dune & Saltmarsh</i>
Sand dune	6,200	<i>Dune & Saltmarsh</i>
Hard cliff	890	<i>Coast & Coastal Cliff</i>
Soft cliff	80	<i>Coast & Coastal Cliff</i>
Coastal grassland	1,600	<i>Coast & Coastal Cliff</i>
Coastal heathland	950	<i>Coast & Coastal Cliff</i>
Acid grassland	152,700	<i>Grassland/Montane</i>
Neutral grassland	35,100	<i>Grassland</i>
Limestone grassland	1,800	<i>Grassland</i>
Marshy grassland	64,500	<i>Grassland</i>
Agriculturally improved grassland	1,280,800	<i>Agricultural</i>
Arable	60,100	<i>Agricultural</i>
Heathland	91,600	<i>Heathland</i>
Blanket and raised bog	58,100	<i>Peatland</i>
Fen and swamp	20,900	<i>Peatland</i>
Standing freshwater	9,400	<i>Lake & Pond</i>
Running freshwater	5,400	<i>River, Stream & Ditch</i>
Broad-leaved and mixed woodland	82,700	<i>Woodland, Parkland & Scrub</i>
Scrub	14,000	<i>Woodland, Parkland & Scrub</i>
Conifer plantations	188,100	<i>Woodland, Parkland & Scrub</i>
Rock exposure	9,160	<i>Lowland Rock Exposure</i>

Table 7. The representation of *Species in Peril* in each ecosystem. Key ecosystems for each taxonomic group are marked with a star.

Group	Agricultural	Cave & Subterranean	Coast & Coastal Cliff	Dune & Saltmarsh	Grassland	Heathland	Lake & Pond	Lowland Rock Exposure	Montane	Peatland	River, Stream & Ditch	Urban & Synanthropic	Woodland, Parkland & Scrub	Grand total
Fungi	1	0	0	35	82*	3	0	1	5	8	0	6	168*	309
Lichens	0	0	22	3	30	10	0	8	93*	1	19	22	113*	321
Mosses & liverworts	0	0	2	7	6	4	3	5	34*	13	10	4	19	107
Stoneworts	0	0	1	1	0	0	1	0	0	4	0	0	0	7
Vascular plants	12	0	17	13	22*	2	9	20	27*	9	5	6	13	155
Moss animals	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Gastropod molluscs	0	0	2	2	1	0	3	0	0	2	0	0	3	13
Bivalve molluscs	0	0	0	0	0	0	0	0	1	1	5	0	0	7
Spiders and allies	0	6	10	8	16	6	0	0	8	20*	1	2	32*	109
Crustaceans	0	1	1	0	1	0	0	0	0	1	1	1	2	8
Springtails	0	1	0	0	2	0	0	0	2	1	0	0	0	6
Centipedes	0	0	2	0	1	0	0	0	0	0	0	1	1	5
Millipedes	0	0	2	0	3	0	0	0	0	0	0	1	2	8
Insects	0	16	98	131	366*	15	33	0	33	291*	152*	5	720*	1860
Fish & lampreys	0	0	0	0	0	0	2	0	0	0	3	0	0	5
Amphibians	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Mammals	2	0	0	0	1	0	0	0	0	0	0	0	3	6
Birds	2	0	10*	1	0	1	0	0	0	5	0	0	0	19
Grand total	17	24	167	202	531	41	52	34	203	356	196	48	1076	2947

Table 8. Number of *Decliners* and *Naturally Rare Species in Peril* found in the 13 ecosystems. Key ecosystems for each taxonomic group are marked with a star.

Group	Agricultural	Cave & Subterranean	Coast & Coastal Cliff	Dune & Saltmarsh	Grassland	Heathland	Lake & Pond	Lowland Rock Exposure	Montane	Peatland	River, Stream & Ditch	Urban & Synanthropic	Woodland, Parkland & Scrub	Grand total
Fungi	0	0	0	21*	9	0	0	1	3	1	0	0	3	38
Lichens	0	0	2	0	15	2	0	0	27*	0	4	0	58*	108
Mosses & liverworts	0	0	2	6	2	1	1	5	27*	8	3	2	11	68
Stoneworts	0	0	1	1	0	0	0	0	0	4	0	0	0	6
Vascular plants	9	0	15*	12	16*	2	7	20*	27*	8	4	4	7	131
Moss animals	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Gastropod molluscs	0	0	2	1	0	0	3	0	0	2	0	0	3	11
Bivalve molluscs	0	0	0	0	0	0	0	0	1	0	5	0	0	6
Spiders & allies	0	3	9	7	15*	6	0	0	8	20*	1	2	28*	99
Crustaceans	0	0	1	0	1	0	0	0	0	1	0	1	2	6
Insects	0	4	62	64	201*	7	33	0	12	155*	109*	3	319*	969
Fish & lampreys	0	0	0	0	0	0	2	0	0	0	2	0	0	4
Amphibians	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Mammals	1	0	1	0	0	0	0	0	0	0	0	0	0	2
Birds	2	0	8*	1	0	1	0	0	0	3	0	0	0	15
Grand total	12	7	103	114	259	19	47	26	105	202	128	12	431	1465

5.3.1. Agricultural ecosystem

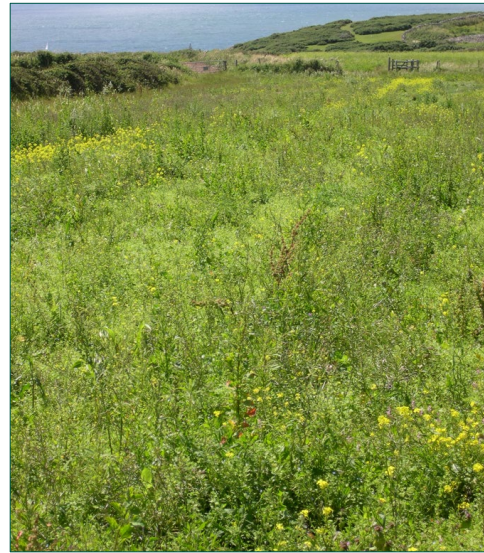
On the whole, the intensively farmed *Agricultural* ecosystem does not now support rare species as most invertebrates, mosses, liverworts, lichens and fungi – the bulk of biodiversity – are restricted to semi-natural habitats. *Species in Peril* analysis has assigned just 16 out of 2955 species to this ecosystem including 12 vascular plants, one fungus (*Puccinia polygoni-amphibii* var. *convolvuli*), two bats (Serotine *Eptesicus serotinus* and Greater Horseshoe Bat *Rhinolophus ferrumequinum*) and two birds (Western Yellow wagtail *Motacilla flava* and Twite *Carduelis flavirostris*) (Table 9). Seven of the vascular plants are associated with arable habitats (Table 10; Figures 11 & 12). Most arable plants would have been widespread under past agricultural management but there have been both historic and more recent losses.

Table 9. *Species in Peril* assigned to *Agricultural* ecosystem.

Group	No. species	Single Site species
Fungi	1	1
Vascular plants	12	5
Mammals	2	0
Birds	2	0
Total	17	6

Table 10. Arable vascular plants included in *Species in Peril*, including extinct species.

Species	Vernacular name	Welsh status
<i>Adonis annua</i>	Pheasant's-eye	Extinct
<i>Anthemis arvensis</i>	Corn Chamomile	4 localities
<i>Briza minor</i>	Lesser Quaking-grass	2 localities
<i>Buglossoides arvensis</i>	Field Gromwell	Extinct
<i>Euphorbia platyphyllos</i>	Broad-leaved Spurge	1 locality
<i>Fumaria densiflora</i>	Dense-flowered Fumitory	Extinct
<i>Galeopsis segetum</i>	Downy Hemp-nettle	Extinct
<i>Galium tricornutum</i>	Corn Cleavers	Extinct
<i>Lolium temulentum</i>	Darnel	Extinct
<i>Ranunculus arvensis</i>	Corn Buttercup	1 locality
<i>Roemeria argemone</i>	Prickly Poppy	4 localities
<i>Scandix pecten-veneris</i>	Shepherd's-needle	5 localities
<i>Torilis arvensis</i>	Spreading Hedge-parsley	Extinct
<i>Valerianella rimosa</i>	Broad-fruited Cornsalad	1 locality



Figures 11 & 12. Arable fields at Dyffryn Home Farm, Vale of Glamorgan © Julian Woodman and The Vile, Gower © Trevor Dines

As a result of long-term agricultural intensification, widespread species associated with grasslands and wetlands have become increasingly confined to protected sites with concomitant reduction in populations and occupied locations. Examples include the Shrill Carder Bee *Bombus sylvarum* and High Brown Fritillary *Fabriciana adippe*. Some species have been lost to Wales including the recent extinctions of Corncrake *Crex crex*, Corn Bunting *Emberiza calandra* and Turtle Dove *Streptopelia turtur* and the more historic losses of Great Yellow Bumblebee *Bombus distinguendus* and Short-haired Bumblebee *Bombus subterraneus*. Agricultural improvement was probably a major factor in the extinctions of widespread moths such as Bordered Gothic *Sideridis reticulata*, Lunar Yellow Underwing *Noctua orbona*, Pale Shining Brown *Polia bombycina* and Sword-grass *Xylena exsoleta*.

The recent *State of Nature* report (Smith *et al.*, 2023) highlighted that the abundance indicator for Welsh farmland birds showed an average decline by 29% since 1994. This is similar to patterns shown in England and Northern Ireland. Such declines may be attributed to intensification of farmed habitats in recent decades in efforts to maximise food production. Targeted wildlife-friendly farming supported by government-funded agri-environment schemes (AES) could halt and reverse declines, although there is little evidence of this to date. Viable breeding populations of two farmland bird species are probably now restricted to five or fewer sites; Yellow Wagtail *Motacilla flava*, breeding in lowland farmed habitats of spring-sown root crops and cereals or pasture in the lowland river valleys of the counties bordering England, and Twite *Carduelis flavirostris* which is now restricted to upland farmed sites in north Wales.

5.3.2. Cave & Subterranean ecosystem

This ecosystem is important for a suite of invertebrates and for hibernating bats including Greater Horseshoe Bat. *Species in Peril* analysis has assigned 24 species to the ecosystem, all of which are invertebrates including three spiders, three mites, 16 insects, one springtail and one crustacean (Table 11). All five bat species included in *Species in Peril* are assigned to ecosystems used for breeding, because other roosts are more widespread and are often used in a transitory way.

Table 11. *Species in Peril* assigned to Cave & Subterranean ecosystem.

Group	No. species	Single Site species
Spiders & allies	6	3
Crustaceans	1	0
Springtails	1	1
Insects	16	7
Total	24	11

Whilst the UK cavernicolous invertebrate faunas are less species-rich than those found in European caves, they still support 108 species which are either restricted to caves (19 species) or strongly associated with caves (89), 84 of which have been recorded in Wales (Howe, 2021a). Three UK species are found only in Wales including the rove beetle *Aloconota subgrandis*, the money spider *Porrhomma rosenhaueri* and the cave mite *Rhagidia odontochela*. Short accounts for these species are included in Appendix 3 (p. 176). A further nine species are restricted to a single locality in Wales.

Key sites (Figure 13 & 14) include Lesser Garth Cave, Ogof Agen Allwedd, Ogof Draenen, Ogof Ffynnon Ddu, Ogof y Ci and Otter Hole.

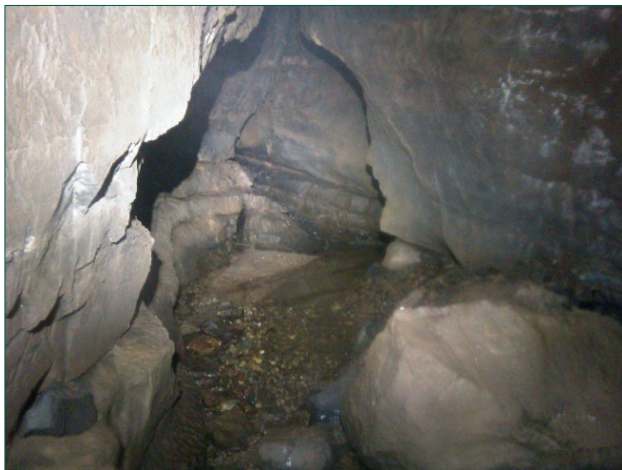


Figure 13 (left). Ogof Ffynnon Ddu; Figure 14 (right). Ogof Draenen. © Lee Knight

5.3.3. Coast & Coastal Cliff ecosystem

The *Coastal & Coastal Cliff* ecosystem (Figure 15 & 16) covers a broad range of habitats including coastal soft cliff, coastal hard cliff, rocky shore and littoral habitats, offshore islands, estuaries, coastal shingle and coastal lagoons. *Species in Peril* analysis has assigned 168 species to this ecosystem, encompassing a range of groups (Table 12).

Table 12. *Species in Peril* assigned to *Coast & Coastal Cliff* ecosystem.

Group	No. species	Single Site species
Lichens	22	10
Mosses & liverworts	2	0
Stoneworts	1	1
Vascular plants	17	4
Gastropod molluscs	2	0
Spiders & allies	10	4
Crustaceans	1	0
Centipedes	2	0
Millipedes	2	1
Insects	98	40
Birds	10	3
Total	167	63

None of Wales' breeding seabirds are endemic yet several species are of significant international importance, where a substantial proportion of their biogeographical or global breeding populations are located in Wales such as Manx Shearwater *Puffinus puffinus*, and Northern Gannet *Morus bassanus*. The last Manx Shearwater breeding census in 2018 within the islands of the Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwn a moroedd Benfro SPA suggested a population of 455,156 (339,924-570,388) apparently occupied sites (AOS) (Perrins, 2018 in Burnell *et al.*, 2023) representing c.37% of the global breeding population.

Coastal cliffs (Figure 17) and offshore islands are critical for breeding seabirds. Islands specifically, provide nesting and chick-rearing habitats for breeding Common Tern *Sterna hirundo*, Arctic Tern *Sterna paradisaea* and Roseate Tern *Sterna dougallii*. Key localities include Ynys Feurig and The Skerries. The only regular breeding locality for Little Tern *Sternula albifrons* is Gronant Dunes within the Liverpool Bay / Bae Lerpwl SPA and holds 12.3% of the UK and Great Britain population and 0.04% of the global population (Burnell *et al.*, 2023). Due to its relatively small foraging range during breeding (usually less than 5km from breeding locations), Little Tern colonies are closely associated with specific coastal features such as shallow sandy waters, tidal inlets or estuaries.

Coastal soft cliffs provide an important refuge for rare invertebrate species as well as rich invertebrate assemblages. Eroding cliffs provide a continuous supply of pioneer habitats including bare ground and extensive pioneer and ruderal plant communities, and seepages, pools and reedbeds add to the interest. In the UK, 29 species are restricted to soft cliff habitats of which four are found in Wales including the Large Mason Bee, known only from Porth Ceiriad and Porth Neigwl in the UK and with just 15 females recorded in 2024 (Dafis, in prep.), the weevil *Sitona gemellatus* and the ground beetle *Tachys micros*. A further 20 UK species are strongly associated with coastal soft cliff for at least some stage of their life cycle and 58 species are associated with coastal soft cliff at least in some part of their geographic range (Howe, 2021b). Key Welsh localities include Porth Ceiriad, Porth Dinllaen and Porth Neigwl on the Llŷn peninsula and Horton Cliffs and Overton Cliff on the south Gower coast.

A total of 65 *Coastal & Coastal Cliff* ecosystem species are restricted to a single Welsh locality including Foxtail Stonewort *Lamprothamnium papulosum*, Sea Pea *Lathyrus japonicus*, the spiders *Callilepis nocturna* and *Diplocephalus erythropus*, the weevil *Trachyploeus heymesi* (at its only UK locality at South Stack) and the long-legged fly *Tachytrechus ripicola*. Other important species include Wedge-leaved Screw-moss *Tortula cuneifolia*, the dimple lichen *Gyalecta foveolaris*, Wild Asparagus *Asparagus prostratus*, Perennial Centaury *Centaurea portense*, Red Hemp-nettle *Galeopsis angustifolia*, Shore Dock *Rumex rupestris* and True Service-tree *Sorbus domestica*.

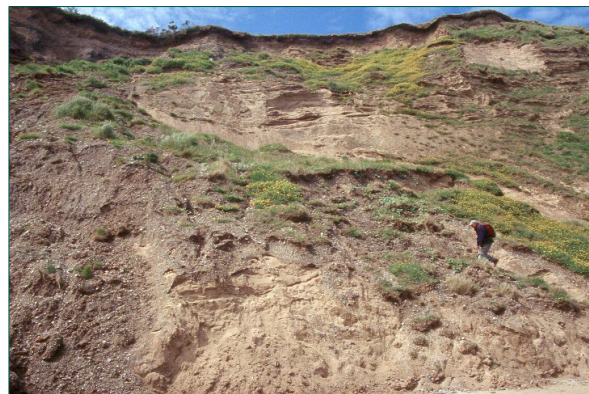


Figure 15 (left). Sparsely vegetated shingle at Cemlyn Bay. © Stuart Smith

Figure 16 (right). Coastal soft cliff at Porth Dinllaen. © Mike Howe



Figure 17. Coastal hard cliffs at South Stack. © Peter Rhind

5.3.4. Dune & Saltmarsh ecosystem

Species in Peril analysis has assigned 202 species to the *Dune & Saltmarsh* ecosystem (Table 13). A more detailed description of the species associated with the dune element of this ecosystem is given in Appendix 1.

Key sites include 13 in the top 50 sites for *Species in Peril* including, in order of importance, Newborough Warren & Forest (130 species), Whiteford Burrows (94) (Figure 19), Pembrey Coast (86), Oxwich & Nicholaston Burrows (84), Kenfig Burrows (82), Merthyr Mawr Warren (74), Newborough Forest (57), Stackpole (54), Morfa Harlech (43), Morfa Dyffryn (35) (Figure 18), Tywyn Aberffraw (34), Ynyslas Dunes (33) and Crymlyn Burrows (25).

Table 13. *Species in Peril* assigned to *Dune & Saltmarsh* ecosystem.

Group	No. species	Dune species	Saltmarsh species	Single Site species
Fungi	35	33	2	12
Lichens	3	3	0	2
Mosses & liverworts	7	6	1	0
Stoneworts	1	1	0	1
Vascular plants	13	9	4	0
Gastropod molluscs	2	1	1	1
Spiders and allies	8	7	1	4
Insects	131	112	19	69
Amphibians & reptiles	1	1	0	0
Birds	1	0	1	0
Total	202	173	29	89



Figure 18. Sand dunes at Morfa Dyffryn. © Stewart Campbell



Figure 19. Saltmarsh at Cwm Ivy. © Liz Howe

5.3.5. Grassland ecosystem

Whilst it has a particular focus on semi-natural grasslands and marshy grassland, some of the 531 species assigned to this ecosystem by *Species in Peril* utilise coastal grassland and dune grassland which overlap with other ecosystems. Insects form the majority of species assigned, with fungi also being important (Table 14). Over 40% of species are restricted to a single locality, including half of the fungi species. This makes them vulnerable to stochastic change and to changes in grazing management such as abandonment, vegetation succession and overgrazing. Indeed, vegetation succession is listed as the key threat to 373 of the 531 species, with tree planting the 2nd most important threat for 82 species.

Table 14. *Species in Peril* assigned to *Grassland ecosystem*.

Group	No. species	Single Site species
Fungi	82	41
Lichens	30	15
Mosses & liverworts	6	1
Vascular plants	22	10
Gastropod molluscs	1	1
Spiders and allies	16	4
Crustaceans	1	0
Springtails	2	1
Centipedes	1	1
Millipedes	3	1
Insects	366	146
Mammals	1	1
Total	531	222

A total of 104 species is associated with early pioneer conditions including 'open habitats' (which covers a range of grassland and other seral habitats), brownfield sites, disturbed

grassland and ruderal vegetation. Limestone grassland, with 55 species, is disproportionately important for *Species in Peril* given its restricted distribution and quantity, whilst only eight species are found on wet and marshy grassland, a far more prevalent grassland type in Wales (Blackstock *et al.*, 2010; Stevens *et al.*, 2010; Table 6).

Key vascular plants restricted to a single locality include Prickly Sedge *Carex muricata* subsp. *muricata*, Field Mouse-ear *Cerastium arvense*, Wild Cotoneaster *Cotoneaster cambricus*, Spotted Cat's-ear *Hypochaeris maculata*, Grass-poly *Lythrum hyssopifolia*, Burnt-tip Orchid *Neotinea ustulata* and Meadow Clary *Salvia pratensis*. Both Scorzonera Smut *Microbotryum scorzonerae* and Scorzonera Rust *Puccinia scorzonerae* are only found at Cefn Cribwr, and Globeflower Smut *Urocystis trollii* is restricted to Cwm Cadlan. Clustered Jelly Lichen *Collema fasciculare* is found at Craig y Cilau and Scaly Stippled Lichen *Endocarpon pusillum* var. *pusillum* at Cwm Alun.

Once widespread in Wales, High Brown Fritillary *Fabriciana adippe* is now restricted to Old Castle Down, whilst the *thyone* subspecies of Grayling *Hipparchia selene* has always been found only on Great Ormes Head. The only contemporary UK locality for the Scarce Awl Robberfly *Neoitamus cothurnatus* is Mynydd y Gaer. Other key invertebrates include Small Plume *Oxyptilus parvidactyla* and Dark-fronted Wingwaver *Herina paludum*, found only on Ogmores Down/Old Castle Down, the weevil *Helianthemapion aciculare* at its only UK locality on Great Ormes Head, and Wormwood Moonshiner *Amara fusca* at Newport Docks. The Skomer Vole *Myodes glareolus skomerensis* is a unique subspecies found only on Skomer's coastal grassland.

Only one grassland is in the top 50 sites for *Species in Peril* - Great Ormes Head (Figure 20), which supports 53 species. Other important sites include Breidden Hill, Castlemartin Range (Figure 21), Craig y Cilau, Eglwyseg Rocks, Graig Fawr, MoD Caerwent, Llanymynech Hill, Minera Grassland & Quarry, Ogmores Down & Old Castle Down, Creigiau Rhiwledyn and Roundton Hill.



Figure 20. Limestone grassland on Great Ormes Head. © Stuart Smith



Figure 21. Neutral grassland on Castlemartin Range. © Guy Knight

5.3.6. Heathland ecosystem

Species in Peril analysis has assigned 41 species to the *Heathland* ecosystem (Table 15) which included both coastal heath (Figure 22), lowland inland and upland heath. Breeding Dartford Warbler *Sylvia undata* was mostly restricted to heathlands on Gower and in Pembrokeshire from 2015 to 2019, with only eight pairs recorded in 2019 (Pritchard *et al.*, 2021). The very localised nature of populations makes the species very vulnerable to cold winters, human disturbance and fires in areas of suitable breeding habitat. The Dartford Warbler requires mature heath with 1-2m high gorse and tall heather, whilst the ground beetle *Lebia cruxminor* is associated with short wet heath and marshy grassland at Llwyn-iarth, its only Welsh locality (Howe, 2020e). The meshweb spider *Lathys stigmatisata* is found on open, coastal heath on Penmaen Dewi and Ramsey Island. Bog Hair-grass *Aristavena setacea* is restricted to heathy pools on Mynydd Cilan and Morfa Nefyn, and Heath Cudweed *Omalotheca sylvatica* is found on open heath at Isallt Crag and Tan-y-fedw. The Turban Lichen *Cladonia peziziformis* is found on short coastal heath at Carn Ingli, Rhossili Down and South Stack.

Key heathland sites include Carn Ingli, Castlemartin Range, Fairwood Common, Llwyn-iarth, Mynydd Hiraethog, Ramsey and South Stack.

Table 15. *Species in Peril* assigned to *Heathland* ecosystem.

Group	No. species	Single Site species
Fungi	3	1
Lichens	10	6
Mosses & liverworts	4	0
Vascular plants	2	0
Spiders & allies	6	1
Insects	15	9
Birds	1	0
Total	41	17



Figure 22. Coastal heath on Holy Island, Anglesey. © Jan Sherry

5.3.7. Lake & Pond ecosystem

Species in Peril analysis has assigned 52 species to this ecosystem, the majority of which are insects (Table 16). The only contemporary UK locality for Glutinous Snail *Myxas glutinosa* is Llyn Tegid (Howe, 2020q), the diving beetle *Dytiscus lapponicus* is restricted in Wales to Llyn-y-parc and Crystal Moss-animal *Lophopus crystallinus* is found at Llangorse Lake. The Anglesey lakes offer the only Welsh localities for the whirligig beetle *Gyrinus paykulli* at Llyn Cerrig Bach (Howe, 2021f), Mr. Scales' Diving Beetle *Hydroporus scalesianus* at Llyn Dinam (Howe, 2020h), the diving beetle *Hydrovatus clypealis* at Llyn Padrig (Howe, 2021g) and the water bug *Arctocoris carinata* at Llyn Alaw.

The last Welsh record of Channelled Crystalwort *Riccia canaliculata* was at Pen-y-Parc, Beaumaris in 1972, although it is considered potentially still extant there as buried, long-lived spores, and the Millimetre Moss *Micromitrium tenerum* is at Dowrog Common, Llyn Hendref and Wyndrush Pastures. Nordic Bladderwort *Utricularia stygia* is found on Cors Gyfelog, Thread Rush *Juncus filiformis* is restricted to Llyn Coedty and Round-fruited Rush *Juncus compressus* is found at Llangorse Lake and Onen. Long-stalked Pondweed *Potamogeton praelongus* (Figure 23) has been recorded at five localities including Montgomery Canal, and Marsh Dock *Rumex palustris* is found at three stations on the Gwent Levels.

Two threatened fish are restricted to deep, oligotrophic lakes. Gwyniad *Coregonus lavaretus* naturally occurs only in Llyn Tegid but it has been introduced recently to Llyn Arenig Fawr as a conservation measure. Arctic Charr (Torgoch) *Salvelinus alpinus* is found at five lakes including Llyn Cwellyn and Llyn Padarn.

Key sites include Cosmeston Lakes, Dowrog Common, Gwent Levels, Llangorse Lake, Llyn Arenig Fawr, Llyn Cerrig Bach, Llyn Cwellyn, Llyn Dinam, Llyn Padarn, Llyn Padrig, Llyn Tecwyn Isaf, Llyn Tegid, Llyn-y-parc, Montgomery Canal and Pysgodlyn Mawr.

Table 16. *Species in Peril* assigned to *Lake & Pond* ecosystem.

Group	No. species	Single Site species
Mosses & liverworts	3	1
Stoneworts	1	0
Vascular plants	9	2
Moss animals	1	1
Gastropod molluscs	3	2
Insects	33	14
Fish & lampreys	2	0
Total	52	20



Figure 23. Long-stalked Pondweed *Potamogeton praelongus* in Llyn Cregennen Isaf. © Lin Baldock/Natural Resources Wales

5.3.8. Lowland Rock Exposure ecosystem

Species in Peril analysis has assigned 34 species to this ecosystem, all of which are fungi, lichens, mosses, liverworts or vascular plants (Table 17) including eleven species of whitebeam *Sorbus* (Table 18; Rich *et al.*, 2019). Breidden Hill supports six species including Swiss Grimmia *Schistidium helveticum*, Shaggy Mouse-ear Hawkweed *Pilosella peleteriana* subsp. *subpeleteriana* and Stirton's Whitebeam *Sorbus stirtoniana* at their only Welsh locality. Stanner Rocks supports eight species including Upright Apple-moss *Bartramia aprica*, Star-of-Bethlehem Smut *Vankya ornithogali*, Radnor Lily *Gagea bohémica*, Perennial Knawel *Scleranthus perennis* subsp. *perennis* and Upright Clover *Trifolium strictum* at their only Welsh locality. The Dog Screw-moss *Tortula canescens* is only found in Wales at Roundton Hill.

Key localities include Breidden Hill, Craig y Cilau, Creigiau Eglwyseg (Figure 24), Cwmyoy, Darren Fach, Roundton Hill, Stanner Rocks, Symond's Yat and sites in the Wye Gorge.

Table 17. *Species in Peril* assigned to *Lowland Rock Exposure* ecosystem.

Group	No. species	Single Site species
Fungi	1	1
Lichens	8	3

Group	No. species	Single Site species
Mosses & liverworts	5	3
Vascular plants	20	9
Total	34	16

Table 18. Whitebeams included in *Species in Peril* associated with *Lowland Rock Exposure*.

Species	Vernacular name	No. Welsh localities	Localities
<i>Sorbus arvonica</i>	Menai Strait Whitebeam	1	Menai Straits
<i>Sorbus cambrensis</i>	Welsh Whitebeam	4	Coed Pantydarren; Craig y Cilau; Cwm Clydach; Cwmyoy
<i>Sorbus cuneifolia</i>	Llangollen Whitebeam	1	Llangollen
<i>Sorbus eminens</i>	Round-leaved Whitebeam	4	Alcove Wood; Blackcliff-Wyndcliff; Lady Park Wood; Parkland D
<i>Sorbus eminentiformis</i>	Doward Whitebeam	2	Lady Park Wood; Parkland D
<i>Sorbus leptophylla</i>	Thin-leaved Whitebeam	2	Craig y Cilau; Craig y Riwarth
<i>Sorbus leyana</i>	Ley's Whitebeam	2	Darren Fach; Penmoellalt
<i>Sorbus minima</i>	Least Whitebeam	3	Craig y Castell; Craig y Cilau; Cwm Claisfer
<i>Sorbus saxicola</i>	Symond's Yat Whitebeam	1	Symond's Yat
<i>Sorbus stenophylla</i>	Llanthony Whitebeam	4	Cwm Ifor; Cwmyoy; Darren Lwyd; Tarren yr Esgob
<i>Sorbus stirtoniana</i>	Stirton's Whitebeam	1	Breidden Hill



Figure 24. Creigiau Eglwyseg. © Sam Bosanquet

5.3.9. Montane ecosystem

This ecosystem encompasses high altitude grassland, heath and scree, montane lakes and some blanket bog and other wetlands. *Species in Peril* analysis has assigned 203 species to this ecosystem, the majority of which are lichens and many of which are restricted to a single locality (Table 19). Many of the species are at the extreme southern edge of their UK range in Wales and are threatened in the medium to long term by climate change. As expected, sites in Eryri support the major element of the flora and fauna, with Yr Wyddfa holding the most species (Table 20). Four localities rank in the top fifty sites for *Species in Peril*: Yr Wyddfa (85 species), Glyderau (67) (Figure 25), Carneddau (47) (Figure 25) and Cadair Idris (25).

A detailed account of the *Montane* ecosystem and its associated species is given in Appendix 1 (p. 160).

Table 19. *Species in Peril* assigned to *Montane* ecosystem.

Group	No. species	Single Site species
Fungi	5	2
Lichens	93	66
Mosses & liverworts	34	16
Vascular plants	27	7
Bivalve molluscs	1	1
Spiders and allies	8	3
Springtails	2	2
Insects	33	11
Total	203	108

Table 20. Key montane sites for *Species in Peril*.

Group	Carneddau	Cadair Idris	Glyderau	Yr Wyddfa
Fungi	0	0	2	4
Lichens	8	7	28	27
Mosses & liverworts	9	4	13	16
Vascular plants	14	1	12	20
Bivalve molluscs	0	0	1	0
Spiders and allies	6	2	0	3
Springtails	0	0	1	0
Insects	10	11	10	15
Total	47	25	67	85

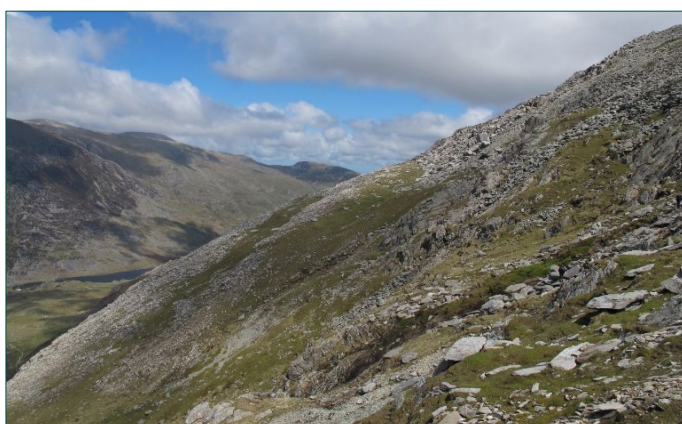


Figure 25 (left). Pant Ifan above Cwm Idwal, Glyderau. © Sam Bosanquet



Figure 26 (right). Llech Ddu, Carneddau. © Sam Bosanquet

5.3.10. Peatland ecosystem

This ecosystem covers a range of wetland habitats including blanket bogs, raised bogs, topogenous fens, soligenous fens, swamps and reedbeds. It also includes wetland areas on the Gwent Levels and similar sites but does not include reens which are covered by the *River, Stream & Ditch* ecosystem. *Species in Peril* analysis has assigned 356 species to this ecosystem (Table 21). Whilst it is not possible to differentiate most species on the basis of these habitats with the current dataset, 36 species are associated with seepages (mostly base-rich seepages) and 16 species are associated with swamps and reedbeds.

The *Peatland* ecosystem supports many species important in an international context including Geyer's Whorl Snail (Howe, 2020s) and Desmoulin's Whorl Snail *Vertigo moulinsiana* (Howe, 2020t). In the UK, the only locality for Black Night-runner *Chlaenius tristis* is Cors Geirch (Howe, 2020b) and the fungus gnat *Exechia spinigera* is restricted to two Welsh localities. The majority of UK populations of the fly *Acrometopia wahlbergi* (Howe, 2020k) and the leafhopper *Cicadella lasiocarpae* (Howe, 2021i) are from peatlands on Anglesey and the Llŷn peninsula. In addition, 126 peatland species are restricted to a single locality in Wales. Fifty-five of the 356 species are classed as Critically Endangered, Endangered or Vulnerable, including 17 species restricted to a single locality (Table 22).

Three species of bird that are associated with upland peatland habitats in Wales are restricted to five or fewer sites in Wales: European Golden Plover *Pluvialis apricaria*, Dunlin *Calidris alpina* and Black Grouse *Lyrurus textrix*. The estimated Welsh breeding population of Golden Plover is fewer than 30 pairs where they are restricted to breeding on heather moorland, acidic grasslands and blanket bog. Adjacent pastures with abundant earthworms and crane-fly larvae are important for feeding adults. Many of these feeding pastures are outside the boundaries of protected sites.

Key sites include nine sites in the top 50 localities for *Species in Peril* – Crymlyn Bog (36 species), Fenn's, Whixall & Bettisfield Mosses (35 species), Cors Erddreiniog (29), Cors Goch (29) (Figure 27), Cors Fochno (27), Cors Caron (25), Cors Geirch (24), Cors Bodeilio (23) and Pant-y-sais (23).

Table 21. *Species in Peril* assigned to *Peatland* ecosystem.

Group	No. species	Single Site species
Fungi	8	3
Lichens	1	1
Mosses & liverworts	13	5
Stoneworts	4	0
Vascular plants	9	1
Gastropod molluscs	2	1
Bivalve molluscs	1	0
Spiders and allies	20	4
Crustaceans	1	1
Springtails	1	1
Insects	291	106
Birds	5	0
Total	356	123

Table 22. IUCN threatened species included in *Species in Peril* restricted to a single peatland locality.

Species	Vernacular name	Status	Habitat	Locality
<i>Chara subspinoso</i>	Rugged Stonewort	Wales-CR	Fen Pools	Cors Goch
<i>Glyphesis cottonae</i>	Cotton's Amazon Spider	GB-VU	Raised Bog	Fenn's Moss
<i>Marpissa radiata</i>	a jumping spider	GB-VU	Base-rich Fen	Crymlyn Bog
<i>Dicranum undulatum</i>	Waved Fork-moss	GB-EN	Raised Bog	Fenns, Whixall & Bettisfield Mosses
<i>Bovista paludosa</i>	Fen Puffball	GB-EN	Fen	Blaen Cilieni
<i>Puccinia cladii</i>	Great Fen Sedge Rust	Wales-CR	Fen	Crymlyn Bog
<i>Tilletia menieri</i>	Reed Canary-grass Smut	Wales-CR	Swamp	Cors Caron
<i>Bidessus unistriatus</i>	One-grooved Diving Beetle	GB-CR	Wetland	Pant-y-Sais
<i>Chlaenius tristis</i>	Black Night-runner	GB-VU	Base-rich Fen	Cors Geirch
<i>Dolichopus agilis</i>	a long-legged fly	GB-VU	Wetland	Nant Melyn, Carms
<i>Euura albipennis</i>	a sawfly	GB-VU	Wetland	Dyffryn Gwaun
<i>Haganella clathrata</i>	Window-winged Sedge	GB-EN	Raised Bog	Bettisfield Moss
<i>Leucorrhinia dubia</i>	White-faced Darter	GB-EN	Raised Bog	Fenn's Moss
<i>Limnephilus tauricus</i>	a caddisfly	GB-VU	Base-rich Fen	Cors Erddreiniog
<i>Odontomyia hydroleon</i>	Barred Green Colonel	GB-CR	Base-rich Seepage	Banc-y-mwldan
<i>Spiranthes romanzoffiana</i>	Irish Lady's-tresses	Wales-CR	Grassland / Bog	Cors Fochno
<i>Grus grus</i> breeding	Common Crane breeding	GB-VU	Wetland	Gwent Levels, Nash & Goldcliff
<i>Grus grus</i> wintering	Common Crane wintering	GB-VU	Wetland	Gwent Levels



Figure 27. Cors Goch National Nature Reserve. © Mike Howe

5.3.11. River, Stream & Ditch ecosystem

Species in Peril analysis has assigned 196 species to this ecosystem (Table 23). The majority of species are associated with four main habitats – exposed riverine sediments (ERS), reens & ditches, riparian habitats and the river channel (Table 24). The invertebrates of ERS are treated in more detail in Section 5.11.5.

Key species which are restricted to a single Welsh locality include Welsh Thread-moss *Bryum gemmiparum*, River Stippled Lichen *Endocarpon adscendens*, the lichen *Caloplaca atroflava*, Grass-wrack Pondweed *Potamogeton compressus*, Scarce Yellow Sally *Isogenus nubecula* (Howe, 2020p) and Allis Shad *Alosa alosa*.

Key sites include five sites in the top 50 *Species in Peril* localities including River Usk (69 species), River A (56), River Wye (48) (Figure 28), Afon Tywi (38) and River B (23).

Table 23. *Species in Peril* assigned to River, Stream & Ditch ecosystem.

Group	No. species	Single Site species
Lichens	19	10
Mosses & liverworts	10	1
Vascular plants	5	3
Bivalve molluscs	5	3
Spiders and allies	1	1
Crustaceans	1	0
Insects	152	63
Fish & lampreys	3	1
Total	196	82

Table 24. *Species in Peril* associated with key habitats within River, Stream & Ditch ecosystem.

Habitat	No. species	Comment
Exposed riverine sediments	55	All insects
Reeds & ditches	6	All insects
Riparian	45	1 vascular plant + 44 insects
Riverine	69	19 lichens, 10 mosses & liverworts, 5 bivalve molluscs, 1 crustacean, 31 insects + 3 fish

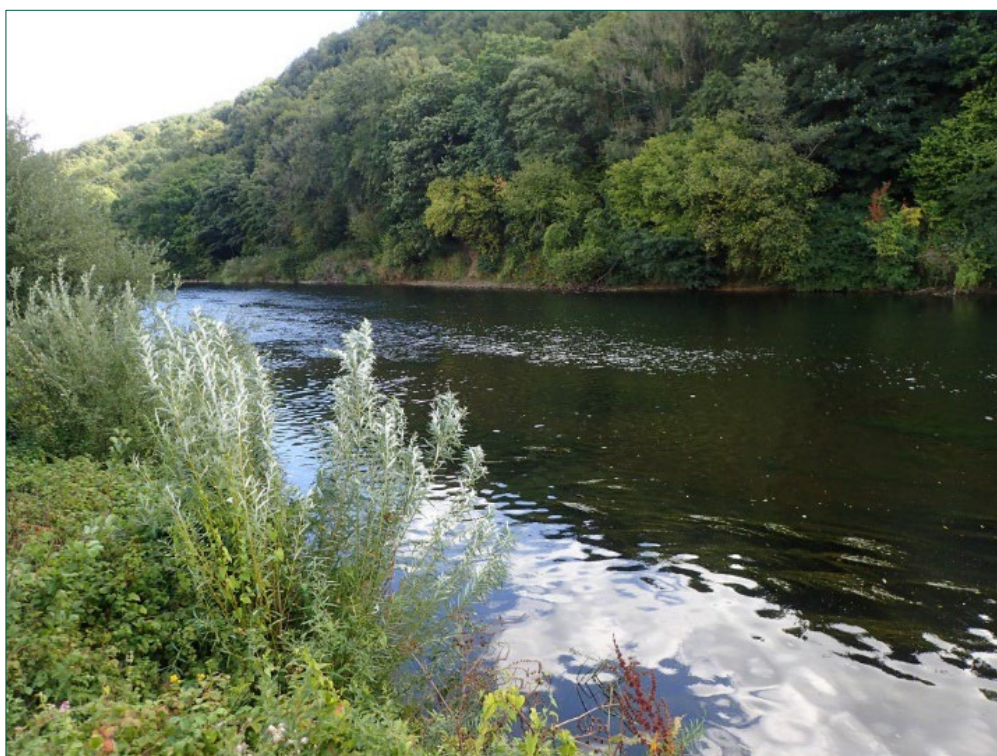


Figure 28. River Wye, Dixon. © Martin Willing

5.3.12. Urban & Synanthropic ecosystem

Species in Peril analysis has assigned 48 species to this ecosystem (Table 25), the majority of which are lichens, mosses and liverworts that are associated with metal mines (Table 26). Many of the species listed in Table 25 are obligate metallophytes, found only where metal concentrations are high and are toxic to most other plants. Some of the metallophyte lichens, such as *Lecidea silacea* and *Miriquidica lulensis* grow on rock, whilst others including *Micarea diminuta* are found on very fine metal-rich spoil; *Cercidospora stereocaulorum*, *Polycoccum tryptethelioides* and *Pseudorobillarda peltigerae* are fungi parasitic on lichens.

Key sites include Site 23, Halkyn Mountain, Nantymwyn Mine and Parys Mountain (Figure 29).

Table 25. *Species in Peril* assigned to *Urban & Synanthropic* ecosystem.

Group	No. species	Single Site species
Fungi	6	2
Lichens	22	15
Mosses & liverworts	4	1
Vascular plants	6	1
Spiders and allies	2	0
Crustaceans	1	1
Centipedes	1	0
Millipedes	1	0
Insects	5	4
Total	48	24

Table 26. Lichens, mosses and liverworts included in *Species in Peril* associated with metal mines.

Species	Vernacular name	Status	No. localities
<i>Cephaloziella nicholsonii</i>	Nicholson's Threadwort	GB-VU	4
<i>Scopelophila cataractae</i>	Tongue-leaved Copper-moss	GB-EN	5
<i>Cercidospora stereocaulorum</i>	a lichen	GB-NR	1
<i>Cladonia monomorpha</i>	a lichen	GB-NR	1
<i>Epigloea filifera</i>	a lichen	Wales-DD	2
<i>Frigidopyrenia bryospila</i>	a lichen	GB-DD	2
<i>Gyalidea lecideopsis</i>	a lichen	Wales-EN	2
<i>Knufia peltigerae</i>	a lichen	GB-NR	1
<i>Lecidea silacea</i>	a lichen	Wales-VU	1
<i>Micarea deminuta</i>	a lichen	Wales-DD	1
<i>Miriquidica atrofulva</i>	a lichen	Wales-VU	1
<i>Miriquidica lulensis</i>	a lichen	Wales-VU	2
<i>Placynthiella hyporhoda</i>	a lichen	Wales-VU	4
<i>Polycoccum tryphethelioides</i>	a lichen	Uncertain	2
<i>Pseudorobillarda peltigerae</i>	a lichen	GB-NR	1
<i>Rhizocarpon caeruleoalbum</i>	a lichen	GB-DD, Wales-DD	1
<i>Rhizocarpon rubescens</i>	a lichen	GB-NR	1
<i>Roselliniella microthelia</i>	a lichen	GB-NR	1
<i>Thelidium submethorium</i>	a lichen	GB-NR	1
<i>Zwackhiomyces martinianus</i>	a lichen	GB-NR	1



Figure 29. Mynydd Parys, Anglesey. © Des Callaghan

5.3.13. Woodland, Parkland & Scrub ecosystem

Species in Peril analysis has assigned 1076 species to *Woodland, Parkland & Scrub* ecosystem (Table 27), significantly more than any other ecosystem (Table 7), and with a considerable number restricted to a single locality. A total of 671 species are associated with broad-leaved woodland although this is likely to be an under-estimate. 29 species are found in wet woodland or are associated with woodland streams and seepages, and 187

are saproxylic species (184 insects and 3 pseudoscorpions). A fuller account of saproxylic invertebrates is given in Section 5.11.5, and parklands are covered in detail in Appendix 1.

287 species are classed as Critically Endangered, Endangered and Vulnerable including 139 restricted to a single locality. Four species are known in the UK only from Welsh localities - Irish Rock-bristle *Seligeria oelandica* from Craig y Cilau, the sawfly *Allantus laticinctus* (a scrub associate), the leafhopper *Edwardsiana rosaesugans* from Cwm Glais, the hoverfly *Epistrophe ochrostoma* from Nant Porth and the ground beetle *Sinechostichus inustus*. Barbastelle Bat *Barbastella barbastellus*, Bechstein's Bat *Myotis bechsteinii* and Leisler's Bat *Nyctalus leisleri* are all associated with broad-leaved woodland.

Many mycorrhizal and saprotrophic fungi are recorded from just a single Welsh locality, including Bearded Tooth *Hericium erinaceus* at Parkland E and the declining *Cantharellus aurora* which only has recent records from the woods around Swallow Falls. However, a significant number of woodland fungi are considered to be *Under-Recorded*. Norwegian Specklebelly *Pseudocyphellaria norvegica* and the related lichen *P. intricata* are known only from the upland-edge woods of Abergwynant, whilst Blackberries in Custard *Pyrenula hibernica* has its only British site south of Scotland in Ceunant Llennyrch. As well as the remarkable saproxylic fauna, woodland insects known from single Welsh sites include Blackthorn Mining Bee *Andrena varians* at Parc Lodge Wood, the elm-feeding White-spotted Pinion *Cosmia diffinis* at Oxwich, the hook-winged lacewing *Drepanopteryx phalaenoides* near Tregaron, and the Privet-feeding Barred Tooth-striped *Trichopteryx polycommata* at Slade Wood.

Though no birds associated with this ecosystem were identified as occupying five or fewer sites, two species are now considered to be extinct in Wales as breeding birds - Wryneck *Jynx torquilla* (woodland habitats) and Red-backed Shrike *Lanius collurio* (scrub habitats). Lesser Spotted Woodpecker *Dendrocopos minor* may be on the verge of extinction as a breeding bird of Wales. It is worth noting that woodland birds are now a fast declining UK bird group, down by 37% between 1970-2022 and are the fastest declining bird group, by 15% over the short-term time period (2017-2022).

Key localities include eleven which are in the top 50 *Species in Peril* sites including Chirk Park (82), Dinefwr Park (81 species), Parkland A (65), Pierce, Alcove & Piercefield Woods (47), Parkland B (38), Parkland C (32), Parkland D (30) (Figure 30), Blackcliff-Wyndcliff (29), Gregynog (28), Coedydd Aber (23) and Parkland E (22).

Table 27. *Species in Peril* assigned to Woodland, Parkland & Scrub ecosystem.

Group	No. species	Single Site species
Fungi	168	83
Lichens	113	59
Mosses & liverworts	19	13
Vascular plants	13	2
Gastropod molluscs	3	3
Spiders and allies	32	7
Crustaceans	2	0
Centipedes	1	0
Millipedes	2	2

Group	No. species	Single Site species
Insects	720	305
Mammals	3	2
Total	1076	476



Figure 30. Piercefield Park, Lower Wye Valley. © James McGill

5.4. Key sites

Species in Peril are found on more than 2000 sites, but a small number of key sites support a disproportionately large number of species (Table 28), as shown by the hotspot map in Appendix 7. Within the top 50 sites, there are dune systems around the Welsh coast (12 sites), parklands and woodlands (11 sites), lowland bogs and fens such as Cors Fochno, Cors Caron and Cors Erddreiniog (10 sites), rivers including the Usk, River A and Wye (5 sites) and montane (4 sites). It should be noted that sites often support a wide range of habitats which promote the rich and diverse mosaics essential to many species (see 5.4.1 to 5.4.4 as illustrations of this). However, for the purposes of this project, each species has been assigned to a single ecosystem and a single habitat.

Table 28. Number of *Species in Peril* recorded from the 50 most important Welsh sites. **This table has been partially redacted as it contains information relating to privately-owned land.**

Site	<i>Species in Peril</i>	Status	Ecosystem
Newborough Warren & Forest	130	NNR, SSSI	<i>Dune & Saltmarsh</i>
Whiteford Burrows	94	NNR, SSSI	<i>Dune & Saltmarsh</i>
Pembrey Coast	86	part SSSI	<i>Dune & Saltmarsh</i>

Site	Species in Peril	Status	Ecosystem
Yr Wyddfa	85	NNR, SSSI	Montane
Oxwich & Nicholaston Burrows	84	NNR, SSSI	Dune & Saltmarsh
Chirk Park	82	SSSI	Woodland, Parkland & Scrub
Kenfig Burrows	82	NNR, SSSI	Dune & Saltmarsh
Dinefwr Park	81	NNR, SSSI	Woodland, Parkland & Scrub
Merthyr Mawr Warren	74	NNR, SSSI	Dune & Saltmarsh
River Usk	69	SSSI	River, Stream & Ditch
Glyderau	67	SSSI	Montane
Parkland A	65	none	Woodland, Parkland & Scrub
Great Ormes Head	56	SSSI	Grassland
River A	56	none	River, Stream & Ditch
Gwent Levels	54	SSSI	River, Stream & Ditch
Stackpole	54	NNR, SSSI	Dune & Saltmarsh
Magor Marsh	50	SSSI	Peatland
River Wye	48	SSSI	River, Stream & Ditch
Carneddau	47	SSSI	Montane
Pierce, Alcove & Piercefield Woods	47	SSSI	Woodland, Parkland & Scrub
Morfa Harlech	43	NNR, SSSI	Dune & Saltmarsh
Afon Tywi	38	SSSI	River, Stream & Ditch
Parkland B	38	none	Woodland, Parkland & Scrub
Crymlyn Bog	36	NNR, SSSI	Peatland
Fenns, Whixall & Bettisfield Mosses	35	NNR, SSSI	Peatland
Morfa Dyffryn	35	NNR, SSSI	Dune & Saltmarsh
Tywyn Aberffraw	34	SSSI	Dune & Saltmarsh
Ynyslas Dunes	33	NNR, SSSI	Dune & Saltmarsh
Parkland C	32	none	Woodland, Parkland & Scrub
Parkland D	30	none	Woodland, Parkland & Scrub
Blackcliff-Wyndcliff	29	SSSI	Woodland, Parkland & Scrub
Cors Erddreiniog	29	NNR, SSSI	Peatland
Cors Goch	29	NNR, SSSI	Peatland
Gregynog	28	NNR, SSSI	Woodland, Parkland & Scrub
Horton Cliffs	28	SSSI	Grassland
Cors Fochno	27	NNR, SSSI	Peatland
Marford Quarry	27	SSSI	Lowland Rock Exposure
Castlemartin Range	26	SSSI	Grassland
River B	26	none	River, Stream & Ditch
Grassland A	26	none	Grassland
Cadair Idris	25	NNR, SSSI	Montane
Crymlyn Burrows	25	SSSI	Dune & Saltmarsh
Cors Caron	25	NNR, SSSI	Peatland
Cors Geirch	24	NNR, SSSI	Peatland
Cors Bodeilio	23	NNR, SSSI	Peatland
Coedydd Aber	23	NNR, SSSI	Woodland, Parkland & Scrub
Pant-y-Sais	23	SSSI	Peatland
Ynys Enlli	23	NNR, SSSI	Coast & Coastal Cliff
Parkland E	22	none	Woodland, Parkland & Scrub
East Aberthaw	19	SSSI	Coast & Coastal Cliff

Some sites are disproportionately important for one taxonomic group. For example, parklands such as Chirk Park (Alexander, 2019b), Parkland A (citation redacted) and Parkland B (citation redacted) are important for saproxylic invertebrates but of limited interest for other groups, although Dinefwr Park is outstanding for invertebrates and lichens (Alexander, 2024; Windle & Douglas, 2023). Others are important across a wide range of taxa, especially the dune systems of Newborough Warren & Forest (Table 29), Whiteford Burrows, Kenfig Burrows, Pembrey Coast and Merthyr Mawr Warren. The Newborough dune system (Figure 31) supports important populations of Mammoth Mushroom *Agaricus macrocarpus*, the fungus *Clitocybe inornata*, Large Hook-moss *Drepanocladus lycopodioides* (Bosanquet, 2019), Baltic Stonewort *Chara baltica* (Stewart & Hatton-Ellis, 2020), Dune Helleborine *Epipactis dunensis*, Shore Dock *Rumex rupestris*, Confounding Sunshiner *Amara nitida* (Howe, 2020b), the rove beetle *Gabrius exiguus* (Howe, 2023b) and Sandhill Rustic *Luperina nickerlii* (Howe, 2020aiv).

Table 29. *Species in Peril* at Newborough Warren & Forest by taxonomic group. The orders that make up the total of 102 invertebrate are listed separately, with counts in brackets.

Group	No. Species
Fungi	19
Mosses & liverworts	4
Stoneworts	1
Vascular plants	4
Terrestrial & freshwater invertebrates	102
Spiders & allies	(5)
Beetles	(58)
Bugs	(13)
Butterflies & moths	(2)
Bees, wasps, ants & sawflies	(11)
Flies	(11)
Lacewings	(2)
Grand total	130



Figure 31. Newborough Warren. © Rhodri Parry

Six other sand dune systems are in the top twenty localities for *Species in Peril*. In order of importance, these are Whiteford Burrows (see Section 5.4.1), Pembrey Coast, Oxwich & Nicholaston Burrows, Kenfig Burrows, Merthyr Mawr Warren and Stackpole (Table 30). Six of these sites are on the south Wales coast, where floras and faunas tend to be richer, the exception being Newborough Warren & Forest. These sites are particularly important for insects and fungi, many of which are associated with bare sand and other early-successional habitats. As some of our biggest dune systems, seven of the sites are National Nature Reserves, whilst Pembrey Coast is part owned by NRW, the MoD and Carmarthenshire County Council. Many of the sites have been the focus of dune rejuvenation management works as part of the recently completed *Sands of LIFE* project to restore pioneer conditions.

Table 30. Welsh dune systems supporting important numbers of *Species in Peril*.

Group	Newborough Warren & Forest	Whiteford Burrows	Pembrey Coast	Oxwich & Nicholaston Burrows	Kenfig Burrows	Merthyr Mawr Warren	Stackpole
Fungi	19	15	12	5	3	4	13
Lichens	0	0	0	0	0	2	13
Mosses & liverworts	4	2	2	0	2	0	2
Stoneworts	1	0	1	0	0	0	0
Vascular plants	4	3	3	2	2	0	4

Group	Newborough Warren & Forest	Whiteford Burrows	Pembrey Coast	Oxwich & Nicholaston Burrows	Kentfig Burrows	Mertthyr Mawr Warren	Stackpole
Bivalve molluscs	0	0	0	0	1	0	0
Gastropod molluscs	0	1	1	1	0	0	1
Spiders & allies	5	3	2	3	4	0	0
Millipedes	0	1	0	0	0	0	0
Insects	97	69	65	73	70	68	20
Total	130	94	86	84	82	74	53
Restricted to single locality	37	19	17	22	19	15	15

Three parklands are in the top twenty localities including, in order of importance, Chirk Park, Dinefwr Park (see Section 5.4.2), and Parkland A (Table 31). The National Trust owns and manages Dinefwr Park and Chirk Park, the former as an NNR. [Sentence redacted]. Saproxylic insects form the majority of *Species in Peril* at all three sites, with lichens also important at Dinefwr Park.

Both Chirk Park and Dinefwr Park have received recent attention in terms of surveys for invertebrates (Alexander, 2019b, 2024), lichens (Sanderson, 2013) and fungi (Bosanquet & Lucas, 2021), whilst the last survey of Park, for saproxylic invertebrates, was in 1996 (Judd, 1999a). Pierce, Alcove & Piercefield Woods is the only woodland to make the top 20 localities, with the majority of species being saproxylic insects. Following recent surveys funded by NRW, the Wye Gorge woodlands have been highlighted as being of international importance for their saproxylic invertebrate faunas, with Pierce, Alcove & Piercefield Woods being a key site within the landscape on the Welsh side of the border (Alexander, 2019c, 2020, 2023b; Howe *et al.*, 2022).

The montane sites of Yr Wyddfa, Glyderau (see Section 5.4.3) and Carneddau support important *Species in Peril* numbers, with lichens, mosses, liverworts and vascular plants being particularly prominent. Montane floras and faunas are at risk from climate change, as witnessed by the recent extirpation of Whiteworm Lichen as a Welsh species (Turner, 2023).

Table 31. Top 20 sites for *Species in Peril* other than dune systems.

Group	Yr Wyddfa	Chirk Park	Dinefwr Park	River Usk	Glyderau	Parkland A	Great Ormes Head	River A	Gwent Levels	Magor Marsh	River Wye	Carneddau	Pierce, Alcove & Piercefield Woods
Fungi	4	2	0	0	2	0	6	0	0	0	0	0	0
Lichens	27	0	7	3	28	0	8	0	0	0	3	8	0
Mosses & liverworts	16	0	0	1	13	0	3	0	0	0	1	9	0
Vascular plants	20	1	0	0	12	0	5	0	0	1	0	14	1
Bivalve molluscs	0	0	0	1	1	0	0	1	0	1	1	0	0
Spiders & allies	3	1	0	1	0	1	6	0	1	0	0	6	0
Crustaceans	0	0	0	0	0	0	0	0	0	0	0	0	1
Millipedes	0	0	0	0	0	0	1	0	0	0	0	0	0
Insects	15	78	74	60	10	64	27	55	44	48	41	10	45
Springtails	0	0	0	0	1	0	0	0	0	0	0	0	0
Fish & lampreys	0	0	0	1	0	0	0	0	0	0	2	0	0
Birds	0	0	0	2	0	0	0	0	9	0	0	0	0
Total	85	82	81	69	67	65	56	56	54	50	48	47	47
Restricted to single locality	33	10	11	15	17	6	10	13	9	14	7	10	11

Three rivers make the top 20 sites, River Usk, River A and River Wye (see Section 5.4.4), with insects associated with exposed riverine sediments (ERS) providing the majority of species. The Usk and the Wye are both SSSIs and SACs, split into lower and upper sections, whilst River A has no statutory protection. River A has been known to be important for ERS specialists and riverine species for over 100 years and the invertebrate fauna interest was reviewed twenty years ago (citation redacted). None of these rivers has received any recent strategic ERS invertebrate surveys, with the last focussing on flies in 2005 (Drake *et al.*, 2007).

The seven SSSIs on the Gwent Levels – 5000ha of reclaimed, mostly agricultural land and 870 miles of ditches (reens) – collectively support 54 species in *Species in Peril*, with the adjoining Magor Marsh supporting 50 species. The majority of these are aquatic and semi-aquatic insects associated with the reens. Given the development pressures on the Gwent Levels, there are regular botanical and invertebrate surveys including assessments of the condition of the reen invertebrate assemblages (e.g. Boyce, 2024).

The only grassland to make the top 20 is Great Ormes Head with 56 species, most of which are insects including the endemic subspecies of Grayling *Hipparchia semele thyone*.

Of the top 50 sites, eight have no statutory site protection – Parkland A (ranked 12th), River A (14th), Parkland B (23rd), Parkland C (29th), Parkland D (30th), River B (39th), Grassland A (40th) and Parkland E (49th). [Sentence redacted]. Consideration should be given to designating these sites as SSSIs given the importance of their faunas and floras and associated habitats (see Section 5.5.3).

The following subsections provide a brief account of four key sites for *Species in Peril*.

5.4.1. Whiteford Burrows

Whiteford Burrows (Figure 32) is part of Twyni Chwitffordd, Morfa Landimôr a Bae Brychdwn/Whiteford Burrows, Landimore Marsh and Broughton Bay SSSI and Carmarthen Bay Dunes/Twyni Bae Caefyrddin SAC. It is also a National Nature Reserve, owned by the National Trust and managed by NRW on a long-term lease. Whiteford Burrows is a 129ha spit dune system lying at the north-west tip of the Gower Peninsula at the mouth of the Burry Inlet. Supporting a range of habitats from bare sand to fixed dune grassland and scrub, the dunes are actively accreting in the south-west but eroding near Whitford Point. A transition zone on the eastern flank supports freshwater seepages, swamp and tall herb vegetation before grading into saltmarsh, and is one of the best examples of this type of transition zone in Britain. Recent management has focussed on the removal of conifer plantations to restore dune habitats and small-scale dune rejuvenation to promote early-successional habitats.

Whiteford Burrows supports 94 *Species in Peril* including 19 restricted to this dune system (Table 28 & Table 30). It ranks as the second most important site for *Species in Peril*, bettered only by Newborough Warren & Forest. Among the vascular plants found in the dune system are Dune Gentian *Gentianella amarella* subsp. *occidentalis* and Fen Orchid, both known from just three Welsh sites, and Early Sand-grass *Mibora minima* at its only south Wales locality (although it has not been recorded here since 2016 and subsequent searches in 2019 and 2022 have failed to locate it). Baltic Bryum *Bryum marratii* and Warne's Thread-moss *Bryum warneum* are both known from three other Welsh sites. A total of 15 *Species in Peril* fungi is found on Whiteford Burrows including the only recorded Welsh population of *Agaricus luteomaculatus*, and six species known from just one other Welsh site including *Geopora arenosa* and *Melanoleuca pseudoluscina*. Of the 74 *Species in Peril* invertebrates, key species include the money spider *Baryphyma gowerense* at its type locality, Strandline Beetle *Eurynebria complanata*, Narrow-mouthed Whorl Snail *Vertigo angustior* and the chalcid wasp *Chalcis sispes* at its only contemporary Welsh locality. A further 17 insect species are currently known only from Whiteford Burrows.



Figure 32. Whiteford Burrows. © Mike Howe

5.4.2. Dinefwr Park

Dinefwr Park (Figure 33), to the immediate west of Llandeilo, is the key component of Dinefwr Estate SSSI, which is also a National Nature Reserve. The 29ha parkland is owned and managed by the National Trust, with the adjacent Castle Woods, Church Wood and South Lodge Wood, which all support mature and veteran trees, owned by the Wildlife Trust of South & West Wales (WTSWW). It is one of several Welsh parkland sites that are very important for their diverse saproxylic invertebrate faunas, but Dinefwr stands out from the others because it is also a highly significant site for Old Forest lichens. Overall, Dinefwr Park supports 81 *Species in Peril* including 11 species restricted to the site (Table 28 & Table 31).

Old Forest lichens include *Collema fragrans*, which is known from just one other Welsh site, and the ancient tree specialists *Buellia hyperbolica*, *Enterographa soledata* and *Microcalicium ahlneri*. Of the c.250 saproxylic beetle species at Dinefwr Park, 13 are included in *Species in Peril* with the featherwing beetle *Ptinella limbata* at its only Welsh locality. Other species include Spatulate-legged Bark Clown *Abraeus granulum*, *Atomaria lohsei*, *Batrisodes venustus*, *Cryptophagus micaceus* and *Euplectus infirmis*. The invertebrates of Dinefwr Park include not only ancient tree specialists, but also rare species of freshwater and grassland ecosystems. The rove beetle *Philonthus corruscus* was last recorded in the UK on exposed riverine sediments on the Afon Tywi on Dinefwr Estate in 1991. A total of 11 invertebrate species is restricted to Dinefwr Park and the wider woodland estate.

Recent surveys of the lichens (Windle & Douglass, 2023) and saproxylic invertebrates (Alexander, 2024) of Dinefwr Estate recommended the planting of new parkland trees and

halo-thinning of veteran trees within woodland blocks, with the latter management commencing in 2024.



Figure 33. Dinefwr Park © Sam Bosanquet

5.4.3. Glyderau

The Glyderau massif (Figure 34) lies within both Eryri SSSI and Eryri/Snowdonia SAC, which also encompass Yr Wyddfa and Carneddau. Glyderau stretches from Mynydd Llandegai to Capel Curig and includes five summits over 3000ft including Glyder Fach, Glyder Fawr and Tryfan. Key localities are Cwm Idwal, Elidir Fach, Elidir Fawr, Glyder Fawr, Mynydd Perfedd, Y Garn, Llyn Idwal and some smaller montane water bodies. It covers an area of about 7000ha with a range of habitats including lichen heath, montane heath, dry heath, wet heath, blanket bog, flush and spring, calcareous, acid and neutral grassland, tall herb and fern ledges, vegetated scree, rock exposures with crevice vegetation and low nutrient tarns.

Glyderau supports 67 *Species in Peril* including 17 which are restricted to this massif and a further 28 species restricted to Eryri (Table 32). In addition, Stabler's Rustwort *Marsupella stableri* is otherwise only known from Cadair Idris and the lichen *Alectoria nigricans* from Mynydd Mawr.

Table 32. *Species in Peril* restricted to Glyderau, either wholly or within Eryri (Glyderau, Carneddau & Yr Wyddfa).

Species	Vernacular name	Restricted to Glyderau	Restricted to Eryri
<i>Puccinia oxyriae</i>	Mountain Sorrel Rust	No	Yes
<i>Russula melitodes</i>	a brittlegill	Yes	No
<i>Allantoparmelia alpicola</i>	a lichen	Yes	No
<i>Catillaria contristans</i>	a lichen	Yes	No
<i>Fuscidea austera</i>	a lichen	No	Yes
<i>Fuscidea mollis</i>	a lichen	No	Yes
<i>Ionaspis odora</i>	a lichen	No	Yes
<i>Jamesiella scotica</i>	Scottish Snot-lichen	No	Yes
<i>Koerberiella wimmeriana</i>	a lichen	No	Yes
<i>Lempholemma radiatum</i>	a lichen	No	Yes
<i>Micarea pseudomarginata</i>	a lichen	Yes	No
<i>Peltigera venosa</i>	Green Veiny Lichen	No	Yes
<i>Rhizocarpon anaperum</i>	a lichen	No	Yes
<i>Rhizocarpon intermediellum</i>	a lichen	Yes	No
<i>Rhizocarpon superficiale</i>	a lichen	Yes	No
<i>Sporastatia polyspora</i>	a lichen	Yes	No
<i>Staurothele hymenogonia</i>	a lichen	Yes	No
<i>Strigula stigmatella</i> var. <i>alpestris</i>	a lichen	Yes	No
<i>Toninia fusispora</i>	a lichen	No	Yes
<i>Dicranodontium asperulum</i>	Orange Bow-moss	Yes	No
<i>Isopterygiopsis muelleriana</i>	Mueller's Silkmoss	No	Yes
<i>Kiaeria falcata</i>	Sickle-leaved Forkmoss	No	Yes
<i>Plagiothecium platyphyllum</i>	Alpine Silkmoss	No	Yes
<i>Pohlia ludwigii</i>	Ludwig's Threadmoss	No	Yes
<i>Scapania ornithopodioides</i>	Birds-foot Earwort	No	Yes
<i>Scapania paludosa</i>	Floppy Earwort	Yes	No
<i>Scapania uliginosa</i>	Marsh Earwort	No	Yes
<i>Arabidopsis petraea</i>	Northern Rock-cress	No	Yes
<i>Bistorta vivipara</i>	Viviparous Bistort	No	Yes
<i>Carex atrata</i>	Black Alpine Sedge	No	Yes
<i>Dryas octopetala</i>	Mountain Avens	No	Yes
<i>Gagea serotina</i>	Snowdon Lily	No	Yes
<i>Juncus triglumis</i>	Three-flowered Rush	No	Yes
<i>Micranthes nivalis</i>	Alpine Saxifrage	No	Yes
<i>Saussurea alpina</i>	Alpine Saw-wort	No	Yes
<i>Saxifraga cespitosa</i>	Tufted Saxifrage	Yes	No
<i>Brachycaudus sedi</i>	an aphid	Yes	No
<i>Catoptria furcatellus</i>	Northern Grass-veneer	No	Yes
<i>Conventus conventus</i>	Arctic-Alpine Pea Clam	Yes	No
<i>Cryptopygus bipunctatus</i>	a springtail	Yes	No
<i>Entephria flavicinctata</i>	Yellow-ringed Carpet	No	Yes
<i>Euura herbacea</i>	a sawfly	No	Yes
<i>Notiophilus aestuans</i>	a ground beetle	Yes	No
<i>Pristiphora staudingeri</i>	a sawfly	Yes	No
<i>Rhamphomyia morio</i>	a dancefly	No	Yes



Figure 34. Castell y Gwynt, Glyderau © Rhodri Parry

5.4.4. River Wye

From its source to its confluence, the main channel of the River Wye (Figure 35) is 250km long, draining a catchment of 4136 sq. km and having the fourth largest flow of any river in England and Wales. Rising at an altitude of 680m on Pumlumon Fawr, the Wye meanders through Wales, Herefordshire and Gloucestershire finally entering the Severn Estuary at Chepstow. The river comprises three SSSIs – River Wye (Upper Wye)/Afon Gwy (Gwy Uchaf); River Wye (Lower Wye)/Afon Gwy (Gwy Isaf); River Wye (Tributaries)/Afon Gwy (Isafonydd) – and a SAC (Rive Wye/Afon Gwy SAC). For the purpose of *Species in Peril*, species assigned to the River Wye refer to the main channel and associated habitats only.

The River Wye is important for a range of habitats and species, including 48 *Species in Peril* of which seven are restricted to the river (Table 28 & Table 31). These include the Delicate Flapwort *Endogemma caespiticia*, aquatic lichens such as River Jelly Lichen *Collema dichotomum*, *Leptogium subtorulosum* and *Rinodina fimbriata*, and Rock Cinquefoil *Potentilla rupestris* where, at its southernmost UK locality, it is situated on a riverine rock platform lightly shaded by trees (Wiggington & Pescott in Stroh *et al.*, 2023).

The Depressed River Mussel *Pseudanodonta complanata*, the water beetle *Oulimnius major* and the caddisfly *Setodes punctatus* are restricted to the Wye in Wales whilst three riffle beetles, *Macronychus quadrituberculatus*, *Riolus nitens* and *Stenelmis canaliculata* have important populations in the river. Exposed riverine sediments are an important invertebrate habitat on the Wye, with 11 of the 90 known ERS species included in *Species in Peril* and the long-legged fly *Rhaphium patulum* found only on the Wye. The Hairy Click Beetle *Synaptus filiformis* is associated with riparian vegetation and restricted to Tintern Old Station in Wales.

There is a large population of Twaite Shad *Alosa fallax* are found on the Wye. Its close relative Allis Shad *Alosa alosa* is also thought to have a small population on the river.



Figure 35. River Wye near Boughrood © Sam Bosanquet

5.5. Site protection

5.5.1. Sites of Special Scientific Interest (SSSIs)

A total of 2222 (75%) *Species in Peril* occurs on at least one SSSI in Wales, including 1402 (47%) found only on SSSIs (Table 33). These figures show just how critical SSSI protection is for our rarest Welsh species, as is managing those SSSI to conserve the plethora of rare species which live on them. With nearly half of the rarest species in Wales restricted to SSSIs, and a large majority represented on (and in many cases almost restricted to) SSSIs, maintaining and enhancing those sites is the only way to prevent significant species loss from Wales. Maps in Appendix 7 show the degree of coincidence between *Species in Peril* site centroids and SSSIs.

Despite a majority of *Species in Peril* being found on SSSIs, only 721 (24%) are currently notified and/or qualify as features of SSSIs. 184 of these have been included as officially notified species features when the SSSI was originally designated, whilst 282 qualify individually for recognition as a SSSI feature but were not specifically notified when the site was designated. 255 species are included in notified or qualifying assemblage features. These different categories might appear arbitrary, but only notified features are legally protected, so species that qualify as SSSI features but were not identified as features when the SSSI was originally notified have no official legal protection. They are however in a better position than the majority of species with highly restricted Welsh ranges, because their recognition as a qualifying feature at least means that they are often taken into consideration when habitat management or monitoring are undertaken.

Table 33. The representation of *Species in Peril* on SSSIs by taxonomic group. Note that 733 species are not represented on SSSIs.

Group	Represented on SSSIs	Not represented on SSSIs	Total	Restricted to SSSIs
Fungi	181	128	309	105
Lichens	266	55	321	225
Mosses & liverworts	95	12	107	75
Stoneworts	7	0	7	7
Vascular plants	130	25	155	80
Moss animals	1	0	1	1
Gastropod molluscs	11	2	13	8
Bivalve molluscs	6	1	7	3
Spiders & allies	95	14	109	55
Crustaceans	5	3	8	3
Springtails	3	3	6	3
Centipedes	1	4	5	0
Millipedes	4	4	8	3
Insects	1379	481	1859	807
Fish & lampreys	5	0	5	3
Amphibians & reptiles	1	0	1	1
Mammals	6	0	6	3
Birds	26	1	27	20
Grand total	2222	733	2955	1402

SSSI monitoring is undertaken to determine the condition of Welsh SSSI features and is therefore critical to guiding the management of sites so as to maintain features in favourable condition. Most SSSI monitoring is carried out in-house by NRW, with a primary focus on vegetation condition. Some monitoring of SSSI species features is carried out, especially for vascular plants, fish and some butterflies and dragonflies, but many species features are too difficult to identify for in-house monitoring to be possible.

The commissioning of species feature monitoring by independent experts is therefore essential, especially for species groups such as mosses, liverworts, lichens, fungi and most invertebrate groups. Without such monitoring, there is no way of determining the status of our rarest species, especially given that such a high proportion of them are found on or restricted to SSSIs. The results of specialist survey and monitoring commissioned over the last eleven years are published in NRW's Evidence Reports Series, totalling some 800 pieces of evidence many of which include assessments of our rarest species.

5.5.2. National Nature Reserves (NNRs)

1047 (35%) *Species in Peril* are present on at least one National Nature Reserve (NNR), so are under the direct management of Natural Resources Wales or a close partner organisation, whilst 353 (12%) are entirely restricted to NNRs (Table 34). These are relatively low numbers compared with representation on SSSIs, in part because a handful of very significant sites are not NNRs (Table 28). That a third of the rarest species in Wales are present on NNRs is still significant, emphasising the active role that NRW can play in their safeguarding.

This number contrasts starkly with the fewer than 150 *Species in Peril* that have been recorded on the Welsh Government Woodland Estate (WGWE), and highlights why management of NNRs is such an essential part of NRW's commitment to reversing the Nature Emergency. Where WGWE contributes to *Species in Peril*, the species are mostly associated with semi-natural habitats rather than coniferous woodland e.g. dune habitats within Newborough Forest (57 species) and Site 38 (35 species), and broadleaved woodland habitats in Site 52 (11 species).

Table 34. *Species in Peril* found on Welsh National Nature Reserves (NNRs). The orders that make up the totals of 688 and 200 invertebrates are listed separately, with counts in brackets.

Group	Represented on NNRs	Restricted to NNRs
Fungi	111	44
Lichens	127	73
Mosses & liverworts	49	16
Stoneworts	5	3
Vascular plants	57	13
Terrestrial & freshwater invertebrates	688	200
Spiders & allies	(57)	(14)
Gastropod molluscs	(4)	(1)
Bivalve molluscs	(2)	(1)
Insects	(625)	(184)
Amphibians & reptiles	1	0
Mammals	3	1
Birds	6	3
Total	1047	353

5.5.3. Non-statutory sites

Of the 733 *Species in Peril* not found on protected sites, 479 (65%) are restricted to single sites (Table 35). Key non-statutory sites for *Species in Peril* include Site 18, Site 20, Site 45 and Site 46 and their importance is highlighted in Table 28 and Table 36. In addition, Site 38, [redacted], supports 35 species included in *Species in Peril*. This is a conifer plantation managed by NRW as part of the WGWE although the species are mostly associated with sand dunes and other semi-natural habitats within the forest. The majority of non-statutory sites support fewer *Species in Peril*, although numbers on Site 1, Site 23 and Site 52 are significant.

Table 35. *Species in Peril* restricted to non-statutory sites by number of sites.

No. sites	No. species
1	479
2	154
3	59
4	31
5	10
Total	733

Table 36. Key non-statutory sites for *Species in Peril*. Site names have been redacted as they relate to privately-owned land.

Non-statutory site no. (Ecosystem in brackets)	Species in Peril	Species restricted to non-statutory Sites	Key species
1. (River, Stream & Ditch)	9	2	<i>Dicranomyia caledonica</i> ; <i>Oxycera terminata</i>
2. (Peatland)	1	0	<i>Vertigo moulinsiana</i>
3. (Dune & Saltmarsh)	7	0	<i>Harpalus serripes</i>
4. (Woodland, Parkland & Scrub)	5	4	<i>Epuraea neglecta</i> ; <i>Rabocerus foveolatus</i>
5. (Urban & Synanthropic)	8	0	<i>Pseudospinolia neglecta</i>
6. (Grassland)	2	0	<i>Acinia corniculata</i> ; <i>Microdon devius</i>
7. (Woodland, Parkland & Scrub)	3	1	<i>Barbastellus barbastella</i> ; <i>Inocybe ovatocystis</i> ; <i>Lactarius glaucescens</i>
8. (Woodland, Parkland & Scrub)	6	4	
9. (Woodland, Parkland & Scrub)	8	3	<i>Empis limata</i> ; <i>Korynetes caeruleus</i>
10. (Woodland, Parkland & Scrub)	2	1	<i>Dendrographa latebrarum</i> ; <i>Telaranea europaea</i>
11. (Woodland, Parkland & Scrub)	2	0	<i>Cystoderma simulatum</i> ; <i>Hohenbuehelia unguicularis</i>
12. (Grassland)	3	3	<i>Lichenochora mediterraneae</i>
13. (Peatland)	1	0	<i>Formica picea</i>
14. (Grassland)	5	3	<i>Agonopterix atomella</i> ; <i>Leptodontium gemmascens</i> ; <i>Mirificarma lentiginosella</i>
15. (Woodland, Parkland & Scrub)	3	1	<i>Parallelomma paridis</i> ; <i>Parallelomma vittatum</i>
16. (Grassland)	1	1	<i>Neotinea ustulata</i>
17. (Peatland)	4	2	<i>Oxycera dives</i>
18. (Woodland, Parkland & Scrub)	32	13	<i>Agaricus lanipes</i> ; <i>Eupachygaster tarsalis</i> ; <i>Gnathoncus communis</i> ; <i>Orthotrichum pallens</i> ; <i>Quedius aetolicus</i> ; <i>Quedius brevicornis</i> ; <i>Sesia apiformis</i>
19. (Woodland, Parkland & Scrub)	1	1	<i>Orthotrichum cambrense</i>
20. (Woodland, Parkland & Scrub)	22	11	<i>Agaricus bohusii</i> ; <i>Corticeus bicolor</i> ; <i>Hericium erinaceus</i> ; <i>Taphrorychus bicolor</i>
21. (Dune & Saltmarsh)	7	1	<i>Odontoscelis fuliginosa</i>
22. (Woodland, Parkland & Scrub)	5	2	<i>Oxypoda flavicornis</i> ; <i>Pammene ochsenheimeriana</i>
23. (Urban & Synanthropic)	13	7	<i>Rhizocarpon rubescens</i> ; <i>Tricholoma sulphurescens</i>
24. (Woodland, Parkland & Scrub)	4	3	<i>Absoconditella lignicola</i> ; <i>Pachyprotasis nigronotata</i>
25. (Woodland, Parkland & Scrub)	5	0	<i>Tritoma bipustulata</i>
26. (Woodland, Parkland & Scrub)	2	1	<i>Leptidea sinapis</i> ; <i>Lobesia occidentis</i>
27. (Grassland)	7	1	<i>Agonopterix atomella</i> ; <i>Euphorbia platyphyllos</i> ; <i>Mirificarma lentiginosella</i>
28. (Grassland)	4	2	<i>Inocybe flavella</i> ; <i>Tricholoma gausapatum</i>
29. (Dune & Saltmarsh)	7	1	<i>Rabigus pullus</i>
30. (Grassland)	2	2	<i>Dicranocephalus medius</i> ; <i>Parallelomma vittatum</i>

Non-statutory site no. (Ecosystem in brackets)	Species in Peril	Species restricted to non-statutory Sites	Key species
31. (Woodland, Parkland & Scrub)	38	14	<i>Atomaria fuscipes</i> ; <i>Corticaria alleni</i> ; <i>Euplectus bonvouloiri</i> ; <i>Latridius consimilis</i> ; <i>Sinechostichus inustus</i> ; <i>Solva marginata</i>
32. (Woodland, Parkland & Scrub)	4	4	<i>Epuraea thoracica</i> ; <i>Mycetophagus populi</i>
33. (Grassland)	4	3	<i>Anthracoides paniceae</i> ; <i>Licinus punctulatus</i> ; <i>Parallelomma vittatum</i>
34. (Grassland)	10	0	<i>Euphrasia pseudokernerii</i>
35. (Grassland)	4	2	<i>Neoitamus cothurnatus</i>
36. (Cave & Subterranean)	2	0	<i>Antrobathynella stammeri</i> ; <i>Porrhomma rosenhaueri</i>
37. (Woodland, Parkland & Scrub)	6	1	<i>Inocybe xanthomelas</i> ; <i>Physcia tribacioides</i> ; <i>Usnea glabrata</i>
38. (Dune & Saltmarsh)	35	12	<i>Chrysis fulgida</i> ; <i>Depressaria discipunctella</i> ; <i>Gaeastrum pectinatum</i> ; <i>Hohenbuehelia petaloides</i> ; <i>Hygrocybe aurantia</i> ; <i>Legnotus picipes</i> ; <i>Macronychia polyodon</i> ; <i>Mimesa bicolor</i> ; <i>Rugosomyces obscurissimus</i> ; <i>Sarcophaga albiceps</i> ; <i>Synanthedon culiciformis</i> ; <i>Xysticus luctuosus</i>
39. (Woodland, Parkland & Scrub)	2	2	<i>Cossonus parallelepipedus</i> ; <i>Minutophoma chrysophthalmae</i>
40. (Woodland, Parkland & Scrub)	30	15	<i>Ampedus rufipennis</i> ; <i>Atropa belladonna</i> ; <i>Corticaria alleni</i> ; <i>Dexiogyia corticina</i> ; <i>Lymexylon navale</i> ; <i>Mycetophagus quadriguttatus</i> ; <i>Notolaemus unifasciatus</i> ; <i>Phortica variegata</i> ; <i>Procræus tibialis</i> ; <i>Scydmaenus rufus</i> ; <i>Skyttea buelliae</i> ; <i>Sorbus eminens</i> ; <i>Sorbus eminentiformis</i> ; <i>Taphrorychus bicolor</i> ; <i>Tillus elongatus</i>
41. (Woodland, Parkland & Scrub)	4	2	<i>Gaeastrum pectinatum</i> ; <i>Mycena seynii</i> ; <i>Rhymbocarpus cruciatus</i>
42. (Woodland, Parkland & Scrub)	65	15	<i>Abdera quadrifasciata</i> ; <i>Acrotrichis arnoldi</i> ; <i>Aeletes atomarius</i> ; <i>Alevonota egregia</i> ; <i>Aulacigaster leucopeza</i> ; <i>Batrissodes venustus</i> ; <i>Carpelimus gracilis</i> ; <i>Cryptophagus insulicola</i> ; <i>Dexiogyia corticina</i> ; <i>Dryodromia testacea</i> ; <i>Epuraea terminalis</i> ; <i>Gnathoncus communis</i> ; <i>Mycetophagus quadriguttatus</i> ; <i>Oligella intermedia</i> ; <i>Pocota personata</i> ; <i>Pseudomicrodota paganettii</i> ; <i>Ptenidium gressneri</i> ; <i>Ptilium marginatum</i> ; <i>Ptilium schwarzi</i> ; <i>Quedius brevicornis</i> ; <i>Rhizophagus oblongicollis</i> ; <i>Synchita separanda</i>
43. (Woodland, Parkland & Scrub)	5	4	<i>Adicella filicornis</i> ; <i>Ellipteroides alboscuteatus</i> ; <i>Lipsothrix nigristigma</i> ; <i>Pediopsis tiliae</i>
44. (Dune & Saltmarsh)	4	2	<i>Limonium recurvum</i> ; <i>Roemeria argemone</i>
45. (River, Stream & Ditch)	56	15	<i>Arctoconopa melampodia</i> ; <i>Bembidion testaceum</i> ; <i>Chrysophilus erythrophthalmus</i> ; <i>Clorismia rustica</i> ; <i>Cosmetopus dentimanus</i> ; <i>Diaphorus hoffmanseggii</i> ; <i>Dolichopus argyrotarsis</i> ; <i>Erioptera limbata</i> ; <i>Odhneripisidium tenuilineatum</i> ; <i>Oxycera terminata</i> ; <i>Platypalpus melancholicus</i> ; <i>Rhaphium gravipes</i> ; <i>Rhaphium penicillatum</i> ; <i>Riolus nitens</i>
46. (River, Stream & Ditch)	26	3	<i>Aloconota eichhoffi</i> ; <i>Bembidion obliquum</i> ; <i>Hexatoma bicolor</i> ; <i>Meotica anglica</i> ; <i>Thinobius newberyi</i>

Non-statutory site no. (Ecosystem in brackets)	Species in Peril	Species restricted to non-statutory Sites	Key species
47. (Grassland)	1	1	<i>Motacilla flava</i>
48. (Woodland, Parkland & Scrub)	5	2	<i>Colin latus</i> ; <i>Herichia cirrhatum</i> ; <i>Oedalea apicalis</i>
49. (Woodland, Parkland & Scrub)	6	4	<i>Sciocoris cursitans</i>
50. (Agricultural)	2	2	<i>Ranunculus arvensis</i> ; <i>Scandix pecten-veneris</i>
51. (Woodland, Parkland & Scrub)	16	7	<i>Corticaria inconspicua</i> ; <i>Eptesicus serotinus</i> ; <i>Euplectus bonvouloiri</i> ; <i>Groenlandia densa</i> ; <i>Rhizophagus cribratus</i>
52. (Woodland, Parkland & Scrub)	11	1	<i>Cerylon fagi</i> ; <i>Quedius aetolicus</i> ; <i>Salebriopsis albicilla</i>
53. (Agricultural)	1	1	<i>Valerianella rimosa</i>
54. (Peatland)	5	1	<i>Carex pauciflora</i> ; <i>Fannia vespertilionis</i>
55. (Grassland)	26	14	<i>Anthonomus conspersus</i> ; <i>Blasticotoma filiceti</i> ; <i>Entoloma elodes</i> ; <i>Entoloma neglectum</i> ; <i>Entoloma plebeiodes</i> ; <i>Exechia spinigera</i> ; <i>Meum athamanticum</i>
56. (Woodland, Parkland & Scrub)	8	5	<i>Buglossoporus quercinus</i> ; <i>Formicoxenus nitidulus</i> ; <i>Inocybe pusio</i> ; <i>Micrommata virescens</i> ; <i>Mycena diosma</i>
57. (Woodland, Parkland & Scrub)	4	2	<i>Adicella filicornis</i> ; <i>Ellipteroides alboscuteatus</i>
58. (Woodland, Parkland & Scrub)	5	3	<i>Aeletes atomarius</i> ; <i>Cryptophagus labilis</i> ; <i>Haploglossa marginalis</i> ; <i>Herichia cirrhatum</i>
59. (Lake & Pond)	1	1	<i>Baldellia repens</i>

5.6. Species status

Of the 2955 *Species in Peril*, 2570 species (87%) have a threat status (Table 37). This is not unexpected as most species with an IUCN threat or spatial threat (Nationally Rare, Nationally Scarce) have a restricted distribution. 743 species (25%) are Critically Endangered (CR), Endangered (EN) or Vulnerable (VU).

5.7. Species protection

Some species are afforded legal protection, independent of protected site status. Schedules 2 and 5 of The Conservation of Habitats and Species Regulations (2017) identify European Protected Species (EPS) for animals (excluding birds) and plants, and Schedules 1, 5 and 8 of the Wildlife and Countryside Act (1981) provide protection of certain birds, animals and plants. Just over 1% of *Species in Peril* have legal protection: nine are EPS and a further 32 have domestic legal protection under the Wildlife and Countryside Act (the nine EPS are also protected under the Wildlife and Countryside Act) (Table 38). See Appendix 6 (p. 196) for details.

Section 7 of the Environment (Wales) Act 2016 includes a “list of the living organisms of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales”. Initially the Section 7 list was copied across from Section 42 of the Natural Environment and Rural Communities Act (2006). This list included nearly 400 species, of which only 156 are included in *Species in Peril* (Table 39).

The Section 7 list has been under review, and the current proposal increases the number of species listed to more than 1200 species, including 549 *Species in Peril*. Overall, however, these 549 species make up just 19% of the 2955 range-restricted species identified by the analyses for *Species in Peril*, a figure which together with the 1% which have legal protection, emphasises how critical SSSIs (protecting 75% of our range-restricted species) really are.

Table 37. *Species in Peril* by threat & spatial status. Status includes both GB and Wales where available. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; DD = Data Deficient; NT = Near Threatened; NR = Nationally Rare; NS = Nationally Scarce.

Group	GB-CR	Wales-CR	GB-EN	Wales-EN	GB-VU	Wales-VU	GB-NT	Wales-NT	GB-DD	Wales-DD	GB-NR	GB-NS	Amber	Total
Fungi	11	25	90	13	114	4	0	0	0	0	0	0	0	257
Lichens	8	24	10	16	18	84	26	14	43	12	19	2	0	276
Mosses & liverworts	5	0	14	0	14	0	7	0	0	0	18	49	0	107
Stoneworts	0	2	0	3	0	1	0	0	0	0	1	0	0	7
Vascular plants	4	33	8	36	7	36	1	1	0	2	12	10	0	150
Invertebrates	15	0	38	0	89	0	140	0	134	0	291	1030	0	1737
Fish & lampreys	0	2	0	0	0	2	0	1	0	0	0	0	0	5
Amphibians & reptiles	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Mammals	0	0	0	1	0	2	0	2	0	0	0	0	0	5
Birds	1	0	4	0	8	0	2	0	0	0	0	0	10	25
Total	44	86	164	70	250	129	176	18	177	14	341	1091	10	2570

Table 38. The number of *Species in Peril* by taxonomic group that are protected under The Conservation of Habitats and Species Regulations (2017) (European Protected Species; Schedules 2 [Animals] and 5 [Plants]), and by the Wildlife and Countryside Act (1981) (Schedules 1 [Birds], 5 [Animals] and 8 [Plants]).

Group	Number of <i>Species in Peril</i> protected which are also EPS	Number of <i>Species in Peril</i> protected which are also protected under the Wildlife and Countryside Act
Mosses & liverworts	0	3
Fungi	0	1
Stoneworts	0	1
Vascular plants	3	13
Molluscs	0	2
Insects	0	4
Spiders	0	1
Fish	0	2
Amphibians & reptiles	1	1
Mammals	5	5
Birds	n/a	8
Total	9	41

Table 39. *Species in Peril* included on Section 7 lists.

Group	No. original S7 spp.	No. proposed S7 spp.
Fungi	8	46
Lichens	39	65
Mosses & liverworts	19	42
Stoneworts	2	4
Vascular plants	31	125
Terrestrial & freshwater invertebrates	41	236
Freshwater fish & lampreys	4	4
Amphibians & reptiles	1	1
Mammals	3	5
Birds	8	21
Total	156	549

5.8. Pressures

As elsewhere in the UK, nature in Wales is under pressure. Management of agricultural land has been identified as the most significant factor driving species population change in the UK (Burns *et al.*, 2016). The greatest threat identified to Welsh species found on five or fewer sites is tree loss (Table 40), threatening nearly a quarter (681 species) of the *Species in Peril*. This is primarily a reflection of the large number of saproxylic invertebrates and epiphytic lichens that have very restricted Welsh ranges, and some of those species will also be threatened by factors other than tree loss, such as air pollution. However, for species that are strictly associated with trees it is undoubtedly the loss of ecologically suitable trees that poses the greatest threat to survival.

Ecologically suitable trees are usually Ancient or Veteran (Ancient Tree Forum, 2024), with decay features such as hollow trunks, rot holes and dead limbs, often combined with significant age and ecological continuity. The loss of these ecologically significant trees cannot readily be compensated for by tree planting as it will take decades for a tree to develop Veteran characteristics and centuries before it becomes Ancient. Carefully sited planting of open-grown trees to provide the next generation of Veterans is possible, but needs detailed assessment of the current species interest of a site and a local focus on habitat production rather than timber production. Veteranisation, the deliberate damaging or wounding of younger trees to accelerate the development of microhabitats typical of large, old trees, is an option to provide a greater resource or to bridge generation gaps.

Tree planting is the primary threat to at least 85 *Species in Peril*, especially grassland fungi, and tree planting on ancient grasslands has the potential to cause significant harm – ‘the right tree in the right place’ is crucial. Deadwood loss, which was identified as the principal threat to 188 species, overlaps with tree loss but highlights how important deadwood is specifically for many invertebrates.

Vegetation succession is the second largest identified threat to our range-restricted species and is considered a greater threat than tree loss to many taxonomic groups including mosses, liverworts, vascular plants, arachnids and insects. This category includes increased plant height in grassland causing shading problems for invertebrates or out-competing mosses, liverworts and lichens, scrub encroachment, and the growth of young trees, brambles and ivy in woodland. A very large number of our rarest species occupy open habitats, and vegetation succession is the main identified threat in a range of non-wooded ecosystems (Table 41) including *Grassland*, *Heathland* and *Lowland Rock Exposure*. Although coastal change was identified as the main threat to *Dune & Saltmarsh* and *Coast & Coastal Cliff* species, vegetation succession is a significant problem in those ecosystems as well. Continued grazing, either by farmed animals or wild mammals such as rabbits, is essential to keep damaging vegetation succession under control, whilst air pollution exacerbates the effects of succession by favouring the rapid growth of a small number of vigorous plants.

Hydrological change is the primary threat in *Peatland*, especially to invertebrates and some mosses and liverworts. In most cases this threat comes from drainage, including the re-opening of historic drains using modern equipment, but groundwater abstraction is also a problem for spring-fed wetlands. Coastal change, including sea level rise, storm surges and dune stabilisation, is a threat to more than 200 *Species in Peril*, most of which are insects.

Table 40. Pressures facing *Species in Peril* in different taxonomic groups. Key pressures, as denoted by number of species, are indicated by a star.

Group	Agricultural change	Air pollution	Climate change	Coastal change	Collection, hunting	Construction	Deadwood loss	Disease	Human disturbance	Hydrological change	INNS	Quarrying/Mining	River modification	Tree loss	Tree planting	Uncertain	Vegetation succession	Water pollution	Grand total
Fungi	1	0	5	0	1	0	0	0	0	5	1	0	0	167*	82*	12	35	0	309
Lichens	0	3	89*	3	0	0	0	0	0	0	0	2	7	87*	1	109*	17	3	321
Mosses & liverworts	0	4	36*	0	0	6	0	0	4	11	1	2	7	12	0	0	24*	0	107
Stoneworts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	7
Vascular plants	13	2	25*	23*	1	4	0	0	2	8	0	3	1	6	2	0	53*	12	155
Moss animals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Gastropod molluscs	0	0	0	4	0	0	0	0	0	3	0	0	0	2	0	0	2	2	13
Bivalve molluscs	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4	7
Spiders & allies	0	0	10	14	0	0	3	0	5	22*	0	0	0	15	0	6	34*	0	109
Crustaceans	0	0	0	1	0	0	0	0	1	0	0	0	0	2	0	3	0	1	8
Springtails	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	3	0	0	5
Centipedes	0	0	2	0	0	0	0	0	1	1	0	0	0	0	0	0	2	0	6
Millipedes	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	3	2	0	8
Insects	9	3	34	171*	0	4	188*	0	2	361*	1	0	57	385*	0	180*	415*	50	1860
Fish & lampreys	0	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	5
Amphibians & reptiles	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mammals	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	1	0	6
Birds	0	0	8*	2	0	0	0	9*	3	3	2	0	0	0	0	0	0	0	27
Grand total	23	12	212	222	2	16	191	9	18	416	5	7	75	681	85	316	586	79	2955

Table 41. Number of *Species in Peril* facing different pressures in each ecosystem. Key pressures, as denoted by number of species, are indicated by a star.

Ecosystem	Agricultural change	Air pollution	Climate change	Coastal change	Collection, hunting, harvesting	Construction	Deadwood loss	Disease	Human disturbance	Hydrological change	INNS	Quarrying/Mining	River modification	Tree loss	Tree planting	Uncertain	Vegetation succession	Water pollution	Grand total
<i>Agricultural</i>	10*	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0	15
<i>Cave & Subterranean</i>	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	15*	0	24
<i>Coast & Coastal Cliff</i>	0	0	2	113*	0	0	0	7	2	3	3	0	0	0	0	28	9	1	168
<i>Dune & Saltmarsh</i>	1	0	1	107*	0	0	0	0	0	1	1	0	0	1	0	28	61*	0	201
<i>Grassland</i>	11	0	5	0	0	2	0	0	0	2	0	1	0	0	82*	60*	373*	0	536
<i>Heathland</i>	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	12	26*	0	41
<i>Lake & Pond</i>	0	0	2	0	0	1	0	0	0	18	0	0	0	0	0	0	2	29*	52
<i>Lowland Rock Exposure</i>	0	4	0	0	0	0	0	0	0	0	0	4	0	0	0	8	18*	0	34
<i>Montane</i>	0	1	193*	0	0	0	0	1	4	1	0	0	2	0	1	1	1	1	206
<i>Peatland</i>	0	2	3	0	0	0	0	1	3	305*	0	0	0	1	0	32	5	6	358
<i>River, Stream & Ditch</i>	0	0	1	0	0	1	0	0	0	56*	0	0	71*	1	0	21	3	42*	196
<i>Urban & Synanthropic</i>	0	0	1	1	0	5	0	0	0	0	0	2	0	0	0	33*	6	0	48
<i>Woodland, Parkland & Scrub</i>	0	5	3	1	2	2	191*	0	0	30	1	0	2	678*	1	93*	67*	0	1076
Grand total	23	12	212	222	2	16	191	9	18	416	5	7	75	681	85	316	586	79	2955

Freshwater habitats are threatened both by water pollution and by other direct changes to rivers including damming for hydropower generation, which threatens at least five range-restricted mosses and liverworts and six rare lichens, abstraction for drinking water, and removal of Exposed Riverine Sediments, the last of these being the primary threat to rare riverine insects. Again, invertebrates are the taxonomic group most threatened by these changes to freshwater although water pollution also threatens at least 12 vascular plant species. In the *Lake & Pond* ecosystem, water pollution is the primary pressure.

Few *Species in Peril* are directly threatened by agricultural activities such as ploughing, although indirect impacts through air and water pollution from agriculture are certainly threats. This is because so many species are restricted to SSSI where the type of agricultural activity that may impact the species cannot take place; indeed positive agricultural management is crucial to the maintenance of many populations including almost all those threatened by vegetation succession. Agricultural activities are a more significant threat to species that remain widespread in Wales but are declining across the country, but those are outside the scope of this project. It is also important to note that most of the birds that have become extinct in Wales over the last century (see 5.9) lost their populations entirely or primarily because of agricultural intensification, so agricultural activities can cause extinction but are now substantially constrained from doing so to most rare species. Agricultural change is an important factor in the declines of various dung beetles, because of the widespread use of systemic worm treatments such as avermectins, and also in the decline of arable vascular plants such as Corn Buttercup *Ranunculus arvensis* (see 5.3.1).

Despite their high profile in the media, Invasive Non-native Species (INNS) have only been identified as a significant threat to five of Wales' rarest species; they are a greater threat to various habitats that lack rare species. Three of the species threatened by INNS are seabirds, European Storm-petrel *Hydrobates pelagicus* Atlantic Puffin *Fratercula arctica* and Manx Shearwater *Puffinus puffinus*, which could suffer terrible losses to introduced cats or rodents, whilst a third is the Shearwater Flea *Ornithopsylla laetitiae*, which parasitizes Manx Shearwater. Most threats to commoner Welsh species from INNS come from their local dominance, but at least two Welsh species are threatened by the removal of INNS. Irish Threadwort *Telaranea europaea* has its only Welsh population under dense Rhododendron *Rhododendron ponticum* at Coed Craflwyn in Eryri, and removal of the INNS under which it grows will almost certainly render conditions too unshaded for the liverwort to survive. The bracket fungus *Fomitiporia hippophaeicola* grows only on the non-native (in Wales but not GB) Sea-buckthorn *Hippophae rhamnoides* which is being actively removed from several Welsh dune systems.

Climate Change is a threat that overarches all species conservation. Although its effects will impact on species across Wales, montane species are particularly under threat. 213 species (just 7% of *Species in Peril*) were identified as having Climate Change as the primary threat to their survival in Wales. Actions to mitigate Climate Change are possible in some parts of lowland Wales, either altering habitat management or improving connectivity between sites to allow distributions to adjust. However, action is potentially not possible in montane Wales, particularly on the highest peaks where habitats such as year-round snowbeds are already almost lost from Wales. A degree of resilience is suggested by the continued survival of a small number of snowbed mosses and liverworts (Hodd, 2023), but long-term survival seems implausible. Whilst safeguarding some of our montane species

may ultimately prove impossible, minimizing any other threats such as overgrazing or vegetation succession should be considered in the short to medium term.

Wildlife disease can have significant and negative impacts on biodiversity. Recent trends towards an emerging range of diseases impacting avian species across the UK, and indeed globally, are likely to continue to be a serious issue for both population maintenance and recovery. For example, Avian Influenza (AI) or bird flu, a disease caused by influenza Type A viruses, is a highly contagious viral disease which affects the respiratory, digestive and/or nervous system of many species of birds. Since 2020, more than 80 different species of birds have been tested positive in the UK for Highly Pathogenic Avian Influenza (HPAI). HPAI is naturally occurring in wild waterfowl and is spread across the globe via migratory pathways. Normally it is a seasonal disease, however the sustained transmission of HPAI H5N1 through populations of breeding seabirds and other wild birds in Great Britain has resulted in the unprecedented persistence of HPAI in GB since 2020. In the summer months of 2022, the HPAI epizootic outbreak continued in Wales at an unprecedented scale with reports of large numbers of infected seabirds and subsequent high mortality in Northern Gannet, Arctic Tern and Common Tern.

5.9. Extinctions

Although it is not yet possible to determine with accuracy how extinction risk is changing over time for most taxa, because the vast majority of species have only a single Red List assessment, it is considered that 304 species have been lost from Wales since systematic biological recording began in the 1800s (Table 42, Table 43 & Table 44; Appendix 2). Despite these losses, the vast majority have been almost unmentioned by Welsh naturalists with a few key exceptions such as Purple Emperor *Apatura iris* and Orange Upperwing *Jodia croceago*. It is thought that since 1800, 11 bird species have been officially declared extinct including Nightingale *Luscinia megarhynchos*, Turtle Dove *Streptopelia turtur*, Corncrake *Crex crex*, Corn Bunting *Emberiza calandra* and Red-backed Shrike *Lanius collurio*.

The ecosystems that have suffered the most losses are *Woodland*, *Parkland & Scrub* and *Grassland*, although over 40 coastal species have been lost and there have been 20 extinctions in montane habitats especially among mosses, liverworts and lichens. Eight vascular plant species associated with arable farmland are now extinct (Dines, 2008).

Table 42. Ecosystems from which Welsh species have become extinct since the 1800s.

Ecosystem	No. species
<i>Agricultural</i>	13
<i>Cave & Subterranean</i>	1
<i>Coast & Coastal Cliff</i>	19
<i>Dune & Saltmarsh</i>	28
<i>Grassland</i>	87
<i>Heathland</i>	6
<i>Lake & Pond</i>	4
<i>Montane</i>	22
<i>Peatland</i>	21

Ecosystem	No. species
<i>River, Stream & Ditch</i>	16
<i>Urban & Synanthropic</i>	4
<i>Woodland, Parkland & Scrub</i>	80
Total	304

Table 43. Taxonomic groups in which species have been lost from Wales since the 1800s.

Taxonomic group	No. species
Lichens	17
Mosses & liverworts	21
Vascular plants	33
Molluscs	5
Spiders	5
Insects	203
Birds	15
Total	304

114 species were last seen in Wales in the 1950s or later and species continue to be lost, with eleven losses since 2000 (Table 45). The major cause of extirpations is vegetation succession, although Whiteworm Lichen *Thamnolia vermicularis* has been lost from Eryri because of the combined effects of Climate Change and air pollution. Despite government funded agri-environment schemes, the farmland birds Corn Bunting *Emberiza calandra* and Turtle Dove *Streptopelia turtur* have both become extinct in Wales in the last 20 years.

For other species, it remains premature to pronounce the finality of extinction in Wales. For example, the last Welsh record of Red Dune Crawler *Rhysothorax rufus* was in 2006 on Merthyr Mawr Warren despite recent targeted searches there and at Kenfig Burrows (Howe, 2020s; Watkins & Mann, 2018). The Snow-patch Heart-shield *Nebria nivalis* has been recorded on a single occasion in Wales, on Yr Wyddfa in 1980 (Garland & Lee, 1981; Howe, 2021k), but there has been no subsequent systematic search. A survey in August 2024 for *Hydrovatus clypealis* at Llyn Padrig on Anglesey, where it was last seen in 2002, was unsuccessful with its preferred small pool habitat at a premium (Skinner, 2025).

Table 44. Key species extinctions in Wales.

Species	Vernacular name	Status	Ecosystem	Last record
<i>Felis silvestris</i>	Wildcat	GB-CR	<i>Woodland, Parkland & Scrub</i>	1800s
<i>Paederidus rubrothoracicus</i>	a rove beetle	GB-RE	<i>Coast & Coastal Cliff</i>	1829
<i>Euphorbia peplis</i>	Purple Spurge	GB-RE	<i>Coast & Coastal Cliff</i>	1841
<i>Cardiophorus gramineus</i>	a click beetle	GB-RE	<i>Woodland, Parkland & Scrub</i>	1860
<i>Aporia crataegi</i>	Black-veined White	GB-RE	<i>Woodland, Parkland & Scrub</i>	1875
<i>Cyaniris semiargus</i>	Mazarine Blue	GB-RE	<i>Grassland</i>	1877
<i>Otanthus maritima</i>	Cottonweed	GB-RE	<i>Dune & Saltmarsh</i>	1894
<i>Delia flavogrisea</i>	a fly	GB-DD	<i>Dune & Saltmarsh</i>	1914
<i>Polyommatus coridon</i>	Chalkhill Blue	GB-VU	<i>Grassland</i>	1916
<i>Thesium humifusum</i>	Bastard-toadflax	Wales-RE	<i>Grassland</i>	1916
<i>Mellinus crabroneus</i>	Sand Digger Wasp	GB-RE	<i>Dune & Saltmarsh</i>	1921
<i>Segmentina nitida</i>	Shining Ram's-horn Snail	GB-NS	<i>Peatland</i>	1927

Species	Vernacular name	Status	Ecosystem	Last record
<i>Apatura iris</i>	Purple Emperor	Local	Woodland, Parkland & Scrub	1930s
<i>Hamearis lucina</i>	Duke of Burgundy	GB-VU	Grassland	1949
<i>Zygaena purpuralis segontii</i>	Transparent Burnet	GB-NS	Grassland	1962
<i>Typhochrestus simoni</i>	a money spider	GB-CR	Montane	1966
<i>Sphagnum balticum</i>	Baltic Bog-moss	GB-EN	Peatland	1967
<i>Fissidens serrulatus</i>	Large Atlantic Pocket-moss	GB-VU	Coast & Coastal Cliff	1968
<i>Herminium monorchis</i>	Musk Orchid	GB-VU; Wales-RE	Grassland	1968
<i>Bombus subterraneus</i>	Short-haired Bumblebee	GB-NS	Grassland	1970
<i>Saxifraga rosacea</i>	Irish Saxifrage	GB-RE	Montane	1970
<i>Crex crex</i>	Corncrake	GB-LC, Red	Agricultural	1973
<i>Bombus distinguendus</i>	Great Yellow Bumblebee	GB-NS	Grassland	1974
<i>Galeopsis segetum</i>	Downy Hemp-nettle	GB-RE	Agricultural	1977
<i>Polia bombycina</i>	Pale Shining Brown	GB-EN	Grassland	1980
<i>Luscinia megarhynchos</i>	Nightingale	GB-VU, Red	Woodland, Parkland & Scrub	1981
<i>Mertensia maritima</i>	Oysterplant	GB-NT; Wales-RE	Coast & Coastal Cliff	1989
<i>Laccornis oblongus</i>	a diving beetle	GB-NT	Peatland	1990
<i>Noctua orbona</i>	Lunar Yellow Underwing	Local	Grassland	1992
<i>Agabus uliginosus</i>	a diving beetle	GB-NT	Peatland	1994
<i>Jodia croceago</i>	Orange Upperwing	GB-CR	Woodland, Parkland & Scrub	1994
<i>Gryllotalpa gryllotalpa</i>	Mole Cricket	GB-CR	Grassland	1995
<i>Brachyptera putata</i>	Northern February Red	GB-NS	River, Stream & Ditch	1996
<i>Sideridis reticulata</i>	Bordered Gothic	GB-CR	Grassland	1997
<i>Nymphalis polychloros</i>	Large Tortoiseshell	GB-RE	Woodland, Parkland & Scrub	1998
<i>Panagaeus cruxmajor</i>	Crucifix Ground Beetle	GB-VU	Dune & Saltmarsh	1998
<i>Xylena exsoleta</i>	Sword-grass	Local	Heathland	1999
<i>Bryum calophyllum</i>	Blunt Bryum	GB-EN	Dune & Saltmarsh	2001
<i>Meesia uliginosa</i>	Broad-nerved Hump-moss	GB-NS	Dune & Saltmarsh	2001
<i>Thamnomia vermicularis</i>	Whiteworm Lichen	Wales-VU	Montane	2001
<i>Anas acuta</i>	Pintail	Amber	Lake & Pond	2004
<i>Chaenotheca phaeocephala</i>	a lichen	GB-RE	Woodland, Parkland & Scrub	2005
<i>Odontomyia hydroleon</i>	Barred Green Colonel	GB-CR	Peatland	2006
<i>Emberiza calandra</i>	Corn Bunting	GB-NT, Red	Agricultural	2007
<i>Streptopelia turtur</i>	Turtle Dove	GB-CR, Red	Agricultural	2011
<i>Lycia zonaria</i>	Belted Beauty	GB-NS	Dune & Saltmarsh	2012
<i>Podalonia affinis</i>	Mud Wasp	GB-NR	Dune & Saltmarsh	2012
<i>Daphne mezereum</i>	Mezereon	GB-VU; Wales-RE	Woodland, Parkland & Scrub	2019

Table 45. Post-2000 species extinctions in Wales and the likely cause of losses.

Species	Reason for extinction in Wales
<i>Anas acuta</i>	Low level breeding from 1988 to 2004
<i>Bryum calophyllum</i>	Loss of dune pioneer slacks to vegetation succession
<i>Chaenotheca phaeocephala</i>	A lichen lost to timber treatment of wooden barns
<i>Daphne mezereum</i>	Lack of woodland management
<i>Emberiza calandra</i>	Agricultural intensification and population fragmentation

Species	Reason for extinction in Wales
<i>Lycia zonaria</i>	Loss of open dune grassland to vegetation succession
<i>Meesia uliginosa</i>	Loss of dune pioneer slacks to vegetation succession
<i>Odontomyia hydroleon</i>	Loss of open seepages to vegetation succession
<i>Podalonia affinis</i>	Loss of bare sand?
<i>Streptopelia turtur</i>	Agricultural intensification and population fragmentation
<i>Thamnolia vermicularis</i>	Climate change and air pollution

5.10. Conservation action

The recovery of species in decline is a significant strand of nature conservation. It is therefore important that we set defined outcomes for species recovery, and measure progress toward those outcomes. There is a wide range of potential approaches for tracking progress and setting targets for species recovery.

Due to the wide range of different life histories, data availability, and environmental pressures and contexts, there are differing perspectives on how best to define what constitutes success in species recovery, which in turn require differing approaches to the way in which species status is described and measured. Conservation action consists of a mixed suite of interventions, including, direct habitat management and modification, advocacy and site protection including reserves and protected sites.

Conservation intervention is perhaps most important for the 56 species that are restricted to Wales in GB, or are endemic to Wales in global terms (Table 46).

Some conservation action is most effective when targeted at a single species, perhaps at its only Welsh or GB site, but some action can benefit a suite of species. Brigaded actions – such as dune rejuvenation, scrub clearance or veteranisation – may benefit a suite of species, particularly on the key sites highlighted in Table 28. However, actions for habitat conservation, or for the protection of one or two high profile species, can also damage other species and it is important that our range-restricted species are taken into consideration when large-scale projects are being planned.

Six of the *Species in Peril* restricted to Welsh sites in the UK are target species in the *Natur am Byth!* programme, which included a score for ‘Wales’ responsibility’ within the species selection matrix for place-based delivery. These six species include Upright Apple-moss *Bartramia aprica*, Black Night-runner *Chlaenius tristis*, Rainbow Leaf Beetle *Chrysolina cerealis*, Strandline Beetle *Eurynebria complanata*, Scarce Yellow Sally *Isogenus nubecula* and Large Mason Bee *Osmia xanthomelana*.

Table 46. *Species in Peril* restricted in the UK to sites in Wales.

Species	Vernacular Name	Sites	Last Recorded
<i>Agroeca dentigera</i>	a ground spider	Ynys-las Dunes	2014
<i>Allantus laticinctus</i>	a sawfly	Creigiau Gwbert; Morfa Abererch; Traeth-y-mwnt	2018
<i>Aloconota subgrandis</i>	a rove beetle	Otter Hole	1978
<i>Bartramia aprica</i>	Upright Apple-moss	Stanner Rocks	2024
<i>Bidessus minutissimus</i>	Minutest Diving Beetle	Dyfi; Mawddach; Rheidol; Tywi; Ystwyth	2010
<i>Chlaenius tristis</i>	Black Night-runner	Cors Geirch	2023
<i>Chrysolina cerealis</i>	Rainbow Leaf Beetle	Yr Wyddfa	2023
<i>Cotoneaster cambricus</i>	Wild Cotoneaster	Great Orme	2023
<i>Cranogona dalensi</i>	Beddau Beast	Cwm Coal Tips, Beddau	2022
<i>Datonychus arquata</i>	Gypsywort Weevil	Pembrey Air Weapons Range	2022
<i>Delia tarsifimbria</i>	a fly	Whiteford Burrows	1972
<i>Draba aizoides</i>	Yellow Whitlow-grass	Mewslade; Paviland; Overton Cliff; Pennard; Pwlldu head	2023
<i>Edwardsiana rosaesugans</i>	a leaf hopper	Cwm Glais	1977
<i>Epistrophe ochrostoma</i>	a hoverfly	Nant Porth	1988
<i>Euphrasia cambrica</i>	Welsh Eyebright	Carneddau; Glyderau; Cwm Padrig; Yr Wyddfa; Cadair Idris	2023
<i>Eurynebria complanata</i>	Strandline Beetle	Laugharne-Pendine Burrows; Pembrey Coast; Whiteford Burrows	2023
<i>Exechia spinigera</i>	a fungus gnat	Newton (Gwent Levels); Grassland A	2015
<i>Exechia styriaca</i>	a fungus gnat	Mallwyd; Stradey Wood; Grassland A	2015
<i>Gagea bohemica</i>	Radnor Lily	Stanner Rocks	2024
<i>Gagea serotina</i>	Snowdon Lily	Yr Wyddfa; Carneddau; Glyderau	2023
<i>Grimmia alpestris</i>	Cadair Idris Grimmia	Cadair Idris	2001
<i>Helianthemapion aciculare</i>	a weevil	Great Ormes Head	2023
<i>Hipparchia semele thyone</i>	Grayling	Great Ormes Head; other sites on Creuddyn?	2024
<i>Isogenus nubecula</i>	Scarce Yellow Sally	River Dee	2022
<i>Limonium paradoxum</i>	St. Davids Sea-lavender	St David's Head	2007
<i>Limonium parvum</i>	Small Sea-lavender	Stackpole; St Govan's Head; Mewsford Point	2015
<i>Limonium transwallianum</i>	Giltar Sea-lavender	Giltar Point	2015
<i>Monardis plana</i>	Rosebud Sawfly	Merthyr Mawr Warren	2023
<i>Myodes glareolus skomerensis</i>	Skomer Vole	Skomer	2023
<i>Myxas glutinosa</i>	Glutinous Snail	Llyn Tegid	2016
<i>Neotamus cothurnatus</i>	Scarce Awl Robberfly	Mynydd y Gaer	1997

Species	Vernacular Name	Sites	Last Recorded
<i>Neurigona biflexa</i>	a long-legged fly	Newborough Warren	1987
<i>Orthotrichum cambrense</i>	Welsh Bristle-moss	Dryslwyn	2023
<i>Osmia xanthomelana</i>	Large Mason Bee	Porth Ceiriad; Porth Neigwl	2023
<i>Porpidia ochrolemma</i>	a lichen	Yr Wyddfa	1994
<i>Porrhomma rosenhaueri</i>	a money spider	Lesser Garth Cave; Ogof Draenen; Ogof y Ci	2023
<i>Rabigus pullus</i>	a rove beetle	Llangennith Burrows; Merthyr Mawr Warren; Oxwich Burrows; Tywyn Burrows; Whiteford Burrows	1998
<i>Rhagidia odontocheila</i>	a cave mite	Ogof Cynnes	1972
<i>Scleranthus perennis</i> subsp. <i>perennis</i>	Perennial Knawel	Stanner Rocks	2024
<i>Seligeria oelandica</i>	Irish Rock-bristle	Craig y Cilau	2020
<i>Simulium morsitans</i>	a blackfly	Afon Teifi (Cors Caron)	2018
<i>Sinechostichus inustus</i>	a ground beetle	Afon Tywi, Llandovery; Dinefwr Park; Llandre; Parkland B	2014
<i>Sorbus arvonicola</i>	Menai Strait Whitebeam	Menai Straits	2023
<i>Sorbus cambrensis</i>	Welsh Whitebeam	Cwmyoy; Craig y Cilau; Coed Pantydarren; Cwm Clydach	2022
<i>Sorbus leptophylla</i>	Thin-leaved Whitebeam	Craig y Riwarth; Craig y Cilau	2018
<i>Sorbus leyana</i>	Ley's Whitebeam	Penmoellalt; Darren Fach	2023
<i>Sorbus minima</i>	Least Whitebeam	Craig y Cilau; Cwm Cleisfer; Craig y Castell	2022
<i>Sorbus stenophylla</i>	Llanthony Whitebeam	Cwm Ifor; Cwmyoy; Tarren yr Esgob; Darren Lwyd	2018
<i>Sorbus stirtoniana</i>	Stirton's Whitebeam	Breidden Hill	2019
<i>Symplecta pusilla</i>	Short-legged Splay Crane-fly	River Usk, Great Hardwick	1997
<i>Tephroseris integrifolia</i> subsp. <i>maritima</i>	Anglesey Fleawort	Penrhosfeilw; South Stack	2023
<i>Theridion hannoniae</i>	a comb-footed spider	Mynydd Bach, Maesteg	2007
<i>Trachyphloeus heymesii</i>	a weevil	South Stack	2016
<i>Trogloneta granulum</i>	a dwarf cobweb spider	Nantlle; Swansea	2012
<i>Tulostoma fimbriatum</i>	a stalkball	Ynyslas	2011
<i>Urocystis trollii</i>	Globeflower Smut	Cwm Cadlan	Post-2000

5.10.1. Saving plants in peril

Scrub clearance as part of the *Natur am Byth!* programme has been carried out to prevent the only British population of Upright Apple-moss *Bartramia aprica* being overwhelmed by brambles at Stanner Rocks (Figures 36 & 37), followed by the introduction of goat grazing to ensure the scrub does not return. Radnor Lily *Gagea bohemica*, Upright Clover *Trifolium strictum* and Perennial Knawel *Scleranthus perennis* subsp. *perennis*, which share the same site, are shielded from grazing goats using electronic ‘no-fence’ collars and goats are excluded from the site during these plants’ key flowering times. More than 20 years of ex situ cultivation of Perennial Knawel and Upright Clover followed by turf stripping, scarification and seed scattering has helped to ensure the survival of those species. Scrub control has also been critical to protecting the last surviving Welsh population of Dog Screw-moss *Tortula canescens*, at Roundton Hill, because gorse and bramble scrub has increased rapidly in the small area of the site where the screw-moss grows.

Dune slack scraping during the Sands of LIFE programme included action targeted specifically at Blunt Bryum *Bryum calophyllum* and Broad-nerved Hump-moss *Meesia uliginosa* at Tywyn Aberffraw. In 2015 and 2020, shallow scrapes were excavated by hand in the two dune slacks where these species were last recorded, in 2001, with some of the upper sand horizons scattered in the scrapes in case any buried propagules were present (Callaghan et al., 2020). At present, neither species has reappeared so this action may have come too late.

Halo-thinning, the removal of adjacent younger, competing trees around mature trees to provide more light and space to grow, has been used to reduce shading on lichen-rich oak trunks at RSPB Carn Gafallt (Figures 36), benefitting species such as Scarce Speckled Lichen *Lecanographa amylacea*, *Toniniopsis separabilis* and *Wadaeana minuta*. The lack of grazing in these woods had allowed dense thickets of young oak and birch to develop, and these are often shading the trunks of mature oaks which makes them unsuitable for light-loving lichen species. Removal of the thickets has been followed by the reintroduction of cattle grazing so that optimal light levels for the site’s lichens can be maintained sustainably. Halo-thinning is now being planned at Dinefwr to benefit both lichens and saproxylic invertebrates.

Intervention and collaboration between NRW and the Vale of Glamorgan Council’s Planning department has been successful in preventing the extinction of the only Welsh location for Corn Buttercup *Ranunculus arvensis* and one of the few locations for Shepherd’s-needle *Scandix pecten-veneris* in Wales. The original field at St. Athan, where the Corn Buttercup was found in 2004, received planning permission for housing development in 2018. Conditions were applied through a section 106 order, and a 100 x 30 metre strip at a depth of 30 cm of topsoil, where the Corn Buttercup grew, was transferred to the margins of a nearby field (Figures 39 & 40). The intention is to cultivate the margins annually. Some seed from the original plants was also placed in the soil of the receptor field margins. So far, success has been mixed, often dependent on the time of cultivation and the weather. A bumper year in 2023 (after an autumn cultivation in 2022) produced 32 Corn Buttercup and 25 Shepherd’s-needle plants (Figures 41 & 42).



Figures 36, 37 & 38. Bramble and Ivy growth threatening three patches of Upright Apple-moss *Bartramia aprica* (marked D-F) at Stanner Rocks NNR (top left) (from Bosanquet, 2024), and the same area showing more open vegetation following goat grazing in 2025 (top right), and rampant growth of young trees around lichen-rich oak trunks subsequently halo-thinned at Carn Gafallt (bottom) (from Sanderson, 2014f).



Figures 39 & 40. Donor site for Corn Buttercup *Ranunculus arvensis* and Shepherd's-needle *Scandix pecten-veneris* with topsoil stripped (left), and one of the field margins receiving the topsoil (right).



Figures 41 & 42. Corn Buttercup *Ranunculus arvensis* (left) and Shepherd's-needle *Scandix pecten-veneris* (right) from the receptor field, St. Athan, Vale of Glamorgan.

5.10.2. Habitat management for invertebrates

With some notable exceptions, habitat management for rare invertebrates often involves small scale actions such as cutting vegetation and scrub to promote early-successional conditions or tweaking grazing management to provide suitable sward heights and composition and sward heterogeneity. A small budget can go a long way to delivering the required conditions to safeguard and enhance populations (Table 47).

Table 47. Habitat management actions for selected *Species in Peril* invertebrates.

Species	Vernacular name	Conservation actions
<i>Chlaenius tristis</i>	Black Night-runner	Scrub removal; Vegetation strimming
<i>Fabriciana adippe</i>	High Brown Fritillary	Grazing management; Scrub removal; Vegetation strimming
<i>Helianthemapion aciculare</i>	a weevil	Scrub removal
<i>Idaea dilutaria</i>	Silky Wave	Scrub removal
<i>Idiocera sexguttata</i>	Six-spotted Crane fly	Scrub removal; Vegetation strimming
<i>Meligethes brevis</i>	a pollen beetle	Scrub removal
<i>Microdon devius</i>	a hoverfly	Scrub removal; Vegetation strimming
<i>Osmia xanthomelana</i>	Large Mason Bee	Fencing; Grazing management; Meadow creation; Nest bank creation; Vegetation strimming
<i>Eurynebria complanata</i>	Strandline Beetle	Provision of refugia; Public information signage
<i>Datonychus arquata</i>	Gypsywort Weevil	Scrub removal
<i>Stratiomys chamaeleon</i>	Clubbed General	Grazing management; Vegetation strimming
<i>Vertigo geyeri</i>	Geyer's Whorl Snail	Grazing management; Vegetation strimming

A variety of management works have been undertaken at Porth Neigwl to prevent the extirpation of the small population of Large Mason Bee *Osmia xanthomelana*. These include meadow management to promote the abundance of Common Bird's-foot-trefoil *Lotus corniculatus*, the sole pollen source for the larvae, provision of sandy nesting banks inland from the cliff edge (Figures 43 & 44) and fencing out of key nesting areas to prevent trampling. Management at its only other known UK site, Porth Ceiriad, where its continued occupation is even more precarious, has focussed on livestock grazing management to enhance flowering of Common Bird's-foot-trefoil as part of the *Natur am Byth!* programme.



Figures 43 & 44. Excavations at Porth Neigwl to provide additional nesting banks for Large Mason Bee *Osmia xanthomelana*. © Dan Grant & Carl Clee

More open fen conditions are being promoted to enhance the population of Black Night-runner on Cors Geirch NNR, its only UK locality, as part of the *Natur am Byth!* programme. Areas of mature dune slack with Gypsywort *Lycopus europaeus* are being retained on Pembrey Air Weapons Range to support Gypsywort Weevil *Datonychus arquata* at its only UK locality, with willow scrub removed episodically to prevent encroachment (Figure 45).



Figure 45. Stand of Gypsywort *Lycopus europaeus* in mature slack on Pembrey Air Weapons Range. © Dave Boyce

Attempts are being made at Whiteford Burrows NNR to prevent the removal of driftwood which provides refugia for Strandline Beetle *Eurynebria complanata* using signage and to add timber to provide additional refugia (Figures 46 & 47). Management for High Brown Fritillary *Fabriciana adippe* at Old Castle Down has been ongoing for three decades. Most recently, work as part of the *Natur am Byth!* programme has undertaken scrub and bracken management and secured appropriate livestock grazing. Winter scrub clearance has helped to provide the open seepages used for breeding by Six-spotted Cranefly *Idiocera sexguttata* (Figures 48 & 49).



Figures 46 & 47. Logs added as refugia for Strandline Beetle *Eurynebria complanata* at Whiteford Burrows and signage informing the public to leave driftwood in situ. © Barry Stewart



Figures 48 & 49. Open seepages on Cors Geirch cleared of encroaching scrub for Six-spotted Cranefly *Idiocera sexguttata*. © Mike Howe

5.10.3. Strategic conservation of Freshwater Pearl Mussel

Freshwater Pearl Mussel *Margaritifera margaritifera* is one of Wales's most endangered species. Adults are slow-growing and long-lived (up to c. 100 years in Wales), with a complex life cycle that includes a parasitic stage living on the gills of salmonid fish (usually trout), and approximately 5 years living as a juvenile buried in clean river sands and gravels. Historically the species was widespread, and millions of individuals would have been present. However, there has been no recruitment in the wild in any Welsh population for at least 20 years, due to siltation of river gravels and simplification of river habitat, resulting in a lack of suitable nursery habitat for juveniles. Today, fewer than 1000 adults remain in the wild in Wales (Hatton-Ellis, 2018).

To address this, NRW set up a strategic group to write and deliver a Recovery Strategy in 2016 (Hatton-Ellis *et al.*, 2017). Building on and consolidating earlier work by CCW, and utilising improved understanding of habitat requirements (Degerman *et al.*, 2009; Denic & Geist, 2015; Geist, 2010; Geist & Auerswald, 2007; Moorkens & Killeen, 2014), and captive rearing techniques (Gum *et al.*, 2011; Lavictoire, 2016; Lavictoire *et al.*, 2016; McIvor & Aldridge, 2008; Thomas *et al.*, 2014;) this aimed to re-establish pearl mussel as a self-sustaining species in Wales. Delivery of the strategy has involved has necessitated a long-term approach based on a combination of (i) habitat restoration and monitoring at key sites where the species is either still present, or where the conditions for restoration are favourable and (ii) captive rearing and release into restored habitat, following IUCN Guidance (see Hatton-Ellis, 2018). This co-ordination of habitat restoration and captive rearing is driven by a dedicated Pearl Mussel Co-ordinator.

Since the commencement, a series of projects have been and continue to be delivered to improve pearl mussel habitat around Wales by reinstating the geomorphological conditions they require (Figure 50 to 53). As well as the Eden, work is being carried out within the project areas of the LifeDeeRiver and 4Rivers4LIFE projects, and on a smaller river in Eryri. Projects have been accompanied by co-ordinated captive rearing of suitable broodstock so that mussels can be introduced once in-river conditions are suitable. Pearl mussel captive rearing techniques have also greatly improved their success rates. Rearing mussels is a significant challenge, as they are slow-growing and sensitive to predation by flatworms and other infaunal organisms during their early life stages. The NRW hatchery has worked in partnership with the Freshwater Biological Association hatchery to share experience, and since 2017 increasing numbers of juvenile Welsh mussels are being successfully reared by both hatcheries. 2024 saw the first releases of captive reared juvenile mussels, into the Afon Eden – Cors Goch Trawsfynydd SAC.



Figure 50. Digger replacing boulders to restore habitat in a pearl mussel river.



Figures 51, 52 & 53. Stages in habitat restoration on the Afon Eden. Top: immediately following boulder reintroduction, May 2022. Middle: following gravel reintroduction. Bottom: December 2022, following gravel redistribution by flood flows. Additional boulders trap gravel around them, maintaining stable well-oxygenated habitat for juveniles.

5.10.4. Natterjack Toad reintroduction

Following its extinction in Wales in the 1960s, the Natterjack Toad *Epidalea calamita* was reintroduced to Talacre Warren in 1995 following the excavation of three shallow dune pools (Herpetological Conservation Trust, 1998). It has since been introduced successfully to Gronant Dunes, Talacre Shore Tip and Bettisfield. Regular management is undertaken to maintain populations and reduce competition from Common Toad *Bufo bufo* and fish. This includes pool re-profiling and clearance of breeding scrapes (Figure 54), fencing to protect pools from disturbance, grassland management and scrub control. This long-term project has involved the active participation of multiple partners, landowners and volunteers.



Figure 54. Re-profiling a pool occupied by Natterjack Toad *Epidalea calamita* © Kim Norman

5.10.5. Barbastelle Bat in Pembrokeshire

As part of the *Natur am Byth!* programme, the Vincent Wildlife Trust is training volunteers to survey for Barbastelle Bat *Barbastella barbastellus*. Breeding populations are restricted to just four locations in Wales - Pengelli Forest, Canaston, Saundersfoot and Wye Valley Woodlands - where they are associated with ancient/old growth broadleaf woodland. This makes the species vulnerable to inappropriate woodland management. In Pembrokeshire, local bat workers have identified additional colonies outside protected sites (Pengelli Forest and Pant-teg Wood SSSI and North Pembrokeshire Woodlands SAC), including within woodlands along on the Eastern Cleddau Estuary (Rush & Billington, 2020). Volunteer engagement combined with spatial modelling techniques will help to secure sympathetic woodland management, improve habitat connectivity and enhance roosting opportunities.

5.10.6. Seabird conservation

There are many potential drivers of seabird population change that affect species population trends in different ways. However, broadly, most pressures are considered to affect breeding productivity by influencing the availability of nest sites or food provisioning during chick rearing and or the survival rates of fledged young, immatures and adults. Predation by native predators (e.g. Peregrine *Falco peregrinus*), non-native predators (e.g. American Mink *Neovison vison*) or a combination of the two are considered to be one of the most important drivers of some species of seabird change. Burnell *et al.* (2023) suggests of the 25 species of UK breeding seabirds where the potential causes of seabird population change were assessed, predation by either native or non-native predators influenced population change in 21 species. In the face of this predation pressure, conservation interventions are required, for example the provision of nest boxes for breeding Roseate Terns *Sterna dougallii* to off-set predation by native avian predators.

More than 50% of Wales' breeding seabirds are dependent on islands. In these cases, other interventions may require seabird island biosecurity measures, where the eggs and chicks of ground-nesting seabirds including Atlantic Puffin *Fratercula arctica*, Manx Shearwater *Puffinus puffinus* and European Storm-petrel *Hydrobates pelagicus* are particularly vulnerable to predation by invasive mammals such as Brown Rat *Rattus norvegicus*. In Wales, biosecurity of our seabird islands include a biosecurity officer, a conservation detection dog to search for and indicate the presence of Brown Rats, information campaigns targeting island visitors, frequent surveillance checks and training of volunteers to support biosecurity implementation across Wales' seabirds island Special Protection Areas.

This approach helps to co-ordinate and support the delivery of effective biosecurity for all of Wales' most important seabird islands such as Grassholm SPA and the Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwn a moroedd Benfro SPA. The work encompasses a range of vital specialist activities which include surveillance and monitoring, responding to suspected or confirmed incursions of rats onto islands, raising awareness of biosecurity among stakeholders, boat operators and the public, supporting the production of Island Biosecurity Plans and ensuring they are being implemented effectively.

Work to eradicate the Brown Rat from Puffin Island SPA took place over the winters of 2023/24 and 2024/25. Currently there are no signs of their presence, though ongoing biosecurity checks will need to run for another two years to confirm successful rat eradication. As a result, further effort is required to eradicate the remaining rats and ongoing monitoring will also be required to evaluate the effectiveness of the work. Current estimates of costs of the eradication, when volunteer time and the use of Biosecurity for Wales resources are factored in, are in excess of £100,000. Island eradication programmes are typically considerably more expensive than this, for example the £4.5million required to restore biosecurity on Rathlin Island (Northern Ireland) to protect seabirds. The lessons from Puffin Island and elsewhere show that investing in effective prevention is much more cost-effective than having to deal with an incursion, as eradications require large amounts of resources, both people and money.

In December 2024, Welsh Government launched a nine-week consultation on a proposed Welsh Seabird Conservation Strategy. The purpose of the Strategy is to further the protection, conservation and restoration of seabirds in Wales by providing a framework for a continuous assessment of the status of seabirds, and of ongoing conservation action in Wales. This will enable identification of potential gaps and, where conservation action needs to be improved or adjusted, the provision of high-level recommendations. It aims to establish conservation projects addressing the gaps with help of ongoing collaboration with stakeholders. Based on these assessments, the Strategy sets priorities for seabird conservation work in Wales working with stakeholders to ensure that appropriate deliverable actions are taken.

5.11. Taxon-specific analyses

5.11.1. Fungi

The vast majority (88%) of fungi that have been recorded from five or fewer localities in Wales are considered to be potentially under-recorded because of identification difficulties. Many of them will be genuinely rare, but the pattern of occurrence is very different to that

of rare lichens, mosses or liverworts with a higher proportion of records coming from keen mycologists' primary recording areas rather than from SSSI or NNR. Most of the fungi that are believed to be well recorded yet have five or fewer Welsh sites grow in coastal dunes, thanks to expert surveys over many years (Evans & Roberts, 2021).

Of the remainder, the seven rare *Hygrocybe* waxcaps are perhaps the most interesting. Despite waxcap grasslands being well described in accessible literature and the subject of numerous detailed surveys, seven species are found in five or fewer sites. These include *Hygrocybe canescens*, which is distinctive despite its grey colour; *Hygrocybe coccineocrenata*, which has one-off records from some well-recorded sites and might just be a very shy fruiter; and *Hygrocybe viola*, which is purple and therefore should be distinctive but appears to grow in Wales on boundary banks rather than grassland.

5.11.2. Lichens

Seventeen lichen species are considered to be extinct in Wales (Table 43) and there are at least five more species which are considered almost certainly extinct. Four of these are relatively obvious macrolichens, whilst the fifth *Xylopsora friesii* is more easily overlooked but grew on acid bark and lignum in an area of Wales with significant ammonia pollution, so its extinction is highly plausible. *Collema occultatum* is an epiphyte recorded in Wales only from Parc Nannau and Glynllifon, which was last recorded in 2002 and could not be relocated at Parc Nannau in 2014; it could possibly remain at Glynllifon, but ammonia levels there are exceptionally high. *Leptogium cochleatum* is another epiphyte, last officially recorded at Abergwynant in 1989 but perhaps never genuinely present in Wales because a similar but undescribed lichen, informally known as *Leptogium* 'aff *cochleatum*', is still present at two Welsh sites and might well be what was found at Abergwynant. *Phaeographis lyellii* is also an epiphyte, lost from Coed Ty Canol since 1979 because of air pollution but not looked for recently at Arthog and therefore perhaps still extant.

Green Veiny Lichen *Peltigera venosa* was last recorded in Wales in 1981 and grew in base-rich montane turf in Eryri, including in some areas that have not been subject to detailed survey so the possibility of its continued existence remains. Eleven lichens are 'probably extinct', with the last Welsh records dating from the 1960s or 1970s, but are sufficiently hard to identify that they might be present somewhere and overlooked.

The two most important habitats for the rarest Welsh lichens are ancient trees and montane rocks. Several parklands and wood pastures are extremely important for rare epiphytic lichens, but not all appear in Table 28 because the highest-scoring parklands for overall range-restricted species are those with well-recorded saproxylic invertebrate faunas. Thus, although Dinefwr and Gregynog appear in the top 50 sites for *Species in Peril*, Ceunant Llennyrch NNR, Parc Nannau SSSI and Caban Lakeside Woodlands SSSI do not.

Most of the 93 montane lichens with very restricted Welsh ranges are found in the three Eryri massifs of Yr Wyddfa, Glyderau and Carneddau, with Yr Wyddfa and Glyderau being the most diverse sites for lichens. The majority are saxicolous, growing on boulders or crags, but a few are found on soil ledges or in lichen heath. Two of our most rapidly declining macrolichens are found in montane lichen heath or boulder scree: *Alectoria nigricans* (Figure 55) survives at just two Welsh sites, having been lost from at least 12 others in recent decades (Turner, 2021), whilst *Bryoria bicolor* remains at three sites in Wales and was formerly known from more than 20. The population trend for many other

Welsh lichens is poorly known, with 210 of the 321 lichens that are known from five or fewer Welsh sites being considered potentially under-recorded.

5.11.3. Mosses & liverworts

Although Table 8 shows the broad ecosystems that the most range-restricted mosses and liverworts in Wales grow in, it only includes well-recorded species rather than *Under-Recorded* species, and it covers 13 ecosystems. Data for more narrowly defined habitats show a similar pattern (Table 48), with montane rock being the most important habitat for our rarest mosses and liverworts, but the woodland ecosystem is split into more precise categories including epiphytes, limestone woodland and oceanic woodland which each include between three and five species. Some habitats that are used more by mosses and liverworts than by other taxa, such as boundary banks, thatched roofs and gravelly tracks, are also highlighted.

Table 48. Habitats supporting *Species in Peril* Mosses & Liverworts.

Habitat	Species	Habitat	Species
Blanket Bog	1	Lowland Woodland	2
Boundary Banks	1	Metal Mines	2
Coastal Cliff	2	Montane Rock	27
Coastal Dune	6	Montane Lake	4
Conifer Plantation	1	Montane Spring	3
Epiphytic	6	Oceanic Montane	3
Fen	3	Oceanic Woodland	4
Heathland	3	Raised Bog	6
Igneous Rock	5	Riverine	10
Lake Margin	3	Saltmarsh	1
Limestone Grassland	6	Thatched Roofs	1
Limestone Woodland	5	Tracks	2

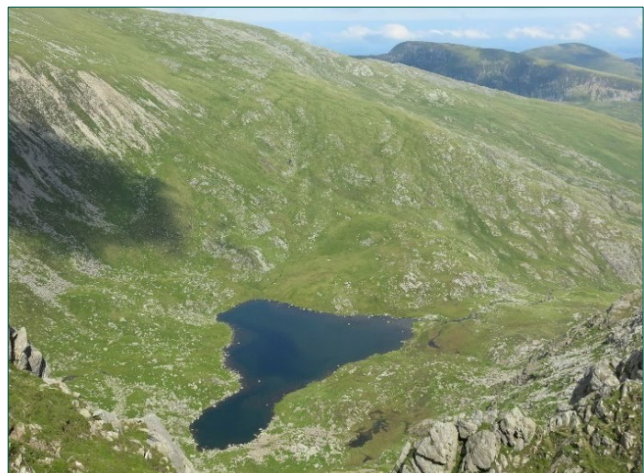


Figure 55. *Alectoria nigricans* (left, from Turner, 2021) is a rapidly declining montane lichen that is now known from two Welsh localities having been lost from at least 12 others in recent decades.

Figure 56. Ffynnon Lloer in the Carneddau is a popular wild swimming spot, but its *Hedwigia striata* and *Pterigynandrum filiforme* populations could easily be wiped out by a misplaced towel.

Greater precision is also possible when considering threats to mosses and liverworts in peril, although many remain broad including climate change and vegetation succession. Specific threats to rare Welsh mosses and liverworts which might not be considered for other species groups include: maintenance of artificially high water levels in lakes and reservoirs, threatening Channelled Crystalwort *Riccia canaliculata*; installation of river revetments, threatening Curl-leaved Forklet-moss *Dicranella crispa*; dune aquifer change, threatening Baltic Bryum *Bryum marratii*; and open water swimming in montane lakes (Figure 55), which threatens Anomalous Grimmia *Grimmia anomala*, Striate Hoar-moss *Hedwigia striata*, Brown Flapwort *Odontoschisma elongatum* and Capillary Wing-moss *Pterigynandrum filiforme*.

5.11.4. Vascular plants & stoneworts

From the analyses, it can be seen that key ecosystems which hold the largest number of our rarest vascular plants are rocky habitats in montane and lowland situations. Grasslands and coastal ecosystems are also key.

In contrast to other taxon groups, agricultural ecosystems are shown to hold some of the rarest and most threatened of Wales' vascular plants. More refinement here shows that it is plant species restricted to arable situations. As well as species restricted to five or fewer sites, a high proportion of our most threatened plants occur in arable situations. Broad-fruited Cornsalad *Valerianella rimosa* has only been found in one location in the last 20 years, on a farm on Gower in South Wales (although it has not been seen even here since 2009). Other threatened species recorded here include Small-flowered Catchfly *Silene gallica* and Narrow-fruited Cornsalad *Valerianella dentata*. Another single Welsh site arable plant, Corn Buttercup *Ranunculus arvensis*, occurs in more clayey soils in the Vale of Glamorgan, here with Shepherd's-needle *Scandix pecten-veneris*, Dwarf Spurge *Euphorbia exigua*, Corn Parsley *Petroselinum segetum* and Small-flowered Buttercup *Ranunculus parviflorus*.

Species found in the mountains of north Wales have always had a restricted distribution, but over the last 100 years many have declined to a perilous state. Much of the reason for decline can be attributed to a combination of past plant collecting and over-grazing. More recently, air pollution and global warming are having a negative impact. One vascular plant species that did become extinct in the 20th Century is Irish Saxifrage *Saxifraga rosacea* (Figure 57). It was last seen in the wild in Wales in 1962 on crags at Cwm Idwal, its sole mainland GB locality although it is more widely distributed on the west coast of Ireland (Turner, 2022). Plants from this site were maintained in cultivation and it was reintroduced to an undisclosed location in Eryri in 2024 as part of the *Natur am Byth!* programme. Snowdon Lily *Gagea serotina* (Figure 57) is another species which is restricted to a few locations in Eryri within GB. This species has remained fairly stable in terms of number of occupied sites, but there is evidence of a continuing decline in population size at two of the four locations (Barbara Jones, pers. comm. [2024]).

Of the 20 species of vascular plant found in lowland rock habitats, many are found on base-rich rocks such as Carboniferous Limestone in north and south Wales including many of the whitebeam *Sorbus* species and Yellow Whitlowgrass *Draba aizoides* (Figure 59). Several others are restricted to a small number of igneous rock sites like Stanner NNR

and Breidden Hill in mid Wales, e.g. Radnor Lily *Gagea bohemica* and Rock Cinquefoil *Potentilla rupestris*.

Of the seven stoneworts listed, six occur on Ynys Môn (Anglesey). Here, pools and ditches on the fen systems of Cors Bodeilio, Cors Erddreiniog and Cors Goch are key for *Chara aculeata*, *Chara curta*, *Chara subspinosa* and *Nitella tenuissima*. The Baltic Stonewort *Chara baltica* is found in dune pools and slacks at Newborough Warren. The Foxtail Stonewort *Lamprothamnium papulosum* was found in the Inland Sea (the stretch of sea between Ynys Môn and Caer Gybi) in 2017, and this is the first and only record of this species in Wales. Starry Stonewort *Nitellopsis obtusa*, was found fairly recently in two locations in Wales, in deeper lakes, and is thought to have colonised both sites recently. More recently, it has colonised Llangorse Lake.



Figure 57 (Left). Irish Saxifrage *Saxifraga rosacea*, on Brandon Co Kerry, Ireland. Figure 58 (Right). Snowdon Lily *Gagea serotina* at Cwm Idwal. © Alex Turner



Figure 59. Yellow Whitlowgrass *Draba aizodes*, Gower coast. © Julian Woodman

Of the 412 species of *Hieracium* currently identified in Britain and Ireland, 26 are considered to be endemic to Wales and occur in 5 or fewer localities. Of these, five are extinct or presumed extinct (Llanfairfechan Hawkweed *Hieracium cambricogothicum*, Taf Fechan Hawkweed *Hieracium elevatum*, Griffith's Hawkweed *Hieracium griffithii*, Penwyllt Hawkweed *Hieracium pusillifolium* and Robert's Hawkweed *Hieracium robertsii*) (Cranmer, 2012; McCosh & Rich, 2018; Rich, 2010, 2012; Rich et al., 2007). Brief accounts for key species are given in Appendices 2 to 4 (pp. 167, 176 & 186).

5.11.5. Terrestrial & freshwater invertebrates

A total of 2017 invertebrate species are included in *Species in Peril*, with 830 species found on just a single locality. The majority of species are associated with grasslands, woodlands & parklands, coastal habitats and freshwater habitats with no species restricted to agricultural ecosystems (Table 49).

It should be noted that many invertebrate taxa are poorly recorded and that any analyses which consider the number of occupied sites should be treated with some caution. However, the major focus is on species with a conservation status (IUCN threat or spatial restriction) and these have therefore been assessed at a GB scale with a higher degree of confidence. That said, there will be many species which are more widespread in the UK but with a very restricted distribution in Wales. These will have been overlooked given the difficulty of accessing relevant maps and species accounts such that the numbers derived for *Edge of Range* species are likely to be a gross underestimate.

Table 49. Ecosystems supporting *Species in Peril* invertebrates.

Ecosystem	Overall species	Single locality species
<i>Agricultural</i>	0	0
<i>Cave & Subterranean</i>	24	11
<i>Coast & Coastal Cliff</i>	115	45
<i>Dune & Saltmarsh</i>	141	74
<i>Grassland</i>	390	154
<i>Heathland</i>	21	10
<i>Lake & Pond</i>	37	17
<i>Montane</i>	44	17
<i>Peatland</i>	316	113
<i>River, Stream & Ditch</i>	159	67
<i>Urban & Synanthropic</i>	10	5
<i>Woodland, Parkland & Scrub</i>	760	317
Total	2017	830

Saproxyllic habitats in Welsh parklands and woodlands support rich invertebrate assemblages, with over 1200 saproxyllic species recorded to date. A large number of these have very restricted Welsh distributions including 69 species which are found at just a single locality (Table 50). These include the beetles *Agathidium confusum*, *Cryptarcha undata* and *Ischnomera cinerascens* at Chirk Park (Figures 60 & 61), *Ptinella limbata* at Dinefwr Estate, Red-horned Cardinal Click Beetle, *Notolaemus unifasciatus*, *Procræus tibialis* and *Scydmaenus rufus* at Parkland D, *Rhizophagus oblongicollis* and *Synchita separanda* at Parkland A, Bast Bark Beetle *Ernoporus tiliae* at Blackcliff-Wyndcliff and

Cosnard's Net-winged Beetle *Erotides cosnardi* in Pierce Wood. The loss of deadwood habitats at any of these sites would result in major extirpations of both species and populations.

Table 50. Habitats supporting *Species in Peril* invertebrates.

Habitat	Overall species	Single locality species
Coastal Dune	77	39
Exposed Riverine Sediments	55	20
Saproxyllic Habitats	187	69
Saltmarsh	20	7
Seepages & Springs	39	14



Figures 60 & 61. Important veteran trees at Chirk Park. © Keith Alexander

Welsh rivers rank as some of the most important for exposed riverine sediment (ERS) (Figures 62 & 63) invertebrate assemblages in the UK, with eight having nationally important faunas – Mawddach, River A, Rheidol, Tywi, River B, Usk, Wye and Ystwyth. Together, they support 225 UK and Welsh specialist ERS species including 114 beetles, 100 flies, nine spiders and two bugs (Howe, 2020avi). ERS has suffered major losses and on Welsh rivers there has been a halving in ERS since the 1940s to 3,000,000 square metres and a decline in the number of ERS bars by 30% (Brewer *et al.*, 2006). 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.

The major threats to the remaining resource include engineering to alleviate flooding and reduce river flow rates, removal of gravels to protect infrastructure such as bridges and roads and for hardstanding for livestock, the compaction and eutrophication of sediments by cattle, siltation, agricultural runoff and vegetational succession as sediments become less mobile. Whilst SSSI affords some protection, River A and River B are not designated and yet support significant numbers of ERS specialist species (Table 51) including Banded Splay Cranefly *Arctoconopa melampodia*, the flies *Argyra atriceps*, *Cosmetopus dentimanus* and *Rhaphium gravipes* on River A and the rove beetle *Aloconota eichhoffi* on River B.

Table 51. Key Welsh rivers supporting exposed riverine sediment (ERS) invertebrates included in *Species in Peril*.

River	Overall species	Single locality species
Chwerfri	1	1
River A	18	4
Rheidol	9	1
River B	11	1
Tywi	18	4
Usk	23	7
Wye	10	1
Ystwyth	10	1
Total	55	20



Figures 62 & 63. Exposed riverine sediments (ERS) on the Afon Tywi. © Andy Godfrey

Welsh sand dunes support over 5000 invertebrate species of which 457 invertebrate species are found in Wales only or mostly on dunes (Howe *et al.*, 2012). Up to 75% of these specialist dune invertebrates are associated with early successional habitats including bare and sparsely vegetated sand, marram, pioneer dune slacks and the strandline. Key species include Strandline Beetle *Eurynebria complanata*, Stackpole Seed-eater *Harpalus melancholicus* on Stackpole Warren, Sandhill Rustic *Luperina nickerlii*, the ground spider *Agroeca dentigera* on Ynyslas Dunes and the weevils *Tychius quinquepunctatus* and *Glocianus pilosellus* on Kenfig Burrows and Merthyr Mawr Warren respectively. Recent management initiatives have focussed on restoring pioneer conditions which should benefit much of the specialist dune fauna. This may have come too late for Belted Beauty *Lycia zonaria* (last seen on Morfa Conwy in 2012), Crucifix Ground Beetle *Panagaeus cruxmajor* (Tywyn Burrows, 1998) and the Mud Wasp (Gronant Dunes & Talacre Warren, 2012), all of which are now listed as extinct in Wales (Figures 64 to 66).

Thirty species of invertebrates in the UK are found only in Wales (Table 46), of which 21 are restricted to a single site (Table 52). Every effort should be made to ensure their continued survival, with surveys undertaken to provide a contemporary assessment.



Figures 64, 65 & 66. Belted Beauty *Lycia zonaria*, Crucifix Ground Beetle *Panagaeus cruxmajor* & Mud Wasp *Podalonia affinis*. All three are listed as extinct in Wales. © Dave Green/Butterfly Conservation, Christoph Benisch & Steven Falk

Table 52. *Species in Peril* invertebrates restricted in the UK to a single Welsh site.

Species	Vernacular name	Sites	Last record
<i>Agroeca dentigera</i>	a ground spider	Ynyslas Dunes	2014
<i>Aloconota subgrandis</i>	a rove beetle	Otter Hole	1978
<i>Chlaenius tristis</i>	Black Night-runner	Cors Geirch	2023
<i>Chrysolina cerealis</i>	Rainbow Leaf Beetle	Yr Wyddfa	2023
<i>Cranogona dalensi</i>	Beddau Beast	Cwm Coal Tips, Beddau	2022
<i>Datonychus arquata</i>	Gypsywort Weevil	Pembrey Air Weapons Range	2022
<i>Delia tarsifimbria</i>	a fly	Whiteford Burrows	1972
<i>Edwardsiana rosaesugans</i>	a leaf hopper	Cwm Glais	1977
<i>Epistrophe ochrostoma</i>	a hoverfly	Nant Porth	1988
<i>Helianthemapion aciculare</i>	a weevil	Great Ormes Head	2023
<i>Hipparchia semele thyone</i>	Grayling	Great Ormes Head; other Creuddyn sites?	2024
<i>Isogenus nubecula</i>	Scarce Yellow Sally	River Dee	2022
<i>Monardis plana</i>	Rosebud Sawfly	Merthyr Mawr Warren	2023
<i>Myxas glutinosa</i>	Glutinous Snail	Llyn Tegid	2016
<i>Neotamus cothurnatus</i>	Scarce Awl Robberfly	Mynydd y Gaer	1997
<i>Neurigona biflexa</i>	a long-legged fly	Newborough Warren	1987
<i>Rhagidia odontocheila</i>	a cave mite	Ogof Cynnes	1972
<i>Simulium morsitans</i>	a blackfly	Afon Teifi (Cors Caron)	2018
<i>Symplecta pusilla</i>	Short-legged Splay Crane-fly	River Usk, Great Hardwick	1997
<i>Theridion hannoniae</i>	a comb-footed spider	Mynydd Bach, Maesteg	2007
<i>Trachyploeus heymesi</i>	a weevil	South Stack	2016

There is an additional suite of species where Welsh populations are important in a UK context and for which Wales therefore has a responsibility to safeguard. Some of the key species are listed in Table 53. Strandline Beetle *Eurynebria complanata*, Minutest Diving Beetle *Bidessus minutissimus*, the rove beetle *Rabigus pullus*, Large Mason Bee *Osmia xanthomelana* and *Porrhomma rosenhaeuri* (Figures 67) are restricted to Wales within the UK. The majority of UK populations of the following species occur in Wales - *Acrometopia wahlbergi*, *Baryphyma gowerense*, *Cicadella lasiocarpae*, *Gabrius exiguus*, Stackpole Seed-eater *Harpalus melancholicus*, Oxbow Diving Beetle *Hydroporus rufifrons*, Silky

Wave *Idaea dilutaria*, *Odontoscelis fuliginosa*, the wolf spider *Pardosa traili* and Clubbed General *Stratiomys chamaeleon* (Figures 67). Others such as Chestnut-coloured Carpet *Thera cognata*, *Hydrovatus clypealis*, Mountain Plate-jaw *Leistus montanus*, *Marpissa radiata*, Dew Moth *Setina irrorella* and *Tachys micros* represent important edge of range or outlier populations.

The majority of Welsh invertebrate *Species in Peril* are either *Naturally Rare* or *Under-Recorded* (Table 54). A few are *Decliners* including high profile species such as High Brown Fritillary *Fabriciana adippe*, Strandline Beetle *Eurynebria complanata*, Freshwater Pearl Mussel *Margaritifera margaritifera* and Sheep Nostril Fly *Oestrus ovis*, whilst others have been lost from a handful of additional sites e.g. Purple-bordered Gold *Idaea muricata*, Silvery Arches *Polia hepatica* and Geyer's Whorl Snail *Vertigo geyeri*. No species are *Edge of Range*, most likely as a consequence of the difficulty of assessing species considered to be Local or Least Concern. In reality, there are likely to be a significant number of species in this category. Few species are *Colonisers* as, by the time they have colonised Wales, most will occur on more than five sites.



Figures 67, 68 & 69. Black Night-runner *Chlaenius tristis*, the money spider *Porrhomma rosenhaueri* & Clubbed General *Stratiomys chamaeleon*. © Christoph Benisch, Richard Gallon & Gwenllian Howe

Table 53. Additional *Species in Peril* invertebrates for which Wales has a special responsibility in a UK context.

Species	Vernacular name	Status	Ecosystem
<i>Acrometopia wahlbergi</i>	a silverfly	GB-VU	<i>Peatland</i>
<i>Allantus laticinctus</i>	a sawfly	GB-VU	<i>Woodland, Parkland & Scrub</i>
<i>Amara nitida</i>	Confounding Sunshiner	GB-EN	<i>Dune & Saltmarsh</i>
<i>Arachnospila consobrina</i>	a spider wasp	GB-NR	<i>Coast & Coastal Cliff</i>
<i>Baryphyma gowerense</i>	a money spider	GB-VU	<i>Peatland</i>
<i>Bidessus minutissimus</i>	Minutest Diving Beetle	GB-VU	<i>River, Stream & Ditch</i>
<i>Callilepis nocturna</i>	a ground spider	GB-VU	<i>Coast & Coastal Cliff</i>
<i>Cicadella lasiocarpae</i>	a leaf hopper	GB-NR	<i>Peatland</i>
<i>Coenophila subrosae</i>	Rosy Marsh Moth	GB-NT	<i>Peatland</i>
<i>Coleophora serpylletorum</i>	Cliff Case-bearer	GB-NR	<i>Grassland</i>
<i>Cosmetopus dentimanus</i>	a dungfly	GB-NR	<i>River, Stream & Ditch</i>
<i>Dicranomyia magnicauda</i>	Bog Bigtail Crane-fly	GB-NR	<i>Peatland</i>
<i>Dolomedes plantarius</i>	Fen Raft Spider	GB-VU	<i>Peatland</i>
<i>Ellipteroides limbatus</i>	Elusive Black Lamb Crane-fly	GB-NR	<i>Peatland</i>
<i>Erotesis baltica</i>	a caddisfly	GB-VU	<i>Peatland</i>
<i>Eugnorisma depuncta</i>	Plain Clay	Local	<i>Woodland, Parkland & Scrub</i>
<i>Eurynebria complanata</i>	Strandline Beetle	GB-EN	<i>Dune & Saltmarsh</i>
<i>Exechia spinigera</i>	a fungus gnat	GB-DD	<i>Peatland</i>
<i>Exechia styriaca</i>	a fungus gnat	GB-NS	<i>Woodland, Parkland & Scrub</i>
<i>Gabrius exiguus</i>	a rove beetle	GB-VU	<i>Dune & Saltmarsh</i>
<i>Gyrinus suffriani</i>	a whirligig beetle	GB-VU	<i>Peatland</i>
<i>Haganella clathrata</i>	Window Winged Sedge	GB-EN	<i>Peatland</i>
<i>Harpalus melancholicus</i>	Stackpole Seed-eater	GB-EN	<i>Dune & Saltmarsh</i>
<i>Hydroporus rufifrons</i>	Oxbow Diving Beetle	GB-EN	<i>River, Stream & Ditch</i>
<i>Hydrovatus clypealis</i>	a diving beetle	GB-NS	<i>Lake & Pond</i>
<i>Idaea dilutaria</i>	Silky Wave	GB-NT	<i>Grassland</i>
<i>Idiocera sexguttata</i>	Six-spotted Crane-fly	GB-NR	<i>Peatland</i>
<i>Idioptera linnei</i>	Beautiful Banded Linkwing Crane-fly	GB-NR	<i>Peatland</i>
<i>Leistus montanus</i>	Mountain Plate-jaw	GB-EN	<i>Montane</i>
<i>Limnebius aluta</i>	a water beetle	GB-NT	<i>Peatland</i>
<i>Limnephilus tauricus</i>	a caddisfly	GB-VU	<i>Peatland</i>
<i>Luperina nickerlii</i>	Sandhill Rustic	GB-NS	<i>Dune & Saltmarsh</i>

Species	Vernacular name	Status	Ecosystem
<i>Macroplox preyssleri</i>	a seed bug	GB-NR	Grassland
<i>Margaritifera margaritifera</i>	Freshwater Pearl Mussel	GB-CR	River, Stream & Ditch
<i>Marpissa radiata</i>	a jumping spider	GB-VU	Peatland
<i>Meligethes brevis</i>	a pollen beetle	GB-NR	Grassland
<i>Micaria alpina</i>	a ground spider	GB-VU	Montane
<i>Microbisium brevifemoratum</i>	Bog Chelifer	GB-NR	Peatland
<i>Ochthebius poweri</i>	Spindrift Beetle	GB-NT	Coast & Coastal Cliff
<i>Odontoscels fuliginosa</i>	Greater Streaked Shieldbug	GB-VU	Dune & Saltmarsh
<i>Osmia xanthomelana</i>	Large Mason Bee	GB-NR	Coast & Coastal Cliff
<i>Pardosa trailli</i>	a wolf spider	GB-VU	Montane
<i>Phlegra fasciata</i>	a jumping spider	GB-NT	Coast & Coastal Cliff
<i>Pilaria nigropunctata</i>	Fen Water-longtail Crane fly	GB-NR	Peatland
<i>Porrhomma rosenhaueri</i>	a money spider	GB-NT	Cave & Subterranean
<i>Pseudomogoplistes vicentae</i>	Scaly Cricket	GB-VU	Coast & Coastal Cliff
<i>Rabigus pullus</i>	a rove beetle	GB-EN	Dune & Saltmarsh
<i>Rhysothorax rufus</i>	Red Dune Crawler	GB-EN	Dune & Saltmarsh
<i>Riolus nitens</i>	a riffle beetle	GB-EN	River, Stream & Ditch
<i>Salebriopsis albicilla</i>	Lime Knot-horn	GB-NR	Woodland, Parkland & Scrub
<i>Setina irrorella</i>	Dew Moth	GB-NS	Coast & Coastal Cliff
<i>Setodes punctatus</i>	a caddisfly	GB-VU	River, Stream & Ditch
<i>Sinechostichus inustus</i>	a ground beetle	GB-NR	Woodland, Parkland & Scrub
<i>Sitona gemellatus</i>	a weevil	GB-NR	Coast & Coastal Cliff
<i>Sphaerophoria loewi</i>	Saltmarsh Globetail	GB-NT	Coast & Coastal Cliff
<i>Sterrhopterix fusca</i>	Brown Sweep	GB-NR	Peatland
<i>Stratiomys chamaeleon</i>	Clubbed General	GB-EN	Peatland
<i>Synaptus filiformis</i>	Hairy Click Beetle	GB-NS	River, Stream & Ditch
<i>Tachys micros</i>	a ground beetle	GB-VU	Coast & Coastal Cliff
<i>Thera cognata</i>	Chestnut-coloured Carpet	Local	Grassland
<i>Thinobius newberyi</i>	Newbery's Rove Beetle	GB-NR	River, Stream & Ditch
<i>Trogloneta granulum</i>	a dwarf cobweb spider	Unknown	Grassland
<i>Tychius quinquepunctatus</i>	a weevil	GB-NR	Dune & Saltmarsh
<i>Wheeleria spilodactylus</i>	Horehound Plume Moth	GB-NR	Grassland
<i>Ylodes simulans</i>	a caddisfly	GB-NT	River, Stream & Ditch

Table 54. *Species in Peril* invertebrates assigned to restriction categories.

Restriction category	No. species
<i>Decliners</i>	30
<i>Naturally Rare</i>	1062
<i>Under-Recorded</i>	914
<i>Edge of Range</i>	0
<i>Colonisers</i>	11
Total	2017

The key pressures to invertebrates included in *Species in Peril* are deadwood and tree loss, vegetation succession, hydrological change, coastal change, river modification and climate change (Table 55). This reflects the importance of saproxylic species and those associated with dune systems, peatlands and exposed riverine sediments. The threat of agricultural change is low as most species are restricted to protected sites such as SSSIs, NNRs, Wildlife Trust reserves and Local Nature Reserves. 1504 of the 2017 species are found on SSSIs of which 882 are restricted to SSSIs. Of these, 183 species are recognised as independently notified and/or qualifying species and a further 181 species are components of SSSI invertebrate assemblage features. The *Species in Peril* project has highlighted that many more species should be evaluated to determine if they should also be SSSI features and has also highlighted key non-statutory sites which should designated as SSSIs such as Parkland C, Parkland D, River A and River B.

Table 55. Pressures on *Species in Peril* invertebrates.

Pressure	No. species
Agricultural Change	9
Air Pollution	3
Climate Change	47
Coastal Change	193
Construction	4
Deadwood Loss	191
Human Disturbance	9
Hydrological Change	389
INNS	1
River Modification	57
Tree Loss	406
Vegetation Succession	455
Water Pollution	58
Unknown	195
Total	2017

5.11.6. Freshwater fish & lampreys

The freshwater fish fauna of Wales is not especially diverse, and only five species meet the relevant rarity criteria for this report (Table 56). Three of these (shads *Alosa* and Smelt *Osmerus eperlanus*) are riverine, migratory species and two (Gwyniad *Coregonus*

lavaretus and Arctic Charr *Salvelinus alpinus*) are glacial relicts restricted to deep, oligotrophic lakes with upland catchments.

Table 56. *Species in Peril* fish and lampreys assigned to restriction categories.

Restriction category	No. species	Species	Sites
<i>Decliners</i>	1	Allis Shad <i>Alosa alosa</i>	River Wye
<i>Naturally rare</i>	3	Twaite Shad <i>Alosa fallax</i> Gwyniad <i>Coregonus lavaretus</i> Arctic Charr <i>Salvelinus alpinus</i>	Rivers Wye, Usk & Tywi Llyn Tegid & Arenig Fawr Llyn Padarn, Cwellyn & Bodlyn
<i>Under-recorded</i>	0	n/a	n/a
<i>Edge of range</i>	1	Smelt <i>Osmerus eperlanus</i>	Rivers Conwy, Dee, Cleddau
<i>Colonisers</i>	0	n/a	n/a
Total	5	5 species	11 different sites



Figure 70. Gwyniad *Coregonus lavaretus*. © Ian Winfield/Countryside Council for Wales

Both Gwyniad (Figure 70) and Arctic Charr are glacial relict species in Wales that are able to survive in cold, deep, nutrient-poor lakes. Although the surface waters of these habitats are too warm for them in summer, they survive this part of the year by retreating to deeper water (the hypolimnion) which remains permanently cool in summer due to thermal stratification of the lake. This property also means that while the lake is stratified, no additional oxygen reaches the hypolimnion, so survival is dependent upon the oxygen demand being low over this period. In clean, nutrient-poor conditions, this does not pose a problem. However, increasing nutrient pollution in these lakes results in greater algal growth in surface waters, which thereby increases the oxygen demand in the hypolimnion as the algae sink and decompose (Winfield *et al.*, 2008; Hatton-Ellis, 2025a). Invasive *Crassula helmsii* has recently been detected in Llyn Tegid (B. Goldsmith, pers. comm.) and poses a significant risk to the spawning grounds of Gwyniad.

The Llyn Arenig Fawr population of Gwyniad was established in the 2000s as a conservation measure to ensure that the Welsh genotype could be safeguarded even in the event of a severe algal bloom occurring in Llyn Tegid that would deoxygenate the hypolimnion (see Winfield *et al.*, 2003, 2008, 2010). This was a concern as early as the 1990s and is an increasing risk with climate change (Hatton-Ellis, 2025a) which is likely to lengthen the stratification period and intensify algal activity (Woolway *et al.*, 2021).

The two shad species have broadly similar habitat requirements in freshwater, requiring unobstructed rivers of reasonable water quality during the spring to autumn period for

spawning and nursery habitat (Aprahamian *et al.*, 1999). Larger rivers are strongly preferred. Twaite Shad populations in the key sites (Rivers Wye, Usk and Tywi) seem to be broadly healthy (Hatton-Ellis, 2025b) and there are some indications that small populations may exist on one or more rivers in the northern Cardigan Bay. In contrast, Allis Shad populations are extremely small and likely require restoration of spawning access up the Severn (Hatton-Ellis, 2025c). Shad conservation has been improved in Wales by a succession of projects aimed at improving fish access, as well as ensuring that new river crossings and structures are designed in such a way as to preclude an impact on migration. This has resulted in improved access up the River Usk in particular. Further work is planned by the 4Rivers4LIFE project.

The distribution and extent of the other riverine fish in Wales, is rather unclear, as it only enters rivers for a brief period in late winter to spawn, and it is consequently under-recorded. Although all three Welsh species are listed on Annex II of the Habitats Regulations, no lampreys were identified as being *Species in Peril*.

5.11.7. Amphibians & reptiles

Natterjack Toad *Epidalea calamita* is the only herpetile to be found on five or fewer sites in Wales, with populations at Gronant Dunes & Talacre Warren SSSI, Talacre Shore Tip and Bettisfield. The toad was first recorded in Wales in the early 20th century but, due to increasing urbanisation resulting in habitat fragmentation, it was thought to be extinct by the 1950s. A partnership project commenced in 1995 to re-introduce the species and spawn was translocated from Ainsdale National Nature Reserve on the Sefton Coast to Talacre in 1996, 1997 and 1998 (Herpetological Conservation Trust, 2001). Spawning took place in 1999 and Natterjack Toad is now breeding sustainably and widely distributed within the dune system at Talacre. This original Welsh reintroduction site has been a source population for other translocations on the Dee Estuary (Bettisfield).

There are no reptiles that are found on five or fewer sites in Wales. The Sand Lizard *Lacerta agilis* is our rarest reptile and did go extinct in the 1960s due to habitat loss. However, during the 1990s a partnership led by the former Herpetological Conservation Trust (now Amphibian and Reptile Conservation) and the Countryside Council for Wales successfully implemented a reintroduction of the species to dune systems within parts of mid and north Wales. Further authorised reintroductions have also been carried out at Ynyslas, Morfa Dyfi, Morfa Harlech, and Gronant Dunes & Talacre Warren. The lizard is known to be present and breeding at three other Welsh sites where no official reintroductions have been carried out, namely Newborough Warren and Tywyn Aberffraw on Anglesey and Llangennith & Broughton Burrows on Gower (Owens *et al.*, 2022).

5.11.8. Mammals

Mammals in Wales are on the whole widely distributed, even if some species are subject to significant population declines and range restriction such as Water Vole *Arvicola amphibius*. Of the six species identified as being present on five or fewer sites, five are bats.

Greater Horseshoe Bat *Rhinoplophus ferrumequinum*, whilst present in a larger number of hibernation sites, has only five recognised maternity colonies in Wales (Mathews *et al.*, 2018), with numbers at these sites being stable or increasing (Mathews *et al.*, 2020). Three of the five maternity roosts are located in Pembrokeshire where the population has

recovered well following dramatic historic declines and the region is considered the Welsh stronghold of the species. One further maternity roost is in the Wye Valley area and is linked to a population in the Forest of Dean, while the fifth is near Cardiff and is a relatively isolated colony. This is a species that is predicted to spread northwards as a result of climate change and increasing observations of low numbers in north Wales support this (S. Dyer, pers. obs.).

Bechstein's Bat *Myotis bechsteinii* and Leisler's Bat *Nyctalus leisleri* are two of Wales' rarest bats. Reliable records for both species originate only in the Wye Valley region. Radio tracking has located one possible Bechstein's Bat maternity roost, although trapping confirmed presence in a number of NRW woodlands in the region. Reliable Leisler's Bat records are similarly scarce with no known maternity roosts, but presence was confirmed from trapping in NRW woodlands in the Wye Valley area, including juveniles (Whitby & Binet, 2020). Occasional records exist for coastal locations suggesting migration through Wales to Ireland may be occurring (Dyer, 2019).

The range of Barbastelle Bat *Barbastella barbastellus* in Wales shows four distinct areas, however evidence of breeding is known for just two of these. Pembrokeshire is considered to be a stronghold for the species in Wales, with two well-studied colonies (Billington, 2003; Rush & Billington, 2020). However, there remains concern regarding the isolation of Pembrokeshire colonies and genetic analysis is required to assess this. Limited evidence also suggests breeding in the Wye Valley area, although no maternity roosts have been located (Whitby & Binet, 2020).

The two known maternity roosts of Serotine *Eptesicus serotinus* in south Wales are suspected to be the same colony and are an extension of the south-west England sub-populations. A maternity roost was found in north Wales in 2013, and an additional colony has since been located. These were shown to be of a genetically distinct sub-population.

Our rarest bats all face significant threats. Bechstein's Bat, Barbastelle Bat and Leisler's Bat are at risk of losses from inappropriate woodland management, with unknown colonies lost before they are discovered. Greater Horseshoe Bat and Serotine roost in buildings and anthropogenic activities, uncontrolled development activities, roost structure degradation or roost obstruction can threaten a whole colony. There remains a significant risk, particularly for the large roosts of Greater Horseshoe Bat in south Wales, that one catastrophic event, such as a building fire, could result in the loss of a large percentage of the population. Impacts of climate change could add further pressure on these species, through forced range shifts and competition.

Skomer Vole *Myodes glareolus skomerensis* is endemic to Skomer Island. Whilst the population shows irregular cycles there is not thought to be any significant threat to the sub-species.

5.11.9. Birds

Wales holds a diverse suite of breeding and non-breeding bird populations, of which some Welsh species populations (breeding, passage or non-breeding) are of global, biogeographical, European or UK importance. Of the estimated 220 wild bird species that regularly occur in Wales, 25 species (27 species populations, because two species are represented by both wintering and breeding populations) are found on five sites or fewer in

Wales (Table 4). Of these, 16 meet the rarity categories of *Decliners* and *Naturally Rare* (Table 5). The second GB IUCN bird assessment suggests that of these 27 species populations, 12 are at risk of extinction (classified as Critically Endangered, Endangered or Vulnerable), two are Near Threatened and 12 are of Least Concern (Stanbury *et al.*, 2021) (Table 57). There are good reasons why the proportion of threatened populations in birds in Wales is high. Stanbury *et al.* (2017) suggested this is related to the risk of extinction tending to increase as the geographical area becomes smaller.

Of the 25 species of bird in *Species in Peril*, 21 are regular breeding birds and four are regularly occurring wintering birds (Table 57). 37% (10 species) are breeding seabirds owing to Wales' important sea bird colonies on remote islands off the Welsh coast, e.g. Northern Gannet *Morus bassanus* on Grassholm. Furthermore, Wales holds large proportions (more than 30%) of the biogeographical population and of global population in the case of Northern Gannet and Manx Shearwater *Puffinus puffinus* (Burnell *et al.*, 2023). Changes in the conservation status of these species can therefore be critical for their conservation, including interventions to safeguard and, when necessary aid recovery. This view is pertinent to the 2022 Highly Pathogenic Avian Influenza (HPAI) epizootic where the outbreak decimated the breeding population of Northern Gannets on the Grassholm SPA in 2023.

Three *Species in Peril* birds are migratory non-breeding waterbirds - Greenland White-fronted Goose *Anser albifrons flavirostris*, European White-fronted Goose *Anser albifrons albifrons* and Bewick's Swan *Cygnus columbianus*. The Greenland White-fronted Goose is perilously close to extinction in Wales as a non-breeding wintering bird, with a population of fewer than 40 birds on three sites: Dyfi SPA, Cefni Valley (Anglesey) and areas near Llyn Alaw (Anglesey). The Dyfi estuary population is on the southern edge of its wintering range and is important for maintaining this range. The global population reached a peak of 35,000 individuals in 1999 but has declined by 57.8% to a total of 14,997 birds in spring 2024 (Fox *et al.*, 2024). At a global level, it is known that productivity of Greenland White-fronted Goose is declining (Fox *et al.*, 2024; Stroud *et al.*, 2012) and whilst the reasons for reduced breeding success are unclear, it is thought to be related to climate change, with unseasonal snowfall during the critical period of courtship and incubation being a key driver of change.

There is a continued long-term decline in the status of Welsh bird populations and there is a need for a fundamental change to our current approach to bird species recovery for the following reasons:

- In the UK, more than 40 million birds have been lost in the last 50 years (no equivalent data is available for Wales);
- A third of all wild birds in Wales are in significant decline (Johnstone *et al.*, 2022);
- For some bird species, Wales has a global, biogeographical, European and/or UK responsibility and yet there are no Welsh or UK frameworks that determine bird species prioritisation for species recovery, monitoring or translocation;
- Many bird species breeding or wintering in Wales are a key indicator of both positive and negative environmental change (e.g. the increase in breeding Eurasian Bittern *Botaurus stellaris* in response to improved wetland management; the

negative effects of climate change on wintering populations of European White-fronted Goose).

Table 57. Conservation status of *Species in Peril* birds.

Species	Population	Extinction risk (2 nd GB IUCN Red List Assessment)	Bird of Conservation Concern Wales 4
Marsh Harrier	Breeding	Least Concern	Amber
Common Crane	Breeding	Vulnerable	Not assessed
Common Crane	Non-breeding	Data Deficient	Not assessed
Manx Shearwater	Breeding	Least Concern	Amber
European Storm-petrel	Breeding	Least Concern	Amber
Northern Gannet	Breeding	Least Concern	Red
Arctic Tern	Breeding	Least Concern	Red
Roseate Tern	Breeding	Vulnerable	Red
Common Tern	Breeding	Endangered	Amber
Sandwich Tern	Breeding	Near Threatened	Amber
Little Tern	Breeding	Least Concern	Red
Greenland White-fronted Goose	Non-breeding	Vulnerable	Red
European White-fronted Goose	Non-breeding	Endangered	Red
Dartford Warbler	Breeding	Endangered	Amber
Avocet	Breeding	Least Concern	Green
Avocet	Non-breeding	Least Concern	Green
Black Grouse	Breeding	Least Concern	Red
Black Guillemot	Breeding	Vulnerable	Amber
Bewick's Swan	Non-breeding	Least Concern	Red
Dunlin	Breeding	Critically Endangered	Red
European Golden Plover	Breeding	Vulnerable	Red
Mediterranean Gull	Breeding	Least Concern	Amber
Eurasian Bittern	Breeding	Least Concern	Red
Yellow Wagtail	Breeding	Vulnerable	Red
Twite	Breeding	Near Threatened	Amber
Cattle Egret	Breeding	Endangered	Amber
Bearded Tit	Breeding	Vulnerable	Amber

6. Key findings

This report provides a comprehensive assessment of the most vulnerable terrestrial and freshwater species in Wales in 2024. Focussing on **spatial rarity** as the measure of vulnerability, we have identified 2955 species which occur on five or fewer sites in Wales – *Species in Peril*. Many of these species are found on SSSIs (75%) and NNRs (35%) and, whilst there is a bias to recording on protected sites, this is thought to be an accurate reflection of the situation.

Key headlines arising from the project include:

- 2955 species are found on five or fewer Welsh sites including 309 fungi, 321 lichens, 107 mosses & liverworts, 7 stoneworts, 155 vascular plants, 2017 terrestrial & freshwater invertebrates, 5 fish & lampreys, 1 amphibian, 6 mammals and 25 birds (including 27 species populations) (see Table 4);
- 56 *Species in Peril* are found only in Wales in Great Britain, including 2 fungi, 1 lichen, 4 mosses & liverworts, 17 vascular plants, 31 terrestrial & freshwater invertebrates and 1 mammal (Table 46 & 52; Appendix 3);
- 1262 species (43%) are found on one site, 692 on 2 sites, 480 on 3 sites, 330 on 4 sites and 191 on 5 sites (see Table 4). Species restricted to a single site are highly vulnerable to habitat change, unsympathetic habitat management, stochastic events and climate change;
- *Species in Peril* are recorded on over 2000 sites, with 49 sites supporting more than 20 species including 17 sites supporting 50 or more species (Table 28);
- The top 20 sites include seven dune systems, three parklands, three rivers, three montane massifs, one grassland, one woodland, one peatland and one grazing levels (Table 28);
- Newborough Warren & Forest ranks the highest with 130 species, with Whiteford Burrows (94), Pembrey Coast (86), Yr Wyddfa (85), Oxwich & Nicholaston Burrows (84), Chirk Park (82), Kenfig Burrows (82), Dinefwr Park (81), Merthyr Mawr Warren (74) and River Usk (69) completing the top ten sites (Table 28);
- 2570 species (87%) have a IUCN or spatial threat, with 743 species (25%) classed as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (Table 37);
- Only 549 species (19%) are listed on the revised Environment (Wales) Act Section 7 list (Table 39);
- 77 species are classed as *Decliners*, 1389 as *Naturally Rare*, 1433 as *Under-Recorded*, 23 as *Edge of Range* and 33 as *Colonisers* (Table 5);
- *Decliners* include 1 fungus, 9 lichens, 9 mosses & liverworts, 17 vascular plants, 30 invertebrates, 1 fish and 10 birds (Table 5; Appendix 5). These are arguably the most threatened species in Wales. Some already have a high profile e.g. Black Grouse *Lyrurus tetrix*, Freshwater Pearl Mussel *Margaritifera margaritifera*, High Brown Fritillary *Fabriciana adippe*, Strandline Beetle *Eurynebria complanata* and Fen Orchid *Liparis loeselii*. Others have declined with little notice e.g. Yellow Wagtail *Motacilla flava*, Plain Clay *Eugnorisma depuncta*, Sheep Nostril Fly *Oestrus ovis*, Grass-wrack Pondweed *Potamogeton compressus*, Brown Shield-moss *Buxbaumia aphylla* and the lichen *Cetraria sepincola*;

- 2222 species (75%) occur on SSSIs, including 1402 species (47%) restricted to SSSIs (Table 33). This highlights the importance of the protected site series for some of Wales' rarest species and the need to manage them both appropriately and sympathetically;
- Just 721 species (24%) are SSSI features, either as independently notified (184) or qualifying (282), or as components of assemblages (255);
- 1047 species (35%) occur on NNRs, with 353 species (12%) restricted to NNRs (Table 34). The conservation management of these species is the direct responsibility of Natural Resources Wales or a partner organisation;
- Of 733 species not found on protected sites, 479 species (65%) are found on single sites (Table 35). Key non-statutory sites include Parkland A (65 species), River A (56), Parkland B (38), Site 38 (35), Parkland C (32), Parkland D (30), River B (26) and Parkland E (22) (Table 36);
- The key ecosystem for *Species in Peril* is *Woodland, Parkland & Scrub* with 1076 species followed by *Grassland* (536), *Peatland* (356), *Montane* (206), *Dune & Saltmarsh* (201), *River, Stream & Ditch* (196), *Coast & Coastal Cliff* (168), *Lake & Pond* (52), *Urban & Synanthropic* (48), *Heathland* (41), *Lowland Rock Exposure* (34), *Cave & Subterranean* (24) and *Agricultural* (15) (Table 7);
- 304 species have been lost from Wales since 1800s (Table 44 & Table 45), with 114 last seen in the 1950s or later. Eleven have been lost since 2000 including Blunt Bryum *Bryum calophyllum*, the lichen *Chaenotheca phaeocephala*, Mezereon *Daphne mezereum*, Corn Bunting *Emberiza calandra*, Belted Beauty *Lycia zonaria*, Broad-nerved Hump-moss *Meesia uliginosa*, Mud Wasp *Podalonia affinis*, Turtle Dove *Streptopelia turtur*, Whiteworm Lichen *Thamnolia vermicularis* and breeding Pintail *Anas acuta* (Appendix 2, p.167).
- 17 key pressures/threats to *Species in Peril* are identified, with tree loss (681 species), vegetation succession (586), hydrological change (416), coastal change (222), climate change (212), and dead wood loss (191) being the most important (Table 40 & Table 41). However, most species will be impacted by multiple pressures and climate change will affect all species and their supporting ecosystems to a greater or lesser degree.
- Conservation action targeted at rare species has continued for many years on SSSI, SAC and especially NNRs. This has been enhanced in recent years by specific programmes, including Sands of LIFE and *Natur am Byth!*, although considerably more action targeted at *Species in Peril* is required with just 39 *Species in Peril* included in *Natur am Byth!*

7. Conclusions

Biodiversity is declining more rapidly than at any other time in human history and our understanding of the scale of change, the underlying causes, and the actions that we need

to take to respond have increased considerably in recent decades. Wales has international commitments to reduce biodiversity loss in line with Global Biodiversity Framework targets, with distinct and evolving policies and powers to recover nature and respond to climate change.

Ecosystems with their full complement of biodiversity are more productive and resilient, providing greater benefits for people and underpinning sustainable economic prosperity. The value of nature must be factored into decisions, with recovering species populations everyone's business: all public bodies, all organisations, all people.

The main conclusion from the analyses carried out in this report is that there is a far greater number of species with very limited Welsh distributions than the current conservation priority lists would suggest. Only a relatively small proportion of the range-restricted species covered by this report are included on the list of priority species under Section 7 of the Environment (Wales) Act, even after a recent revision taking the total up to 549 species (19% of *Species in Peril*). Only a minority of those species which are listed under Section 7 receive any kind of active conservation, rather than passive avoidance of damage, and active conservation is essential for the survival of many species with limited ranges. Without active conservation, the survival of many species with a limited range is highly uncertain, resulting in further extinctions in Wales. In particular, those species threatened by vegetation succession – 20% of all *Species in Peril* – need active grazing, mowing or scrub clearance to prevent their loss, and this can only be carried out sustainably in collaboration with landowners. A programme of active conservation for our most range-restricted species in the context of a resilient ecological network, over and above the small number covered by the *Natur am Byth!* programme (67 species) would be a significant step in combating the Nature Emergency. Broad-scale habitat conservation will help some species, especially on hotspot sites (see Section 5.4), but targeted interventions may also be required for ecological specialists, which account for the majority of our range-restricted species.

The current status of many of our rare species is poorly known: the average (mean) year of the last record is 2006, following analysis of more than 2600 species. Species monitoring is urgently needed, particularly on Welsh SSSIs but, because this requires taxonomic specialists to identify most species that are either standalone SSSI features or assemblage components, there is very little carried out at present. Specialist monitoring under contract is the most viable option for accurate species identification.

More than 75% of *Species in Peril* are present on at least one SSSI and 47% are found only on SSSIs. Although only a minority of the rare species that qualify as SSSI features are notified as such, the presence of the SSSI affords some protection from agricultural intensification or damage from construction. Notification of additional SSSIs, especially the nine currently unprotected sites identified as holding 20 or more *Species in Peril*, could safeguard a significant number of additional species. Notification alone will not, however, provide the necessary protection; effective, resourced, long-term site management is needed to reduce the risk of losing a significant suite of species to extinction. A focus on linking action both in and outside of protected sites, as recommended at the Biodiversity Deep Dive, will provide resilience for isolated populations of rare species.

With 35% of *Species in Peril* occurring on NNRs (including 12% restricted to NNRs), NRW has a direct responsibility to ensure that these species are safeguarded, fulfilling our role

as stewards of a public estate and collaborating with landowners on privately owned NNRs. Well-resourced and well-managed NNRs are key to delivering Welsh Government's internationally binding biodiversity targets, fulfilling commitments under the Wellbeing of Future Generations Act, and delivering Nature Recovery in collaboration with land managers and partners across Wales.

For most *Species in Peril*, safeguarding and enhancing populations comes at relatively modest financial cost. Often, it can be achieved by tweaking existing management, strimming vegetation to provide open conditions for those species requiring early-successional habitats or controlling encroaching scrub. For the many species associated with veteran trees, it is a question of safeguarding the current resource, adopting sympathetic management practices to reduce deleterious impacts and ensuring the next generation of veterans succeed.

8. Recommendations

The following recommendations would help support the conservation of *Species in Peril* to help reverse the loss of biodiversity and contribute to action to address the nature emergency:

1. Develop a prioritised action plan to address the status of the key *Species in Peril*, with a particular focus on *Decliners*, species restricted to Wales in a GB context and species for which Wales holds internationally important populations or is critical to maintaining geographical range. This action plan should identify low cost options and should inform species conservation planning and delivery across the environmental sector in Wales, ensuring targeted action to prevent further extinction. The action plan should be developed in the context of an ecological resilient network and a wider strategy for nature recovery in Wales;
2. Consider how *Species in Peril* are measured and valued, and the associated opportunities that they present to Green Finance investment, how they can be incorporated into existing strategies and policies and inform the setting of Welsh Biodiversity targets;
3. Develop collaborative partnerships in autecological research, monitoring and implementation of conservation measures to aid the recovery and/or maintenance of key *Species in Peril* in Wales;
4. Scope options to secure sympathetic management for *Species in Peril* in SSSIs, NNRs and other sites that will help to safeguard these species from extinction and improve their conservation status. In many cases, this can be achieved at little cost;
5. Scope opportunities for guidance for effective habitat / ecosystem management to support rare species, either as stand-alone guidance or as part of wider habitat management guidance, and deliver a prioritised guidance programme integrating with other schemes as appropriate;

6. Consider notifying key non-statutory sites for *Species in Peril* as SSSIs as part of a prioritised framework for SSSI designation in Wales;
7. Consider adding key qualifying *Species in Peril* as features on existing SSSIs;
8. Highlight *Species in Peril* in relevant reporting mechanisms such as SoNaRR and State of Nature reports, including the importance of SSSIs and NNRs for their protection;
9. Scope options for a targeted surveillance programme to determine the current status of key *Species in Peril* in Wales, with identified triggers for intervention to avoid extinction or improve the status of a species;
10. Scope options for incorporating *Species in Peril* into current or new species monitoring frameworks for Wales as appropriate;
11. Scope options for incorporating the management requirements of *Species in Peril* into current and proposed protected site projects and programmes;
12. Review species considered to be recently extinct, and identify opportunities to undertake targeted surveys as appropriate;
13. Maintain and update the *Species in Peril* master spreadsheet as new Red Lists and Species Status Reviews are published, and new distributional information and atlases become available.

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11. Appendix 1: Ecosystem accounts

Synopses for each of the 13 ecosystems are given in Section 5.3. The following accounts provide more detail to the dune element of the *Dune & Saltmarsh Ecosystem*, the parkland element of *Parklands, Woodland & Scrub* ecosystem and the *Montane* ecosystem.

Sand Dunes (part of *Dune & Saltmarsh* ecosystem)

Welsh sand dunes are biological hotspots supporting 439 species of vascular plants, 171 mosses & liverworts, 66 lichens, 289 fungi and over 5000 invertebrate species (Howe *et al.*, 2012). Thirty-two vascular plants, 22 mosses & liverworts and ten fungi were identified as being restricted in Wales to coastal dunes (Bosanquet, 2019; Rhind & Jones, 1999), and Spooner & Roberts (2005) list 33 species of obligate UK dune macrofungi of which 26 are found in Wales. A total of 457 invertebrate species are found in Wales only or mostly on dunes (Howe *et al.*, 2012). Important species include Dyffryn Thread-moss *Bryum dyffrynense*, Warne's Thread-moss *Bryum warneum*, Early Sand-grass *Mibora minima*, Dwarf Rush *Juncus capitatus*, Fen Orchid *Liparis loeselii*, Strandline Beetle *Eurynebria complanata*, Gypsywort Weevil *Datonychus arquata*, Sandhill Rustic *Luperina nickerlii* and Natterjack Toad *Epidalea calamita*. As a consequence, the majority of Welsh dune systems are designated as nationally and internationally important sites, with twenty included within the boundaries of seven Natura 2000 sites.

Many of the specialist species are dependent upon early successional or pioneer dune habitats. Up to 75% of the specialist dune invertebrates are associated with bare and sparsely vegetated sand, marram, pioneer dune slacks and the strandline (Howe *et al.*, 2012). Of the 29 nationally rare or scarce mosses and liverworts recorded on Welsh dunes, more than half are restricted to dune slacks with open vegetation whilst the remainder grow on open, calcareous dune grassland (Howe *et al.*, 2012). Ten of 28 vascular plants identified as independent qualifying features on Welsh SSSI dune systems are associated with pioneer conditions. Ten of 28 vascular plants identified as independent qualifying features on Welsh SSSI dune systems are associated with pioneer conditions. Eight of the ten Natura 2000 features on Welsh dunes are dependent upon pioneer conditions, at least in part.

Welsh sand dunes are a shadow of their former glory following historic losses to agricultural reclamation, urban and industrial development, caravan parks and conifer plantations, and now occupy just 5670ha (Howe *et al.*, 2012). These smaller, more fragmented and isolated remnant dunes have also experienced increasing stabilization over the last 70 years with a concomitant loss of pioneer conditions and early successional habitats to vegetation. Since the 1940s, there has been an 87% loss of bare sand amounting to in excess of 1500ha. Mobile dunes currently occupy just 6% of the entire Welsh resource compared to over 70% in the 1950s, with bare sand accounting for just 200 to 250ha (Pye & Blott, 2011a & b, 2012; Pye *et al.*, 2014). These factors are having a significant impact upon the specialist fauna and flora, with historic extinctions and recent extirpations. The rove beetle *Paederidus rubrothoracicus* was last recorded in Wales in 1829 and the Sand Digger Wasp *Mellinus crabroneus* in 1921. Both are now extinct in the UK. The Duke of Burgundy *Hamearis lucina* was last seen in Wales on Merthyr Mawr Warren in 1949. Blunt Bryum *Bryum calophyllum* has not been seen on any of the four dune systems previously supporting it since 2001 and Broad-nerved Hump-moss *Meesia*

uliginosa was last recorded on Tywyn Aberffraw, its only Welsh locality, in 2001 (Bosanquet, 2019; Hollyoak, 2002; Litt *et al.*, 2021). Strandline Beetle was once widespread on both sides of the Bristol Channel but is now restricted in the UK to the Carmarthen Bay dune systems, having become extinct in Pembrokeshire in 2013 (Howe, 2016; Stewart, 2017, 2023). The Gypsywort Weevil still occurs on Pembrey Air Weapons Range, its only UK locality, but numbers remain perilously low with just 14 adults recorded in 2022 (Boyce, 2023c).

Since the winter of 2011-12, attempts have been made to restore pioneer conditions on the larger Welsh dune systems as part of ongoing Sands of LIFE and nationally funded programmes (Litt *et al.*, 2021).

Despite losses of dune extent and declines in habitat condition, Welsh dune systems continue to support a rich fauna and flora with 15 sites ranking in the top 50. Indeed, six sites are in the top 10 including Newborough Warren & Forest (ranked 1st), Whiteford Burrows (2nd), Pembrey Coast (3rd), Oxwich & Nicholaston Burrows (5th), Kenfig Burrows (7th) and Merthyr Mawr Warren (9th) (Table 58). Collectively, Welsh dunes support 81 species which are restricted to a single Welsh locality including one amphibian (Natterjack Toad), two mosses (Blunt Bryum and Broad-nerved Hump-moss), one stonewort (Baltic Stonewort *Chara baltica*), ten fungi, 64 invertebrates, two lichens and one vascular plant (Dwarf Rush) (Table 59). Newborough Warren & Forest support 15 such species, with Kenfig Burrows and Whiteford Burrows supporting 10 species.

Table 58. Number of *Species in Peril* by Welsh dune system.

Dune system	No. species
Crymlyn Burrows	25
Gronant Dunes & Talacre Warren	18
Kenfig Burrows	82
Merthyr Mawr Warren	74
Morfa Dyffryn	35
Morfa Harlech	43
Newborough Warren & Forest	130
Oxwich & Nicholaston Burrows	84
Pembrey Coast	86
Stackpole	54
Tywyn Aberffraw	34
Whiteford Burrows	94
Ynyslas Dunes	33

Table 59. Dune systems supporting *Species in Peril* restricted to a single Welsh locality.

Dune system	Fungi	Lichens	Mosses & liverworts	Stoneworts	Vascular plants	Invertebrates	Amphibians	Total
Beddmanarch-Cymyran	0	0	0	0	1	0	0	1
Broughton Burrows	0	0	0	0	0	1	0	1
Crymlyn Burrows	0	0	0	0	0	1	0	1
Gronant Dunes & Talacre Warren	0	0	0	0	0	2	1	3
Kenfig Burrows	1	0	0	0	0	9	0	10
Llangennith Burrows	0	0	0	0	0	1	0	1
Merthyr Mawr Warren	0	0	0	0	0	7	0	7
Morfa Bychan	0	0	0	0	0	1	0	1
Morfa Conwy	0	0	0	0	0	1	0	1
Morfa Dyffryn	1	0	0	0	0	0	0	1
Morfa Harlech	0	0	0	0	0	1	0	1
New Quay	0	1	0	0	0	0	0	1
Newborough Warren & Forest	3	0	0	1	0	11	0	15
Nicholaston & Oxwich Burrows	0	0	0	0	0	7	0	7
Pembrey Coast	1	0	0	0	0	8	0	9
Pendine Burrows	1	0	0	0	0	0	0	1
Poppit Dunes	0	0	0	0	0	1	0	1
Stackpole Warren	0	0	0	0	0	1	0	1
Tywyn Aberffraw	0	1	2	0	0	1	0	4
Whiteford Burrows	1	0	0	0	0	9	0	10
Ynyslas Dunes	2	0	0	0	0	2	0	4
Total	10	2	2	1	1	64	1	81

Parkland, Wood Pasture & Veteran Trees (part of *Woodland, Parkland & Scrub* ecosystem)

Old and veteran deciduous trees, and particularly those in parkland and wood pasture settings, support rare lichens, fungi and deadwood (saproxylic) invertebrates as well as providing nesting and roosting opportunities for birds and bats. Over 2000 invertebrates in the UK are associated with the deadwood habitats supported by veteran trees including 822 beetle species, 740 flies and 335 Hymenoptera (bees, wasps & sawflies) (Alexander, 2018a). Of these, over 1200 occur in Wales including 533 beetles, 439 flies and 141 Hymenoptera (Howe, in prep.).

The first assessment of the Welsh saproxylic invertebrate fauna was undertaken in 1975 when five sites were visited as part of a UK survey (Harding, 1978). In the early 1990s, the Countryside Council for Wales (CCW) produced a dossier of 201 Welsh parkland and wood pasture sites which may support important invertebrate and lichen assemblages on the basis of current knowledge and aerial imagery (Stage 1; Bray, 1993, 1994). This was followed by a survey (Stage 2) of 160 sites to assess tree population structure and current

land use (Ecosurveys Ltd., 1994a, b, c & d). These were ranked on their nature conservation potential as Very Good (15 sites), Good (42), Fair (57) and Poor (46). Subsequent surveys of epiphytic lichens at 22 parklands were undertaken in 1995 and 1996 (Orange, 1996) and of saproxylic invertebrates (mostly beetles) at 32 sites in July to August 1994, 14 of which were visited twice because of their interest (Hammond & Hine, 1994). This resulted in more intensive surveys of the saproxylic faunas of Chirk Park (Judd, 1999b), Dinefwr Park (Levey & Pavett, 2000), Parkland B (citation redacted) and Parkland A (citation redacted). More recently, Natural Resources Wales has commissioned surveys of the saproxylic faunas of Chirk Park (Alexander, 2019b), Dinefwr Estate (Alexander, 2024), Gregynog (Alexander, 2023a), Old Cilgwyn (Boyce, in prep.), Parkland D (citation redacted) and the Wye Valley woodlands (Alexander, 2018b, 2019c, 2020; Boyce, 2021; Howe *et al.*, 2022; Whitehead, 2013), and Carn Gafallt and Gilfach Reserve were surveyed as part of the *Natur am Byth!* development phase (Boyce, 2023a&b). There has also been a recent assessment of the saproxylic fauna of orchards on the Gwent Levels (Whitehead, 2022).

Eight Welsh parks rank in the top 50, including Chirk Park (6th), Dinefwr Park (8th), Parkland A (12th), Parkland B (23rd), Parkland C (29th), Parkland D (30th), Gregynog (34th) and Parkland E (49th) (Table 60). Collectively, they support 49 species restricted to a single Welsh locality including three fungi, two lichens and 44 insects (Table 61). Saproxylic invertebrates are also an important component of *Species in Peril* species at Pierce, Alcove & Piercefield Woods (20th), Blackcliff-Wyndcliff (31st) and Coedydd Aber (46th).

Important species include the pin lichen *Calicium adspersum*, which was last recorded at its only Welsh locality, Gregynog, in 1979 (Sanderson, 2018), Oak Lecanora *Lecanora quercicola* at the same site, Bearded Tooth *Hericium erinaceus* at Parkland E, and the beetle *Rhizophagus oblongicollis* at Parkland A, last seen in 1994. Cosnard's Net-winged Beetle *Erotides cosnardi* has been recorded in Piercefield Wood, its only Welsh locality, in 2018 and 2022 (Alexander, 2019c&d, 2023b; Howe, 2020d).

Table 60. Number of *Species in Peril* at key Welsh parklands.

Parkland/Woodland	No. species
Blackcliff-Wyndcliff	29
Chirk Park	82
Coedydd Aber	23
Dinefwr Park	81
Parkland C	32
Parkland E	22
Gregynog	28
Parkland B	38
Pierce, Alcove & Piercefield Woods	47
Parkland D	30
Parkland A	65

Table 61. Parklands supporting *Species in Peril* restricted to a single Welsh locality.

Parkland	Fungi	Invertebrates	Lichens	Total
Chirk Park	1	10	0	11
Dinefwr Park	0	12	0	12
Parkland C	0	2	0	2
Parkland E	2	2	0	4
Gregynog	0	1	2	3
Parkland B	0	4	0	4
Parkland D	0	6	0	6
Parkland A	0	7	0	7
Total	3	44	2	49

Montane ecosystem

Although much of Wales is hilly, truly upland habitats where montane and boreal species occur are restricted to Eryri and Bannau Brycheiniog and, to a lesser extent, the Cambrian Mountains and Berwyn. The crags of Eryri hold rich assemblages of ‘arctic-alpine’ vascular plants, mosses, liverworts and lichens. Some of these extend further south to Pumlumon in the Cambrian Mountains and Bannau Brycheiniog, but many are restricted to the highest Welsh mountains, especially where base-rich rock is present. Similarly, many Arctic-Alpine and boreal invertebrates reach their southern UK limit on Welsh mountains. The majority of these are associated with the fourteen peaks above 3000 feet (915m) of north-west Wales including Eryri and Cadair Idris, with smaller numbers found on Pumlumon and the higher peaks of Bannau Brycheiniog. Other montane habitats occupied by range-restricted species include scree, springs and upland lakes and smaller water bodies.

Among the rich array of montane vascular plants restricted to a handful of Welsh sites are Alpine Mouse-ear *Cerastium alpinum*, Arctic Mouse-ear *C. nigrescens*, Mountain Avens *Dryas octopetala*, Snowdon Lily *Gagea serotina* which is restricted in GB to Eryri, Alpine Saxifrage *Micranthes nivalis*, Alpine Saw-wort *Saussurea alpina*, Alpine Woodsia *Woodsia alpina* and Oblong Woodsia *W. ilvensis*. These species are associated with areas of base-rich igneous rock and are therefore highly localised even within the sites where they occur. The same is true of the mosses such as Wispy Leskea *Pseudoleskeella rupestris*, Short Rock-bristle *Seligeria brevifolia* and Brown Screw-moss *Syntrichia princeps* (Bosanquet & BBS, 2015), and the lichens *Catillaria scotinodes*, *Coccotrema citrinescens* and *Koerberiella wimmeriana* (Fryday, 1996). Mountain Grisette *Amanita nivalis* grows with dwarf willows on Elidir Fach, Mynydd Perfedd and Pen-Yr-Ole-Wen.

Both the Yellow-ringed Carpet *Entephria flavicincta* and the aphid *Nasonovia saxifragae* feed on saxifrages and therefore frequent the same crags as many of the rarer plants, although the former has only been recorded from Eryri and the latter from Bannau Brycheiniog (Blackman, 2010; Mullard, 2014). The aphid *Brachycaudus sedi* feeds on *Sedum rosea* and was last seen at its only Welsh locality, Cwm Idwal, in 1962 (Jacob, 1964). The sawflies *Euura herbacea* and *Pristiphora staudingeri* feed on *Salix herbacea* on Glyderau, with the former also found on the Carneddau, whilst *Euura clibrichella* feeds on sedges on the Carneddau. The rove beetle *Parabolitobius barnevillei* is restricted to Cadair Idris, Carnedd Llewelyn, Lliwedd & Yr Wyddfa (Stenhouse & Dallimore, 2024).

Massive boulders below the cliffs of Cwm Idwal support Tufted Saxifrage *Saxifraga cespitosa* at its only Welsh site, whilst beds of smaller boulders in Eryri hold scree specialists such as the wolf spider *Pardosa trailli*, the Mountain Plate-jaw beetle *Leistus montanus* (National Museums Liverpool, 2018), the rove beetle *Stenus glacialis* (Gallon & Fowles, 2004) and the mosses Many-fruited Dog-tooth *Cynodontium polycarpon* and Orange Bow-moss *Dicranodontium asperulum* along with an array of saxicolous lichens. Late snow-lie is an increasingly rare feature of the Welsh mountains, but snow-bed areas support small populations of the mosses and liverworts Stabler's Rustwort *Marsupella stableri* and Ludwig's Threadmoss *Pohlia ludwigii* (Hodd, 2023) and the lichen *Frutidella caesioatra* (Fryday, 1996) isolated from the mountains of Scotland and continental Europe, and at least formerly supported the Snow-patch Heart-shield ground beetle *Nebria nivalis* which was last seen on Yr Wyddfa in 1980 (Garland & Lee, 1980). Montane springs are home to Chickweed Willowherb *Epilobium alsinifolium* and Spiral Apple-moss *Philonotis seriata* (Bosanquet & BBS, 2015), whilst montane lakes hold the lichens *Lecanora achariana* and *Pterygiopsis concordatula*, and the mosses and liverworts *Bryum muehlenbeckii*, Anomalous Grimmia *Grimmia anomala* and Brown Flapwort *Odontoschisma elongatum*. These lakes also support the Arctic-Alpine Pea Clam *Conventus conventus* and the diving beetles *Boreonectes multilineatus* and *Dytiscus lapponicus*, although oddly the only Welsh locality for the latter is at much lower altitude (Foster *et al.*, 2016).

The Welsh montane spider fauna is relatively rich, with 14 specialist species (Gallon, 2014; Lavery & Gallon, 2019). Seven of these have very restricted distributions including *Pardosa trailli*, with Cadair Idris supporting the strongest population in the UK, the money spiders *Agyneta nigripes*, *Mughiphantes whymperi*, *Oreoneta frigida*, *Oreonetides vaginatus* and *Typhochrestus simoni*, last seen on Y Lliwedd in 1966 (Cooke, 1967; Goodier, 1967), and the ground spider *Micaria alpina* which was last recorded on the Carneddau in 2002 (Gallon, 2004) despite subsequent targeted searches. Montane grassland and heath support the Dusky Sweep moth *Acanthopsyche atra* and the Northern Grass-veneer *Catoptria furcatellus*. Thyme-rich montane crags and grassland are the last refuge of the Rainbow Leaf Beetle *Chrysolina cerealis* which is now restricted in the UK to a handful of suitable localities on Yr Wyddfa having last been seen in Cwm Idwal in 1980 (Howe, 2020!; National Museums Liverpool, 2017; World Museum Liverpool, 2016).

An assessment of the Welsh upland invertebrate invertebrate was made in 2007 (Gallon, 2007), with a survey of the montane invertebrate fauna of Cadair Idris undertaken in 2010 (Boyce, 2011). A baseline survey for monitoring the Cadair Idris fauna was established in 2023 (Gallon & Dallimore, in prep.).

Four montane massifs are in the top 50 - Yr Wyddfa (4th), Glyderau (11th), Carneddau (19th) and Cadair Idris (41st) (Table 62). Collectively, they support 47 species restricted to a single Welsh locality, especially lichens (Table 63). Climate change means that montane species are among the most threatened in Wales, although direct conservation action is particularly difficult.

Table 62. Number of *Species in Peril* at key Welsh montane massifs.

Site	No. species
Yr Wyddfa	85
Glyderau	67
Carneddau	47
Cadair Idris	25

Table 63. Montane massifs supporting *Species in Peril* restricted to a single Welsh locality.

Site	Spiders & allies	Bivalvie molluscs	Mosses & liverworts	Fungi	Insects	Lichens	Vascular plants	Total
Yr Wyddfa	0	0	2	1	3	15	3	24
Glyderau	0	1	2	1	0	7	1	12
Carneddau	2	0	1	0	1	3	1	8
Cadair Idris	0	0	1	0	0	2	0	3
Total	2	1	6	2	4	27	5	47

12. Appendix 2: Key species extinctions in Wales

Lichens

Chaenotheca phaeocephala

This pinhead lichen has only been recorded twice in Wales: once on an ancient Oak near Welshpool and once on a derelict timber barn in Radnorshire. Both colonies have been lost, and the species is considered extinct in Wales. One of the handful of other British records came from a timber barn, in Surrey, and the species may once have been widespread on timber buildings. Changes to timber treatment and barn construction mean that there is now far less available habitat for *C. phaeocephala* than there would have been historically.

Whiteworm Lichen *Thamnolia vermicularis*

In 2001 a survey of the summit ridge of Cadair Idris showed this montane lichen to be reasonably widespread, but by 2022 it could not be found at all despite a detailed survey. Its three other recorded Welsh localities, all in Eryri, also no longer support *Thamnolia* and it was declared probably Extinct in Wales in 2023. The combined effects of climate change, N pollution and heavy sheep grazing are believed to have caused its loss from Wales.

Mosses & liverworts

Blunt Bryum *Bryum calophyllum*

The last Welsh record of this specialist moss of dune slacks came from Tywyn Aberffraw in 2001 and several visits to the area where it was last recorded have failed to relocate a population. There has been ongoing floristic succession in the last occupied slack, leaving drier conditions than the *Bryum* requires. Habitat restoration by shallow scraping within the slack does not appear to have worked.

Large Atlantic Pocket-moss *Fissidens serrulatus*

The only Welsh record of this large pocket-moss was made from a sea cave 'near Harlech' in 1967. This deliberately vague location information, designed to protect the species from collection, prevented searching until 2009 when the original finder was asked where the *F. serrulatus* grew (Bosanquet, 2009). This led to a visit to the sea cave, which unfortunately no longer held *F. serrulatus*. The species remains extant at a handful of sites in Devon and Cornwall.

Broad-nerved Hump-moss *Meesia uliginosa*

The only site in Wales where this Nationally Scarce moss has ever been recorded is Tywyn Aberffraw. It was relocated there in 2001 following many decades without a Welsh record, but subsequent scrutiny of the slack in which it grew has failed to relocate any plants. The slack vegetation has closed over substantially in the intervening years and it could not be relocated in 2015 (Holyoak, 2015); attempts at rejuvenating it with shallow scrapes appear to have failed. In northern England and Scotland, *Meesia* grows both in upland flush systems and dune slacks, and it is declining in both these habitats.

Baltic Bog-moss *Sphagnum balticum*

The only accurately identified record of this rare *Sphagnum* of raised bogs came from Cors Caron west bog in 1967. Since then, the water table of the bog has been substantially lowered through drainage, and then substantially raised as part of a LIFE project, whilst extensive fires affected the whole of the West Bog in the late 20th century. Targeted surveys have failed to locate *S. balticum* on Cors Caron, although similar-looking plants of *S. fallax* caused brief hopes of its survival in 2022 (Callaghan *et al.*, 2023). Only four colonies remain in Britain.

Vascular plants

Mezereon *Daphne mezereum*

This small deciduous shrub of open limestone woodland became extinct at its last native site at Carmel Woods in 2019 (BSBI DDB). It was never a common species in Wales with other native locations at The Minnets (last recorded 1971) and the Lower Wye Valley pre 1920s (Evans 2007).

Downy Hemp-nettle *Galeopsis segetum*

This species was formerly established at one site near Bangor (Caernarfonshire), where it has often been regarded as a native, and though it used to appear annually following its discovery there in 1802, it has not been seen since 1977, and is now presumed to be extinct. (Walker & Stroh in BSBI Atlas Online).

Llanfairfechan Hawkweed *Hieracium cambricogothicum*

Only confirmed from its type locality in Llanfairfechan, where it was last recorded in 1953, Llanfairfechan Hawkweed was not refound during searches between 2004 and 2006 (McCosh & Rich, 2018; Rich *et al.*, 2007)).

Taf Fechan Hawkweed *Hieracium elevatum*

A Welsh endemic recorded from Taf Fechan and Capel-y-ffin. Taf Fechan Hawkweed was last seen 1969 and not refound during searches in 2011 (McCosh & Rich, 2018; Rich, 2012).

Griffith's Hawkweed *Hieracium griffithii*

A Welsh endemic, only recorded from the Nant Ffrancon Valley in Eryri. Griffith's Hawkweed was last recorded in 1916, despite repeated searches at its old site and wider area (Cranmer, 2012; McCosh & Rich, 2018; Rich, 2012).

Penwyllt Hawkweed *Hieracium pusillifolium*

A Welsh endemic only known from exposed limestone rocks at Penwyllt in the western Brecon Beacons, where it was last recorded in 1920. It was not refound during targeted searches in 2010 and may have been lost to quarrying (McCosh & Rich, 2018; Rich, 2010, 2012).

Robert's Hawkweed *Hieracium robertsii*

A Welsh endemic known from Craig y Dulyn, Caernarvon. It was last recorded in 1953 and searches in 2012 & 2013 failed to refind any plants (Cranmer, 2012; McCosh & Rich, 2018; Rich, T., C.G., unpublished).

Musk Orchid *Herminium monorchis*

This orchid was last recorded in dune grassland at Kenfig Burrows, Glamorgan in 1958 (Wade, 1994).

Oysterplant *Mertensia maritima*

A perennial herb of coastal shingle. The last location for this species in Wales was at Abergele on the North Wales coast, in 1989 (BSBI DDB).

Irish Saxifrage *Saxifraga rosacea*

This species was first recorded in Snowdonia at Cwm Idwal in 1796. It was last recorded here in 1962 at its only Welsh location. Specimens from this location have been in cultivation since then plants have been planted out in two locations in 2023 and 2024 and are doing well so far.

Terrestrial & freshwater invertebrates

Agabus uliginosus

This water beetle was last recorded in Wales on Magor Marsh in 1994, with previous records from Portland Sea Wall, Whitson in 1991 and Sully Island in 1950. Additional Welsh records are thought to be erroneous and are not mapped in the predaceous water beetle atlas (Foster *et al.*, 2016; Howe, 2021e). It is mostly associated with ephemeral water bodies but can be found in permanently wet primary fen (Foster, 2010). A search on Magor Marsh in spring 2024 failed to locate the beetle or find suitable habitat (Dave Boyce, pers. comm.).

Purple Emperor *Apatura iris*

Historically, the Purple Emperor was widespread but very scarce in Wales but was last recorded as a breeding resident in the 1930s (Asher *et al.*, 2001). It has been recorded sporadically since then, with most records from the border counties, most recently in 2006 in Abergavenny. The butterfly is associated with well-wooded landscapes where larvae feed on the leaves of Goat Willow *Salix caprea*.

Great Yellow Bumblebee *Bombus distinguendus*

Once widespread but local in Wales, the last record of Great Yellow Bumblebee was from the Botanic Gardens at Leckwith in 1974. It is now restricted to the north coast of Scotland, the Western Isles, Orkney and western Ireland where it is associated with flower-rich grassland and machair (Else & Edwards, 2018).

Short-haired Bumblebee *Bombus subterraneus*

There are records of Short-haired Bumblebee from Dinas Powis, Old Cogan and Penarth in the first half of the 20th Century, with the last Welsh record seemingly from Ceredigion in 1970. Associated with herb-rich grassland, the bee was last seen in the UK in 1988 and officially declared extinct in 2000 (Else & Edwards, 2018). It has since been reintroduced to Dungeness in Kent.

Northern February Red *Brachyptera putata*

This stonefly, which is endemic to the UK (Macadam, 2023), is found in the middle and lowland sections of large and medium-sized rivers mainly in north and north-east Scotland, but with recent records from the River Wye in Herefordshire and from the River Usk. Larvae are associated with shallows or riffles comprising some bedrock but usually

possessing large boulders, cobbles and smaller material, feeding on algae and detritus attached to the substrate. Larvae were recorded on the Usk at Llantrisant in January 1983 and a single adult female was found at Llangynidr Bridge in April 1996. Subsequent surveys failed to locate the species (Hammett, 2001, 2002, 2003, 2005).

Mole Cricket *Gryllotalpa gryllotalpa*

Formerly widespread in southern England and south Wales (Haes & Harding, 1997), it is now Critically Endangered in the UK with a relict population in the New Forest (Sutton, 2015). Occasional reports elsewhere may refer to accidental importations. It was first recorded at Kidwelly in 1693 and the last possible Welsh breeding population is from the same locality in 1995. It was reported from Barry in 1964 and 1971, North Cornelly in 1993 and Newport in 2019, the latter a suspected importation.

Orange Upperwing *Jodia croceago*

Orange Upperwing was formerly widespread in southern England and Wales but had declined markedly by the mid-1980s. The last UK sightings of a breeding population were in Tregaron 1994, although a suspected immigrant was recorded in Sussex in 2006 (Randle *et al.*, 2019). Surveys around Tregaron (Tillotson, 2002) and in Snowdonia (Waring, 2002) have failed to locate the moth.

Laccornis oblongus

This water beetle is a post-glacial relict species that is predominantly associated with small, isolated sites where it is confined to shallow, mossy areas of temporary base-rich fens (Foster, 2010). In Wales, it is known from a single adult found on Whitewall Common, part of Magor Marsh, in April 1990 (Angus, 1990) and has not been recorded since despite targeted searches in March 2002 by the Countryside Council for Wales (Howe, 2020e). A search on Magor Marsh in spring 2024 also failed to locate the beetle or find suitable habitat (Dave Boyce, pers. comm.).

Belted Beauty *Lycia zonaria*

The Belted Beauty moth was first recorded in Wales on Merthyr Mawr Warren in 1864 (Gilmore *et al.*, 2014) but all other records are from the north Wales coast where it was historically widespread from Talacre Warren to Morfa Conwy. Most populations were extirpated in the late 1800s to early 1900s, although it persisted at Morfa Deganwy up to 1929 (Howe, 2020av). It occurred on Morfa Conwy from 1903 until 2012 and is now presumed extinct in Wales. Associated with pioneer dune grassland, attempts were made to provide more suitable habitat conditions at Morfa Conwy for over a decade and the population was reinforced by captive rearing. Translocations to Kinnel Dunes and Newborough Warren failed to establish the moth.

Lunar Yellow Underwing *Noctua orbana*

Always scarce in Wales, substantial UK historical declines have reduced the Lunar Yellow Underwing to three strongholds – Breckland and the Sandlings in East Anglia and the Hampshire-Wiltshire borders (Randle *et al.*, 2019) – where it is associated with grasslands and other open habitats. Most Welsh records are from the border counties and it was found on Anglesey and the adjoining mainland in the 1970s and 1980s although these may have been erroneous (North Wales Lepidoptera website). The last confirmed Welsh record was from Cernydd Carmel in 1992, with recent records from Dale Fort in Pembrokeshire either requiring verification or representing dispersing individuals.

Large Tortoiseshell *Nymphalis polychloros*

The Large Tortoiseshell was once widespread across southern and central England where it was associated with woodlands supporting elm *Ulmus*, the main larval foodplants, and willows *Salix* for nectaring adults. It is considered extinct in the UK (Asher *et al.*, 2001) with recent sporadic records either immigrants or the result of releases from captive-reared stock. In Wales, it was most numerous along the English-Welsh border and in Monmouthshire although breeding was recorded on the Creuddyn peninsula in the 1960s and 1970s (Michaelis, 1970). Recent records from Ceredigion, Glamorgan and Monmouthshire are unlikely to represent breeding populations, although the increasing breeding population in south-east England (Langdon, 2023) raises the possibility of this species recolonising Wales.

Barred Colonel *Odontomyia hydroleon*

The Barred Colonel soldierfly has been recorded from just two sites in the UK, Banc y Mwdan in Ceredigion and Seivedale Fen in north Yorkshire (Stubbs *et al.*, 2001). It was first found in Wales in 1986 (Fowles, 1986), with peak adult numbers recorded the following year (Fowles & Morgan, 1987; McLean *et al.*, 1987). Subsequent counts were small and it was last seen in 2006, with visits from 2007 to 2017 failing to find the fly. Favouring open, base-rich seepages for breeding, extirpation was probably the result of seepages becoming rank and dominated by tall rushes and horsetails as a consequence of reduced livestock grazing (Howe, 2020q).

Crucifix Ground Beetle *Panagaeus cruxmajor*

In Wales, the Crucifix Ground Beetle was found on Llanrhidian Marsh, Gower in April 1915 (Tomlin, 1921) but not recorded again until 12 adults were seen at Tywyn Burrows at the western end of Pembrey dune system in April 1985 where they were associated with a seasonally-flooded dune slack (Anon., 1986; Fowles & Morgan, 1987). Small numbers were recorded in 1991 and 1992, with elytral remains found in 1997 and a single female in 1998 (Entotax Consultants U.K, 1999), and this proved to be the last Welsh record. Coastal erosion resulted in the loss of the occupied slack and despite the creation of a number of artificial scrapes in the winter of 1998-99, no beetles were found in 1999 (Entotax Consultants U.K, 2000) or subsequently (Howe, 2020j).

Mud Wasp *Podalonia affinis*

In the UK, the Mud Wasp is found on sand dunes and inland sandy heaths mainly in south-east England and the south coast, with outlier populations in Lincolnshire, Yorkshire, The Wirral and Lancashire (Edwards, 1997a). In Wales, it is known only from Talacre Warren where it was first recorded in August 1995 (Judd, 1996). It has been recorded episodically since, with three adults in 1996 (Clee, 1999; Judd, 1997), one adult in 2000 and four adults recorded in 2012 (Clee, 2012; Howe, 2020y). However, none was found during targeted searches in 2018 (Dixon, 2018; Howe, pers. obs.).

Pale Shining Brown *Polia bombycina*

The Pale Shining Brown was widespread historically south and central England but, following severe declines since the 1970s, it is now restricted to small areas of grassland and open woodland in Hertfordshire, Norfolk, Oxfordshire and Wiltshire (Randle *et al.*, 2019). It was widespread if somewhat local in Wales, with most records from south and western coastal areas. It was last recorded on Nicholaston Burrows in 1980.

Bordered Gothic *Sideridis reticulata*

Once widespread in open habitats over much of England and the Welsh Borders, the Bordered Gothic is now extinct as a resident in Britain, although it still occurs along the south coast of Ireland (Randle *et al.*, 2019). It was last recorded in Wales from Breconshire and Denbighshire (Gresford) in 1997.

Typhochrestus simoni

This money spider is considered a montane species in Europe, although contemporary UK records are from Bindon Down, Lulworth and Porton Down (Harvey *et al.*, 2017). However, it was first recorded in UK on the south-facing slopes of Y Lliwedd in Eryri in February to March 1966 when a single male was captured in a pitfall trap set in Fescue - Matgrass (*Festuca* - *Nardus stricta*) rocky grassland (Cooke, 1967; Goodier, 1967). Another male was found in March to April 1966, also from a pitfall trap, with both being recorded at elevations of 450 to 590 metres. The spider has not been found subsequently, despite a targeted search in April 2018 (Richard Gallon, pers. comm; Howe, 2020u).

Sword-grass Xylena exsoleta

The Sword-grass was once widespread throughout mainland Britain, inhabiting moorland, grassland and open woodland, but is now largely restricted to north-east Scotland and the Isle of Man (Randle *et al.*, 2019). It was widespread in Wales, particularly around the coast and along the Welsh Borders, with regular records on Kenfig Burrows throughout the 1980s, but was last recorded as a breeding species in late 1990s, with a record from Coedydd Aber in 1999. Contemporary record from Talwrn on Anglesey, Cwm Llinau in mid Wales and Marloes in Pembrokeshire are most likely to represent dispersing individuals rather than breeding populations.

Transparent Burnet Zygaena purpuralis segontii

The Transparent Burnet is associated mostly with steep, south and south-west facing coastal grassland where the larvae feed on Wild Thyme *Thymus drucei*. It is found on the Inner Hebrides from Skye southwards to Jura and on the mainland at Ardnamurchan in Scotland and in western Ireland (Randle *et al.*, 2019). Transparent Burnet was first recorded near Abersoch in 1887 (Tutt, 1899) and was found regularly up to 1930, with adults sometimes numbering in hundreds. The Welsh population was recognised as a distinct subspecies, *segontii*, in 1958 (Tremewan, 1958) and was last recorded at its only Welsh locality in 1962 (Heath & Maitland Emmet, 1985) and not found on subsequent visits (Waring *et al.*, 2003).

Amphibians & reptiles

Sand Lizard Lacerta agilis

Sand Lizard was once widespread along the North Wales coast. Numerous threats and pressures, such as development, public pressure and human changes to coastal ecosystems (leading to increased habitat succession and erosion), combined to cause the extinction of Sand Lizard in Wales by the mid-20th Century (Edgar, 2007). As part of a Species Recovery Project and the UKBAP action plan, the species was reintroduced in 1995 to Morfa Harlech (re-enforced in 2000 and 2008). This population is now well established, and the range has increased as lizards have been reintroduced to more locations. In 2003 releases began at Gronant, followed by Presthaven/Talacre in 2004. In 2006, animals were released at Towyn, Aberdovey along with Ynys Las in 2009. Surveillance has shown that animals have spread out on each site from the original release foci (Howe, 2018a).

Populations were found at Aberffraw on Anglesey in 2010, at Newborough Warren in 2012 and on Gower in 2018. These populations result from unauthorised releases (Owens *et al.*, 2022) and were not part of the planned UKBAP project.

Natterjack Toad *Epidalea calamita*

The Natterjack Toad was first recorded in Wales in the early 20th century. However, increasing urbanisation, changes to coastal ecosystems (leading to increased habitat succession and the lowering of water tables), habitat fragmentation and the decline of the traditional grazing management of coastal habitats, the species disappeared from Wales altogether by the 1960s (Edgar, 2007).

As part of a Species Recovery Project and the UKBAP action plan, Natterjack Toad was reintroduced in 1995 to sites in Gronant and Talacre (Point of Ayr). In 2003, an intervening site was established at Presthaven. While natural range expansion has been very limited, spawn was translocated to Bettisfield on the Dee Estuary coast in 2015, 2016 and 2017 creating a fourth distinct site. All sites are monitored each year for calling males and the numbers of spawn strings are counted within breeding pools.

Birds

Pintail *Anas acuta*

The Pintail is a very rare breeder in Great Britain (GB) with a population between 25-30 pairs, mainly in north-west Scotland (Orkney, North Uist and Tiree) and isolated sites in south-east England (Eaton & Rare Breeding Birds Panel, 2022). The GB population is on the southern edge of its breeding range and is thought to be declining (Eaton & Rare Breeding Birds Panel, 2022). Pintail have breed in Wales on several occasions, with confirmed breeding in Pembrokeshire (1988, 1989, 1990-1996, 2002) and Carmarthenshire (1989). Despite occasional records of summering pairs, the last confirmed breeding record in Wales was in 2002 on Skomer Island (Pritchard *et al.*, 2021).

Corncrake *Crex crex*

Historically, the Corncrake rapidly declined throughout much of its breeding range, which extends from the western Palearctic east to southeastern Siberia and is red-listed on the fifth UK assessment of Birds of Conservation Concern (BoCC) (Stanbury *et al.*, 2021). However, the population in Europe may be stabilising. Monitoring in Russia, which holds the vast majority of the global population, suggests breeding numbers maybe increasing (BirdLife International, 2021). In GB, the bulk of the population, estimated to be 1,100 males (Woodward *et al.*, 2020), are found in the Hebrides, Scotland and Ireland (Eaton & Rare Breeding Birds Panel, 2022).

In the 19th Century, Corncrakes were a common and familiar breeding bird in Wales. This is supported by quarry bags, for example up to 90 birds were shot on one Estate in Ceredigion between 1851 and 1860, with many birds killed particularly on Partridge shoots in September (Roderick & Davies, 2010). The last conformed breeding record/calling birds in Wales was in 2013 (Llyn Barfog, Meirionnydd) (Pritchard *et al.*, 2021). Declines are considered to be related to agricultural intensification and grassland management.

Reintroduction trials in England have had limited success, a similar reintroduction scheme might be possible in Wales if favourable land management practices could be achieved at scale.

Corn Bunting *Emberiza calandra*

The Corn Bunting breeds in lowland, arable habitats, particularly Barley, and during the 20th Century has undergone steep population declines with local extinctions across large parts of its former GB and European range. In Britain, the population decline was notable between the first breeding bird Atlas period 1968-1972. The Corn Bunting is red listed in the last UK assessment of Birds of Conservation Concern and Near Threatened in the second GB IUCN Red List (Stanbury *et al.*, 2021).

In the mid-1990s the Welsh breeding population was estimated to be 15 pairs and restricted to the counties of Denbighshire and Flintshire, declining to four pairs in 1999 (Pritchard *et al.*, 2021). Other than sporadic reports no breeding had been confirmed between 2000 to 2019. The last confirmed breeding attempt in Wales, may have occurred in 2020 at a cross-border location, but it was not known whether the pair bred in Wales or England.

Nightingale *Luscinia megarhynchos*

The Nightingale, a breeding bird of scrub and open woodland breeds in a broad band across much of central and western Europe and in Britain is restricted to southern and eastern England. The latest population estimate of Woodward *et al.* (2020) suggests 5,500 singing males. The Nightingale is red listed in the latest UK assessment of Birds of Conservation Concern and classed as Vulnerable in the second GB IUCN Red List (Stanbury *et al.*, 2021).

The Nightingale's breeding range in England has continued to contract towards the south and east with reasons often associated with reduced woodland management and browsing damage by increase deer populations leading to a deterioration in suitable breeding and foraging habitat (Holt *et al.*, 2012).

Pritchard *et al.* (2021) suggests the Nightingale was never common throughout Wales, yet it has had considerable cultural recognition in Welsh literature. The Welsh population in the late 19th and early 20th Century seems to have been mainly confined to Gwent and Glamorgan and were still apparently locally numerous in the 1920 and 1930s. The last definitive confirmed breeding record in Wales was in East Glamorgan in 1981, Llanishen, Glamorgan (Pritchard *et al.*, 2021). However, there are records of long-staying males that may suggest probable breeding. The Welsh wet climate may never have been conducive to a species that prefers a warmer, drier or a more continental climate. The prospects of the Nightingale becoming a regular breeding bird in Wales seems remote.

Turtle Dove *Streptopelia turtur*

The Turtle Dove's purring song is a quintessential sound of the summer in farmland habitats. However, the Turtle Dove has shown a rapid and steep decline in both population numbers and breeding range with a UK population in 2016 as low as 3,600 pairs (Woodward *et al.*, 2020). Recent data suggest the UK populations has declined by 97% between 1994 and 2023 (Stanbury *et al.*, 2021). The Turtle Dove is red listed in the latest UK assessment of Birds of Conservation Concern and classed as Critically Endangered in the second GB IUCN Red List (Stanbury *et al.*, 2021), in Wales it is also Red-listed

(Johnstone *et al.*, 2022). These UK populations declines are mirrored by chronic declines across its European range. The key reasons driving population decline across a large geographical space are predominantly habitat destruction, especially the removal of hedgerows, widespread application of herbicides leading to reduced food resources and hunting pressure on migration routes.

Wales is on the western edge of the Turtle Dove's breeding range, but though it was uncommon it was a regular breeding bird in Glamorgan and Denbighshire in the late 19th Century. The last confirmed breeding attempt in Wales was 2011 in a conifer plantation in Radnorshire (Pritchard *et al.*, 2021). The species is now recorded in Wales mainly as a passage migrant in April-June and during October and numbers of migrant birds are also declining. The likelihood of Turtle Dove becoming a regular breeding bird in Wales are very low.

Mammals

Beaver

The Eurasian Beaver *Castor fiber* is native to Britain but the last record of beaver presence in Wales is from the River Teifi in 1188 AD and it is likely that beavers were extinct in Wales by the 15th century (Jones *et al.*, 2012). Hunting for their pelts and also for castoreum and meat led to their extinction, with habitat loss thought to have been a lesser factor (Gaywood, 2015). In 2024, following an evidence review by NRW (Natural Resources Wales, 2023), Welsh Government announced that they supported the managed reintroduction of beavers to Wales. Beavers are however already known to be present in Wales in a number of locations, likely to be the result of escapes of captive animals or illegal releases (Natural Resources Wales, 2023).

13. Appendix 3: *Species in Peril* restricted to Wales in the UK

Fungi

Tulostoma fimbriatum

Three species of *Tulostoma* Stalkball have been known from Britain for many years, but a fourth was only discovered in 2011. This new species, *T. fimbriatum*, was collected at Ynyslas during a British Mycological Society workshop on dune fungi (Hobart, 2012). It is reasonably common in continental Europe.

Globeflower Smut *Urocystis trollii*

Although its host plant, Globeflower *Trollius europaeus*, remains widespread in Wales the only record of its smut fungus *Urocystis trollii* is from Cwm Cadlan. This is one of only two British records on native *Trollius*, the other being from Scotland in the 1920s. *Trollius* has undergone a substantial decline in Wales in the last 50 years and continues to decline, so the long-term survival of its specialist fungus is highly doubtful.

Lichens

Porpidia ochrolemma

The base-rich rocks of Cwm Uchaf in the Yr Wyddfa massif are home to a suite of very rare montane lichens. The first person to study them in detail, Alan Fryday (1996), collected “a sterile crustose lichen with a smooth, yellow-orange thallus” that turned out to be *P. ochrolemma* new for Britain. It has not been found subsequently anywhere else in the UK.

Mosses & liverworts

Upright Apple-moss *Bartramia aprica*

Stanner Rocks is the only remaining British site for this moss, following its loss from Breidden Hill in the 1960s due to quarrying and from single sites in England and Scotland. Scrub encroachment and shading, exacerbated by N pollution from surrounding intensive agriculture, threaten the colony. *Natur am Byth!* work is focused on reducing scrub growth and reintroducing sustainable grazing.

Cadair Idris *Grimmia alpestris*

This is one of a group of small, saxicolous mosses that are difficult to identify even with a microscope. The only British specimen was collected in 2001 near the summit of Cadair Idris by a tourist from Belgium, who picked a few mosses to take home to his bryologist brother (Werner & Smith, 2004). Among these collections was *G. alpestris*! A targeted survey four years later failed to relocate the colony.

Welsh Bristle-moss *Orthotrichum cambrense*

One of very few mosses found solely in Britain, *O. cambrense* grew in reasonable abundance on several tree trunks at Dryslwyn, Carmarthenshire in 2012. It was formally described by international *Orthotrichum* expert Francisco Lara (Bosanquet & Lara, 2012). Ivy growth threatens the colony, which had declined substantially by 2024.

Irish Rock-bristle *Seligeria oelandica*

The disjunct global distribution of this small moss comprises arctic Canada, Alaska, arctic Russia, Scandinavia, the Alps and north-west Ireland. It was discovered new to Britain in 2009 on Craig y Cilau, where it grows in reasonable abundance on one permanently flushed, vertical limestone rockface. Farr (2020) studied the hydrology of the colony to determine whether water supply changes could be a threat to its survival.

Vascular plants

Wild Cotoneaster *Cotoneaster cambricus*

This apomictic species only occurs on the Great Orme in a global context. There has been much debate in the recent past as to its native status and taxonomy. This has been clarified recently (Moore et al. 2010) and *Cotoneaster cambricus* is currently accepted as native. There are currently six original plants surviving and about 44 introduced plants still surviving. More population bolstering of this species here is planned.

Yellow Whitlowgrass *Draba aizoides*

A member of the cabbage family, this species only occurs as a native in the UK, on the South Gower Coast in Glamorgan, South Wales. In Europe it occurs in mountainous regions in central and southern Europe. It was first described in the UK, 1796 growing near Worms Head. Yellow Whitlow Grass now occurs in several locations on the limestone cliffs along the south Gower coast and on the ruined walls of Pennard Castle.

Welsh Eyebright *Euphrasia cambrica*

This endemic eyebright has always been restricted to the mountainous regions of North Wales, in nutrient poor, acidic and calcareous grassland. The fortunes of this diminutive, annual, hemiparasite are rather dependent on the right amount of grazing (not too high or too low) and nutrient levels remaining low. More specifically It has been found more recently (post 1987) in several locations in Eryri, Cwm Idwal, The Carneddau and Cader Idris, but only the first two post have post 2010 records.

Radnor Lily *Gagea bohemica*

This bulbous lily was first found within the UK, at its only station, Stanner Rocks, in 1965, but not named as this until 1975. Globally it also occurs in central and southern Europe and North Africa. At Stanner it is found on the droughted, thin soiled ledges over the Dolerite rock. Here it can be found frequently but always flowers shyly. It is vulnerable to scrub encroachment.

Snowdon Lily *Gagea serotina*

The mountains of Snowdonia have always been the only station for this species in the UK. Globally it is more widespread across the mountainous regions of Europe, Asia and North America. Within Yr Wyddfa and Cwm Idwal it prefers North facing open rock faces on rocks types ranging from basaltic to rhyolitic (B. Jones in Wittington 1999). In North Wales it is fairly stable in number of locations but shows some decline in populations at individual sites (Barbara Jones pers comm). It is currently found in three locations (with sub-sites) in the Yr Wyddfa, Glyderau and Carneddau massifs.

Small-leaved Hawkweed *Hieracium angustatifforme*

A Welsh endemic currently restricted to a single locality, Craig Cerrig Gleisiad NNR, in the Bannau Brycheiniog National Park. Previously found at two other locations. Associated with rocks and scree of Old Red Sandstone.

Hepste Hawkweed *Hieracium apheles*

A Welsh endemic restricted to a single locality, in the Hepste Glen. Five plants were last seen in 2013 growing on sandstone rocks on the Afon Hepste north of Penderyn in Breconshire.

Star-haired Hawkweed *Hieracium asteridiophyllum*

A Welsh endemic restricted to a single locality, Craig y Cilau NNR in the Bannau Brycheiniog National Park, where it grows on Carboniferous Limestone cliffs.

Attenborough's Hawkweed *Hieracium attenboroughianum*

A Welsh endemic restricted to a single locality, Cribyn, within the Bannau Brycheiniog National Park where it is found on Old Red Sandstone ledges. Described as new to science in 2014, with 300 individual plants found at that time.

Brecon Hawkweed *Hieracium breconense*

A Welsh endemic restricted to a single locality, at Craig y Cilau NNR in the Bannau Brycheiniog National Park, where it is found on Carboniferous Limestone rocks. Previously found at two other locations within the National Park.

Beacons Hawkweed *Hieracium breconicola*

A Welsh endemic restricted to sandstone cliffs at Fan Nedd in the western part of the Bannau Brycheiniog National Park.

Summit Hawkweed *Hieracium cacuminum*

A Welsh endemic restricted to three localities on sandstone cliffs and rocks within Bannau Brycheiniog National Park.

Welsh Hawkweed *Hieracium cambricum*

A Welsh endemic restricted to Carboniferous Limestone cliffs and rocks on Great Ormes Head and Creigiau Eglwyseg, near Llangollen. It has been lost from a third location, Craig Fawr near Dyserth, Flintshire.

Slender-toothed Hawkweed *Hieracium charitodon*

A Welsh endemic restricted to four localities in the Bannau Brycheiniog National Park. All populations are in river gorges on the Need and Tawe, and previously on the Mellte.

Cille Hawkweed *Hieracium cillense*

A Welsh endemic restricted to Carboniferous limestone cliffs at Craig y Cilau NNR in the Bannau Brycheiniog National Park.

Disc-leaved Hawkweed *Hieracium discophyllum*

A Welsh endemic restricted to two localities within the central and eastern parts of the Bannau Brycheiniog National Park, Cwm Claister and Pwll Byffre. Previously recorded from four other locations, all within the National Park.

Crass-leaved Hawkweed *Hieracium inspissatum*

A Welsh endemic restricted to Carboniferous Limestone rocks in an old quarry, Pwll Byffre, near to Ogof Ffynnon Ddu NNR. The population was reduced to a single plant in 2024 (Andy Shaw, pers. comm.).

Tongue-leaved Hawkweed *Hieracium linguans*

A Welsh endemic restricted to limestone rocks at Cwm Haffes, Glyntawe within western part of the Bannau Brycheiniog National Park.

Craig Gleisiad Hawkweed *Hieracium neocoracinum*

A Welsh endemic restricted to Craig Cerrig Gleisiad NNR within the Bannau Brycheiniog National Park. This is currently and historically the only location for this species. Numbers of individual plants have fluctuated in recent years from 147 in 2004 to over 3200 in 2020, but had dropped again by 2021 due to increased competition.

Neath Hawkweed *Hieracium nidense*

A Welsh endemic, currently restricted to two localities in the Mellte Glen, on rocks in Mellte river, north of Neath and a ravine in Merionethshire. Previously known from ten other locations in Wales.

Purple-flushed Hawkweed *Hieracium pseudoleyi*

A Welsh endemic restricted to Carboniferous Limestone rocks and crevices on Great Ormes Head and Little Ormes Head. Not seen recently at a third location nearby.

Radyr Hawkweed *Hieracium radyrense*

A Welsh endemic restricted to five localities, all in the Radyr district of Cardiff. It occurs on railway sidings, walls and roadsides. There have been some losses of sites but more recent gains.

Riddelsdell's Hawkweed *Hieracium riddelsdellii*

A Welsh endemic currently restricted to three localities in the western Brecon Beacons, Craig-y-nos Ridge, Penwyllt and Llyn y Fan Fach where it grows on limestone and sandstone rocks. It was not found at a fourth historic locality, Craig y Rhiwarth, during searches since 2000.

Snowdon Hawkweed *Hieracium snowdoniense*

A Welsh endemic currently restricted to one locality in Eryri mountain range, having previously been found at seven sites. There are currently less than ten plants on one cliff face. This is one of the target species in the Tlysau Mynydd Eryri project area, part of *Natur am Byth!* project to restore populations of key species in Wales.

Llanwrtyd Hawkweed *Hieracium subminutidens*

A Welsh endemic restricted to four localities in the River Irfon catchment, near to Llanwrtyd Wells and Abergwesyn in Breconshire.

Tawe Hawkweed *Hieracium tavense*

A Welsh endemic restricted to one locality north of Glyntawe in the Bannau Brycheiniog National Park.

St David's Sea-lavender *Limonium paradoxum*

Sea-lavenders of the *Limonium binervosum* aggregate are a critical group of apomictic long-lived perennials with some endemic species found on the coastal cliffs of Pembrokeshire, southern England and the Channel Islands. *L. paradoxum* is found on the sea cliffs of St. David's Head where the populations remain stable.

Small Sea-lavender *Limonium parvum*

This species is restricted to the Carboniferous Limestone sea cliffs at Castlemartin and Stackpole. It has been found in several locations but only recorded post 2000 from two locations. It is not known if it has been searched for, and not found, at other 1990's locations.

Giltar Sea-lavender *Limonium transwallianum*

Restricted to Giltar Point on steep Carboniferous Limestone cliffs. There are modern records from a few stations but some pre 2000 locations only, it is not known if these are lost or haven't been searched for.

Perennial Knawel *Scleranthus perennis* subsp. *perennis*

This subspecies is restricted to Stanner Rocks NNR in the UK but is more widely distributed in southern, central and northern Europe. At Stanner, it is found on droughted south-facing rock ledges in more bare rocky situations than Radnor Lily. Population bolstering in the last 10 years has been very successful.

***Sorbus aria* group**

The UK has some of the key centres of *Sorbus* diversity globally, these are Avon Gorge, Wye Valley and Brecon Beacons. More widely in Wales some unique species occur in widely scattered sites from the Menai Strait to The Black Mountains. This group consists of several unique species, many of which are endemic to the UK and some endemic to Wales. It is considered an actively evolving group with differing levels of apomixis and hybridisation often leading to increasing ploidy levels and thus development of new species.

Menai Strait Whitebeam *Sorbus arvonicola*

A tetraploid apomict. This species was first named in 2014, although a unique *Sorbus* taxon was known from the Bangor side on cliffs of the Menai Strait since 1888. Numbers of individuals appear to be pretty stable and are in the 50 – 100 range. A further location on Anglesey has been confirmed recently (T. Rich, pers. comm.).

Welsh Whitebeam *Sorbus cambrensis*

A pentaploid apomict probably derived from *Sorbus rupicola* and *S. porrigentiformis*. It is endemic Welsh tree, confined to the eastern Brecon Beacons. About 180 individual trees are found across 3 sites, Craig y Cilau, Cwm Clydach and Coed Pantydarren. (TCG Rich in BSBI Online atlas and DDB.)

Thin-leaved Whitebeam *Sorbus leptophylla*

An apomictic tetraploid derived from *Sorbus porrigentiformis*. It is endemic to the Brecon Beacons growing on limestone cliffs in two sites; Craig y Riwarth and Craig y Cilau, where about 80 individual trees have been counted in recent years. (TCG Rich in BSBI Online atlas and DDB).

Ley's Whitebeam *Sorbus leyana*

A triploid apomict derived from *S. aucuparia* and *S. porrigentiformis*. A Welsh endemic, there are currently 9 individual trees at 2 locations just north of Merthyr Tydfil. (TCG Rich in BSBI Online atlas and DDB).

Least Whitebeam *Sorbus minima*

A triploid apomict derived from *S. aucuparia* and *S. rupicola* or *S. porrigentiformis*. A Welsh endemic it is confined to three locations all in the eastern Brecon Beacons. There were about 770 individual trees counted in the early 2000's. (TCG Rich in BSBI Online atlas and DDB).

Llanthony Whitebeam *Sorbus stenophylla*

A pentaploid apomict probably derived from *Sorbus rupicola* and *S. porrigentiformis*. It is endemic to the eastern Brecon Beacons found in 4 locations, one to the south of Abergavenny the others in the Llanthony valley to the north. About 100 individual trees counted. It is a Welsh endemic. (TCG Rich in BSBI Online atlas and DDB).

Stirton's Whitebeam *Sorbus stirtoniana*

A tetraploid apomict related to *Sorbus leptophylla* (with which it was include until recently). About 39 individual trees are found in a single location in Montgomeryshire, Breidden Hill. It is a Welsh endemic. (TCG Rich in BSBI Online atlas and DDB).

Anglesey Fleawort *Tephrosia integrifolia* subsp. *maritima*

This subspecies of fleawort is a Welsh endemic found only in grassland and heathland, on the coastal cliffs of Ynys mon, at South Stack and Penrhosfeilw. Population is in the 1,000's and appears stable.

Terrestrial & freshwater invertebrates

Agroeca dentigera

This ground spider is restricted to a single UK locality, Ynyslas Dunes, where it was first recorded in 1989. It has subsequently been found in 2002 and 2014, always in small numbers. The most recent record in 2014 was of a single female found in dense marram following a 136-hour search (Howe, 2020a; National Museums Liverpool, 2015).

Allantus laticinctus

This sawfly was found new to the UK in 2003 during a survey of Welsh coastal soft cliffs (Knight, 2006; Knight & Howe, 2006) and it is known from just three localities, Creigiau Gwbert, Traeth-y-mwnt and most recently at Morfa Abererch in 2018 (Musgrove, 2023). Larvae feed on the older leaves of various rose *Rosa* species.

Aloconota subgrandis

A rove beetle that has only been recorded in the UK from the Otter Hole cave system in Monmouthshire in 1978 (Hammond, 1981; Hyman & Parsons, 1994).

Minutest Diving Beetle *Bidessus minutissimus*

A diving beetle associated with clean, fine silt at the edges of rivers, often among the roots of plants such as Reed Canary-grass *Phalaris arundinacea*, and in pools with extensive

growths of filamentous algae although populations are much sparser in pools clogged with silt (Foster, 2010). Once more widespread both in Wales and the UK, it is now restricted to pools and backwaters associated with exposed riverine sediments on the Dyfi, Mawddach, Rheidol, Tywi and Ystwyth (Foster *et al.*, 2016; Godfrey, 2024b; Howe, 2023e) although a population was established temporarily in a single quarry pond near Presteigne, Herefordshire in 2009 (Watson, 2009).

Black Night-runner *Chlaenius tristis*

The only UK locality for the Black Night-runner is Cors Geirch where it was first recorded in 1976 (Ismay *et al.*, 1978; Warne, 1977). This predatory beetle remains widespread on the wetland where it is associated with bare peat and open, short-sward fen (Boyce, 2010; Hall, 2024a; Howe, 2020c).

Rainbow Leaf Beetle *Chrysolina cerealis*

The Rainbow Leaf Beetle is associated with thyme growing in montane grassland and scree on Yr Wyddfa, its only UK locality. It was previously found in Cwm Idwal where it was last recorded in 1980. In recent years, adult numbers have been low and it may have retreated to higher altitudes perhaps as a response to grazing or climate change (Howe, 2020l; National Museums, Liverpool, 2017; World Museum Liverpool, 2016).

Beddau Beast *Crangona dalensi*

This millipede was recorded new to the UK from Cwm Tips in 2016 as part of the surveys undertaken by the Colliery Spoil Biodiversity Initiative (Olds, 2017a&b). It has since been found at its only UK locality in 2020, 2022 and 2024.

Gypsywort Weevil *Datonychus arquata*

The Gypsywort Weevil is restricted to mature dune slacks on Pembrey Air Weapons Range, its only UK locality, where it feeds on Gypsywort *Lycopus europaeus*. It was first recorded in 1997 and has since been found in 1998 (11 adults), 2006 (2 adults), 2016 (7) and 2022 (14) (Boyce, 2023c; Howe, 2023f). A sympathetic management regime is now in place following inappropriate summer mowing.

Delia tarsifimbria

An anthomyiid fly restricted to coastal dunes in south Wales and first recorded in the UK at Porthcawl in 1914 (Fonseca, 1953). It was subsequently found on Oxwich Burrows in 1952 (Fonseca & Cowley, 1953) and on Whiteford Burrows in 1972 (Falk & Pont, 2017).

Edwardsiana rosaesugans

A leafhopper recorded from just a single UK locality in the UK, Cwm Glais in Taf Fechan Nature Reserve in 1977 where it was found on a rose bush *Rosa* (Claridge & Wilson, 1978). Subsequent searches have failed to find the species and it may now be extinct (Kirby, 1992).

Epistrophe ochrostoma

This hoverfly was recorded for the first and only occasion in the UK from a woodland glade at Nant Porth on the Menai Strait in 1988 (Ball & Rogers, 2014; Heaver, 1990). Whilst the fly was found in suitable habitat, it has been suggested that it is not ordinarily resident (Ball *et al.*, 2011).

Strandline Beetle *Eurynebria complanata*

Once widespread on sand dunes on both sides of the Bristol Channel, the Strandline Beetle is now restricted to the three major dune systems in Carmarthen Bay where it is an active predator along the driftline (Howe, 2016, 2020n; Stewart, 2023). Active at night, adults retreat under logs and other refuges during the day and are at risk of disturbance and the removal of these refuges for firewood and barbeques and during beach cleaning operations.

Exechia spinigera

A fungus gnat first recorded in the UK at Newton on the Gwent Levels in 2009 (Gibbs, 2011) and found here again in 2014 and at Trawscoed near Bala in 2015. Its biology and habitat requirements are unknown (Chandler, 2022).

Exechia styriaca

All British records of this fungus gnat are from Wales. Whilst it was known from a handful of sites in north Wales from 1971 to 1978, recent records are restricted to Mallwyd (1994) and Trawscoed (2015) in Meirionnydd and Stradey Wood in Ceredigion (1995) (Chandler, 2022). The fly is associated with broad-leaved woodlands.

Helianthemapion aciculare

This weevil is restricted to the Great Orme in the UK, where it was first found in 1992. Both adults and larvae feed on rock-rose, having a preference for luxuriant plants on lightly-grazed, south-facing slopes. Most records are from Haulfre Gardens and Invalids' Walk (Howe, 2023g).

Grayling *Hipparchia semele thyone*

This subspecies of Grayling is endemic to Great Ormes Head where it was first described in 1941 (Thompson, 1944). It varies from the typical form of Grayling (*Hipparchia semele semele*) by being markedly smaller, having an underside with less contrast and pale areas tinged with ochreous, and smaller spots on the forewing. Adults also emerge three weeks earlier than the nominate subspecies, although there is considerable overlap. Larval foodplants include Sheep's Fescue *Festuca ovina* and Red Fescue *Festuca rubra*. Recent sightings suggest that it may occur more widely on the Creuddyn peninsula.

Scarce Yellow Sally *Isogenus nubecula*

The Scarce Yellow Sally has only been recorded reliably in the UK from the River Dee. It is associated with mature, lowland sections of large, stony rivers where the nymphs are predatory. It was first recorded on the Dee in 1959 and subsequent surveys found it along a 45km stretch of the river from Newbridge to the Afon Alun confluence. A record from 1995 was the last for 22 years until it was refound at Bangor-on-Dee in 2017. Recent surveys suggest a distribution over a 19.6km stretch of the lower Dee (Davy-Bowker *et al.*, 2018, 2019, 2020; Howe, 2020v).

Rosebud Sawfly *Monardis plana*

The Rosebud Sawfly was recorded new to the UK from Merthyr Mawr Warren in 2003 and again in 2005 where adults were found in abundance in association with Burnet Rose *Rosa spinosissima* (Gibbs, 2006). A targeted search in 2023 relocated the sawfly at the same site, its only UK locality (Musgrave, 2023).

Glutinous Snail *Myxas glutinosa*

Historically widespread in England, the Glutinous Snail is now only found in Llyn Tegid in the UK. It was first recorded here prior to 1852 and was regarded as numerous in the early 1950s. The population has been irregularly monitored since year 2000, the most recent assessment taking place in 2014 (Willing & Hughes, 2017). The snail is widespread around the lake perimeter where there is a cobble substrate but is to a water depth of 0.6 to 2.7m. Threats to the population include algal bloom, water draw down and non-native freshwater molluscs (Howe, 2020w; Willing *et al.*, 2014).

Scarce Awl Robberfly *Neoitamus cothurnatus*

The only contemporary UK site for the robberfly is Mynydd y Gaer where it was recorded in 1997 (Stubbs *et al.*, 2001). More typical of woodlands, it was associated here with stands of dense bracken on flushed acid grassland. Subsequent searches have failed to find the fly.

Neurigona biflexa

This long-legged fly was recorded new to the UK on Newborough Warren in 1987 where a single adult was found in scrub in the centre of the dune system (Cole, 1989, 1991). This remains the only UK record (Drake, 2018).

Large Mason Bee *Osmia xanthomelana*

This solitary bee was historically widespread in the UK but by the 1990s was seemingly restricted to the Isle of Wight until it was found at Porth Ceiriad in 1998 and Porth Neigwl in 1999. No longer occurring on the Isle of Wight, populations at its two Welsh localities are small and vulnerable to cliff erosion, loss of freshwater seepages and a paucity of flowering common bird's-foot-trefoil (Howe, 2021c). A survey in 2023 found just 19 nests at Porth Neigwl and recorded just a single female at Porth Ceiriad (Dafis, 2023).

Porrhomma rosenhaeuri

This troglobytic money spider is known from just three cave systems in the UK, all in south Wales. First recorded in Ogof y Ci, part of Nant Glais Cave, in 1971, it has since been found in Lesser Garth Cave (1979) and Ogof Draenen (2023). There are contemporary records from all three sites (Howe, 2020g; Knight *et al.*, 2025).

Rabigus pullus

Other than single, old records from Cheshire and Hampshire, UK records of this rove beetle are restricted to dune systems in Glamorgan and Carmarthenshire (Boyce, 2022). First recorded in 1920, there are contemporary records from Llangennith Burrows (1981), Oxwich Burrows (1984), Tywyn Burrows (1998), Whiteford Burrows (1980) and most recently from Merthyr Mawr Warren (2020) (Boyce, 2020; Howe, 2023c). There is a preference for relatively open dune grassland where there is still sufficient disturbance to maintain patches of bare sand, with a particular association with sparsely vegetated damp sand in the upper draw-down zone of dune slacks.

Rhagidia odontochela

The cave mite *Rhagidia odontochela* was described new to science from Ogof Cynnes (Turk, 1972), which lies beneath Mynydd Llangynidr, and this remains its only UK locality.

Simulium morsitans

This blackfly is associated with large weedy streams and small to medium-sized rivers. It was found historically found on the River Forth in Scotland, River Derwent in Yorkshire and the By Brook in Gloucestershire, but contemporary records of this blackfly are restricted to the Afon Teifi as it flows through Cors Caron (Bass, 2009, 2019; Howe, 2020h).

Sinechostichus inustus

A ground beetle that has only been recorded on four occasions in the UK, all as singleton adults from Welsh localities - Afon Tywi, Llandovery (2003; Bates *et al.*, 2005), Llandre (2014; Austin, 2014), Dinefwr Park and Llanover Park both in 1996 (Level & Pavett, 1999a). It is thought to be associated with shaded running water and is partly subterranean. There is speculation as to whether it is long-established native or a recent introduction (Telfer, 2016).

Short-legged Splay Crane fly *Symplecta pusilla*

Originally found on the River Monnow in Herefordshire from 1907 to 1911, the only contemporary UK record of this crane fly is from the River Usk at Great Hardwick in 1997 (Howe & Howe, 2001). Two males and two females were recorded in the shade of young willows along the sandy river margin (Stubbs, 2021).

Theridion hannoniae

A comb-footed spider recorded in Britain only from Mynydd Bach in Glamorgan between 2007 and 2009 (Gallon, 2014; Warmington, 2008; Warmingham & Merrett, 2009). In total, five males, five females and several juveniles were recorded under stones derived from a discarded gabion at the side of a track. It is unclear whether the population represents a recent introduction rather than an indigenous species (Spider Recording Scheme website). Its main centre of distribution lies in the western Mediterranean region.

Trachyploeus heymesii

This broad-nosed weevil was recorded new to the UK from clifftop coastal grassland at South Stack in 2016. A single adult was found in June 2016, with an additional two adults in September of the same year (Gurney, 2016; Howe, 2023d).

Trogloneta granulum

Records of the dwarf cobweb spider *Trogloneta granulum* from two sites in Wales in 2012 represent not just a species new to the UK but also a family, Mysmenidae. Single females were discovered under a rock in woodland near Swansea in March 2012 and within a large slate spoil heap at Dorothea Quarry in October 2012 (Gallon, 2014; Harvey, 2012). In Europe, this tiny spider is known to inhabit upland scree habitats.

Mammals

Skomer Vole *Myodes glareolus skomerensis*

A unique subspecies of the Bank Vole found only on Skomer's coastal grassland. The population shows large annual, but irregular, variations in numbers but can reach very high numbers (Loughran, unpublished).

14. Appendix 4: Welsh *Species in Peril* with important populations in a UK context

Fungi

Fen Puffball *Bovista paludosa*

This wetland fungus has its only known Welsh population on the Epynt Ranges, where it grows among mosses in a base-rich fen. Despite peatland surveyors being made aware of the appearance of this distinctive puffball, no further colonies have been found.

Scorzonera Rust *Puccinia scorzonerae*

One of the two Welsh populations of Viper's-grass *Scorzonera humilis* supports three fungi that are specific to this rare flowering plant. Not every plant of *Scorzonera* is infected, and populations of the fungi vary in size every year.

Lichens

Biatoridium monasteriense

The only Welsh population of this epiphytic lichen is in Allt-y-Benglog NNR. Its main host tree, a mature wych elm, fell over in 2013 and was winched upright and tethered with metal ropes. Remarkably it survived, and the *Biatoridium* was still present in 2015 when two additional trees supporting it were found nearby.

Cetraria sepincola

Nitrogen deposition has caused the loss of *Cetraria sepincola* from all but one of its 16 Welsh colonies since the 20th century. The sole remaining population is at Cors y Llyn, where it grows on birch trees on a small raised bog. A ring of trees including some conifers helps to screen this colony from air pollution.

Blackberries in Custard *Pyrenula hibernica*

Ceunant Llennyrch is the only location in Wales where this very rare specialist of smooth bark in Hyperoceanic ravines grows. It is found on a few mature hazels on a broad ledge where coppicing would never have taken place. This species serves as a reminder that not all hazels should be coppiced.

Toniniopsis separabilis

This epiphytic lichen, formerly called *Bacidia subincompta*, was listed as Regionally Extinct because the only Welsh record came from an elm at Elan Village that had subsequently died. However, a 2023 survey of the nearby Carn Gafallt reserve revealed a small population on an oak there, so this specialist of tree trunk wound tracks remains extant in Wales.

Mosses & liverworts

Spiral Apple-moss *Philonotis seriata*

Three flush complexes in the Carneddau of Eryri hold the only British population of this montane moss south of Scotland. Although there were dense patches of *P. seriata* in 2015, survey in 2023 showed significant damage to many of them from livestock poaching. This combines with Climate Change to render this species severely threatened.

Irish Threadwort *Telaranea europaea*

This is an unusual case of a native species benefitting from an Invasive Non-Native Species, because Rhododendron provides the deep shade and humidity which *T. europaea* needs to survive. It colonised Wales via spore drift from SW Ireland in the early 2000s, but its sole colony, at Coed Craflwyn, has lost most of its Rhododendron to clearance works and the *Telaranea* colony has reduced to covering about 3cm².

Vascular plants & stoneworts

Perennial Centuary *Centaureum portense*

As a native species, this species is restricted to coastal grassland on the cliff tops of Newport, Pembrokeshire over about three kilometres, and 2 sub-populations at Hayle, Cornwall (Rich & McVeigh, 2019).

Baltic Stonewort *Chara cf. baltica*

The exact identity of this stonewort is unclear, but it is known in Britain only from a few alkaline sandy pools in Newborough (Stewart & Hatton-Ellis 2019).

Dwarf Spike-rush *Eleocharis parvula*

This is a plant of muds in tidal pans and banks of tidal rivers. Its GB centres of distribution include Merionethshire in North West Wales (where the majority of the GB population is found). Then occurs in Scotland in a couple of disparate sites, south Hampshire and Cornwall.

Slender Cottongrass *Eriophorum gracile*

In Wales this species is found in open peaty, wet ground in fens and smaller bogs on the llyn peninsula in North Wales and then three locations in South Wales the most extensive being Crymlyn Bog.

Goldilocks Aster *Galatella linosyris*

A significant proportion of the GB population is found in three locations in Wales, Great Orme, Castlemartin Range and several sub-populations along South Gower coast. All are on thin Carboniferous limestone grassland near the coast.

Wedge-leaved Hawkweed *Hieracium cuneifrons*

A GB endemic found at one Welsh locality, Darren Cilau on Mynydd Llangatwg, and one English locality, Red Daren in the Black Mountains near the England-Wales border.

Foxtail Stonewort *Lamprothamnium papulosum*

This rare stonewort species, requiring brackish conditions, was found in the Inland Sea, Anglesey, in 2017 (Stewart & Hatton-Ellis, 2019). It is otherwise known only from the Outer Hebrides and a handful of scattered sites on the South Coast of England.

Dwarf Stonewort *Nitella tenuissima*

This small stonewort requires areas of wet, seasonally flooded bare peat on alkaline fens. It is now very rare in Britain and its main stronghold is the Anglesey Fens, where populations are threatened by undergrazing and vegetation succession (Stewart & Hatton-Ellis 2019).

Viper's Grass *Scorzonera humilis*

A large colony of this species was found at Cefn Cribwr near Bridgend, South Wales in 1996. Found in a series of fields in species-rich, slightly base-rich marshy grassland. A second single plant site was subsequently found in 1997 in similar habitat on Gower.

Rock Cinquefoil *Potentilla rupestris*

This species has two centres of distribution in Wales – on crags, mostly quarried now, at Breidden Hill, Montgomeryshire. Here the population has been supplemented over many years and is doubtful if original plants still persist. The other population is at Boughrood on rocks by the River Wye, Radnorshire.

Spotted Rockrose *Tuberaria guttata*

The centres of distribution for this annual, Mediterranean-Atlantic species in Britain and Ireland, have always been the coast of Anglesey and West Cork. In Wales there is also a small population on the furthest tip of the Llŷn Peninsula. Numbers fluctuate with weather conditions and habitat structure, preferring open grassland with areas of parched, bare ground.

Llangollen Whitebeam *Sorbus cuneifolia*

The vast majority of this British endemic is found at Creigiau Eglwyseg, near Llangollen, with a smaller population at Blodwell Rocks in Shropshire, England. (Rich & Procter, 2009).

Terrestrial & freshwater invertebrates

Acrometopia wahlbergi

Other than single localities in Cumbria and the New Forest, the silverfly *Acrometopia wahlbergi* is found at Cors Bodeilio, Cors Erddreiniog and Cors Goch on Anglesey, and Cors Geirch and Cors Gyfelog on the Llŷn peninsula. It is associated with stands of Slender Sedge *Carex lasiocarpa* where larvae probably feed on scale insects (Howe, 2020k).

Confounding Sunshiner *Amara nitida*

Once widespread in the UK, this seed-feeding ground beetle has few post-1980 localities, the most important of which is Newborough Warren where it is associated with mature dune slacks (Howe, 2020b; Loxton, 2017, 2018).

Baryphyma gowerense

Other than three localities in the Norfolk Broads, this money spider is found two sites on Anglesey - Cors Bodeilio and Cors Erddreiniog – and three sites on Gower – Cefn Bryn Common, Oxwich Burrows and Whiteford Burrows. It is associated with a range of habitats including *Sphagnum* bog, dense tussocks of Black Bog-rush *Schoenus nigricans* and Sea Rush *Juncus maritimus* saltmarsh (Gallon, 2020).

Callilepis nocturna

This ground spider feeds on ants and is restricted to four coastal localities in the UK - Prawle Point and Signalmans Point in Devon, Tennyson Down on the Isle of Wight and

Marloes Cliffs in Pembrokeshire, where it was first recorded in 2002 (Harvey, 2002). It was refound on Marloes Cliffs in June 2021 (Gallon & McGill, 2023).

Cicadella lasiocarpae

Other than a 1989 record from Roydon Fen in East Anglia, the leafhopper *Cicadella lasiocarpae* is restricted to Cors Bodeilio, Cors Erddreiniog and Cors Goch on Anglesey and Cors Geirch on the Llŷn peninsula, where it is associated with stands of Slender Sedge (Howe, 2021i).

Rosy Marsh Moth *Coenophila subrosea*

The Rosy Marsh Moth is restricted to four sites in the UK – Roudsea Woods in Cumbria and Cors Caron, Cors Dyfi and Cors Fochno in Ceredigion (Randle *et al.*, 2019). At the latter locality, larvae feed mostly on Bog-myrtle *Myrica gale* whilst at Cors Caron they feed on Crowberry *Empetrum nigrum*, Bilberry *Vaccinium myrtillus* and Cross-leaved Heath *Erica tetralix* (Howe, 2021d).

Cliff Case-bearer *Coleophora serpylletorum*

This micromoth is known in the UK only from The Lizard in Cornwall and Great Ormes Head, although there is a record from Gloddaeth dating from 1978 (Howe, 2021j). Larvae feed on Wild Thyme *Thymus praecox*.

Arctic-Alpine Pea Clam *Conventus conventus*

This Arctic relict species is found at a handful of cold water lakes in Scotland. Lost from the Lake District, the population in small upland pools on Glyderau marks its southern-most outpost and is highly threatened by climate change (Howe, 2020x).

Bog Bigtail *Dicranomyia magnicauda*

This crane fly is known from two sites in the Scottish southern uplands, one site in Cumbria and Llyn Hafodol and Llyn Ystumlllyn in north-west Wales where it is associated with floating bogs and mats of vegetation on small lakes (Howe, 2022c; Stubbs, 2021).

Fen Raft Spider *Dolomedes plantarius*

In the UK, the Fen Raft Spider is restricted to Redgrave & South Lopham Fen in East Anglia, Pevensey Levels in Sussex and Crymlyn Bog, Pant-y-sais (Tennant Canal) and Red Jacket Fen near Swansea where it feeds mostly on invertebrates but also fish and amphibians (Howe, 2020m).

Gabrius exiguus

Other than a 1964 record of Wast Water in Cumbria, the rove beetle *Gabrius exiguus* is restricted to Morfa Dyffryn, Newborough Warren and Tywyn Aberffraw in the UK (Denton & Loxton, 2012; Howe, 2023b; Loxton, 2017, 2018). At its Welsh localities, it is associated with damp dune slacks with closed vegetation.

Stackpole Seed-eater *Harpalus melancholicus*

The only contemporary UK records of the Stackpole Seed-eater are from Bewl Water in Sussex and Stackpole Warren in Pembrokeshire (Harrison, 1994; Howe, 2024b; Telfer, 2018). At its Welsh locality, it is associated with vegetated sand-dune encroaching over outcropping limestone with adults seen feeding on the seeds of Lesser Hawkbit *Leontodon saxatilis*.

Oxbow Diving Beetle *Hydroporus rufifrons*

The beetle is mostly found in shallow, temporary or fluctuating pools in unimproved pasture, often in old oxbow systems. Most UK records are from Scotland and northern England, but the population associated with Afon Teifi is an important southern outlier (Foster *et al.*, 2016; Howe, 2020o).

Mr. Scales' Diving Beetle *Hydroporus scalesianus*

Widespread in Ireland, the only Welsh population of Mr. Scales' Diving Beetle at Llyn Dinam on Anglesey is an important outlier from its UK stronghold in East Anglia. It is associated with floating vegetation mats or tussocky, mossy areas in base-rich pool systems (Foster *et al.*, 2016; Howe, 2020i).

Hydrovatus clypealis

With most UK populations of this water beetle found in muddy shallow ponds and ditches near the sea along the south coast of England, its only Welsh locality at Llyn Padrig on Anglesey marks a significant outlier (Foster *et al.*, 2016; Howe, 2021g). First recorded here in 2002, it was not found during a targeted search in August 2024.

Silky Wave *Idaea dilutaria*

The Silky Wave is restricted to three UK localities – Avon Gorge near Bristol, Great Ormes Head and Horton Cliffs and Overton Cliff & Mere on south Gower coast (Howe, 2020aiii; Randle *et al.*, 2019). Larvae feed at night on the withered leaves of large plants of Common Rock-rose *Helianthemum nummularium*.

Six-spotted Cranefly *Idiocera sexguttata*

Contemporary UK records of this cranefly are restricted to five localities – Eype Mouth and St. Gabriel's in Dorset, Stony Moors in the New Forest, Cefn Bryn Common on Gower and Cors Geirch (Howe, 2022b). At its Welsh sites, it is associated with open, shallow base-rich seepages.

Mountain Plate-jaw *Leistus montanus*

Once more widespread in the UK, recent records of this ground beetle are restricted to Langdale Pikes and Skiddaw in Cumbria and Cadair Idris and Y Lliwedd in Wales (National Museums Liverpool, 2018; Telfer, 2016). It is associated with montane scree where it feeds on springtails.

Limnebius aluta

Most UK records of this water beetle are from East Anglia, with outlier populations on the Somerset Levels and Strensall Common in Yorkshire (Foster *et al.*, 2020). Restricted to relict lowland fen, it is also known from five sites on Anglesey - Cors Bodeilio, Cors Goch, Cors y Farl, Rhos y Gad and Malltraeth Marsh (Howe, 2024a).

Limnephilus tauricus

Recent UK records of this caddisfly are restricted to just four localities - Leckford in Hampshire, Market Weston Fen and The Patch, Hollesley in Suffolk and Cors Erddreiniog on Anglesey (Wallace & Wallace, 2023). It was first found at its Welsh locality in 2006 in a small area of permanently wet, gently-flowing, spring-fed fen which supports an extensive bed of Yellow Flag *Iris pseudacorus* (Wallace *et al.*, 2010), and most recently recorded in 2022 (Aron & Palin, 2022).

Sandhill Rustic *Luperina nickerlii*

Sandhill Rustic Luperina nickerlii gueneei is associated with coastal dunes in north Wales, the Wirral and south Lancashire (Randle *et al.*, 2019) where larvae feed on the rhizomes of Sand Couch *Elytrigia juncea*. The key Welsh localities are Gronant Dunes & Talacre Warren and Newborough Warren (Wallace *et al.*, 2017). Other sites are colonised periodically including Rhosneigr Dunes, Morfa Conwy and Kinnel Dunes (Howe, 2020aiv).

Marpissa radiata

In the UK, the jumping spider *Marpissa radiata* is restricted mostly to the fenland areas of Norfolk, Suffolk and Cambridgeshire, where it can be locally common (Harvey *et al.*, 2002). It is generally associated with low vegetation in open fen. In Wales, it is found only on Crymlyn Bog where it was first recorded in 1989 (Holmes *et al.*, 1991) and most recently in 2021 (Gallon & McGill, 2023).

Micaria alpina

This boreo-alpine ground spider is restricted in the UK to four high altitude mountains in northern Scotland and to Carnedd Dafydd, although there are additional older records from Cadair Idris, Glyderau and Y Lliwedd (Howe, 2020p). The only UK post-2000 record is from Carnedd Dafydd in 2002 (Gallon, 2004). It is associated with montane scree and grassland.

Greater Streaked Shieldbug *Odontoscelis fuliginosa*

Other than Sandwich Bay and Deal area of Kent, this shieldbug is restricted to the coastal dunes on Castlemartin peninsula in Pembrokeshire where it feeds on Common Stork's-bill *Erodium cicutarium* in bare or very sparsely-vegetated areas. Sites include Broomhill Burrows, Brownslade Burrows, Freshwater East, Linney Burrows and Stackpole Warren (Howe, 2024c).

Pardosa trailii

This montane wolf spider is associated with scree and boulders in Scotland, Cumbria and north Wales. Cadair Idris is its most southerly outpost and supports the most robust population in the UK (Howe, 2020r).

Fen Water-longtail *Pilaria nigropunctata*

This cranefly is restricted to five fen localities in the Norfolk Broads, a single locality in Hampshire and three sites in Wales – Crymlyn Bog, Cors Geirch and Cors Goch (Howe, 2021h; Stubbs, 2021). It is associated with swampy fen.

Scaly Cricket *Pseudomogoplistes vicentae*

The Scaly Cricket is associated with coastal shingle at Chesil Fleet in Dorset and Branscombe in Devon. It was first found in Wales in 1999 at Marloes Sands in Pembrokeshire (Anon., 2001) and has since been recorded at Freshwater West, Monkstone Beach and West Dale Bay (Howe, 2020z). It is vulnerable to habitat loss and rising sea levels at its Welsh localities.

Red Dune Crawler *Rhysothorax rufus*

The Red Dune Crawler beetle has recently been recorded from dunes in south Lancashire. The only other recent UK records are from Kenfig Burrows in 1994 and Merthyr Mawr Warren in 2006 (Howe, 2020s). It was not found during targeted searches of these sites in 2017 (Watkins & Mann, 2018).

Dew Moth *Setina irrorella*

The Dew Moth is associated with rocky coasts, shingle beaches and calcareous grassland in southern England, Isle of Man and western Scotland (Randle *et al.*, 2019) where larvae feed on lichens. In Wales, it is restricted to Ramsey Island and nearby mainland localities - Dinas Fach, Dinas Fawr, Llandeloy and Solva (Howe, 2023a).

Sitona gemellatus

The weevil *Sitona gemellatus* is known from a single Welsh locality, Porth Dinllaen, where it is associated with legumes on eroding sandy cliffs. Otherwise restricted in the UK to the Dorset coast, the weevil was first found at Porth Dinllaen in 1996 (Howe, 2002b) and has since been recorded in 2002 (Knight & Howe, 2006) and 2023 (Hall, 2024b), always in very small numbers.

Clubbed General *Stratiomys chamaeleon*

Contemporary UK sites for the Clubbed General soldierfly are restricted to Braelangwell Wood on the Black Isle in Scotland, Cothill Fen & Parsonage Moor and Dry Sandford Pit in Oxfordshire and Cors Bodeilio, Cors Erddreiniog, Cors Goch, Rhos y Gad and Waun Eurad on Anglesey (Howe, 2020t). Larvae are associated with open, often tufaceous calcareous seepages whilst adults nectar on umbellifers.

Tachys micros

This ground beetle is restricted to a handful of coastal localities in Dorset, Hampshire, Sussex and Porth Neigwl on the Llŷn peninsula where it is associated with damp sand, silt or clay at the base of coastal soft cliffs (Telfer, 2016).

Chestnut-coloured Carpet *Thera cognata*

In the UK, this moth is mostly restricted to Scotland and south-east Cumbria where it is associated with a variety of open habitats (Randle *et al.*, 2019), with larvae feeding on Common Juniper *Juniperus communis*. Welsh populations on limestone grassland on Great Ormes Head and south Gower coast are isolated, southern outliers (Howe, 2021l).

Newbery's Rove Beetle *Thinobius newberyi*

A UK endemic (Macadam, 2023) associated with bare, exposed riverine sediments at a handful of localities in Scotland, Cumbria and Afon Rheidol, Afon Tywi, Afon Ystwyth and Llandinam gravels in Wales (Howe, 2023h).

Trichoncus saxicola

In the UK, this money spider is restricted mostly to southern and south-west England where it is found in a variety of open habitats. It was recorded for the first time in Wales on Ramsey Island in August 2022 from rocky, coastal heath (Gallon & McGill, 2022, 2023).

Freshwater fish & lampreys

Allis Shad *Alosa alosa*

Allis Shad is a very rare migratory clupeid with a southwesterly distribution in Britain. Larger than the closely related twaite shad, with which it hybridises, there is thought to be a small population still present in the Wye. It is likely that its main stronghold was the River Severn, where it formerly migrated as far as Welshpool (Aprahamian *et al.*, 1999). Smaller populations may exist in some rivers in south west England (Hillman, 2002).

Twaite Shad *Alosa fallax*

Twaite Shad is a migratory clupeid with a southwesterly distribution in Britain. Its three strongest populations are the Wye, Usk and Tywi in South Wales, though a significant population also exists on the Severn in England where it is threatened by barriers to migration. It was formerly more widespread in England, where river modification has caused significant declines (Aprahamian *et al.*, 1999). Smaller populations may exist in one or more Cardigan Bay rivers (Hatton-Ellis, 2025b) and in some rivers in south west England (Hillman, 2002).

Gwyniad *Coregonus lavaretus*

Gwyniad is a rare glacial relict fish confined to only ten sites in the UK, where it is known by various local names (Winfield *et al.*, 2013). Three of these are conservation translocations to safeguard existing populations considered at risk. Wales supports two populations, including, in Llyn Tegid, the most southerly and one of the largest.

Birds

Manx Shearwater *Puffinus puffinus*

Confined to a few offshore islands, the Welsh Manx Shearwater breeding populations predominately resides in the Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA. With a UK breeding population of just over 1 million apparently occupied sites (AOS) this Welsh SPA represents 45% of the UK breeding population and 37% of the global population.

Northern Gannet *Morus bassanus*

This species is highly colonial with the two Welsh colonies on offshore islands (Grassholm SPA and Ynys Badrig). The last GB seabird census (2015-2021) suggested Grassholm SPA held a significant proportion of the UK population and 6% of the global population.

Greenland White-fronted Goose *Anser albifrons flavirostris*

The population of Greenland White-fronted Goose is small and their world range is limited. Breeding occurs in low arctic west Greenland, where autumn and spring staging areas are restricted to south and west Iceland. The entire global wintering population is endemic to Britain and Ireland. In Wales, this species is restricted to the Dyfi Estuary SPA and the Isle of Anglesey. Though the Welsh wintering population does not contribute significantly to the British wintering population it represents a relatively important contribution to global range maintenance.

15. Appendix 5: Decliners in Species in Peril

Species	Vernacular name	Status	Ecosystem
<i>Cantharellus aurora</i>	a fungus	GB-VU	Woodland, Parkland & Scrub
<i>Alectoria nigricans</i>	a lichen	Wales-VU	Montane
<i>Anaptychia ciliaris</i> subsp. <i>ciliaris</i>	Eagle-claw Lichen	GB-EN, Wales-EN	Woodland, Parkland & Scrub
<i>Bryoria bicolor</i>	a lichen	Wales-VU	Montane
<i>Cetraria sepincola</i>	a lichen	Wales-VU	Woodland, Parkland & Scrub
<i>Collema fragrans</i>	a lichen	GB-EN, Wales-RE	Woodland, Parkland & Scrub
<i>Collema occultatum</i>	a lichen	Wales-VU	Woodland, Parkland & Scrub
<i>Lecanographa amylacea</i>	Scarce Speckled Lichen	GB-VU, Wales-EN	Woodland, Parkland & Scrub
<i>Leptogium cochleatum</i>	a jelly-skin lichen	GB-VU, Wales-CR	Woodland, Parkland & Scrub
<i>Peltigera venosa</i>	Green Veiny Lichen	GB-VU, Wales-CR	Montane
<i>Anomodon longifolius</i>	Long-leaved Tail-moss	GB-VU	Woodland, Parkland & Scrub
<i>Bryum knowltonii</i>	Knowlton's Threadmoss	GB-VU	Dune & Saltmarsh
<i>Bryum warneum</i>	Warne's Thread-moss	GB-VU	Dune & Saltmarsh
<i>Buxbaumia aphylla</i>	Brown Shield-moss	GB-EN	Woodland, Parkland & Scrub
<i>Chionoloma recurvifolium</i>	Drooping-leaved Beard-moss	Nationally Scarce	Montane
<i>Dicranum undulatum</i>	Waved Fork-moss	GB-EN	Peatland
<i>Tomentypnum nitens</i>	Woolly Feather-moss	GB-VU	Peatland
<i>Tortula canescens</i>	Dog Screw-moss	GB-EN	Lowland Rock Exposure
<i>Tortula cuneifolia</i>	Wedge-leaved Screw-moss	GB-CR	Coast & Coastal Cliff
<i>Anthemis arvensis</i>	Corn Chamomile	GB-EN	Agricultural
<i>Gastridium ventricosum</i>	Nit Grass	GB-NS	Coast & Coastal Cliff
<i>Liparis loeselii</i>	Fen Orchid	Wales-CR	Dune & Saltmarsh
<i>Lythrum hyssopifolia</i>	Grass-poly	Wales-CR	Grassland
<i>Mentha pulegium</i>	Pennyroyal	Wales-CR	Grassland
<i>Myosurus minimus</i>	Mousetail	Wales-EN	Agricultural
<i>Neotinea ustulata</i>	Burnt-tip Orchid	Wales-CR	Grassland
<i>Omalotheca sylvatica</i>	Heath Cudweed	Wales-CR	Heathland
<i>Oxybasis urticae</i>	Upright Goosefoot	Wales-RE	Agricultural
<i>Potamogeton compressus</i>	Grass-wrack Pondweed	GB-EN	River, Stream & Ditch
<i>Potamogeton friesii</i>	Flat-stalked Pondweed	Wales-NT	River, Stream & Ditch
<i>Pseudorchis albida</i>	Small-white Orchid	Wales-CR	Grassland
<i>Ranunculus arvensis</i>	Corn Buttercup	Wales-CR	Agricultural
<i>Roemeria argemone</i>	Prickly Poppy	Wales-EN	Agricultural
<i>Scandix pecten-veneris</i>	Shepherd's-needle	Wales-CR	Agricultural
<i>Silene noctiflora</i>	Night-flowering Catchfly	Wales-EN	Agricultural
<i>Valerianella rimosa</i>	Broad-fruited Cornsalad	Wales-CR	Agricultural
<i>Conventus conventus</i>	Arctic-Alpine Pea Mussel	GB-VU	Montane
<i>Margaritifera margaritifera</i>	Freshwater Pearl Mussel	GB-CR	River, Stream & Ditch
<i>Vertigo angustior</i>	Narrow-mouthed Whorl Snail	GB-VU	Dune & Saltmarsh
<i>Vertigo geyeri</i>	Geyer's Whorl Snail	GB-NT	Peatland
<i>Anthicus bimaculatus</i>	an ant-like flower beetle	GB-VU	Dune & Saltmarsh
<i>Baetis digitatus</i>	Scarce Iron Blue	Local	River, Stream & Ditch
<i>Bembidion testaceum</i>	Pale Pin-palp	GB-VU	River, Stream & Ditch
<i>Boloria euphrosyne</i>	Pearl-bordered Fritillary	GB-VU	Grassland
<i>Boudinotiana notha</i>	Light Orange Underwing	GB-NS	Woodland, Parkland & Scrub
<i>Brachyptera putata</i>	Northern February Red	GB-NS	River, Stream & Ditch
<i>Celypha woodiana</i>	Mistletoe Marble	GB-NS	Woodland, Parkland & Scrub
<i>Cosmia diffinis</i>	White-spotted Pinion	Local	Woodland, Parkland & Scrub
<i>Eugnorisma depuncta</i>	Plain Clay	Local	Woodland, Parkland & Scrub
<i>Eurynebria complanata</i>	Strandline Beetle	GB-EN	Dune & Saltmarsh
<i>Gyrinus minutus</i>	a whirligig beetle	GB-NS	Lake & Pond
<i>Fabriciana adippe</i>	High Brown Fritillary	GB-CR	Grassland
<i>Idaea muricata</i>	Purple-bordered Gold	GB-NS	Peatland
<i>ptidea sinapis</i>	Wood White	GB-EN	Woodland, Parkland & Scrub

Species	Vernacular name	Status	Ecosystem
<i>Luperina nickerlii</i>	Sandhill Rustic	GB-NS	<i>Dune & Saltmarsh</i>
<i>Lycia zonaria</i>	Belted Beauty	GB-NS	<i>Dune & Saltmarsh</i>
<i>Meligethes brevis</i>	a pollen beetle	GB-NR	<i>Grassland</i>
<i>Noctua orbona</i>	Lunar Yellow Underwing	Local	<i>Grassland</i>
<i>Nomada roberjeotina</i>	Tormentil Nomad Bee	GB-NR	<i>Grassland</i>
<i>Oestrus ovis</i>	Sheep Nostril Fly	GB-NT	<i>Grassland</i>
<i>Onthophagus fracticornis</i>	a dung beetle	GB-VU	<i>Woodland, Parkland & Scrub</i>
<i>Osmia xanthomelana</i>	Large Mason Bee	GB-NR	<i>Coast & Coastal Cliff</i>
<i>Panagaeus cruxmajor</i>	Crucifix Ground Beetle	GB-VU	<i>Dune & Saltmarsh</i>
<i>Polia hepatica</i>	Silvery Arches	GB-NS	<i>Peatland</i>
<i>Tachytrechus ripicola</i>	a long-legged fly	GB-CR	<i>Coast & Coastal Cliff</i>
<i>Thera cognata</i>	Chestnut-coloured Carpet	Local	<i>Grassland</i>
<i>Alosa alosa</i>	Allis Shad	Wales-CR	<i>River, Stream & Ditch</i>
<i>Anser albifrons albifrons</i>	European White-fronted Goose	GB-EN, Red	<i>Grassland</i>
<i>Anser albifrons flavirostris</i>	Greenland White-fronted Goose	GB-EN, Red	<i>Grassland</i>
<i>Calidris alpina</i> breeding	Dunlin breeding	GB-VU, Red	<i>Montane</i>
<i>Carduelis flavirostris</i>	Twite	GB-EN, Red	<i>Grassland</i>
<i>Cygnus columbianus</i> wintering	Bewick's Swan wintering	GB-CR, Red	<i>Grassland</i>
<i>Lyrurus tetrix</i>	Black Grouse	GB-VU, Red	<i>Montane</i>
<i>Motacilla flava</i> breeding	Yellow Wagtail	GB-NT, Red	<i>Grassland</i>
<i>Pluvialis apricaria</i> breeding	European Golden plover breeding	GB-LC, Green	<i>Montane</i>
<i>Sterna dougallii</i> breeding	Roseate Tern breeding	GB-EN, Red	<i>Coast & Coastal Cliff</i>
<i>Sternula albifrons</i> breeding	Little Tern breeding	GB-VU, Amber	<i>Coast & Coastal Cliff</i>

16. Appendix 6: *Species in Peril* with legal protection under The Conservation of Habitats and Species Regulations (2017) as European Protected Species (EPS; Schedules 2 and 5) or under Wildlife and Countryside Act (1981) (Schedules 1, 5 and 8), by taxonomic group

Group	Number of <i>Species in Peril</i> protected under the Habitats Regulations as EPS and/or the Wildlife and Countryside Act	<i>Species in Peril</i> receiving legal protection with the number of remaining Welsh sites for each species given in brackets
Mosses & Liverworts	3	<i>Anomodon longifolius</i> (1) <i>Dendrocryphaea lamyana</i> (2) <i>Micromitrium tenerum</i> (3)
Fungi	1	<i>Hericium erinaceus</i> (1)
Stoneworts	1	<i>Lamprothamnium papulosum</i> (1)
Vascular Plants	13	<i>Eleocharis parvula</i> (2) <i>Eriophorum gracile</i> (5) <i>Gagea bohemica</i> (1) <i>Gagea serotina</i> (3) <i>Gentianella amarella anglica</i> (1)* <i>Gentianella amarella occidentalis</i> (3) <i>Liparis loeselii</i> (3)* <i>Lythrum hyssopifolia</i> (1) <i>Orobancha picridis</i> (4) <i>Potentilla rupestris</i> (2) <i>Rumex rupestris</i> (2)* <i>Salvia pratensis</i> (1) <i>Tephrosia integrifolia maritima</i> (2)
Molluscs	2	<i>Margaritifera margaritifera</i> (4) <i>Myxas glutinosa</i> (1)
Insects	4	<i>Fabriciana adippe</i> (1) <i>Boloria euphrosyne</i> (5) <i>Chrysolina cerealis</i> (1) <i>Hydrochara caraboides</i> (2)
Spiders	1	<i>Dolomedes plantarius</i> (3)
Fish	2	<i>Alosa alosa</i> (1) <i>Alosa fallax</i> (3)
Amphibians & Reptiles	1	<i>Epidalea calamita</i> (2)*
Mammals	5	<i>Barbastella barbastellus</i> (4 breeding)* <i>Eptesicus serotinus</i> (3 breeding)* <i>Myotis bechsteinii</i> (1 breeding)* <i>Nyctalus leisleri</i> (1 breeding)* <i>Rhinolophus ferrumequinum</i> (5 breeding)*

Group	Number of <i>Species in Peril</i> protected under the Habitats Regulations as EPS and/or the Wildlife and Countryside Act	<i>Species in Peril</i> receiving legal protection with the number of remaining Welsh sites for each species given in brackets
Birds	8	<i>Botaurus stellaris</i> (3 breeding) <i>Circus aeruginosus</i> (3) <i>Cygnus columbianus</i> (3 wintering) <i>Larus melanocephalus</i> (4 breeding) <i>Panurus biarmicus</i> (1) <i>Recurvirostra avosetta</i> (3 breeding; 3 wintering) <i>Sternula albifrons</i> (1 breeding) <i>Sylvia undata</i> (3 breeding)

* species which are both EPS and protected under the Wildlife and Countryside Act

17. Appendix 7: distribution and hotspot maps for *Species in Peril*

During the final stages of production of the report, the benefit of producing a distribution map of sites supporting *Species in Peril* was identified. As the master spreadsheet did not include spatial information, centroid grid references have been assigned to all 2300 sites. **These grid references do not represent the precise location of individual species records and should not be treated as such.** For example, all species occurring on Whiteford Burrows have been assigned the site centroid of SS443949 and those on Yr Wyddfa have been assigned SH609543.

Figures 71 & 72 highlight that *Species in Peril* are distributed widely throughout Wales but with concentrations with both large and small SSSIs. It should be noted that species records would be scattered across larger sites, e.g. Cors Fochno and Elenydd in Figure 72, as mapping relates only to the site centroids.

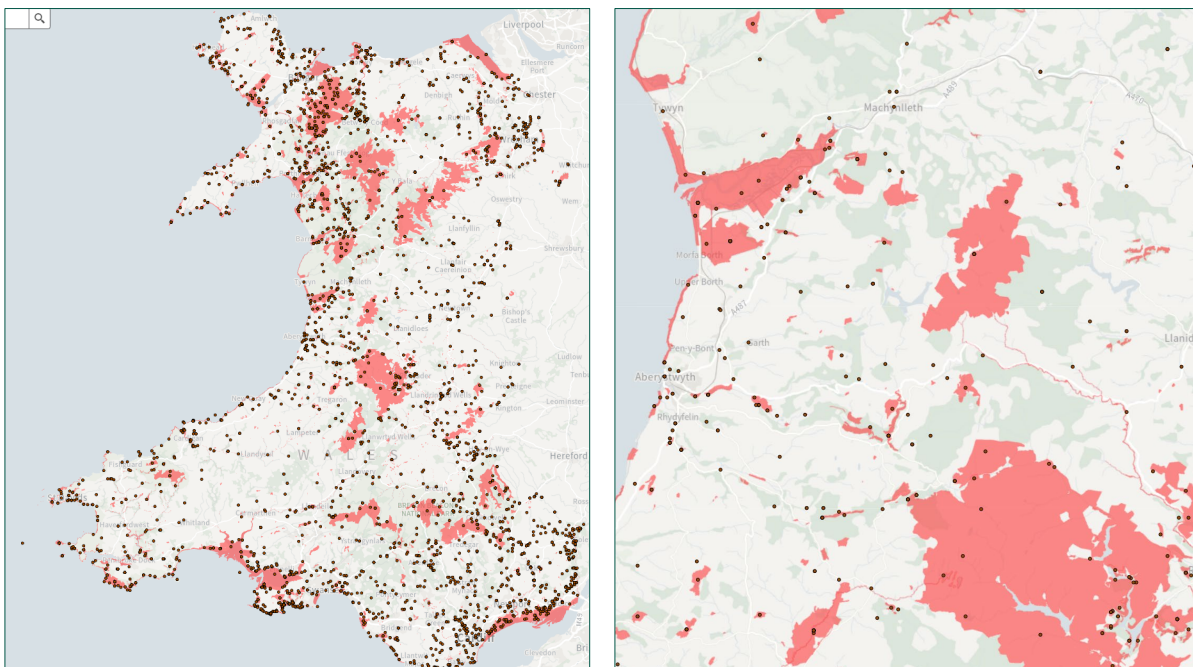


Figure 71 (left) and Figure 72 (right). The distribution of sites supporting *Species in Peril* in Wales. Note the strong coincidence between *Species in Peril* site centroids (black dots) and SSSIs (red areas).

As well as point maps, hotspot maps have been produced to highlight the key sites supporting *Species in Peril* (Figures 73, 74 & 75). Sites with few species are mapped as blue, and those supporting multiple species are mapped as red with higher numbers represented by more intense colouration. The maps clearly highlight key sites and landscapes for *Species in Peril* including the dune systems of south-west Ynys Môn and the south Wales coast, the Anglesey fens and Crymlyn Bog, the high mountains of Eryri and Cadair Idris, parklands such as Chirk Park, Dinefwr Park and [location redacted], the Gwent Levels, and limestone grassland on Great Ormes Head.

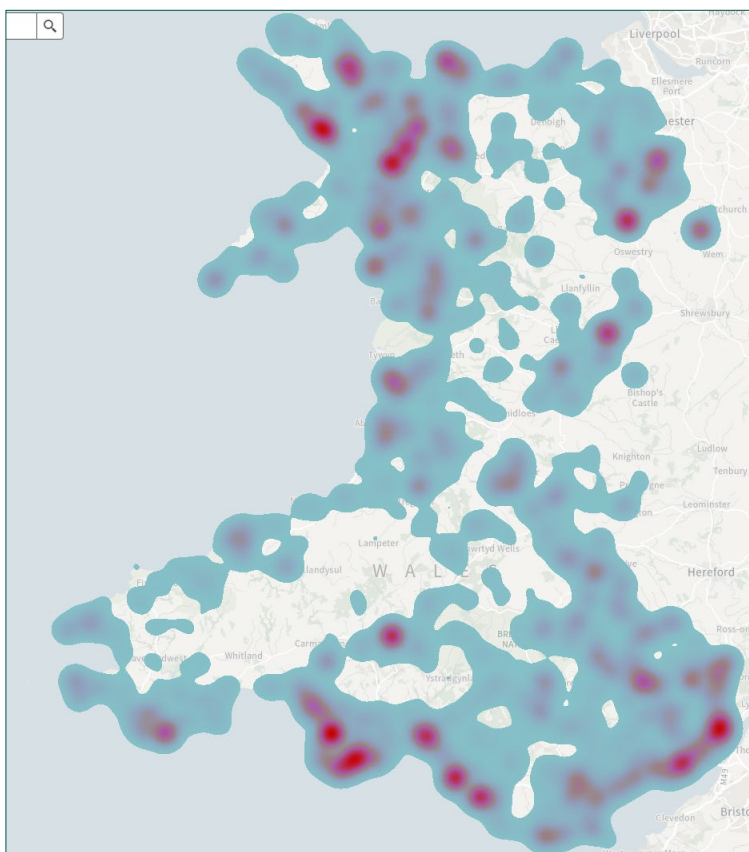


Figure 73. Hotspot map of Wales highlighting key sites and landscapes for *Species in Peril*, with areas supporting more species indicated by more intense red colouring.

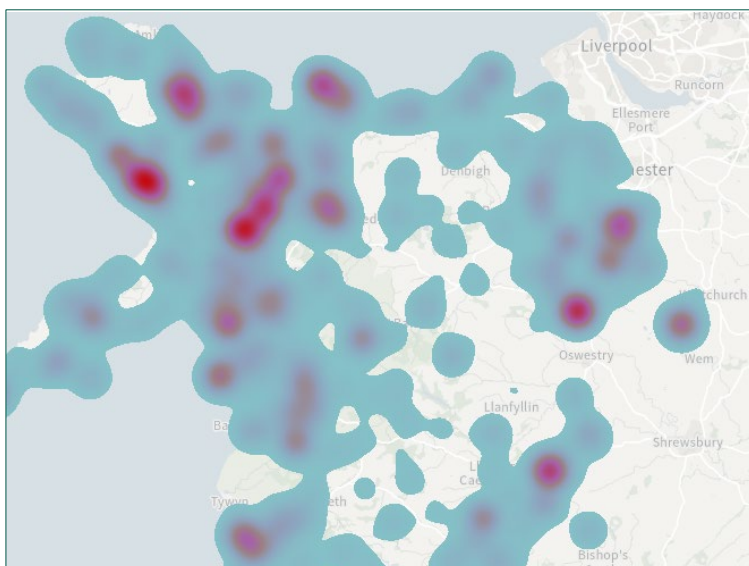


Figure 74. Hotspot map of north and central Wales highlighting key sites and landscapes (in red) for *Species in Peril*. These include Newborough Warren & Forest, the Anglesey fens, Great Ormes Head, Eryri, [location redacted], Chirk Park, [location redacted], the Fenn's & Whixall mosses complex and Cors Fochno.

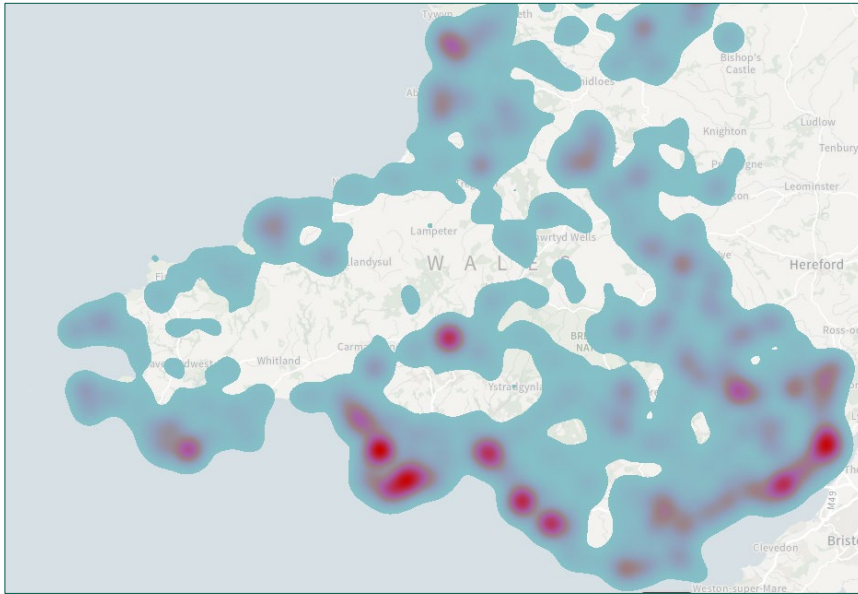


Figure 75. Hotspot map of south and central Wales highlighting key sites and landscapes (in red) for *Species in Peril*. These include Stackpole Warren & Castlemartin Range, Pembrey Coast, Whiteford Burrows, Oxwich Burrows & south Gower coast, Dinefwr Park, Crymlyn Bog & Pant-y-Sais, Kenfig Burrows, Merthyr Mawr Warren, [location redacted], Gwent Levels, [location redacted] and sites in the Wye Gorge.

Data archive appendix

Data outputs associated with this project are archived on server-based storage at Natural Resources Wales.

The data archive contains:

- [A] The final report in Microsoft Word and Adobe PDF formats.
- [B] A spreadsheet of all *Species in Peril* in Microsoft Excel format.

The metadata for this project is held as record no. **NRW_DS161307**.

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