Ecological appraisal of Ty Gwyn, Cefn Coch, Llanrhaeadr-ym-mochnant, Powys, SY22 0BP

Oakwood Ecology

by Simon Cope MSc MCIEEM

For: Alan Bridger & Fiona Slater,
Ty Gwyn,
Cefn Coch,
Llanrhaeadr-ym-mochnant,
Powys,
SY22 0BP

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Oakwood Ecology
Pen-y-geulan, Cefn Coch, Llanrhaeadr-ym-Mochnant, Powys, SY10 0BT
Tel. 01691 780783 Mob: 07772 768461 Email: simon.cope2@btinternet.com

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Summary

An ecological appraisal of land at Ty Gwyn was commissioned by the owners, Alan Bridger and Fiona Slater. This report includes the results of a desk-study, a survey of the higher plants and habitats on the site, and a survey to assess the presence or likely absence of various protected species. Also included are recommendations to enhance the property for wildlife.

There are six statutorily designated sites within two kilometres of the site, but none of these include habitats similar to those found at Ty Gwyn. The NBN Atlas contained 221 historical records within a two-kilometre search radius, many of which are classified as records of mobile animal species that could potentially visit the property.

The habitats on the site include neutral grassland, woodland, hedgerows, streamway, and the buildings and garden; plant species diversity in these habitats is moderate, with a moderate ecological value. A number of further surveys are suggested to gather more information about the wildlife present on the site.

A range of recommendations are suggested which would increase the complexity of the habitats on the site which would consequently increase biodiversity. The would include the establishment of scrub and woodland, the re-introduction of large herbivores at a very low stocking rate, the creation of wetlands of various types, and the possible management of some areas as flower-rich hay meadow. Also recommended is the implementation of a suite of ecological monitoring surveys which would measure the changes in biodiversity over time and inform future management.

1 Introduction

1.1 Overview

1.1.1 This ecological appraisal was commissioned by Alan Bridger and Fiona Slater to gather information on the biodiversity of the site and to inform the future management of the habitats at Ty Gwyn, Cefn Coch, Llanrhaeadr-ym-mochnant, Powys, SY22 0BP (grid ref. SJ10112681) (Figures 1 & 2). The aim of the ongoing management is to optimise the property for biodiversity; to that end, this report provides baseline information on the existing biodiversity at Ty Gwyn, and suggests enhancements that could be implemented to increase biodiversity on the property.

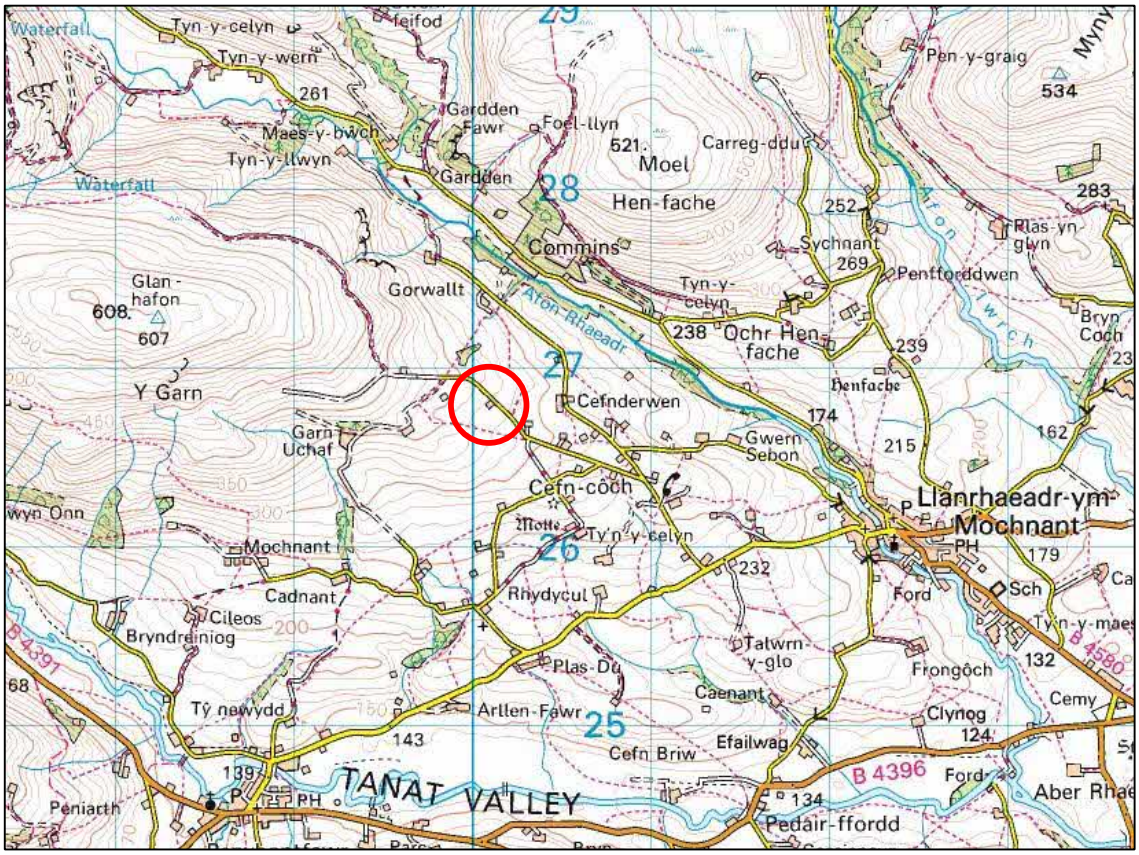

Figure 1. Location map of Ty Gwyn (circled red).
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Figure 2. Property layout (outlined red).
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1.2 Aims

1.2.1 This appraisal includes the results of a desk study, a phase 1 habitat survey, and a protected species survey, and follows industry best practice guidelines (CIEEM, 2017). The results of these surveys provide a baseline against which future surveys can be gauged. Where further information is required to effectively carry out this assessment, recommendations for further surveys are made.

1.3 Surveyor qualifications

1.3.1 My formal qualifications include an MSc in Biological Recording and a Post-graduate Certificate in Ornithology from Birmingham University. I have attended many short courses on survey techniques, ecological impact assessment and mitigation as part of my programme of Continuing Professional Development; I am licensed to survey Bats and Great Crested Newts in Wales and England (Licence no's S086636/1 (NRW Bats) and S085282/1 (NRW Newts)); and I have been a self-employed Ecological Consultant since 2004, having worked with a wide range of habitats and species. I am a full member of the Chartered Institute of Ecologists and Environmental Managers (CIEEM).

1.3.2 It is the policy of Oakwood Ecology, in accordance with CIEEM Code of Professional Conduct, that all biological records collected during these surveys are submitted to the relevant local biological records centre.

2 Methodology

2.1 Desk study

2.1.1 The desk study was carried out to identify any designated sites and protected or otherwise notable species in the vicinity of the site that may be similar to those found on the site. The study area covers the property and extends beyond its boundary for two kilometres for protected species and five kilometres for designated sites.

2.1.2 The following sources were consulted:

MAGIC interactive maps (www.magic.gov.uk/MagicMap.aspx)

The National Biodiversity Network (NBN) Atlas (NBN Atlas - UK's largest collection of biodiversity information)

2.2 Habitat survey

2.2.1 A habitat survey was carried out using the UKhab classification scheme (UKHab, 2023) and using the botanical nomenclature of Stace (2019). All habitats and features were classified, recorded, and mapped, and all plants were identified to species level where possible using Stace (ibid.) and Rose (2006). The scientific (Latin) names of species recorded during the survey are given in Appendix 1. The frequency of species in the habitats was recorded using subjective DAFOR categories (Dominant, Abundant, Frequent, Occasional, or Rare), with the prefix L if there is localised variation.

2.3 Protected species survey

2.3.1 Any field signs of statutorily protected animal species observed during the survey were noted. Bird names are taken from the BOU British List (2022). The protected species and field signs searched for include:

[redacted]

Bats (Order Chiroptera) – scratch marks or droppings at likely roosts (trees, buildings, or other structures);

Birds (Class Aves) - note specially protected species (Schedule 1 of W&CA);

Dormouse (Muscardinus avellanarius) - suitable habitat in woodland, scrub and hedgerows, nests, and dormouse-nibbled nuts (Sept – Dec);

Great Crested Newt (Triturus cristatus) - freshwater ponds or terrestrial habitat within 500m, habitat suitability index (HIS) assessment when ponds are present;

Invertebrates (various phyla) – desk study;

Otter (Lutra lutra) - suitable water course habitat. Field signs such as holts, spraints, couches, footprints and feeding remains at suitable sites;

Reptiles (Class Reptilia) - note suitable habitat (heathland, scrub, rough grassland, moorland, sea cliffs and sand dunes), look for basking reptiles and check refugia;

Water Vole (Arvicola amphibius) - note suitable habitat (watercourses). Check for burrows, droppings, runs in vegetation and signs of feeding;

White-clawed Crayfish (Austropotamobius pallipes) - note suitable habitat (watercourses), check refugia (boulders on streambed).

Other protected species that may have been recorded in the area, as highlighted by the desk study.

2.3.2 During the survey, the suitability of the habitats for protected animal species was continuously assessed.

3 Results

3.1 Desk-study

3.1.1 Montgomeryshire can be roughly divided into two parts: the higher altitude, sparsely populated moorlands of the Berwyn and Cambrian mountains, and the lower altitude, more intensively-used farmland to the east. Ty Gwyn lies on the boundary between these two ecosystems.

3.1.2 Ty Gwyn is set in a landscape dominated by livestock farming, with numerous other farmsteads within 2km of the property. The habitats surrounding Ty Gwyn are predominantly permanent pasture, with small patches of coniferous plantation and mostly intact hedgerows (Figure 3). Water bodies often attract wildlife; there is a wet ditch on the property, and the Afon Rhaeadr is less than one kilometre to the north-east. These linear features (hedgerows, streams and rivers) means that habitat connectivity is good across the landscape.

Figure 3. Aerial photo of land around Ty Gwyn (circled red).
(Imagery dates from 2009, courtesy of Google Earth)

3.1.3 There are six statutorily designated sites within the 5km search radius (Figure 4). These include three Sites of Special Scientific Interest (SSSI), two Special Areas of Conservation (SAC), and one Special Protection Area (SPA), although some of these overlap and have multiple designations. Table 1 shows the characteristics of these sites.

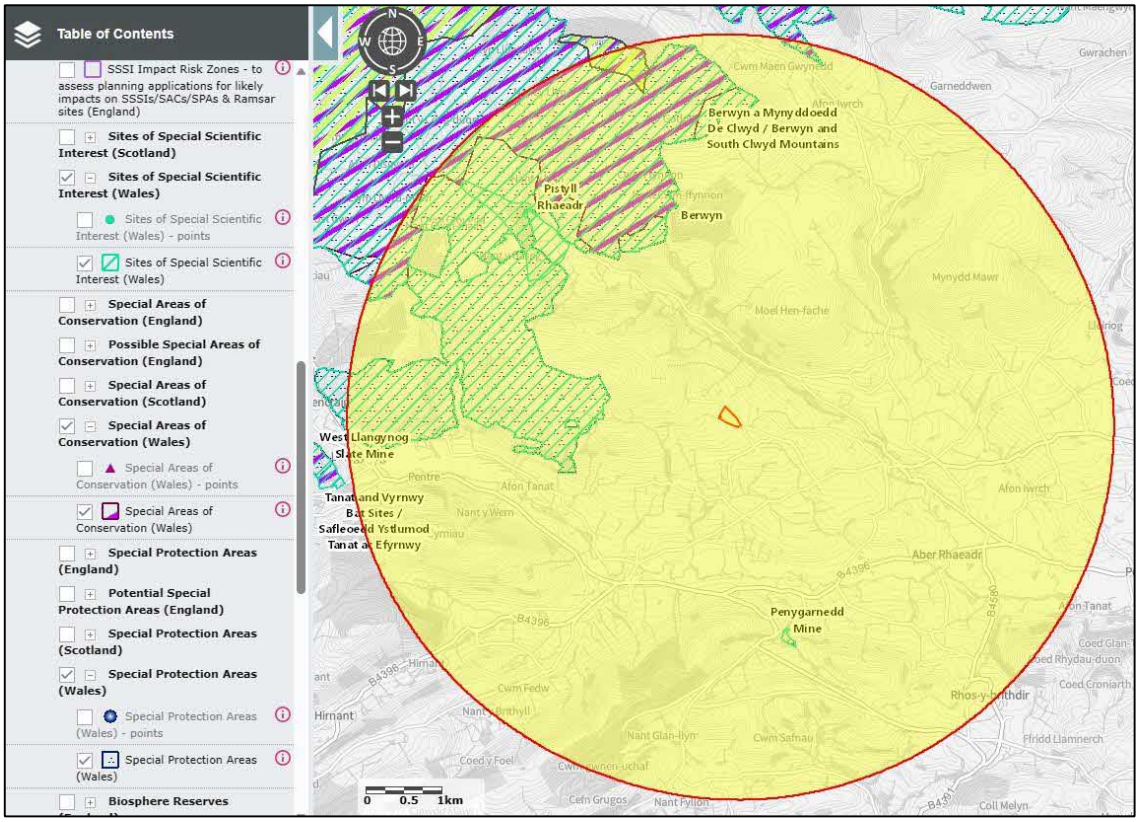

Figure 4. Map showing designated sites within a 5km radius around the site.
(From MAGIC Interactive Maps)

Site name	Designation	Distance from Ty Gwyn	Qualifying features
Berwyn	SSSI & SPA	1493m	Breeding bird assemblage and moorland vegetation
Berwyn and South Clwyd Mountains	SAC	2446m	Moorland vegetation
Penygarnedd Mine/ Tanat and Vyrnwy Bat Sites	SSSI/SAC	2780m	Lesser horseshoe bat hibernaculum
Pistyll Rhaeadr	SSSI	2937m	Fluvial geomorphology

Table 1. Characteristics of the designated sites within 5km of Ty Gwyn.

3.1.4 No surveys have previously been carried out on the site, but there are 221 historical biological records on the NBN Atlas within the 2km search radius. These results are summarised in Table 2.

3.1.5 A distinction is made between species considered to be relatively mobile (those able and likely to move more than 500m in one period) and those that are relatively immobile, because the mobile species are much more likely to utilise the site, even if only infrequently.

Taxon	No. of records	Mobile species (>500m) (Y/N)
[redacted]		
Bats	5	Y
Birds	64	Y
Bony fish	2	Y
Brown Hare	1	Y
Common Frog	1	N
Common Shrew	1	N
Ferns	1	N
Flatworms	1	N
Flowering plants	76	N
Fox	1	Y
Freshwater shrimp	1	N
Fungi	7	N
Grey squirrel	1	Y
Hedgehog	1	Y
Insects	47	Y & N
Mink	1	Y
Mole	1	N
Mosses	3	N
Otter	1	Y
Rabbit	1	N
River limpet	1	N
Worms	2	N

Table 2. Summary of the results of the historical records search.

3.1.6 Mobile protected species recorded within the 2km study radius include:

[redacted]

Bats – including Natterer's bat (M. nattereri), brown long-eared bat (Plecotus auritus), lesser horseshoe bat (Rhinolophus hipposideros) have all been recorded, as well as indeterminate bat species.

Birds – 61 species have been recorded within 2km of Ty Gwyn, as detailed in Table 3.

Bony fish – including brown trout and bullhead, both denizens of fast-flowing rivers and streams

Brown hare (Lepus europaeus) – their preferred habitat is the woodland edge, with cover in woodland and scrub, and foraging opportunities in adjacent grassland.

English name	Scientific name
Blackbird	Turdus merula
Blackcap	Sylvia atricapilla
Blue Tit	Cyanistes caeruleus
Brambling*	Fringilla montifringilla
Bullfinch	Pyrrhula pyrrhula
Buzzard	Buteo buteo
Carrion crow	Corvus corone
Chaffinch	Fringilla coelebs
Chiffchaff	Phylloscopus collybita
Coal tit	Periparus ater
Collared dove	Streptopelia decaocto
Common whitethroat	Curruca communis
Crossbill*	Loxia curvirostra
Curlew	Numenius arquata
Dunnock	Prunella modularis
European bee-eater*	Merops apiaster
Garden warbler	Sylvia borin
Goldcrest	Regulus regulus
Goldfinch	Carduelis carduelis
Great spotted woodpecker	Dendrocopos major
Great tit	Parus major
Green woodpecker	Picus viridis
Greenfinch	Chloris chloris
Grey wagtail	Motacilla cinerea
House martin	Delichon urbicum
House sparrow	Passer domesticus
Jackdaw	Coloeus monedula
Jay	Garrulus glandarius
Kestrel	Falco tinnunculus
Lesser black-backed gull	Larus fuscus
Linnet	Linaria cannabina

English name	Scientific name
Long-tailed tit	Aegithalos caudatus
Magpie	Pica pica
Meadow pipit	Anthus pratensis
Mistle thrush	Turdus viscivorus
Nuthatch	Sitta europaea
Pheasant	Phasianus colchicus
Pied flycatcher	Ficedula hypoleuca
Pied wagtail	Motacilla alba
Raven	Corvus corax
Redstart	Phoenicurus phoenicurus
Reed bunting	Emberiza schoeniclus
Robin	Erithacus rubecula
Siskin	Spinus spinus
Skylark	Alauda arvensis
Snipe	Gallinago gallinago
Song thrush	Turdus philomelos
Sparrowhawk	Accipiter nisus
Spotted flycatcher	Muscicapa striata
Starling	Sturnus vulgaris
Stock dove	Columba oenas
Swallow	Hirundo rustica
Swift	Apus apus
Tawny owl	Strix aluco
Treecreeper	Certhia familiaris
Wheatear	Oenanthe oenanthe
Whinchat	Saxicola rubetra
Willow warbler	Phylloscopus trochilus
Wood pigeon	Columba palumbus
Wren	Troglodytes troglodytes
Yellowhammer	Emberiza citrinella

Table 3. List of birds recorded within 2km of Ty Gwyn.

* = Schedule 1 species

Fox (Vulpes vulpes) – a very versatile generalist mesocarnivore occupying most habitats.

Grey squirrel (Sciurus carolinensis) – a non-native arboreal rodent that has displaced the native red squirrel (Sciurus vulgaris).

Hedgehog (Erinaceus europaeus) - prefers woodland/grassland edge or scrub and hedgerows with some cover.

Insects – including eight orders: Coleoptera (beetles), Diptera (true flies), Ephemeroptera (up-winged flies), Lepidoptera (butterflies and moths), Odonata (dragonflies and damselflies), Orthoptera (grasshoppers and crickets), Plecoptera (stoneflies), and Trichoptera (caddis flies). Insects are an under-recorded taxon, and more detailed and targeted surveys would undoubtedly find many more species.

Mink (Neovison vison) – this is the American mink which is a non-native species that established after escaping from fur farms, usually restricted to riparian habitats. It has had a devastating impact on the water vole (Arvicola amphibius) population in the UK.

Otter - have an obvious affinity with water bodies, but otters will also commute over land.

3.2 Habitat survey

3.2.1 The field survey was carried out on the 8th of July 2023, and the distribution of habitats on the site is depicted in Figure 5. Appendix 1 contains a list of vascular plant species observed during the field survey, and illustrative photographs are presented in Appendix 2. Non-vascular plants (bryophytes and lichens) were not surveyed. The following habitats were recorded:

g3c Other neutral grassland (67 species)

3.2.2 At some point, all of the fields have had land-drains installed and, at least in the recent past, they have been shut up for a hay or silage crop most years and grazed the rest of the time with sheep or cattle. They are mostly fairly flat, with a slight slope to the south-east.

3.2.3 A range of common grass species dominate this habitat, including frequent or locally abundant common bent, crested dog's-tail, red fescue, Yorkshire Fog, sweet vernal-grass, and rough-stalked meadow-grass, amongst others that are less common on the site. Other graminoids include a limited range of common sedges and rushes that are occasional at most.

3.2.4 Forbs (herbaceous flowering plants that are not graminoids) are common, and include frequent red clover and white clover, occasional and/or locally frequent yarrow, creeping thistle, bird's-foot trefoil, selfheal, and creeping buttercup, and a reasonable range of other species that are rare on the site.

3.2.5 Groundwater seeps to the surface in numerous places and has created patches of marshy grassland. These patches contain more rushes (mostly sharp-flowered rush), sedges, and creeping bent, along with a suite of forbs better suited to damp conditions, e.g., sneezewort, marsh ragwort, ragged robin, and marsh and fen bedstraws. These are presumably relicts surviving from pre-drainage times.

w1h5 Mixed woodland (mainly broadleaves) (51 species)

3.2.6 A narrow strip of woodland habitat occurs all along the southern boundary of the site, along with a small pocket in the eastern corner. The tree canopy is a mixture of native and exotic species that prefer dry or wet conditions; exotic species that were planted include locally frequent Japanese larch, occasional Norway spruce and silver fir, and a mixture of other coniferous and deciduous species that are rare on the site. Native species (that may or may not have been planted) include occasional alder, ash, aspen, crab apple, downy birch, sessile oak, and wild cherry. The shrub layer is patchy or non-existent, but includes occasional or rare blackthorn, elder, common gorse, hawthorn, holly, and Rowan in dry areas, and grey willow and osier (appearing planted in rows) in wetter areas.

3.2.7 Apart from some small exclosures in the southern strip, the woodlands have been open to grazing, so little in the way of a woodland field layer has been preserved. The only survivors are species that can also persist in grassland or hedgerows, including pignut, herb-Robert, hedge woundwort, enchanter's nightshade, scaly male fern, and common dog-violet. Bluebell was not recorded in the woodland, but a few plants were observed in the grassland nearby

3.2.8 The woodlands at Ty Gwyn have limited age and structural diversity – most of the trees are young or semi-mature, with only one or two mature specimens, and there are no over-mature trees on the site. Self-set seedlings of native species were recorded in places alongside the linear southern woodland.

3.2.9 There is almost no standing or fallen deadwood. Two ash trees have recently been pollarded and these will provide a core of standing deadwood habitat. There are a number of ash trees on the site, and these have contracted and are likely to succumb to ash die-back (Hymenoscyphus fraxineus), which will result in a pulse of deadwood habitat in the near future.

h2a Priority hedgerow (40 species)

3.2.10 Hedgerows run along the northern and part of the western boundaries of the site, and all have historically been trimmed with a flail. They have all been excluded from grazing livestock.

3.2.11 Twenty woody species were recorded in this habitat, including frequent hazel and grey willow, and occasional osier, aspen, and hawthorn. Climbing and rambling species are well represented, with locally frequent bramble, occasional ivy, field rose and dog-rose, and rare honeysuckle.

3.2.12 Herbaceous species include a range of woodland species typical of this habitat in this area, including frequent cow parsley, occasional garlic mustard, lady fern, herb-Robert, hedge woundwort, and greater stitchwort. Some of these are Ancient Woodland Indicator species, implying that the hedgerows themselves have an ancient origin (i.e., pre-17th century).

r2b Stream (ditch) (13 species)

3.2.13 An open ditch enters the property at the northern corner and runs along that western edge and then south-eastwards along the southern boundary before exiting the site in the southern corner. The excavation is mostly between 1-1.5m deep and approx. 1m wide, although the water course has been dammed in a couple of places and has silted up and spread across a wider area (up to 3m wide). Apart from these silty areas, the stony bedload is visible in the bottom of the ditch.

3.2.14 During the survey and other walkovers, the water depth was shallow, although it is likely to be flashy and significantly deeper when in spate. Stretches of it are excluded from grazing livestock by fencing or by a steep gradient. There are two short sections of the waterway that are culverted to allow crossing by foot traffic or a tractor, and one section that has in the past been diverted into a pond, although this is now dry.

3.2.15 In terms of vegetation, there is very little that is truly aquatic - most often, the ditch is overhung by terrestrial species growing in the adjacent woodland and grassland. However, in the silted-up areas, a limited range of riparian and aquatic species persist, and include locally dominant flag iris and floating sweet-grass, locally abundant marsh marigold and round-leaved crowfoot, locally frequent pond water-starwort, occasional water mint, and rare pendulous sedge, tufted forget-me-not, and lesser spearwort.

w1g6 Line of trees (9 species)

3.2.16 There are two lines of trees on the site: three mature alders along a fence-line between two fields that may be a the remains of an old hedgerow, and a row of young Sitka spruce planted along part of the western boundary. They are both underlain by a continuation of the adjacent grassland habitat.

u1 House and garden

3.2.17 This anthropogenic habitat was not surveyed in detail, but the garden did appear to contain a reasonable range of exotic plants which may have some wildlife value, and it does contain a small pond.

Figure 5. Map of habitats at Ty Gwyn.

3.3 Protected species survey

3.3.1 No field signs of any protected species were recorded during the field survey. In terms of the potential for utilisation of the habitats found onsite, the following were noted:

Badgers

3.3.2 None are resident on the property, and no field signs were found, but the woodland and grassland habitats were considered suitable as foraging and commuting habitat.

Bats

3.3.3 The grasslands are thought to be of moderate value as foraging habitat, based purely on their moderate plant species richness. The linear woodland and ditch provide some forage and are of high value as commuting habitat. The absence of over-mature and veteran trees means that tree-roosting opportunities are limited on the property.

3.3.4 An informal dusk emergence survey of the house on the 23rd of August 2023 recorded common pipistrelle (Pipistrellus pipistrellus), noctule (Nyctalus noctula), Daubenton's bat (Myotis daubentonii), whiskered bat (M. mystacinus), and indeterminate bats. At least three bats were observed emerging from roosts in the roof, under slates and ridge tiles.

3.3.5 A passive survey was also carried out between the 9th and the 20th of July, with two detectors deployed in the strip of woodland (marked on Figure 5 as PD1 & PD2). These recorded calls of the following species: common pipistrelle (Ppip in the figure below), indeterminate myotis, Daubenton's bat (Md), whiskered bat (Mmys), soprano pipistrelle (Pipistrellus pygmaeus, Ppyg), noctule (Nn), lesser horseshoe bat (Rhip), indeterminate pipistrelle (Pip), Natterer's bat (Mn), indeterminate bat (Unknown), brown long-eared bat (Paur), and greater horseshoe bat (Rhinolophus ferrumequinum, Rferr).

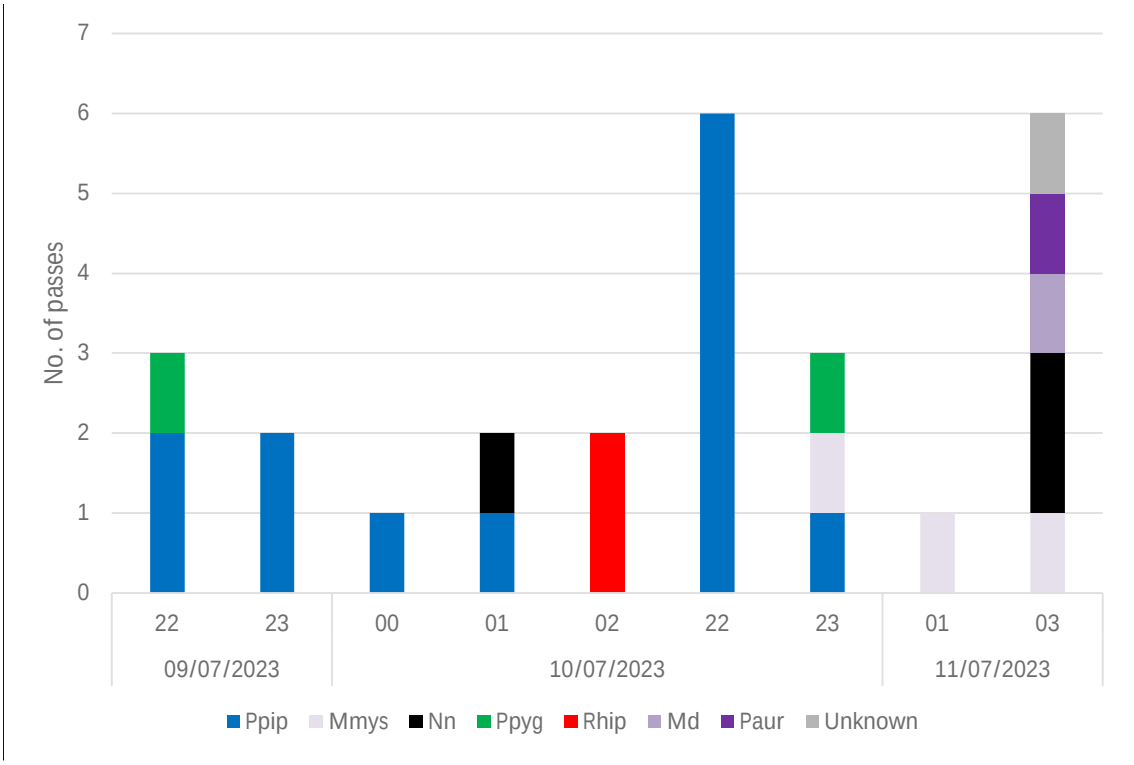

Figure 6. Bat activity recorded at PD1.

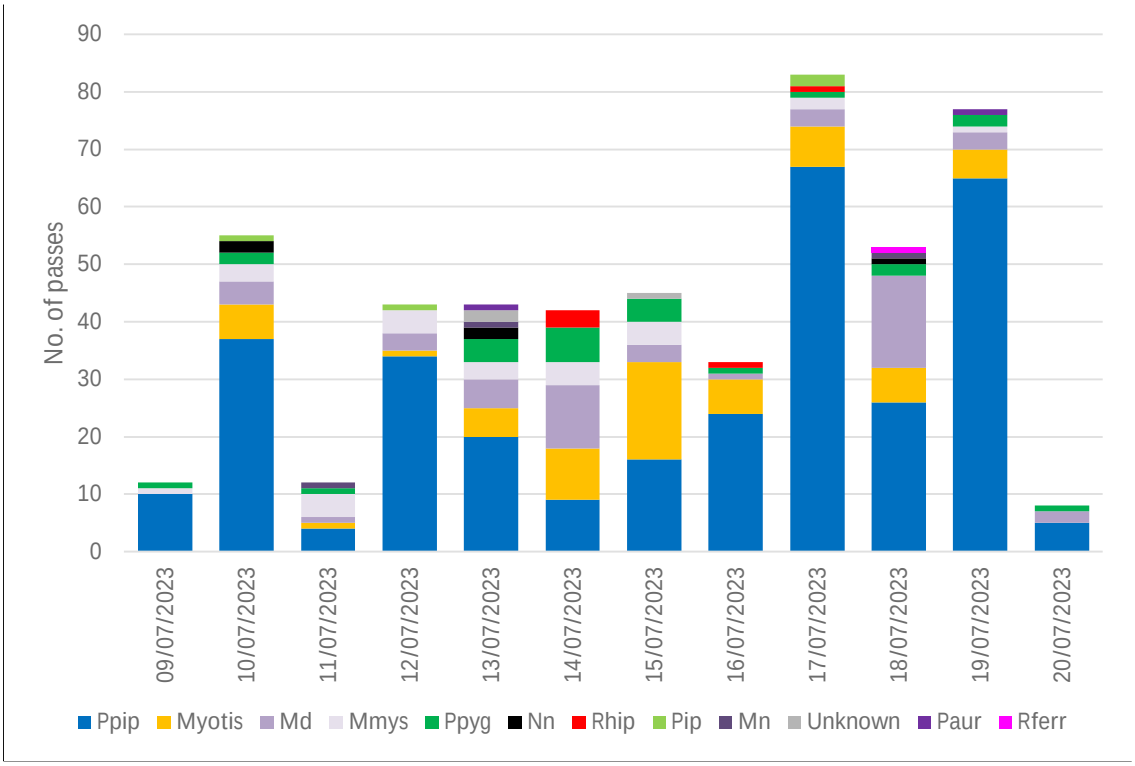

Figure 7. Bat activity recorded at PD2.

Birds

3.3.6 The woodlands and hedgerows are highly suitable as nesting, roosting and foraging habitat for a wide range of species, and the grasslands are also suitable as foraging habitat for some species. All of the 61 bird species listed in the data search could be found at Ty Gwyn, although European bee-eater is unlikely to be a regular visitor. Some could breed on the site, while others may use the site on a peripatetic basis for occasional foraging.

3.3.7 Other Schedule 1 species that are present in the wider area and that might utilise the site include barn owl, fieldfare, goshawk, hobby, red kite and redwing, but probably only for occasional foraging. Other species on the red or amber list that might utilise the site for foraging, roosting or breeding include cuckoo, lapwing, lesser spotted woodpecker, marsh tit, starling, tree pipit, and woodcock.

Dormouse

3.3.8 Dormouse have not previously been recorded within the 2km search area, although they are generally an under-recorded species, and the absence of evidence is not the same as evidence of absence. The woodland and hedgerow habitats on the site are moderately suitable as nesting and foraging habitat.

Great Crested Newt

3.3.9 The terrestrial habitats ostensibly constitute good-quality foraging, commuting and refuge habitat for this species. According to the NBN Atlas, they appear to be restricted to lowland sites; this might be due to some intrinsic physiological limit, or it might be due to the scarcity of ponds in upland areas There is one small pond in the garden at Ty Gwyn that could potentially act as breeding habitat for great crested newts

Invertebrates

3.3.10 This taxon is very poorly recorded generally, and no specialist surveys have been undertaken on this site. While it is not practicable to inventory all invertebrate organisms on the site, it is undoubtedly the case that there are already more than 52 invertebrate taxa at Ty Gwyn, and it is generally the case that invertebrate diversity will increase with habitat diversity. In terms of the habitats on the site, the semi-natural ones are of moderate quality, and the buildings and garden also provide a range of niches for a wide variety of invertebrates.

Otters

3.3.11 Otters do not generally stray far from their preferred habitat of running water, and there are no significant streams on the property. They are, however, present in the wider countryside, along the major river corridors, and it would not be out of the question for an otter to occasionally explore along the ditch. No field signs of this

species were observed during the survey, and it is highly unlikely that otters will ever be resident on the property with the habitats as they stand.

Reptiles

3.3.12 The habitats recorded on the site would offer limited potential for foraging reptiles, and these species are unlikely to be present in significant numbers. Grass snakes (Natrix helvetica) may visit occasionally to feed on amphibians in the garden pond or in the marshy grassland. The habitats on the property are sub-optimal for Common lizards (Zootoca vivipara) and for slow-worm (Anguis fragilis), and not suitable at all for the more specialist adder (Vipera berus), with limited south-facing slopes for basking and a general lack of structural heterogeneity in the vegetation.

Water Voles

3.3.13 The ditch would be moderately suitable for water vole, although water levels were generally too low during all of the survey visits and no field signs were observed. They have mostly been eradicated from the area by American mink, which has been recorded nearby.

White-clawed Crayfish

3.3.14 There is no suitable habitat (permanently wet streamways) on the property for this species.

Plants

3.3.15 The only statutorily protected plant species recorded on the site was bluebell.

4 Conclusions and recommendations

4.1 Conclusions

4.1.1 Ty Gwyn is part of a farmed landscape that has, in common with most of the wider Welsh and UK countryside, been degraded in terms of ecological value in the name of agricultural 'improvement'.

4.1.2 At Ty Gwyn, this has taken the form of land drainage which has dried out the grasslands. The absence of high-fertility indicator grassland species implies that the grasslands have not had routine applications of artificial fertiliser, but the limited range of species does imply inappropriate overgrazing for a number of years. In addition, it may be that the Ty Gwyn fields have also had a dressing of lime at some point - the neighbouring fields immediately to the south of Ty Gwyn are unimproved and have an acidic flora while the Ty Gwyn fields are neutral in character – liming would have increased soil drainage, increased soil pH and therefore changed the plant assemblage.

4.1.3 All of the above means that there is plenty of scope for raising the biodiversity of the site, and the following recommendations are aimed at maximising biodiversity.

4.2 Recommendations for ecological enhancement

4.2.1 The best way to achieve maximum biodiversity is to mimic a natural system as closely as possible. In this part of the world, that natural ecosystem would comprise a dynamic mosaic of grassland, scrub, woodland and wetland, whose arrangement is to some extent dictated by the foraging habits of large herbivores.

4.2.2 In essence, this theory of natural succession, based on work by Vera (2000), starts with the establishment in open grassland of thorny scrub that is unpalatable to grazers. This becomes established and spreads along an ever-expanding front, acting as protection from grazing for non-thorny, woody, more palatable species that arise within it. These species could then grow into high-canopy woodland that would eventually shade out the thorny, light-demanding species and allow the development of a true woodland flora. Eventually the thorny barrier would develop gaps which would allow grazing animals back in, and these would prevent the natural regeneration of vulnerable woodland species. The stand would then age and die, and the area would eventually return to grassland. This whole cycle might take hundreds or thousands of years, but if it takes place at different times, at different rates, and covers varying areas in different places, then some idea of the complexity and dynamism of this system can be gained.

4.2.3 Added into this mix are (at least) two other modifying factors: firstly, in a truly wild system, the distribution of those herbivores would be partly regulated by the actions of predators, and, secondly, abiotic factors such as soil type, climatic factors, and hydrology will also influence what vegetation can occur on a site.

4.2.4 Other factors that may not be easily reproducible in an artificially managed system on a small site would include disturbance, in the form of wild boar and other animals that disturb the soil, and a fully functioning necrobiome - in wild populations, around three quarters of all herbivores die of starvation rather than predation, and their carcasses provide food for a whole suite of scavenger species.

4.2.5 It is impossible to state definitively what vegetation would naturally occur at Ty Gwyn because it has changed almost completely from its primordial state and there are no examples of similar unaltered habitat left in the UK, but it can probably be approximately characterised as a mixture of wet woodland, dry woodland, unimproved acid grassland, and wetlands. Depending on how wet the ground originally was, there may even have been sphagnum bog as part of the mosaic. The majority of riparian wetlands would have originally been inhabited by beavers (Castor fiber); an ecosystem engineer par excellence. The microhabitats that they create in the form of dams, ponds, wetlands and coppiced woodland would have supported a whole host of other species that struggle to survive in the modern landscape.

4.2.6 In an artificial situation where no predators exist, that role has to be assumed by the human managers of the site. In order to re-establish natural processes (or proxies for them) and partially recreate these habitats, a number of measures aimed at rewilding the site should be implemented:

Either plant trees and shrubs to kick-start the establishment of woodland on the site and protect them from livestock;

Or remove livestock until natural regenerated woody species have achieved the same result;

Re-introduce large herbivores to the site after trees and shrubs have become established or been otherwise protected;

In the absence of beavers, dig new ponds and install Beaver Dam Analogues (BDA's) on the ditch.

If desired, part of the site could be managed as a hay meadow to maximise the benefit for pollinators and other invertebrates that depend on those plant species. This would also provide winter forage for livestock if that ever proved necessary. It should be borne in mind, however, that all of those plants, pollinators, and other denizens of hay meadows originally evolved in the natural dynamic system described above, and not in the artificially static habitat of a hay meadow.

Woodland and scrub

4.2.7 Ideally, in order to preserve the spread of genetic diversity across the UK, site-native plants will be sourced from locally derived seed. In theory, tree nurseries advertise stock with local provenance, but in practice they often cannot provide it and end up

substituting exotic plants. Far better to either collect local seed and grow it on for planting or allow the natural regeneration of local trees. Natural regeneration will result in a natural distribution of seedlings that are best suited to the site, but it does mean that the introduction of livestock would have to be delayed until the trees are either well established or protected in some way, because the natural thorny protection may well be missing or take some time to develop.

4.2.8 The range of woodland species on the site is limited, however, but that range can be expanded by importing more species (woody and herbaceous) of local provenance. A list of suitable species is provided in Appendix 3.

Re-introduction of large herbivores

4.2.9 Native herbivores used to come in many shapes and sizes, all of them with different browsing and grazing preferences. Many of these animals, such as the aurochs, red deer, bison, moose, and wild boar, are now at least locally extinct, but a range of near-proxies are available in the form of their artificially bred descendants, e.g., cattle, horses, and pigs.

4.2.10 There is an optimal balance between the number of herbivores and the structure of the vegetation they eat. Too many animals and the grassland never succeeds to woodland because tree seedlings are eaten before they can establish, too few and tree growth continues unchecked resulting in persistent closed-canopy woodland. Different animals are assigned different values as livestock units, ranging from lactating dairy cattle at 1 livestock unit (LU), through horses at 0.8 LU and beef cows at 0.75 LU, to a medium-sized ewe at 0.08 LU. Early research indicates that rewilding sites without predators require a stocking rate of around 0.05 livestock units per hectare in order to promote the dynamic vegetation mosaic that will maximise biodiversity.

4.2.11 At Ty Gwyn, with 3.5Ha, this optimal stocking rate translates as 0.175 LU all year round, 1 LU for around two months, or 2.25 LU (three beef cows) for under one month. Obviously, these cattle would require other places to graze for most of the year to allow a naturalistic vegetation pattern to develop at Ty Gwyn.

Wetland habitats

4.2.12 Without doubt, the fastest way to boost biodiversity at Ty Gwyn would be to construct some new wetland habitats. This would facilitate the colonisation of a whole new suite of plant assemblages with all their attendant animal species. In the absence of beavers, this could be achieved by the following:

The water table across part or all of site should be raised by blocking the land drains that currently feed into the ditch. As a result of this, the area of marshy grassland will spread and become more resilient in the face of droughts.

Dig a series of new ponds and scrapes within the wetter areas of the site. Some of these ponds can be designed to permanently retain water, whereas others could dry out to various extents to provide a drawdown zone that is attractive to some specialist plant and animal species. These would ideally be situated on the flatter parts of the site to minimise the need for retaining walls. Off-line ponds are easiest to construct and control from an engineering point of view because there is no need to counter the erosive forces present in an active streamway, which may be subject to sudden drastic increases in flow rate. Off-line ponds can also be topped up as required with a feed from a nearby water source.

The flow of water in the ditch should be interrupted and slowed by the installation of a series of carefully placed BDA's; Figure 8 is an example of how these might be constructed. These will help to raise the water table, and will cause the flooding of any adjacent low-lying areas, so their placement should take this into account with regard to the impact on neighbouring property.

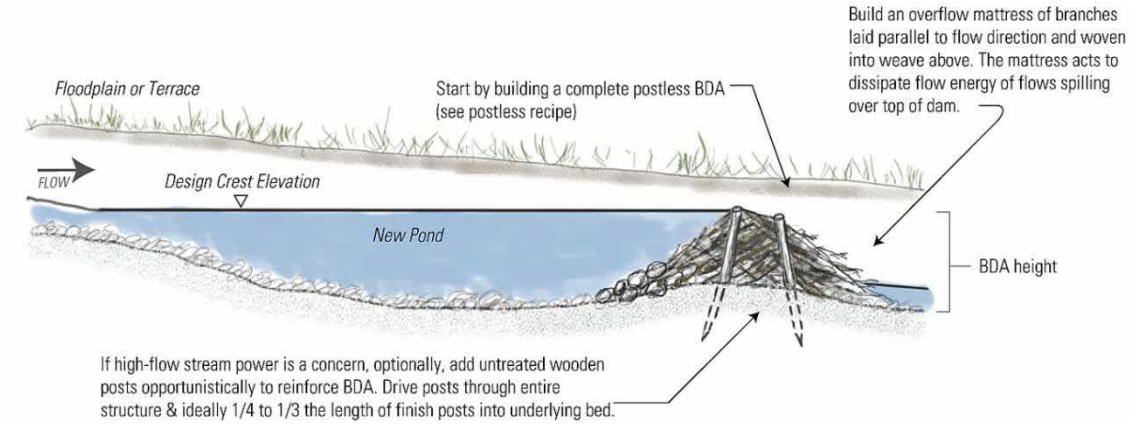

Figure 8. An example of a BDA in a streamway.

Hay meadow management

4.2.13 The species richness in the sward of any areas reserved for management as hay meadow should be increased. This can be achieved in three stages:

1. Cut and remove a hay crop and then scarify the remaining sward to expose the bare soil,

2. Sow hay rattle (Rhinanthus minor) into the existing sward where it will parasitise the dominant grasses and reduce their competitive vigour

3. Enrich the sward with forbs, either by spreading green hay, or by planting well-grown plug plants of desired species.

4.2.14 However the seed is introduced, it should be obtained from a local species-rich source. If a hay crop is taken, it should be cut after the desired species have set seed and the aftermath should be grazed, or alternatively a foggage system can be

employed, whereby the standing crop is eaten down by livestock after seed-set. The livestock in both of these systems is important because it treads the seed in. The same applies to enrichment of the grassland in the rewilded areas, and a list of suitable forb species is given in Appendix 3.

Other enhancement measures

4.2.15 A number of other measures can be implemented that will address the current sparsity of natural roosting and nesting opportunities for wildlife on the site. These could include:

The installation of a range of bird and bat boxes on trees around the property. See Appendix 4 for suitable models.

The construction of hibernacula for amphibians and reptiles. These should be constructed to the design given in Figure 9, using the spoil excavated from the new ponds.

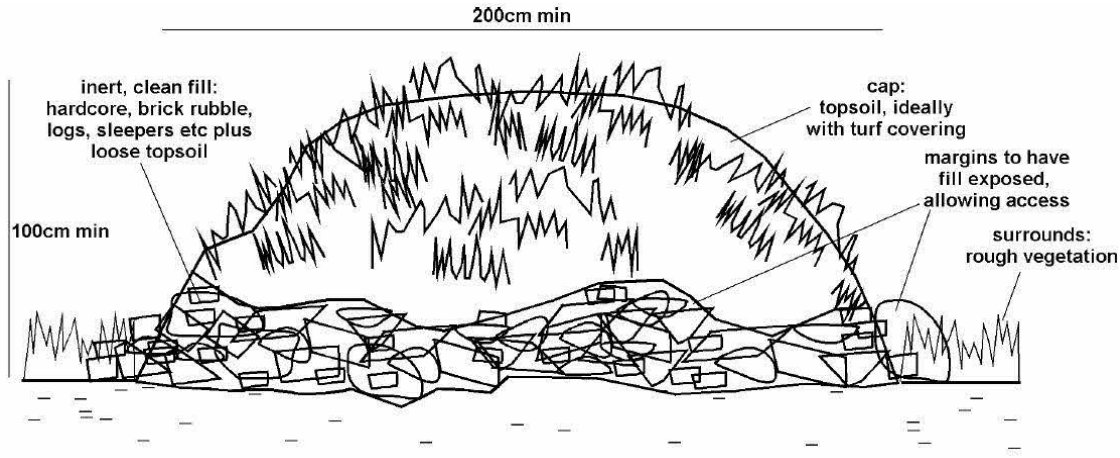

Figure 9. Suggested hibernacula design (taken from English Nature, 2001).

The annual trimming of hedgerows should be stopped because this removes valuable food sources for a wide range of wildlife in the form of flowers and fruits - when not alongside a road, they should be left to grow out, and then laid on a ten year cycle to renovate them if desired. Roadside hedges can be trimmed on a two- or three-year cycle on a rotation so that they always offer some forage.

If the land to the south of the site can be purchased, that will secure a relatively contained catchment that would allow the release of beavers without negatively impacting on anybody else's property. At the moment, this release would have to be into a pen, and it would require the provision of more woodland habitat alongside the water course to be feasible, so it could not happen until all of those things are in place. In the meantime, it may be that there will be a nationwide wild release of beavers, after which they would probably rapidly colonise most watercourses in Wales.

4.3 Recommendations for further surveys

4.3.1 The surveys undertaken to date have established a baseline with regard to habitat distribution and plant species on the site, and for usage of parts of the site by bats. Given that the emphasis of management on the site will now be focussed on maximising biodiversity as opposed to livestock productivity, the types and distribution of habitats will almost certainly undergo dramatic changes in the coming years. The monitoring of a range of taxa over a number of years will track these changes and can inform and fine tune management decisions in the future. The following surveys are recommended:

Plants – baseline and every three years thereafter - more detailed (Phase 2) vegetation surveys should be carried out using the National Vegetation Classification (NVC) methodology (Rodwell, 1991), whereby the presence and cover of all plant species within a standardised fixed-point quadrat are recorded. These would capture the detail of changes in species richness and abundance, and could also capture elements of structural complexity, for example as a habitat transitions from grassland, through scrub to woodland.

Fixed-point photography – baseline and every three months thereafter - another simple way to illustrate habitat transformations, where vantage points are chosen to capture major changes in vegetation structure; photographs can be taken in four cardinal directions every three months, and then compared over time.

Soil survey – baseline and every five years – send off samples to a lab to check for carbon and nutrient levels.

Amphibians – annually - torch surveys to record counts in the pond in the Spring. Extend to other ponds when established.

Bats – extend baseline survey into grassland habitat and then every five years - deploy passive detectors in different habitats around the property to record bat calls over multi-night periods.

Birds – annually - transect surveys in spring and summer for breeding birds to record species richness and abundance.

Butterflies – annually – transect surveys in spring and summer to record species richness and abundance.

Other invertebrates – ongoing - invite specialists to carry out surveys, e.g., Montgomeryshire moth group.

Reptiles – ongoing - place artificial refuges across the site and check weekly over the Spring and Summer.

Fungi – invite local experts to carry out surveys. Soil samples can also be analysed for eDNA.

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Appendix 1:
Site species list

Habitat codes:

g3c	Other neutral grassland (patches of marshy grassland)
w1h5	Mixed woodland (mainly broadleaves)
h2a	Priority hedgerow
r2b	Stream (ditch)
w1g6	Line of trees

Frequency codes:

D = Dominant

(L)A = (Locally) Abundant

(L)F = (Locally Frequent)

(L)O = (Locally) Occasional

R = Rare

Scientific name	Common name	Habitat	Frequency (DAFOR)
Abies alba	Silver fir	w1h5	LO
Acer pseudoplatanus	Sycamore	h2a	R
Achillea millefolium	Yarrow	g3c	O (LF)
Achillea ptarmica	Sneezewort	g3c	R (LO)
Agrostis capillaris	Common bent	g3c, w1h5	F (LA)
Agrostis stolonifera	Creeping bent	g3c, w1h5	O
Ajuga reptans	Bugle	g3c	LO
Alliaria petiolata	Garlic mustard	h2a	O
Alnus glutinosa	Common Alder	w1h5, h2a, w1g6	R (LF)
Alopecurus pratensis	Meadow foxtail	g3c	O
Anthoxanthum odoratum	Sweet vernal-grass	g3c, w1h5	F (LA), O
Anthriscus sylvestris	Cow parsley	h2a	F
Arrhenatherum elatius	False oat-grass	g3c, h2a, w1g6	O
Athyrium filix-femina	Lady-fern	h2a	O
Bellis perennis	Daisy	g3c	R
Betula pendula	Silver birch	h2a	R
Betula pubescens	Downy birch	w1h5	O
Callitriche stagnalis	Pond water-starwort	r2b	LF
Caltha palustris	Marsh marigold	r2b	LA
Campanula rotundifolia	Harebell	g3c	R
Cardamine pratensis	Ladies-smock	g3c	O
Carex leporina	Oval sedge	g3c	O
Carex nigra	Common sedge	g3c	LO
Carex pallescens	Pale sedge	g3c	R
Carex pendula	Pendulous sedge	r2b	R
Cerastium fontanum	Common mouse-ear	g3c	O
Cerastium glomeratum	Sticky mouse-ear	g3c	R
Chamaecyparis lawsoniana	Lawson's cypress	w1h5	R
Circaea lutetiana	Enchanter's nightshade	w1h5	R

Scientific name	Common name	Habitat	Frequency (DAFOR)
Cirsium arvense	Creeping thistle	g3c, w1h5	O (LF)
Cirsium palustre	Marsh thistle	g3c, r2b	O
Cirsium vulgare	Spear thistle	g3c, w1h5	R
Conopodium majus	Pignut	g3c, w1h5	LO
Corylus avellana	Hazel	h2a	F
Crataegus monogyna	Hawthorn	w1h5, h2a, w1g6	O, O, R
Cynosurus cristatus	Crested dog's-tail	g3c	F (LA)
Dactylis glomerata	Cock's-foot	g3c, w1h5	O, F
Deschampsia cespitosa	Tufted Hair-grass	g3c	R
Digitalis purpurea	Foxglove	w1h5, h2a	R, O
Dryopteris affinis	Scaly male fern	w1h5	R
Dryopteris dilatata	Broad buckler-fern	h2a	R
Dryopteris filix-mas	Male fern	g3c	R
Dryopteris filix-mas	Male fern	h2a	R
Epilobium ciliatum	American willowherb	g3c	R
Epilobium tetragonum	Square-stalked willowherb	w1h5	R
Festuca rubra	Red fescue	g3c, w1h5	F (LA)
Fraxinus excelsior	Ash	g3c, w1h5, h2a	R
Galium aparine	Cleavers	w1h5, h2a	O (LA)
Galium palustre	Marsh bedstraw	g3c, r2b	R, O
Galium saxatile	Heath bedstraw	w1h5	LO
Galium uliginosum	Fen bedstraw	g3c	R
Geranium robertianum	Herb-Robert	w1h5, h2a	O
Glyceria fluitans	Floating sweet-grass	r2b	LD
Hedera helix	Ivy	h2a	O
Heracleum sphondylium	Hogweed	g3c, w1h5, h2a	R
Holcus lanatus	Yorkshire Fog	g3c, w1h5	F (LA)
Holcus mollis	Creeping soft-grass	w1h5	LF

Scientific name	Common name	Habitat	Frequency (DAFOR)
Hyacinthoides non-scripta	Bluebell	g3c	R
Hypericum androsaemum	Tutsan	g3c	R
Hypericum humifusum	Trailing St. John's-wort	w1h5	R
Hypericum perforatum	Perorate St. John's-wort	h2a	R
Hypochaeris radicata	Cat's-ear	g3c, w1h5	O, R
Ilex aquifolium	Holly	w1h5, h2a	R
Iris pseudacorus	Flag iris	r2b	LD
Jacobaea aquatica	Marsh ragwort	g3c	R
Jacobaea vulgaris	Common ragwort	g3c	R
Juncus acutiflorus	Sharp-flowered rush	g3c	O (LF)
Juncus effusus	Soft rush	g3c, r2b	R, F
Laburnum anagyroides	Laburnum	h2a	R
Lamium galaeobdolon argentatum	Variegated yellow archangel	h2a	R (LA)
Lapsana communis	Nipplewort	h2a	O
Larix kaempferi	Japanese larch	w1h5, w1g6	LF, R
Lathyrus pratensis	Meadow vetchling	g3c, w1h5	R (LO)
Leontodon autumnalis	Autumn hawkbit	g3c	R
Leucanthemum vulgare	Ox-eye daisy	g3c	R
Lolium perenne	Perennial rye-grass	g3c	O
Lonicera periclymenum	Honeysuckle	h2a	R
Lotus corniculatus	Bird's-foot trefoil	g3c	O (LF)
Lotus pedunculatus	Greater bird's-foot trefoil	g3c	O
Luzula campestris	Field wood-rush	g3c	O (LF)
Lychnis flos-cuculi	Ragged Robin	g3c	R
Malus sylvestris	Crab apple	w1h5	R
Meconopsis cambrica	Welsh poppy	h2a	R
Mentha aquatica	Water mint	r2b	O
Myosotis laxa	Tufted forget-me-not	r2b	R

Scientific name	Common name	Habitat	Frequency (DAFOR)
Phleum pratense	Timothy	g3c	R (LO)
Picea abies	Norway spruce	w1h5	O
Picea sitchensis	Sitka spruce	w1g6	LD
Plantago lanceolata	Ribwort plantain	g3c	O
Plantago major	Broad-leaved plantain	g3c	R
Poa trivialis	Rough-stalked meadow-grass	g3c	O (LF)
Polypodium vulgare	Common polypody	h2a	R
Populus tremula	Aspen	w1h5, h2a	O
Potentilla anserina	Silverweed	g3c	LO
Potentilla erecta	Tormentil	h2a	O
Prunella vulgaris	Selfheal	g3c	O (LF)
Prunus avium	Wild cherry	w1h5	R
Prunus spinosa	Blackthorn	w1h5, h2a	R, F
Pteridium aquilinum	Bracken	w1g6	O
Quercus petraea	Sessile oak	w1h5	R
Ranunculus acris	Meadow buttercup	g3c	O
Ranunculus bulbosus	Bulbous buttercup	g3c	O
Ranunculus flammula	Lesser spearwort	g3c, r2b	R
Ranunculus omiophyllus	Round-leaved crowfoot	r2b	LA
Ranunculus repens	Creeping buttercup	g3c, r2b	O (LF)
Rosa arvensis	Field rose	h2a	O
Rosa canina	Dog-rose	h2a	O
Rubus fruticosus agg.	A bramble	w1h5, h2a, w1g6	O (LF)
Rubus idaeus	Raspberry	w1g6	R
Rumex acetosa	Sorrel	g3c, w1h5	O
Rumex obtusifolius	Broad-leaved dock	g3c, w1h5	O
Salix cinerea	Grey willow	h2a, w1g6	F, R
Salix fragilis	Crack willow	h2a	R
Salix viminalis	Osier	w1h5, h2a	LO

Scientific name	Common name	Habitat	Frequency (DAFOR)
Sambucus nigra	Elder	w1h5, h2a	O, R
Sequoiadendron giganteum	Giant sequoia	w1h5	R
Silene dioica	Pink campion	h2a	R
Sonchus oleraceus	Smooth sow-thistle	g3c	R
Sorbus aria	Whitebeam	w1h5	R
Sorbus aucuparia	Rowan	w1h5, h2a	R, O
Stachys sylvatica	Hedge woundwort	w1h5, h2a	O
Stellaria graminea	Lesser stitchwort	g3c	O
Stellaria holostea	Greater stitchwort	h2a	O
Symphytum officinalis	Comfrey	h2a	R (LA)
Taraxacum agg.	A dandelion	g3c, w1h5	F
Thuja plicata	Western red cedar	w1h5	R
Trifolium medium	Zig-zag clover	g3c	O
Trifolium pratense	Red clover	g3c	F (LA)
Trifolium repens	White clover	g3c	F
Tsuga heterophylla	Western hemlock	w1h5	R
Ulex europaeus	Common gorse	w1h5	R
Urtica dioica	Nettle	g3c, w1h5	R (LD)
Veronica chamaedrys	Germander speedwell	w1h5	R
Veronica serpyllifolia	Thyme-leaved speedwell	g3c	R
Viccia cracca	Tufted vetch	g3c	R
Viccia sepium	Bush vetch	h2a	R
Viola riviniana	Common dog-violet	w1h5	R

Appendix 2:
Photographs

Photo's 1 & 2. Views of the grassland at Ty Gwyn. Although grasses dominate the sward, forbs are sometimes frequent.

Photo's 3 & 4. Views of the mixed woodland. Above is the area at the east end of the site, and below is part of the woodland along the southern boundary.

Photo 5. View of the hedgerow along the northern boundary. It is relatively species-rich (in woody species) and is probably of ancient origin.

Photo 6. The ditch runs along the southern boundary. It could be enhanced by the installation of BDA's which would raise the water table, create ponds and slow the flow of water through the site.

Photo 7. One of the lines of trees is mostly made up of young Sitka spruce.

Photo 8. On the neighbouring land to the south, a textbook example of the way a barrier of thorny scrub (gorse and bramble) can promote the growth of more palatable trees and shrubs, even in the presence of low intensity grazing.

Appendix 3:
Candidate plant species for enrichment

Dry woodland and/or hedgerows	
Scientific name	Common name
Adoxa moschatellina	Moschatel
Allium ursinum	Wild garlic
Anemone nemorosa	Wood anemone
Arum maculatum	Lords-and-ladies
Asplenium scolopendrium	Hart's-tongue
Betonica officinalis	Betony
Betula pubescens	Downy birch
Bromopsis ramosa	Hairy brome
Campanula latifolia	Giant bellflower
Ceratocapnos claviculata	Climbing corydalis
Convallaria majalis	Lily-of-the-valley
Cornus sanguinea	Dogwood
Cruciata laevipes	Crosswort
Daphne laureola	Spurge-laurel
Euonymus europaeus	Spindle
Eupatorium cannabinum	Hemp agrimony
Euphorbia amygdaloides	Wood spurge
Ficaria verna	Lesser celandine
Ficaria verna	Lesser celandine
Frangula alnus	Alder buckthorn
Galium album	Hedge bedstraw
Galium odoratum	Woodruff
Geranium sylvaticum	Wood cranesbill
Glechoma hederacea	Ground-ivy
Hypericum pulchrum	Slender St. John's-wort
Lamiastrum galeobdolon	Yellow archangel
Lathyrus linifolius	Bitter-vetch
Ligustrum vulgare	Wild privet
Luzula Pilosa	Hairy wood-rush
Luzula sylvatica	Great wood-rush
Malus sylvestris	Crab apple
Melampyrum pratense	Common cow-wheat
Melica uniflora	Wood melick
Milium effusum	Wood millet
Moehringia trinervia	Three-nerved sandwort
Myosotis sylvatica	Wood forget-me-not
Narcissus pseudonarcissus	Wild daffodil
Neottia ovata	Common twayblade
Pinus sylvestris	Scot's pine
Platanthera bifolia	Lesser butterfly-orchid
Platanthera chlorantha	Greater butterfly-orchid
Poa nemoralis	Wood meadow-grass
Polystichum aculeatum	Hard shield-fern
Polystichum setiferum	Soft shield-fern
Populus tremula	Aspen
Prunus padus	Bird cherry
Pyrola minor	Common wintergreen
Pyrus pyraster	Wild pear

Dry woodland and/or hedgerows	
Scientific name	Common name
Quercus petraea	Sessile oak
Ranunculus auricomus	Goldilocks buttercup
Rhamnus cathartica	Buckthorn
Ribes nigrum	Blackcurrant
Ribes rubrum	Redcurrant
Ribes uva-crispa	Gooseberry
Rubus idaeus	Wild raspberry
Rubus saxatilis	Stone bramble
Schedonorus giganteus	Giant fescue
Silene dioica	Pink campion
Sorbus aria	Common whitebeam
Sorbus torminalis	Wild service
Taxus baccata	Yew
Tilia cordata	Small-leaved lime
Tilia platyphyllos	Large-leaved lime
Trollius europaeus	Globeflower
Ulmus spp.	Disease-resistant elms (see Elms – Resistant Elms)
Viburnum lantana	Wayfaring tree
Viburnum opulus	Guelder rose
Viola odorata	Sweet violet

Wet woodland and riparian vegetation (M = marginal aquatic)	
Scientific name	Common name
Allium ursinum	Wild garlic
Angelia sylvestris	Wild angelica
Berula erecta	Lesser water-parsnip (M)
Betula pubescens	Downy Birch
Calamagrostis canescens	Purple small-reed
Cardamine amara	Large bitter-cress (M)
Carex acuta	Slender tufted-sedge (M)
Carex acutiformis	Lesser pond-sedge (M)
Carex elata	Tufted sedge (M)
Carex elongata	Elongated sedge
Carex laevigata	Smooth-stalked sedge (M)
Carex paniculate	Greater tussock-sedge (M)
Carex pseudocyperus	Cyperus sedge (M)
Carex riparia	Greater pond-sedge (M)
Carex rostrata	Bottle sedge (M)
Carex vesicaria	Bladder sedge (M)
Crepis paludosa	Marsh hawk's-beard
Dryopteris carthusiana	Narrow buckler-fern
Epilobium hirsutum	Great willowherb
Eupatorium cannabinum	Hemp agrimony
Filipendula ulmaria	Meadowsweet
Frangula alnus	Alder buckthorn
Geum rivale	Water avens
Glyceria declinata	Small sweet-grass
Glyceria maxima	Reed sweet-grass
Glyceria notata	Plicate sweet-grass
Helosciadium nodiflorum	Fool's water-cress (M)
Juncus subnodulosus	Blunt-flowered rush
Lamiastrum galeobdolon	Yellow archangel
Lotus pedunculatus	Greater bird's-foot trefoil (M)
Lycopus europaeus	Gypsywort (M)
Lysimachia vulgaris	Yellow loosestrife (M)
Lythrum salicaria	Purple loosestrife (M)
Mentha aquatica	Water-mint (M)
Myosotis scorpioides	Water forget-me-not (M)
Oenanthe fistulosa	Tubular water-dropwort (M)
Oreopteris limbosperma	Lemon-scented fern
Osmunda regalis	Royal fern
Phalaris arundinacea	Reed canary-grass (M)
Phegopteris connectilis	Beech fern
Phragmites australis	Common reed (can be invasive) (M)
Prunus padus	Bird cherry
Prunus padus	Bird cherry
Pyrola rotundifolia	Round-leaved wintergreen
Ranunculus flammula	Lesser spearwort (M)
Rubus idaeus	Wild raspberry
Rumex hydrolapathum	Water dock (M)

Wet woodland and riparian vegetation (M = marginal aquatic)	
Scientific name	Common name
Salix alba	White willow
Salix aurita	Eared willow
Salix fragilis	Crack willow
Salix pentandra	Bay willow
Salix purpurea	Purple willow
Salix viminalis	Osier (M)
Scirpus sylvaticus	Wood club-rush
Scrophularia aquatica	Water figwort
Scutellaria galericulata	Skullcap (M)
Stachys palustris	Marsh woundwort
Symphytum officinale	Comfrey
Thelypteris palustris	Marsh Fern
Valeriana dioica	Marsh valerian

Neutral grassland and hay meadow (W = wet, D = dry, M = marginal aquatic)	
Scientific name	Common name
Agrimonia eupatoria	Agrimony (D)
Alchemilla spp.	Lady's mantle species (D)
Alopecurus geniculatus	Marsh fox-tail (W)
Angelica sylvestris	Wild angelica (W)
Avenula pubescens	Downy oat-grass (D)
Betonica officinalis	Betony (D)
Briza media	Quaking grass (D)
Bromus hordeaceus	Soft Brome (D)
Campanula rotundifolia	Harebell (D)
Carex caryophyllea	Spring sedge (D)
Carex elongata	Elongated sedge (W)
Carex laevigata	Smooth-stalked sedge (M)
Chrysosplenium alternifolium	Alternate-leaved golden saxifrage (W)
Cicuta virosa	Cowbane (M)
Clinopodium vulgare	Wild basil (D)
Colchicum autumnale	Meadow saffron (D)
Crepis paludosa	Marsh hawk's-beard (W)
Cruciata laevipes	Crosswort (D)
Daucus carota	Wild carrot (D)
Deschampsia cespitosa	Tufted hair-grass (W)
Deschampsia flexuosa	Wavy hair-grass (D)
Euphrasia agg.	Eyebright (D)
Festuca ovina	Sheep's fescue (D)
Galium verum	Ladies' bedstraw (D)
Geranium pratense	Meadow cranesbill (D)
Geranium sylvaticum	Wood cranesbill (D)
Geum rivale	Water avens(W)
Glechoma hederacea	Ground-ivy (D)
Hypericum perforatum	Perforate St. John's-wort (D)
Knautia arvensis	Field scabious (D)
Koeleria macrantha	Crested hair-grass (D)
Lamium album	White dead-nettle (D)
Lathyrus linifolius	Bitter-vetch (D)
Leontodon hispidus	Rough hawkbit (D)
Leaucanthemum vulgare	Ox-eye daisy (D)
Luzula campestris	Field wood-rush (D)
Lychnis flos-cuculi	Ragged-robin (W)
Medicago lupulina	Black medick (D)
Oenanthe fistulosa	Tubular water-dropwort (W)
Ononis repens	Common restharrow
Ophioglossum vulgatum	Adder's tongue (D)
Orchis mascula	Early purple orchid (W)
Parnassia palustris	Grass-of-Parnassus (W)
Pimpinella major	Greater burnet-saxifrage (D)
Pimpinella saxifrage	Burnet-saxifrage (D)
Plantago media	Hoary plantain (D)
Platanthera bifolia	Lesser butterfly-orchid (D)

Neutral grassland and hay meadow (W = wet, D = dry, M = marginal aquatic)	
Scientific name	Common name
Platanthera chlorantha	Greater butterfly-orchid (D)
Potentilla anserina	Silver-weed (M)
Potentilla palustris	Marsh cinquefoil (M)
Potentilla reptans	Creeping cinquefoil (D)
Poterium sanguisorba	Salad Burnet (D)
Primula veris	Cowslip (D)
Pulicaria dysenterica	Common Fleabane (W)
Ranunculus bulbosus	Bulbous buttercup (D)
Ranunculus sceleratus	Celery-leaved buttercup (W)
Rhinanthus minor	Yellow rattle (D)
Saxifraga granulate	Meadow saxifrage (D)
Schedonorus arundinaceus	Tall fescue (D)
Scrophularia aquatica	Water figwort (W)
Serratula tinctoria	Saw-wort (D)
Silaum silaus	Pepper-saxifrage (D)
Stachys palustris	Marsh woundwort (W)
Succisa pratensis	Devil's-bit scabious (W)
Symphytum officinale	Comfrey (W)
Thalictrum flavus	Common meadow-rue (D)
Thymus drucei	Wild Thyme (D)
Torilis japonica	Upright hedge-parsley (D)
Triglochin palustris	Marsh arrowgrass (W)
Trisetum flavescens	Yellow oat-grass (D)
Trocdaris verticillatum	Whorled carroway (W)
Trollius europaeus	Globeflower (W)
Valeriana dioica	Marsh valerian (W)
Veronicca chamaedrys	Germander speedwell (D)
Viola palustris	Marsh violet (W)

Standing water (marginals may also grow in riparian and running water habitat) (M = marginal, E = emergent, F = floating, S = submerged)	
Scientific name	Common name
Alisma Plantago-aquatica	Water-plantain (M)
Berula erecta	Lesser water-parsnip (M)
Butomus umbellatus	Flowering-rush (M & E)
Calamagrostis canescens	Purple small-reed (M)
Cardamine amara	Large bitter-cress (M)
Carex acuta	Slender tufted-sedge (M)
Carex acutiformis	Lesser pond-sedge (M)
Carex appropinquata	Fibrous tussock-sedge (M)
Carex diandra	Lesser tussock-sedge (M)
Carex elata	Tufted sedge (M)
Carex laevigata	Smooth-stalked sedge (M)
Carex paniculata	Greater tussock-sedge (M)
Carex pseudocyperus	Cyperus sedge (M)
Carex riparia	Greater pond-sedge (M)
Carex rostrata	Bottle sedge (M & E)
Carex vesicaria	Bladder sedge (M)
Ceratophyllum demersum	Hornwort (S)
Cicuta virosa	Cowbane (M)
Cladium mariscus	Great fen-sedge (M)
Elatine hydropiper	Eight-stamened waterwort (M & E)
Eleacharis palustris	Common spike-rush (can be invasive) (M & E)
Eleocharis acicularis	Needle spike-rush (M & E)
Epilobium hirsutum	Great willowherb (M)
Eupatorium cannabinum	Hemp agrimony
Geum rivale	Water avens (M)
Glyceria declinata	Small sweet-grass (M)
Glyceria maxima	Reed sweet-grass (M)
Glyceria notata	Plicate sweet-grass (M)
Helosciadium inundatum	Lesser marshwort (M)
Helosciadium nodiflorum	Fool's water-cress (M)
Hippuris vulgaris	Mare's-tail (E)
Hottonia palustris	Water-violet (E)
Hydrocharis morsus-ranae	Frogbit (F)
Juncus filiformis	Thread rush (M)
Juncus subnodulosus	Blunt-flowered rush (M)
Lobelia dortmanna	Water lobelia (E)
Lycopus europaeus	Gypsywort (M)
Lysimachia vulgaris	Yellow loosestrife (M)
Lythrum salicaria	Purple loosestrife (M)
Menyanthes trifoliata	Bog-bean (M & E)
Myosotis scorpioides	Water forget-me-not (M)
Myriophyllum spicatum	Spiked water-milfoil (S)
Myriophyllum verticillatum	Whorled water-milfoil (S)
Najas flexilis	Slender naiad (S)

Standing water (marginals may also grow in riparian and running water habitat) (M = marginal, E = emergent, F = floating, S = submerged)	
Scientific name	Common name
Nasturtium officinale	Water-cress (M)
Nuphar lutea	Yellow water-lily (E)
Nymphoides peltata	Fringed water-lily (E)
Oenanthe aquatica	Fine-leaved water-dropwort (M)
Oenanthe fistulosa	Tubular water-dropwort (M)
Persicaria amphibia	Amphibious bistort (M & E)
Persicaria hydropiper	Water-pepper (M)
Phalaris arundinacea	Reed canary-grass (M)
Phragmites australis	Common reed (can be invasive) (M)
Potamogeton berchtoldii	Small pondweed (S)
Potamogeton compressus	Grass-wrack pondweed (S)
Potamogeton crispus	Curled pondweed (S)
Potamogeton friesii	Flat-stalked pondweed (S)
Potamogeton gramineus	Various-leaved pondweed (S)
Potamogeton lucens	Shining pondweed (S)
Potamogeton natans	Broad-leaved pondweed (E)
Potamogeton obtusifolius	Blunt-leaved pondweed (S)
Potamogeton perfoliatus	Perfoliate pondweed (S)
Potamogeton praelongus	Long-stalked pondweed (S)
Potamogeton pusillus	Lesser pondweed (S)
Rumex hydrolapathum	Water dock (M)
Ruppia spiralis	Spiral tasselweed (S)
Sagitaria sagittifolia	Arrowhead (E)
Schoenoplectus lacustris	Common club-rush
Scrophularia aquatica	Water figwort (M)
Scutellaria galericulata	Skullcap (M)
Scutellaria minor	Lesser skullcap (M)
Sparganium emersum	Unbranched bur-reed (M & E)
Sparganium erectum	Branched bur-reed (M & E)
Sparganium natans	Least bur-reed (E)
Stuckenia filiformis	Slender-leaved pondweed (S)
Stuckenia pectinata	Fennel pondweed (S)
Trollius europaeus	Globeflower (M)
Valeriana dioica	Marsh valerian (M)
Veronica beccabunga	Brooklime (M)
Zannichellia palustris	Horned pondweed (S)