LOWLAND PEATLAND SURVEY OF WALES

SURVEY MANUAL

S.D.S. Bosanquet, P.S. Jones, D.K. Reed, K.S. Birch & A.J. Turner

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Sam Bosanquet and Dave Reed surveying Clawdd Ddu common, Ceredigion, with the magnificent backdrop of the Cors Caron West Bog. September 2010.

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SUMMARY

The primary objective of the Lowland Peatland Survey of Wales (LPSW) is to characterise and evaluate the vegetation cover of lowland peatlands in Wales based upon a programme of plant (sub-) community level sampling and mapping. The LPSW began in full in 2005 and fieldwork is expected to continue until at least 2016. It is needed to ensure the identification, protection and management of important peatland sites. The survey provides standardised definitive descriptive and evaluative accounts of the best surviving examples of the lowland peatland habitat resource of Wales. This is achieved through a standardised survey methodology employing a combination of plant community sampling and description, and vegetation mapping. This report provides a detailed account of the survey methodology, including the rationale for the survey, the criteria employed for site selection, the main survey activities of vegetation sampling and mapping, data entry and the digital capture of mapped community boundaries, and report writing and production. This manual also describes the main plant communities encountered during the survey, including many new units, and also itemises the main condition classes which are used to convey important additional information about vegetation condition and the identity of key dominant species. This manual provides an important record of the survey methodology and will be of value to all those engaged in Phase II vegetation survey, particular in peatland environments.

CRYNODEB

Prif nod yr Arolwg o Fawndiroedd ar Iseldir Cymru yw disgrifio a gwerthuso'r llystyfiant sy'n gorchuddio mawndiroedd ar iseldir Cymru, yn seiliedig ar raglen o samplo a mapio cymunedau/isgymunedau planhigion. Dechreuodd yr Arolwg o ddifrif yn 2005 a disgwylir i'r gwaith maes barhau tan 2016 o leiaf. Mae'n ofynnol er mwyn sicrhau y gellir pennu, gwarchod a rheoli mawndiroedd pwysig. Mae'r arolwg yn cyflwyno gwybodaeth ddisgrifiadol a gwerthusol ar ffurf safonedig a therfynol am yr enghreifftiau gorau a erys o gynefinoedd mawndir ar iseldir Cymru. Gwneir hyn trwy wneud defnydd o fethodoleg arolygu safonedig sy'n defnyddio cyfuniad o samplo a disgrifio cymunedau planhigion ar y naill law, a mapio llystyfiant ar y llaw arall. Yn yr adroddiad hwn ceir gwybodaeth fanwl am fethodoleg yr arolwg, yn cynnwys y sail resymegol dros gynnal yr arolwg, y meini prawf a ddefnyddiwyd ar gyfer dewis safleoedd, prif weithgareddau'r arolwg o safbwynt samplo a mapio llystyfiant, cofnodi data a chipio data digidol o ffiniau cymunedau a fapiwyd, ac ysgrifennu a chynhyrchu adroddiad. Mae'r llawlyfr hwn hefyd yn disgrifio'r prif gymunedau planhigion y daethpwyd ar eu traws yn ystod yr arolwg, yn cynnwys nifer o unedau newydd, a hefyd mae'n rhestru'r prif ddosbarthiadau cyflwr a ddefnyddir i gyfleu gwybodaeth ychwanegol bwysig am gyflwr y llystyfiant a phennu rhywogaethau trech pwysig. Yn y llawlyfr hwn ceir cofnod pwysig o'r fethodoleg a ddefnyddiwyd yn yr arolwg, a bydd o werth i bawb sy'n cynnal arolygon Cam II o lystyfiant, yn arbennig ar fawndiroedd.

LOWLAND PEATLAND SURVEY OF WALES

SURVEY MANUAL

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In memory of Dr David Stevens

1. Introduction

1.1. Introduction to this document

This document describes the strategic purpose of the Lowland Peatland Survey of Wales (LPSW) Programme and provides detailed guidance on the methodology employed in site selection, survey and reporting. Aspects of the survey methodology relating to the sampling, definition, description and mapping of plant community types largely follows the so-called Phase II survey scheme and would be broadly applicable to other lowland habitat types.

The document has been written by staff of the Countryside Council for Wales (CCW) Habitats Survey Team. It is intended to serve as both a reference manual for members of the survey team and for other staff engaged in Phase II Survey of peatland environments, and as a record of the methods employed which can then be referred to in site, Area of Search and region-wide accounts, and in the ultimate written product of the survey. However, we hope that the document will also prove useful to other colleagues within and beyond Wales engaged in Phase II (plant community level) survey work.

1.2. Strategic objective, purpose and applications of the Lowland Peatland Survey of Wales.

The primary objective of the Lowland Peatland Survey of Wales is to *characterise and evaluate the vegetation cover of lowland peatlands in Wales based upon a programme of plant (sub-)community level sampling and mapping*. The survey is needed to ensure the identification, protection and management of important peatland sites.

The LPSW provides *standardised definitive descriptive and evaluative accounts of the best surviving examples of the lowland peatland habitat resource of Wales*. This is achieved through a standardised survey methodology employing a combination of plant community sampling and description, and vegetation mapping. The resultant accounts enable evaluation of sites and definition of their special features, thus leading to the selection of key examples for both statutory protection and notification to local authorities and other bodies as important non-statutory examples of section 42 habitats. These and the other main applications of the survey are summarised in Table 1.

Lack of survey information for an acceptable proportion of the Welsh lowland peatland resource constitutes a significant or even the primary risk to the effective delivery of each of the eight key activities described in Table 1. Decisions relating to SSSI notification are especially vulnerable to legal challenge if unsupported by recent high quality Phase II survey. At the start of the survey, lowland peatlands were the last of the core lowland habitats of predominantly agricultural landscapes in Wales to lack strategic coverage to NVC level.

1.3. Timetable, organisation and origin of survey.

The current survey began with a trial month of peatland site survey in 2004 during the last year of the CCW lowland grassland survey programme. The following year (2005) marked the first full season of survey. The survey is based entirely in-house with three permanent full-time specialist staff located in Llandeilo (Sam Bosanquet, SDSB – Survey Team Co-ordinator and CCW Bryologist), Aberystwyth (Dave Reed, DKR) and Bangor (Kathryn Birch, KSB, who succeeded Alex Turner, AJT, in 2006). SDSB provides the lead technical, data standards and wider quality assurance role across the survey team's remit. Dr Jane Stevens supports the survey through field-work, data analysis and data migration to Recorder. Peter Jones (PSJ) supports the current peatland focus of the team, through his wide, overarching knowledge of the Welsh peatland resource.

Table 1. Primary applications of the Lowland Peatland Survey of Wales.

Activity heading	*Description*
Site protection – identification /designation	Survey outputs provide a comparative evaluation of sites and definition of their special features to enable SSSI selection and feature revisions/additions, and also identification of sites for notification to local authorities and other bodies as key examples of section 42 habitats[1]. At least 30 lowland peatland sites in Wales which are currently un-protected are likely to meet minimum standards for SSSI selection. Accurate plant community level survey data is an absolute requirement for SSSI selection and feature definition/revision because the standard JNCC criteria for site selection (NCC, 1989; JNCC, 1994) are based on judgements relating to the quality and representation of NVC communities and peatland habitat elements within candidate sites.
Spatial mapping of conservation priorities, targeting of conservation action, development of wetland inventories	Mapping of all high quality peatland sites (both in and outside SSSI) is increasingly important given the current shift to a wide range of spatial planning and delivery mechanisms: examples include the priority mapping exercises being undertaken by the Wales Biodiversity Partnership Ecosystem Groups, mapping to identify site networks as part of the Ecosystem Approach, mapping of priority areas for Glastir delivery, and the development of national (UK) and Welsh wetland inventory projects, including the current EA wetland opportunities mapping project. The latter is currently more or less confined to urban settings but needs to be expanded: LPSW survey findings would be a core part of this.
Ongoing development of guidance on priorities for conservation and protection	Information on the conservation status and distribution of individual plant community types and the wetland types they help define is essential for informing the development of conservation priorities and the long-overdue revision of the SSSI guidelines. Some feature components of key conservation significance lack proper characterisation in either a Wales or UK context – examples at community level include M14, S24, M9*pp*[2], M5*pp*, and at a feature/sub-feature level, ombrogenous or relict-ombrogenous mires outside the core suite of lowland raised bogs, and poor fens. Insufficient conservation priority is being given to these and other features/communities in Wales. The recent JNCC analysis of critical gaps in the NVC (Mountford, 2011) has shown the importance of the evolving LPSW Welsh dataset, and survey findings have already been fed into a preliminary review of required changes to the SSSI selection guidelines.
Site condition monitoring	Site condition monitoring must focus on assessing the condition and status of statutory interest features. In the case of peatlands (and most other terrestrial habitats) this is best defined by using NVC mapping to identify core features or feature elements. It follows that Phase II survey coverage is an essential requirement for effective condition monitoring (Jones & Guest, 2006).

[1] The relevant terrestrial wetland habitats listed under the section 42 duty of the NERC Act (2006) for Wales are lowland raised bog, blanket bog, lowland fen, wet reedbed, upland fen and flush.

[2] *pp* refers to *pro parte* or in-part; when applied to plant communities it denotes that only part of the community is relevant to the preceeding statement.

Activity heading	*Description*
Meeting international reporting obligations	Reporting on the status and condition of habitats listed under Annex I of the Habitats & Species Directive[3] is a statutory requirement for the UK under Article 17 of the Directive. Reporting must include territory wide assessment of the habitat resource, not just that within Special Areas of Conservation. The UK interpretation of the Annex I habitats is based on the NVC scheme – it follows that comprehensive NVC survey coverage of the Welsh resource of the 8 Annex I terrestrial wetland habitats is essential for effective reporting under Article 17. Furthermore, during the 2012/13 reporting round, LPSW survey outputs provided one of the key sources of information on habitat condition and key pressures and threats (Jones *et al*., 2012) – and more or less the sole source of information for the non-statutory resource. Recent resource assessment of Annex I peatland habitats commissioned by Natural England was based on NVC community presence, extent and quality (Tratt *et al*., 2012)
Development of evidence base for external funding applications	Most of the main external funding mechanisms demand a strong science-based case for applications, with statements which establish in quantitative terms the status of a given habitat resource in a wider national or international context being a key example. NVC data collected for the Anglesey & Lleyn sites, and the particular perspective which survey of the application sites enabled, figured as an important component of the successful LIFE bid for these sites (CCW, 2007).
Implementation of management/restoration programmes	Community-level survey of sites provides the best means of understanding the key environmental processes and management effects within a site and hence ongoing management requirements. Lack of community-level information is hindering (or even preventing) the application of appropriate management/restoration measures across Wales. A common consequence of Phase II survey has been definition for the first time of the core interest feature/s of a site, enabling appropriate focussing of management effort. Accurate NVC data provide an essential basis for identifying and planning management and restoration work. The Anglesey & Lleyn Fens Project (Hanson *et al*., 2012) provides a good example of this, with key decisions on which management prescription to focus where being guided by LPSW survey outputs. Every survey report contains a section on management recommendations and the detailed description and mapping of key feature elements, and the hydrological features that they so often highlight, provides an indispensable basis for all aspects of site management.
Delivery of impact assessment and *Programmes of Measures* under the Water Framework Directive	The status of groundwater dependent terrestrial wetlands is one of the tests employed to characterise the status of groundwater bodies under the Water Framework Directive (Brooks *et al.,* 2007). The definition of a groundwater dependent terrestrial ecosystem and judgements on the degree of groundwater dependence are based on the NVC scheme (UK TAG on the Water Framework Directive, 2009). This places a very significant emphasis on the acquisition of high quality plant community survey data for Welsh peatlands in particular given that the Welsh input to the latest round of RBMP characterisation has demonstrated these are more likely to be groundwater dependent than other semi-natural terrestrial habitats.

[3] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

The team continues to operate with a deficit of one staff member (B band). All members of the team work within the Terrestrial Ecosytems Group of CCW's Evidence and Advice Directorate.

With a full staff complement of 4 surveyors, survey completion would have been expected at the end of the 2012 or 2013 field season. However, team strength was already reduced to three at the beginning of the survey and capacity was reduced still further by half a post following SDSBs promotion to CCW Bryologist in 2009 and AJTs move to another role in 2006, though fortunately the latter was replaced by KSB. At the time of writing (February 2013), Dave Reed is due to move to another temporary role until September 2014, reducing core survey team capacity to 1.5 persons for the 2013 and 2014 field seasons. Requests for the survey team to undertake survey of non-peatland sites for a variety of reasons has also delayed progress. Field-survey is unlikely to be completed before the end of the 2016 field season.

The survey team and survey methodology originated from the Lowland Grassland Survey of Wales (LGSW) programme (1997 to 2004 – see Stevens *et al*., 2010), which was led and coordinated by the late Dr David Stevens. David and Tim Blackstock built up the current survey team and in the face of many pressures and with the support of Dr Malcolm Smith (former CCW Chief Scientist) succeeded in maintaining its dedicated focus and commitment to the very highest standards of survey work. Their support and encouragement in enabling the development of the current peatland focus of the team cannot be overstated and is gratefully acknowledged.

1.4. Previous survey coverage.

Up until the current survey programme, the most comprehensive survey data-set for Welsh lowland peatlands was the Welsh Lowland Peatland Survey (WLPS; Ratcliffe & Hattey, 1982), with the main period of field work taking place during the summers of 1977-1979 (and thus pre-NVC – see Annex II). This survey provided an initial basis for SSSI selection and also succeeded in producing a classification of vegetation noda and site types. The vegetation noda show only partial correspondence to the NVC (see Annex I), and most WLPS site accounts provide only an indication of community extent and little information on condition. The Welsh Lowland Peatland Survey nevertheless remains a very valuable information resource and parts of it are now accessible electronically through the FenBASE Access application[4] (Shaw & Wheeler, 1998) and also an excel spreadsheet compiled by Jo Hughes which holds summary information for all the sites surveyed.

Other survey effort conducted during and since the era of the Welsh Lowland Peatland Survey can be grouped as follows: (i) survey of over 100 sites between the end of the WLPS in 1982 and 1987 which utilised most if not all aspects of the WLPS methodology, including the pre-NVC vegetation noda, (ii) projects which referred vegetation units to site specific noda or communities defined by Wheeler (1980a,b & c), and (iii) surveys executed using the NVC scheme. Surveys belonging to the last category are mostly relatively recent (*c*. post 1990) and usually include NVC community maps, although resurveys by LPSW surveyors have shown that most are of rather poor quality and regularly omit or misinterpret key features. Surveys corresponding to headings (i) and (ii) generally involve a fair amount of quadrat sampling effort but little formal mapping (at least in the sense applied to current Phase II survey practice), with noda being indicated for each quadrat – sometimes with

[4] Information for WLPS sites has been captured in a range of FenBASE data fields such that searches can be undertaken to select groups of sites based on a range of criteria. One of the most useful features of FenBASE is that it stores all of the WLPS quadrat records plus all those for Welsh sites resulting from the habitat conditions associated with British fens projects funded by NCC (Shaw & Wheeler, 1991). Site selections can be undertaken using the syntaxonomic units of these schemes.

approximate community boundaries. An incomplete inventory of surveys undertaken according to categories (ii) and (iii) above is provided in Annex II.

1.5. Key terms and their definition

A bewildering array of terms has evolved in different parts of the world to describe variation in the character of different wetland types. Some of the more important terms relevant to the LPSW programme are reviewed briefly here.

The term ***peatland*** relates to any tract of land founded on peat, whether it supports semi-natural peatland vegetation or other land cover types such as improved grassland and conifer plantations. ***Peatland habitat*** describes semi-natural vegetation found upon peat and includes both peat-forming (active) and vegetation which is not currently laying down peat. ***Deep peat*** describes peat profiles 0.5 or more m thick. The most fundamental level of division for peatland habitats is between exclusively ***ombrotrophic*** (rain-fed) ***bogs***, and a wide range of ***minerotrophic peatlands*** which receive part of their water income from essentially terrestrial (***telluric***) sources, including groundwater, runoff and over-bank flooding from streams and rivers. Most schemes refer to such peatlands as fens, with subdivision into ***rich-poor*** and ***poor-fen*** being based upon pH and base-cation status. Poor fens show considerable floristic overlap with bogs, and the recent review by Wheeler & Proctor (2000) recommends the term ***mesotrophic bog*** for ultra-poor (i.e. acidic) fens. A different classification scheme can be used to subdivide fens of all types into two fundamental groups – ***soligenous*** fens and ***topogenous*** fens – these are the primary units employed for the classification of statutory site fen features. The former category includes ***springs*** and ***flushes*** and covers fens fed by laterally moving water derived from hillslope runoff and groundwater discharge. Springs tend to be highly discrete features of modest patch size; flushes can be much more extensive features covering whole tracts of hillslope. Topogenous fens include those occurring in topographic basins, valleys and floodplains, and refer to mires maintained in wet state by the topographic detention of water as well as by supply. Some fens are not strictly peatland habitats and are based instead upon silt (mainly floodplain fens) or a variety of skeletal soil types or even tufa. These are accommodated within the general term ***mire*** which covers any habitat subject to perennially high water tables – mire is thus not a term exclusive to (or synonymous with) peatlands, and includes swamps and fens based upon substrates other than peat. ***Fen meadow*** has a fairly restricted phytosociological usage and covers relatively species-rich vegetation referable to the NVC communities M22 and M24 which occur on seasonally (sometimes perennially wet) humose or peaty soils. Both communities can also be embraced by the terms rich fen and peatland when present on deep peat. The communities M27 and M28 sit awkwardly within these various schemes. The NVC refers to them as mires, but this only properly applies to examples on peat (fen) rather than to less perennially wet stands on mineral soil. Cases of the latter are best referred to marshy grassland.

Swamps can be based on peat (in which case they can be regarded as peatland habitats) or a variety of inorganic deposits; exposure to summer-time flooding and dominance by one or a few tall graminoid species are their main characteristics.

2. Site Selection for the Lowland Peatland Survey of Wales

A necessarily selective approach has been taken in identifying sites for survey. An initial long-list of sites has been compiled as described in sections 2.1 – 2.3, with criteria then applied to prioritise sites for survey.

2.1. Altitudinal range.

The survey programme is almost wholly confined to lowland mires, i.e. those below the upper functional limit of agricultural enclosure[5]. A few mires above this limit may be considered for survey where these display essentially lowland characteristics as defined by hydrotopographical context (e.g. enclosed basins), vegetation, or their confined character[6], or else where survey would provide additional critical information for rare communities.

2.2. SSSI series.

The survey encompasses all lowland SSSI supporting at least one independently qualifying peatland features. The only exceptions to this are (i) the largest of the raised mires (namely Cors Fochno, Cors Caron, and Fenns, Whixall, Bettisfield, Wem & Cadney Mosses)[7], and (ii) any sites for which recent reliable information collected in a manner broadly comparable to that of the current survey is already available. In both cases, limited survey may be undertaken to (i) check on the quality of pre-existing survey information, (ii) provide a qualitative record of community extent for comparison against the emerging strategic data-set, and (iii) provide a limited series of quadrat records, again for comparison against the emerging strategic data-set. SSSI where peatland habitat occurs as a mixture or non-qualifying component will be considered for survey where (i) the status of the feature is considered likely to approach or exceed the minimum standards for selection as an independently qualifying feature, (ii) the feature is extensive and/or includes notable community types or local manifestations of these, and (iii) the site supports an appreciable component of the AoS resource of a community/series of communities, or mire type. The first case is likely to be encountered quite frequently as most Welsh peatland SSSI were notified prior to adoption of NVC criteria as the key facet of site selection.

2.3. Non-SSSI sites.

The selection of non-statutory sites for survey will be according to the following criteria:

- Sites with a peatland feature judged likely to be of individually qualifying status, including (but not confined) to those listed on candidate [c] or proposed [p] SSSI registers.
- Sites listed as supporting a notable mire element in Phase I survey district reports.
- Sites which appear to support a significant area of semi-natural mire vegetation based on Phase I mapping, supported by recent aerial photography and any relevant soils information.
- Sites identified by Shaw & Wheeler (1991) or Bryan Wheeler's fen register for Anglesey and Caernarvonshire.

[5] *c*. 300 m above sea level.
[6] This criterion rules out most upland blanket mires which tend to drape landscapes beneath a mantle of peat – i.e. they are regarded as *unconfined*.
[7] NVC survey for the larger raised mires is arguably less relevant than for other site types given the importance of these sites is already established and NVC level information is unlikely to be as critical to site management as in other contexts. Sub-NVC microform level data may be more relevant for assessing habitat recovery in such contexts.

- Any other site proposed for survey on the basis of local or national specialist knowledge which meets the primary objective and strategic aim of the survey programme. This criterion should at least consider for survey so called 'second-tier' sites – lists of which should be available from district teams and Local Biodiversity Action Plan (LBAP) coordinators. Some BSBI vice-county recorders were asked to recommend potential survey sites and Arthur Chater (v.c. 46, Cardiganshire) was especially helpful in this regard.

2.4. Size thresholds

Most strategic survey programmes utilise a minimum site size cut-off; the Welsh Lowland Peatland Survey (Ratcliffe & Hattey, 1982) employed 1 ha. This approach has obvious merits in maintaining a manageable survey 'population' and also in excluding the smallest and thus sometimes most fragmented sites. However, there is no doubt that the 1 ha threshold of the WLPS excluded many naturally small but important basin mires, and mainly for this reason a 'blanket' size-based threshold has not been employed. A 0.5 ha threshold for individual or groups of communities has been used to help prioritise sites for survey – see table 2.

2.5. Prioritisation of sites for survey

Prioritisation for survey is generally based on the principles laid out in Table 2. Sites will often include combinations of the features defined in column 1.

In all cases the rarity of a habitat component or other within an AoS or vice-county may lead to a site being selected for survey even though its size and/or quality would normally rule this out. The presence of rare species which are particularly indicative of habitat quality may also be used to justify survey of a site. In some cases, scrutiny of aerial photographs has indicated the presence of a potentially interesting non-statutory peatland, for example newly discovered raised bogs at Cors Blaenduad (Carmarthenshire) and Cors Craig y Bwlch (Ceredigion).

Sites identified as candidates for survey are listed in the Candidate Peatland Survey Sites Excel spreadsheet on Ffynnon/PEATSURV and categorised as priority 1 or 2 based on the above. All members of the survey team have contributed to this list. The list is generally regarded as most complete for the south-west counties of Pembrokeshire, Ceredigion and Carmarthenshire and also Monmouthshire, with reasonably complete lists also prepared for Anglesey, Montgomeryshire, Breconshire, Radnorshire, Glamorgan and Flintshire. Areas for which the Candidate Sites list is likely to be less complete include Llyn and Meirionnydd.

2.6. Site numbering scheme

Site numbers begin with the letter-based 100 km prefix followed by a forward slash and then the site number running from 1 to n. These numbers follow those used by the Welsh Lowland Peatland Survey for sites also surveyed during that programme. Sites surveyed in detail by the WLPS are listed under the spreadsheet 'Wales Wetland Survey Spreadsheet' on Ffynnon/PEATSURV and this includes the relevant site codes. Sites codes for WLPS 'sites' only covered at reconnaissance level can be found in Annex II of Ratcliffe & Hattey (1982) or else as mapped outlines of the sites on the 10 km master sheets in the Welsh Lowland Peatland Survey archive on Ffynnon. Sites not registered at all by the WLPS should be given the next consecutive number for the 10 km square (i.e. a 'new' site occurring in a 10 km square with 13 wetland sites recognised by the WLPS would be given the number 14). In all cases, upper-case P is used as a suffix for all site codes to denote the inclusion of that site in the current site programme, and also to prevent confusion with site codes originating from the grassland survey programme. For example, Cors Gyfelog, which was covered by the WLPS as SH44/2 was included in the current survey as SH44/02P. The 0 in 02P is important to allow sequential sorting in spreadsheets and databases.

Table 2. Criteria used to prioritise sites for inclusion in the Lowland Peatland Survey of Wales programme.

A. Habitat feature / plant community criteria supporting prioritisation of sites			
Community/feature/sub-feature with example NVC communities	*Minimum area of 0.5 ha usually applies?*	*Poor quality may lead to exclusion**	*Typical priority status*
Type 1: Oligotrophic rich fen (M9, M10, M13, M14, S1, S2, S27b, CM)	No	No	1
Type 2: Ombrogenous bog (M1-3, M17-20)	No	Not usually	1
Type 3: Modified ombrogenous bog (M15, 16, 20, 25)	Yes	Yes	2
Type 4: Topogenous poor fen (M1-5, M15sv, N19, M21, Spp-rCxr)	No	Yes	1
Type 5: Soligenous poor fen (M4, M6, M21, M29, M30, NF)	Yes	Yes	2
Type 6: Topogenous mesotrophic fen (M23aS, M25c*pp*, S27)	Yes	Yes	2
Type 7: Fen meadow communities on deep peat (M22, M24)	Yes**	Yes	2
Type 8: Eutrophic swamp / reed-fen (S4*pp*, S5-S6, S12, S14, S25, S26, S28)+.	Yes	Yes	2
Type 9: Mesotrophic swamp / reed-fen (S3*pp*, S4*pp*, S7, S10*pp*, S11, S13, S20, S24*pp*, S27*pp*)+.	Yes	Yes	2
Type 10: Oligotrophic swamp / reed-fen (S1, S2, S3*pp*, S8, S9, S10*pp*, S19, S24*pp*, S27*pp*)+.	No	Yes	1
B. Additional ecological criteria supporting prioritisation of sites (any can result in a priority 1 score)			
Evidence of intact (primary) peat sequence.			
Evidence of a surviving bog dome			
Natural patterning / ongoing succession			
Peat growth likely to be ongoing (i.e. *active* sites)			
Presence of multiple feature elements with good quality transitions			
Presence of uncommon or well developed WetMechs which relate to habitat feature elements – e.g. seepage faces, spring-heads.			

* Site visits may be required to determine if survey is worthwhile. Most sites excluded as a result of a site visit will be described in outline as a file note, but generally without quadrat samples or any formal vegetation mapping.

** Most examples of M22 are likely to be selected for survey.

+ Applies mainly to examples on deep peat. Sites have generally not been prioritised for survey where the swamp interest is primarily hydroseral in context and strongly limited to deep water margins.

3. Field Survey Protocols

Field survey is preceded by a desk-based review of existing information and the preparation of aerial photograph print-offs with a superimposed 100 or 250 m grid to support mapping (see 3.5.5). Survey normally begins with a rapid walk-over or at least site overview from an adjacent vantage point to identify key features of interest where quadrat sampling is likely to be focussed. Some preliminary mapping may be undertaken in the office/car – for example to map off site boundaries and well established scrub/woodland boundaries.

3.1. Quadrat sampling

3.1.1. Aims of quadrat sampling

Quadrat sampling is undertaken for a range of reasons, including one or more of the following:

- to provide an unambiguous quantitative record of the vegetation,
- to aid subsequent classification of vegetation where this is not clear at the time of survey,
- to provide a population of samples upon which subsequent analysis can be undertaken to refine community definition or aid the characterisation of new communities (in time, all samples added by the survey programme are expected to feed in to a future anticipated review of the NVC),
- to provide a complete list of species which would not otherwise be readily seen during mapping work,
- to aid the development of performance indicators for monitoring,
- to provide surveillance points.

Quadrat recording is undertaken to a standardised format using a double-sided recording card developed specifically for the survey (see Annex III).

3.1.2. Where and when to sample?

Quadrat sampling is a relatively time consuming process and a selective approach is required. The following points will help guide decisions on when and where to sample.

- Any community which forms the core expression of the feature of interest should be sampled at least once. Extensive stands may require more than one sample point. Sampling may be required in each main stand of a community, particularly where these are remote from each other.
- Sampling should reflect any prominent variations in floristic character or trends in the condition of key communities.
- At least one sample should usually be collected for any significant examples of the following communities: (poor and intermediate fens, including M1, M2, M4, M5, M6 pp, M18, M21, S27 *pp*, Nodum 19; calcareous rich-fens, including M9, M10, M13, M22, S2, S24; tall-herb fens, including S27*pp*, S26*pp*, S25*pp*, S24; bogs, including M17, 18, 19 and 20).
- Sampling should be considered to characterise the vegetation of rare or otherwise notable species[8].

[8] These may include species listed under schedule 8 of the Wildlife and Countryside Act, nationally rare or scarce species, species represented by one vice-county record, S.42 species, or any other category deemed relevant.

Quadrats should be deployed in visually homogenous examples of the target vegetation and should generally avoid locations bearing signs of recent localised disturbance relative to the surrounding vegetation – e.g. heavily grazed microsites, cut stumps, burnt patches etc. They should not be positioned randomly, even though that may seem more scientific than careful placement, because their role is at least in part to act as voucher records for mapping and small-scale variation in stands often means that a randomly placed quadrat includes one or two atypical species. In an ideal world, as taught on NVC courses, five quadrats would be placed in every stand, but that would make survey impossibly long-winded.

3.1.3. Treatment of mosaics

Quadrats may be recorded within vegetation mosaics, but care must be taken to ensure that they fall entirely within one element of the mosaic, rather than including parts of two or more elements.

3.1.4. Quadrat size and shape

Quadrats are normally square and of 2 x 2 m (i.e. 4 m^2) in area. This size fits the majority of mire vegetation types in as much as it seems roughly compatible with the scale of vegetation patterning and its overall 'grain', and usually incorporates a reasonable proportion of the species encountered in examples of the main bog, poor fen and rich fen vegetation types.

Vegetation dominated by tall graminoids is typically sampled with a larger 4 x 4 m quadrat (16 m^2). Smaller quadrats of 1 x 1 m can be used for naturally small discrete features such as bryophyte-dominated spring heads. Elongated quadrats of 4 m^2 measuring 4 x 1 m are occasionally used for essentially linear features such as spring heads or runnels.

3.1.5. Marking out quadrats

Quadrats should be marked out using corner poles (bamboo or fibre-glass) or wire pins. A string outline connected to each corner marker is highly desirable. Permanent marking of quadrats may in time be requested by regional staff for surveillance purposes and suitable long-term permanent plot marking techniques are provided on CCW's intranet under monitoring methodologies.

3.1.6. Recording quadrat locations

Quadrat locations are recorded using a hand-held GPS to provide 10 figure NGRs. GPS instruments need periodic rechecking against each other or known points, but the Garmin hand-sets have given very little trouble to-date.

In all cases quadrat locations should also be marked on the field vegetation map, with a cross or dot marking the quadrat location and its number.

3.1.7. Recording cover abundance

The cover of all rooted taxa (including vascular plants, bryophytes and lichens) should be recorded using the ten point Domin scale as defined in the General Introduction chapter to the five NVC volumes and repeated here in modified form as Table 3. Some vegetation ecologists have employed additional codes such as '0', '+' or 'p' to denote presence of species in close proximity to the quadrat but not actually rooted within it, but this practice is avoided in the current survey. Such associated species should instead either be included as part of stand wide 'DAFOR' assessment, or else noted as present in the community/quadrat description section of the recording card.

Table 3. Definition of Domin units according to percentage cover ranges.

Percentage area of ground surface covered.	*Qualifier*	*Corresponding Domin score*
91 – 100%		10
76 – 90%		9
51 – 75%		8
34 – 50%		7
26 – 33%		6
11 – 25%		5
4 – 10%		4
<4	Many individuals	3
<4	Several individuals	2
<4	Few individuals	1

Cover estimates should be made by visually estimating the area of ground covered by a vertical projection of the above ground biomass of each species. Many surveyors find that this is accomplished most easily by mentally aggregating all patches of individual stems of a given species within one corner of the quadrat, from which quarters, fifths etc of the quadrat area covered can be assessed. Inexperienced surveyors are advised to accompany more experienced colleagues in their first attempts at quadrat recording in order to achieve some form of rough 'calibration' of their cover abundance estimates. Assessment of the same quadrat by different experienced surveyors indicates a high degree of consistency amongst the team, with Domin estimates rarely varying by more than one class difference. Cover values can (and usually do) add up to more than 100% as a result of stratification.

The time taken to record quadrats varies, but the principle of diminishing returns certainly applies! For a typical species density of around 25 species in a 2 x 2 m quadrat, completion of all the various recording categories is likely to take between 25 and 45 minutes. Lower plants are afforded the same degree of recording priority as higher (vascular) plants, and smaller species should be searched for carefully. Most recorders avoid walking or standing within the quadrat until cover abundance values for species noted up until that point have been assigned. Thereafter, a search of the central portion of each quadrat is usually worthwhile.

Separate assessment for the seedling, sapling and mature individual growth phases of tree and scrub species are prompted by the standard recording forms.

Sum cover values should be recorded for the key ecological/physiognomic components of graminoids, ericoids, forbs, Sphagna and other bryophytes excluding Sphagna.

3.1.8. Recording species frequency data at stand level

Quadrat recording can only provide a sample of the vegetation. Careful choice of sampling locations should ensure that samples are representative of the stand, but the resultant record will inevitably miss a number of species and will not provide any information about the frequency and abundance (cover) of species within the stand, nor how these attributes vary across the stand. For these reasons, quadrat records are sometimes supplemented by separate scores of species frequency and abundance judged from a rapid walkover survey of the stand sampled. Typical occasions where this will be undertaken include the following:

- where the stand represents a key part of the feature for which the site was notified;
- where vegetation is quite heterogenous and thus its character relatively poorly reflected by 'spot' quadrat samples;
- to provide a record of vegetation supporting a rare or otherwise notable species;

- where time does not permit the collection of a standard quadrat record.

The scoring system used is abbreviated as the acronym DAFOR and the component categories are defined in Table 4.

Table 4. Definition of DAFOR abundance categories.

Abbreviation	*Frequency*	*Cover*
D	Throughout	>50%
A	Throughout	10-50%
F	50 – 100%	<10%
O	<50%	<10%
R	A few plants or clumps	<<10%

This should be used to record the frequency/abundance of all rooted species within an approximately defined radius within a single stand. The system should also be applied to bryophytes and lichens, including those epiphytic on herbaceous and ericoid sub-shrubs. Local within-stand variation is indicated by a second DAFOR value (e.g. R.A is rare but locally abundant), and the standard record sheet provides a column for this purpose.

3.1.9. Vegetation height

Vegetation heights are recorded to the nearest cm relative to the substrate surface and for each of the five sum cover categories described under 3.1.7. The surveyors' judgement of average height was employed at the beginning of the survey but this was found to yield inconsistent results (even on the part of individuals) and so ranges are now employed. Strata which are relatively uniform obviously yield rather limited height ranges. In cases where the flowering height is markedly different from the vegetative (as is the case with *Phragmites* and *Cladium*, for example) then measurements should be based on the latter.

3.1.10. Use of quadrat recording cards

Quadrat records should employ the recording cards developed specifically for the current survey programme as these are based on the most frequently encountered plants on Welsh peatlands. It is usually easiest to score through the species name each time a new taxon is encountered, and then add in DOMIN scores for the entire quadrat once the list has been assembled. All species entries should be double-checked to ensure that cover abundance and, where relevant, stand-based frequency/abundance information has been entered against each ticked-off species. All numbers and lettering should be recorded as legibly as possible as data entry may be undertaken by persons other than the recorder. Perhaps counter-intuitively, fine-point biro's are favoured for recording for legibility; pencil records should be confined towet weather when there is a risk of ink run. An example of how a completed record card should appear is shown below as Table 5.

Table 5. An example of part of a completed peatland survey quadrat recording card. A line drawn through the specific part of the species name indicates the occurrence of that taxon in the stand and/or quadrat. Abundance estimates and Domin scores are entered in the the three columns to the left of each species name, with stand-wide abundance being scored in the first column and local variations upon this in the second (middle) column. The quadrat recording card can be used for recording quadrat and/or stand abundance data. If used for both, a diagnonal line should be drawn through the Domin box for species recorded within the stand but not the quadrat.

			Ulex	europae				Festuca	arundin
A		6		~~gallii~~	F	R	5		~~ovina~~
			Vaccinium	myrtill					pratensis
			FERNS						rubra
			Athyrium	filix-fem				Glyceria	declinat
			Dryopteris	affinis					fluitans
O		3		~~carthus~~					maxima
				dilatata					notata
				filix-mas	R		/	Holcus	~~lanatus~~
			Equisetum	arvens					mollis

3.2. Recording non-biological attributes

3.2.1. Water table

The position of the water table (or at least the free water surface) should be recorded to the nearest centimetre relative to the surveyors' best judgement of ground level at each quadrat location. This may equate to the peat/soil surface in some cases. Water levels above or below this point should be prefixed + and – respectively. Water levels in the context of buoyant vegetation rafts should also be recorded as a value 'on compression'. Vegetation dominated by soft bryophyte carpets introduces the problem of judging any reasonable concept of ground level; in such cases the carpet should be parted gently and depth to water table estimated with reference to the bryophyte surface or the stem bases of rooted vascular species. A range of water depths may be present – for example in emergent vegetation bordering a water body. In all cases a mean water depth is preferable rather than a range, although this can be provided as supplementary information. The comparability of water table data collected across a season and throughout the summer will obviously be limited because of seasonal and year-year changes in water table position. This is next to impossible to control for, but simple reliable measurements will nonetheless be of long term value and have some use in interpreting and describing vegetation trends.

Where subsurface, water table position is best estimated by coring a shallow auger hole. The deeper the core is pursued beneath the water table, the longer it will take for water levels to equilibrate with the surrounding water table prior to measurement. Accordingly, it is sensible to core the inspection hole at the start of quadrat recording, and then measure levels at the end. This should normally ensure at least 15 minutes equilibration time, enough for a reasonably reliable impression of water table depth given that the rate at which water levels equilibrate is greatest during the early phase of recovery. 'Heel-of-boot' techniques can have the effect of compacting the peat and may result in the expression and subsequent transient pooling of water from the unsaturated zone above the water table – this will lead to erroneously high water level measurements.

In the absence of direct measurements of water table depth, site or point wetness can be assessed using the surveyor's judgement of the range of values within which the water table resides relative to the surface. The categories employed by Shaw & Wheeler (1991) provide a useful framework, together with standardised descriptive terms (Table 6).

Table 6. Terms employed by Shaw & Wheeler (1991) to describe water table position relative to peat surface level for different water table depth ranges.

Term	*V. Low*	*Low*	*Moderate*	*High*	*V. High*
Water table depth range (cm); - = below soil, + = above soil (flooded)	< - 25	-25 to -10	-9 to + 1	+1 to +9	> + 10

3.2.2. Other hydrological features

General observations on site wetness can be very useful – e.g. "the mire was very dry at the time of the survey, with water rarely closer than 25 cm to the surface". More specific notes concerning the apparent influence of drainage ditches and natural water-courses should be made, including reference to any visible surface shrinkage effects next to ditches, surface dehydration and also directions of flow (to be noted on vegetation maps). Specific hydrological features such as seepage lines or faces, spring heads and soakways are likely to mark the discharge and movement of groundwater within sites and should be noted[9].

3.2.3. Peat depth

Peat depth should be noted at all quadrat locations and also where judged useful along key vegetation boundaries, particularly where this information is crucial to feature discrimination – see Table 7. The latter is achieved most easily by using a narrow (*c*. 5 mm diameter) fibreglass pole with insulating tape marking 50 cm, the peat depth threshold employed in the Phase I habitat classification for a range of critical habitat splits. Such threshold assessments will normally suffice for judging mapping unit boundaries. At quadrat locations, measurement of peat depth to the nearest cm up to the depth limit of the probe is desirable. Peat is usually identified by the ease with which the probe is inserted, but this is not wholly reliable as certain organic silts have a very similar 'feel'. A number of probings is usually required to obtain a reasonable estimate of peat depth.

Table 7 Assignment of NVC communities to Phase I habitats based on peat depth

NVC communities occurring on shallow and deep peats	*Phase I habitat diagnosis resultant from peat depth < 0.5 m*	*Phase I habitat diagnosis resultant from peat depth > 0.5 m*
M15, M16	Wet heath	Blanket bog, raised bog, valley mire
M25	Marshy grassland	

3.2.4. Substrate type

Detailed descriptions of substrate type lie beyond the scope of the current survey programme, but broad categorisation as peat, clay, silt and their intermediates would be useful at locations where shallow cores are drilled, and also at quadrat locations where very short holes are drilled for water table measurements. General guidance on the discrimination of the main units are provided in Table 8.

Coring should only be undertaken on a selective basis as it is time consuming and dirty work, and only yields fairly crude qualitative information unless undertaken carefully and by very experienced observers. Cores should normally be pursued to at least 0.5 m depth and obvious stratigraphic boundaries should be noted to the nearest cm below ground.

The main purpose of coring will be to confirm the results of peat depth probing and to provide a rough idea of the developmental history of sites.

[9] The Water Framework Directive makes specific provision for what have become known as groundwater-dependent terrestrial ecosystems. Evidence of groundwater influence upon sites is therefore worth noting given the general lack of such information.

Obvious variations in the density of peat and its water content are worth noting; for example zones of low bulk density aqueous peat sandwiched between recent superficial deposits and deeper peats are likely to indicate secondary hydroseral sequences, usually resulting from peat cutting.

Table 8. Synopsis of broad sediment types encountered on peatland sites in Wales.

	Texture	*Colour*	*General characterisation*
Clay	Usually rolls easily into a sausage	Usually grey, often slightly mottled. Lacustrine deposits less often mottled than boulder clay, can be blue-grey in appearance with laminations.	Often bulky and stiff to core and handle; can be present as water lain (lacustrine) deposits, or as the matrix of a wide range of glacigenic drift deposits on sloping ground.
Silt	Slightly gritty texture.	Brown, black, grey	Rarely present as more or less pure deposits, unless on floodplains.
Loam	Crumbly	Brown	Blend of organic matter, clay and silt.
Peat	Exudes water when squeezed, or else much of the sample volume extrudes easily between fingers. No grittyness to touch.	Light brown – black	Organic matter overwhelmingly dominant, macrofossils sometimes evident.
Sand	Sandy to touch, with definite grains discernible on rolling.	Usually visible as pale grains on smearing.	Rarely present as more or less pure deposits. Low density of grains more the norm.

The degree to which peat has humified (decomposed) is quite a useful stratigraphic attribute which with a little practice can be recorded quickly, easily and consistently – see Table 9.

Table 9. The Von Post system for recording humification (adapted from Burton & Hodgson, 1987).

Von Post Humification score	**Characteristics**. Decomposition status in italics. Comments about water/peat refer to the characteristics of the material when squeezed.
H1	*Undecomposed*. Yields only clear colourless water.
H2	*Mostly undecomposed* – plant structures still quite distinct. Yields yellow-brown but almost clear water.
H3	*V weakly decomposed*, plant structures distinct. Yields turbid brown water but no peat.
H4	*Weakly decomposed*, plant structures distinct. Yields muddy, dark, turbid water but no peat.
H5	*Moderately decomposed* – plant structures becoming indistinct. Yields much turbid brown water and *c*. 10% of peat volume.
H6	*Strongly decomposed* – plant structures somewhat indistinct , but clearer after squeezing. Yields one-third of the peat and muddy water.
H7	*Strongly decomposed* – plant structures indistinct but visible. Yields *c*. one half of the peat and strongly muddy water.
H8	*V strongly decomposed* – only resistant plant structures visible. Yields two-thirds of peat, little free water.
H9	*Almost completely decomposed*, nearly all of the peat extruded. No free water.
H10	*Completely decomposed* - all of the peat extruded. No free water.

3.2.5. Aspect and slope

Aspect should be recorded as N, NE, E, SE, S, SW, W or NW at quadrat locations, although in most cases the flat character of the terrain means there is no aspect as such. This latter point also applies to slope, which should be estimated visually as assessed as flat, gentle, moderate or steep.

3.2.6. Site context

Site reports should include an outline of the main catchment characteristics (at least for sites with a definable catchment). This should include information on surrounding land use in so far as this can be determined from within the boundaries of the wetland, with habitats categorised ideally to Phase I level. Information on the general topography of the site and its surroundings should also be noted, including slope (categorised as above) and how this varies immediately adjacent to the wetland, and the presence of outcrops. Approximate catchment area is worth noting; precise measurements are time-consuming to obtain from MapInfo and should not be attempted until a proposed tool to calculate this semi-automatically has been developed.

Various attempts have been made to classify the physical context within which wetlands occur in the landscape. These exercises are not merely of academic interest because the kind of contexts within which wetlands develop can have a strong bearing on wetland development and the ultimate character of interest features. Probably the most satisfactory classification of landscape contexts is the *Situation Type* scheme developed by Dr Bryan Wheeler. The seven main situation types are outlined in Annex IV and survey sites should be assigned to the most appropriate category.

3.2.7. Wetland Water Supply Mechanisms (WETMECs)

The Wetland Framework project developed by Dr Bryan Wheeler (Wheeler *et al*., 2009) provides a hierarchy of different wetland water suppy mechanisms (WETMECs) which can be used to define critical hydroecological elements within sites on the basis of *inter alia* mode of water supply and vegetation ecology. A preliminary training course on the use of the Wetland Framework approach was provided for the LPSW programme in May 2010 and the synoptic account of the Wetland Framework provides a useful guide to its critical elements. Wherever possible, key recognisable WETMEC types should be described and referred to in survey reports.

3.2.8. Reporting Potentially Damaging Operations

Any potentially or actually harmful land-use activity within the site or its immediate catchment should be noted and reported as soon as possible to the appropriate Conservation Officer[10]. These may include operations within the wider site catchment as well as activities directly abutting or within the SSSI boundary. Examples include ploughing and other forms of cultivation, application of inorganic and organic fertiliser, drainage, clear-felling, disposal of abattoir waste and other agricultural co-products, and discharge of silage effluent. If possible, digital photographs should be taken as supporting evidence to written notes[11], but only if this can be done discretely and without provocation to potential offenders. Persons believed to be committing a PDO on the day's of survey should not be challenged without guidance from District Staff, **and under no circumstances whatsoever when lone working**.

3.3. Species nomenclature and identification

3.3.1. Species nomenclature

Nomenclature generally follows Stace (1997) for vascular plants, Blockeel & Long (1998) for bryophytes and Coppins (2002) for macrolichens. All three of these Floras/checklists have

[10] Surveyors should ideally acquaint themselves with the relevant PDO's at each site and also ask Conservation Officers for any recent history of PDO infringement.
[11] Written notes are essential and may be needed as admissible evidence in proceedings.

been superseded subsequently, but were the nomenclature sources in wide use by the Botanical Society of the British Isles, British Bryological Society and British Lichen Society when the survey started.

3.3.2. Identification of critical taxa and species within difficult groups

Identification is to species level except in a few difficult groups of vascular plants and bryophytes; only 'macrolichens' belonging to genera such as *Cladonia* and *Cetraria* were recorded, and the only algae noted were charophytes. Treatment of critical and difficult vascular plants is as follows (this draws on experience over the last 8 years of survey):

- *Agrostis canina* and *A. stolonifera* were identified using the length of the palea, and non-flowering/fruiting plants were recorded with the cf. notation.
- *Betula* was identified to species except when seedlings were encountered, in which case the notation "*Betula* sp." was used.
- *Callitriche* species were checked carefully and were not assumed to be *C. stagnalis*, despite the lack of other species on the Quadrat Recording Card.
- *Carex acuta*, *C. acutiformis*, *C. aquatilis* and *C. riparia* presented problems when non-flowering/fruiting and hybrids were also noted on at least two sites. Care was taken to find flowering or fruiting material within stands whenever possible.
- *Carex dioica* and *C. pulicaris* were sometimes difficult to identify when non-fertile.
- *Carex viridula* subsp. *brachyrhyncha*, *C. viridula* subsp. *oedocarpa* and a few intermediates between them were noted, as were hybrids between these two subspecies and *Carex hostiana*. The hybrid was found regularly and was recorded separately as *C.* × *fulva*.
- *Dactylorhiza* were identified to species when flowering, but non-flowering plants were recorded as "*Dactylorhiza* sp." and some putative hybrids were noted. *Dactylorhiza incarnata* subsp. *pulchella* and *D. traunsteinerioides* were especially problematic.
- *Deschampsia cespitosa* was all assumed to be subsp. *cespitosa*, and no material was checked to rule out the unlikely (on habitat) possibility of subsp. *parviflora*.
- *Drosera* hybrids were sought occasionally in mixed populations, but were only found at the known site of Cors a Llyn Barfog.
- *Eleocharis multicaulis* and *E. quinqueflora* were checked carefully whenever encountered. All *E. palustris* was assumed to be subsp. *vulgaris*.
- *Epilobium* species were examined critically and some hybrids were found on survey sites, although not in quadrats.
- *Euphrasia* was only recorded at the aggregate level except on one site, Cors Geuallt, where *E. scottica* was collected and identified from species-rich poor-fen vegetation.
- *Galeopsis bifida* and *G. tetrahit* were usually collected for identification.
- *Glyceria declinata*, *G. fluitans* and *G. notata* were checked carefully when found, but no hybrids were found.
- *Gymnadenia conopsea* was only identified to species level during quadrat recording, although attempts were made to differentiate the subspecies on Anglesey.
- *Juncus bulbosus* was not separated into subsp. *bulbosus* and subsp. *kochii* despite suggestions that this would be ecologically informative (A.O. Chater pers. comm.).
- *Juncus* × *surrejanus* was only recorded on a few sites and may be under-represented in the dataset. There was some checking of fruiting *J. acutiflorus* and some use of the notation "*Juncus* cf. *acutiflorus*", especially for flowering material.
- *Lemna minor* may have been slightly over-recorded for *L. minuta*, although the latter was seen on several occasions. It is also possible that non-gibbous *L. gibba* was overlooked as *L. minor*.
- *Luzula multiflora* was only recorded at the species level.

- *Mentha* hybrids were seen regularly when sites were surveyed in late summer, and were suspected on a number of other occasions. The notation "*Mentha* sp." was used when there was any likelihood that a plant was not *M. aquatica*.
- *Molinia caerulea* was not separated into subsp. *caerulea* and subsp. *arundinacea* for practical reasons, although they often appeared to occupy different niches on a site.
- *Myosotis* caused constant problems, but only because their identification characters are so forgettable. It is unlikely that many errors were made because notes were frequently recorded on hair and flower characters.
- *Poa humilis* was encountered far more regularly than *P. pratensis*.
- *Potamogeton* were examined critically, and at least one population was found that showed characteristics of both *P. natans* and *P. polygonifolius*.
- *Potentilla* hybrids were seen occasionally on drier sections of survey sites but were not thought to be a problem in quadrat samples, where *P. erecta* was constant. The latter was not identified to subspecies level.
- *Rhinanthus minor* was collected from transition mire at two sites and was found to be subsp. *minor* (rather surprisingly).
- *Rubus fruticosus* was recorded as "*Rubus* sp.".
- *Salix* seedlings were recorded as "*Salix* sp.", but most other willows were identified to species/hybrid level.
- *Sparganium erectum* was only identified to species level.
- *Taraxacum* were recorded as "*Taraxacum officinale* agg.".
- *Trichophorum cespitosum* was only checked critically on a few raised bogs, such as Cors Goch Llanllwch and Cors Goch Trawsfynydd. *T. cespitosum* nothossp. *foersteri* was only found on one occasion and might have been overlooked.
- *Utricularia minor* was by far the most frequently recorded species, even on sites where other *Utricularia* had been noted in the past. Whether other species were overlooked, or previously misidentified is uncertain.

Difficult bryophytes that require microscope checking are indicated with an asterisk (*) on the Quadrat Recording Card (Annex III). Particular problems included:

- *Amblystegium radicale* proved to be relatively frequent in reedbeds and *Equisetum* fen in south Wales. Records were also made for *A. humile* and *A. varium*, and this complex proved very difficult to unravel.
- *Aneura* sp., variably named *A. maxima*, *A. pellioides* and *A. euromaxima*, occurs on at least one Welsh peatland, Cors Bodeilio, although it is more typical of wet woodland.
- *Brachythecium rivulare* and *B. rutabulum* are both common in wetland quadrats and some scrappy plants were only provisionally identifiable.
- *Bryum pseudotriquetrum* and *B. bimum* were recorded together as "*B. pseudotriquetrum s.l.*".
- *Calliergon cordifolium* and *C. giganteum* were sometimes difficult to distinguish, especially on rich-fen sites where a high water table made the latter species appear laxer than usual.
- *Calypogeia fissa* and *C. muelleriana* were identified using underleaf characters, as detailed in Paton (1999). The former was much commoner than the latter. *Calypogeia sphagnicola* was always identified microscopically.
- *Campylium stellatum* var. *stellatum* and var. *protensum* seem poorly differentiated on Welsh fens and many specimens were intermediate in size and morophology.
- *Cephalozia loitlesbergeri*, *C. macrostachya* and *C. pleniceps* were all recorded rarely, and all may have been overlooked because of the ubiquity of *C. connivens*.
- *Cephaloziella* were usually recorded as "*Cephaloziella* sp." when non-fertile, although in all probability most were *C. hampeana* judging by that species' frequency as fertile material.

- *Dicranum bonjeanii* and undulate-leaved *D. scoparium* were identified using leaf cross-sections, but may have been misidentified occasionally.
- *Drepanocladus cossonii* and *D. revolvens* were recorded occasionally, and apparent intermediates were identified with reference to cell length.
- *Hypnum cupressiforme sensu stricto* was very rarely noted except on rocks on the edge of sites: *H. jutlandicum* is overwhelmingly the most abundant *Hypnum* on Welsh peatlands.
- *Kurzia* species were checked microscopically unless growing in the typical saturated bog-pool habitat of *K. pauciflora*.
- *Leucobryum glaucum* was not checked critically because of the unlikelihood of *L. juniperoideum* occurring on open peatlands.
- *Lophozia ventricosa* was only identified at the species level in quadrats, although some material was collected for identification to variety level for site lists.
- *Palustriella commutata* was routinely identified to subspecies level.
- *Pellia* sp. were identified to species level unless non-fertile, in which case they were recorded as "*Pellia* sp.".
- *Pohlia nutans* was sometimes represented by a form with very long setae, growing out of *Sphagnum* hummocks. This was provisionally named var. *longiseta*.
- *Polytrichum commune* was all assumed to be var. *commune* except for one collection of short plants on dry ground on Cors Goch Trawsfynydd, which was identified microscopically as var. *perigoniale*. Plants of *Polytrichum* in dry heath or desiccated bog were regularly checked for *P. formosum*.
- *Riccardia chamedryfolia* and *R. multifida* were only identified using oil body characters, and dried specimens could only be recorded as "*Riccardia chamedryfolia*/*multifida*".
- *Scapania paludicola* was found at a number of new sites during the survey, but was sometimes confused with forms of *S. irrigua*.
- *Sphagnum affine* may have been overlooked in the early years of the survey, as it was only recorded twice: in 2010 and 2011 on mires in north Wales.
- *Sphagnum angustifolium* was identified on a few occasions but was probably somewhat overlooked among carpets of *S. fallax*.
- *Sphagnum austinii* was only identified on Cors Goch Trawsfynydd, but was checked for regularly when dense mounds of *S. papillosum* were encountered.
- *Sphagnum capillifolium* subsp. *rubellum* was far commoner than subsp. *capillifolium* on Welsh lowland peatlands, but the latter was seen on a handful of occasions on bogs. Many colonies appear intermediate and identification was often only to the species level.
- *Sphagnum denticulatum* and *S. inundatum* were often collected for microscopic checking.
- *Sphagnum fallax* subsp. *isoviitae* was noted a few times in bog pools but is now thought to be an invalid taxon.
- *Sphagnum flexuosum* was recorded regularly in neutral flushes and fens.
- *Sphagnum magellanicum* is sometimes mimicked by *S. palustre*, and voucher specimens were collected from most newly discovered sites for the former.
- *Sphagnum palustre* var. *centrale* was confirmed from Cors Goch Trawsfynydd by M.O. Hill but may well have been overlooked on other sites. The polymorphism of *S. papillosum* on peatlands meant that putative *S. palustre* var. *palustre* was routinely collected for checking and often proved to be *S. papillosum*. On a number of occasions, the cell papillae appeared rather weak and hybrids were suspected.
- *Sphagnum subsecundum* was only identified microscopically and is rare on Welsh peatlands.
- *Sphagnum warnstorfii* has not been found yet during the survey, even on sites where it has previously been recorded.

3.4. Photographic records

3.4.1. General guidance on camera settings and photographic practice

The following pointers are offered as a general guide only.

- Colour and contrast seem to be captured most faithfully by using 'cloudy-skies' white balance exposure settings.
- Auto-flash is best disabled even when capturing images on the macro setting.
- Photographs on all but the macro-setting usually benefit from wide-angle settings.
- As a general guide, expect to collect between 5 and 15 images on all but the largest of sites.
- The 'Fine' (high resolution) setting should be used.

It is vital that a record is kept of the location and direction of every photograph taken on site. Ideally photos should be marked on to a field map or aerial photograph as arrows pointing in the direction of the photo, labelled with a unique identifier (e.g. S3, S4, S5 etc.). A suitable selection can then be renumbered sequentially (photo 2, photo 3 etc.), stored and indicated on a digital map (see section 3.5).

Photographs are of enormous value to District teams, many of which continue to lack ready access to high quality digital photography.

3.4.2. What to photograph?

The advent of high-quality digital photography and compact light-weight cameras are major advances which we should exploit to the full. However, the ease with which copious photographic records can be made also requires a degree of discipline if we are to avoid the accumulation of unmanageably large numbers of image files. The following criteria should be used as a general guide to decisions on what to photograph.

'Point-based' photographs of species, quadrats or stands.

- Stands or quadrats of communities which comprise the core interest features at each site.
- Any stand or quadrat which marks a key aspect of the range of floristic character exhibited by communities.
- Any stand of quadrat which demonstrates a key trend in condition which it would be helpful to convey to site managers, particularly where these have been mapped or specific reference made to them in the text of survey reports.
- Rare or notable species and species emblematic of the site or its key features of interest. Macro-photos should usually be accompanied by context shots.
- Specific features of importance to the condition of the site, including drainage ditches, eutrophication hot-spots and signs of recent grazing.

Site 'over-view' photographs

- Ideally these should be taken at relocatable points, facing away from the sun.
- At least one photograph should be taken which illustrates the site within its topographic context.
- Photographs should reflect key 'whole-site' trends such as scrub encroachment; photographs taken on slopes above a site can also be helpful in illustrating community transitions and zonations.

3.4.3. Image storage and file name conventions

The compact cameras issued to the survey team from 2004 onwards typically yield sizable

JPEG images of > 1.5 Mb – and more recently often up to 8 Mb. Image shrinkage/compaction is not advised for long-term storage as JPEGs. In the absence (2013) of any agreed standard approach to image storage, files should continue to be saved under the relevant regional/AoS/site folder of PEATSURV on the N drive. File names should be recorded according to the following convention: Site code Site name photo no. (for the site) (e.g. SH44-02P Cors Gyfelog photo3). Details of the photographer, subject, comments, and keywords reflecting photographic content can be attached to images using Microsoft Explorer (right-click on image icon, select properties, select summary, enter text in desired fields), but is quite a tedious process.

3.4.4. Image reproduction and circulation

Digital photographs should be printed as photosheets in cases where 1-8 photographs have been collected or where it is possible to select up to 8 photographs from a more extensive collection from a given site; photographs should be printed two to a page with a caption. Photosheets of more than eight images and thus exceeding 4 photosheets should usually be avoided. All digital photographs should be made available in digital format to District teams, ideally on archive quality CDs.

3.5. Mapping

3.5.1. Introduction

A key output of the survey is the production of high quality digital orthorectified maps showing the distribution and character of herbaceous mire communities mapped to community/sub-community level. These are a basic requirement for resource assessment work at an individual site level, with obvious applications for management planning and objective setting, monitoring, and site evaluation and selection. Such information also enables objective comparison of multi-site data at a range of geographical scales; other analytical opportunities include investigation of community inter-relationships, site-type analyses at a range of geographical scales, and investigations of site characteristics in relation to other geo-spatial data including climate, geology and land-use. The advent of modern GIS tools means that all mapping work is ultimately transcribed to durable and transmissible digital format subject to modern standards of electronic data curation.

Mapping should be undertaken at least to discrete community and where possible to sub-community level. The only general exception to this is where two or more communities occur in such intimate juxtaposition to necessitate mapping as a mosaic. Mappable units include any NVC communities/sub-communities occurring within the defined survey area, together with a relatively long list of communities, sub-communities and variants additional to the NVC scheme which have emerged during the early years of the current survey, the grassland survey, and more generally the combined experience of the survey team (see Table V4). Certain condition categories have also been recognised which nest within specific communities/sub-communities but which are nonetheless deemed sufficiently distinct to merit specific mapping, generally because of the abundance of one or more critical taxa or because of specific structural aspects. These 'extra-NVC' mapping units are listed in Annex V.

3.5.2. Definition of area to be mapped relative to statutory site and natural wetland boundaries

Mapping should extend to management boundaries that are visible both on the ground and on OS Mastermap maps (which should always be overlain on to the field map during printing). In some cases a management unit may include a large area of dry, or even improved grassland, in which case the boundary of the peat body may be a more usable limit for mapping. This is often visible as a change of slope or a striking change in vegetation type.

The chosen mapping area needs to be recorded on the field map and subsequently explained in the Site Account.

On most smaller SSSI it is useful to map the entire statutory site unless there is already adequate coverage of non-peatland habitat by the Lowland Grassland Survey of Wales or another NVC survey. In some cases, the grassland survey map will be accurate for grassland habitats but will have the peatland recorded as "swamp" or "mire", in which case mapping of just the peatland will suffice. Some SSSI boundaries extend into peripheral non-peatland habitats that act as buffers, and these should be mapped (but not necessarily sampled using quadrats) to NVC community level because that can provide useful information on the state of the buffer zone. SSSI boundaries may, on occasion, follow an arbitrary line that is not apparent on the field, and it is often easiest to map to a field boundary and then cut the map down to cover the SSSI during/after digitising. If the SSSI excludes areas of peatland that are clearly part of the same wetland complex then they should be mapped, providing that access has been secured, even if they are in suboptimal or non-SSSI quality.

3.5.3. Mapping scales

Sites should be mapped at 1:2500 scale except in the case of very tiny basin mires where 1:1250 is the ideal scale. The 1:5000 scale, used by the Lowland Grassland Survey of Wales, is not sufficient to discriminate fine-scale patterning of runnels and peat cuttings that is so critical to the understanding of peatland functioning.

3.5.4. Minimal size of mappable units

Mapping at 1:2500 scale allows recording of many narrow runnels and small patches of vegetation. In general, if a stand is clearly visible on a 1:2500 aerial photograph then it should be mapped separately; if not then is should be included as a component of a mosaic. Recording of bushes and trees allows monitoring of their spread in the future and all but the skinniest of trees should be mapped.

3.5.5. Practicalities of mapping

Each surveyor has their own preferred way of mapping a site, and that will vary from site to site depending on compartment size, height of vegetation and complexity of patterning. Mapping direct on to an aerial photograph with biro or thin permanent marker often seems easiest but can lead to difficulties in interpreting the field map after several months, as the contrast between the photograph and pen is minimal. Alex Turner found that waterproof, semi-transparent, matt laminating pouches can be used for field mapping, especially when combined with a laminated aerial photograph (Figure 3.1). This waterproof mapping paper has four major advantages:

- pencil can be used and therefore easily erased and corrected;
- the aerial photograph remains clear of writing so subtle patterning is still visible;
- the resulting field map is black & white and easily legible at a later date;
- mapping can continue in the rain.

It takes a few attempts before mapping on to semi-transparent paper becomes as easy as drawing on to a photograph, but the improved results mean that this is now the preferred mapping medium.

Aerial photographs need to be printed on A4 paper (to fit into A4 Weather Writers), using the latest available aerial imagery (currently 2009 across most of Wales). OS Mastermap must be overlain on to the photograph (Style Override set to black-edged, no pattern polygons), as must the SSSI boundary (Style Override to red-edged, no pattern polygons). Addition of a 100m or 50m grid aids orientation in the field using a GPS. The entire survey site needs to be

covered at 1:2500 scale by a series of photographs, and it is sensible to ensure that each compartment fits neatly on to at least one photograph, so that the mapper does not have to keep switching photographs in the field. If there is any probability of rain then at least one copy of each photograph should be laminated with normal, non-matt laminating pouches (writing on the matt laminating pouches used for field mapping smudges if they are used for laminating). The semi-transparent mapping paper should be stapled to the aerial photograph along one edge only, so that it can be peeled back to check details on the photograph.

It is usually worthwhile to draw the site boundary and any field boundaries on to the mapping paper before starting, in part to ensure that the mapping paper remains lined-up. Drawing a 'wire-frame' that includes all distinct polygons is also a useful way of initially assessing patterning on a site. There are then two main mapping techniques (Figure 1):

1. distinct stands of vegetation are seen on the aerial photograph and drawn around on the mapping paper, then the surveyor moves from stand to stand recording what community each represents and making any necessary changes to stand boundaries;
2. a field is covered by a series of zig-zag transects, using a GPS to maintain direction, and any stand edges that are crossed are marked on to the map.

Technique 2 is easier in featureless sites with few bushes and trees, whereas 1 tends to be more straightforward where there are plenty of distinct bushes that can be used for orientation. Surveyors often map bushes using shaded-in polygons (Figure 1). In head-high reedbeds, bushes may be the only means of navigation, necessitating 'bush hopping', where a surveyor moves from bush to bush looking for stand boundaries.

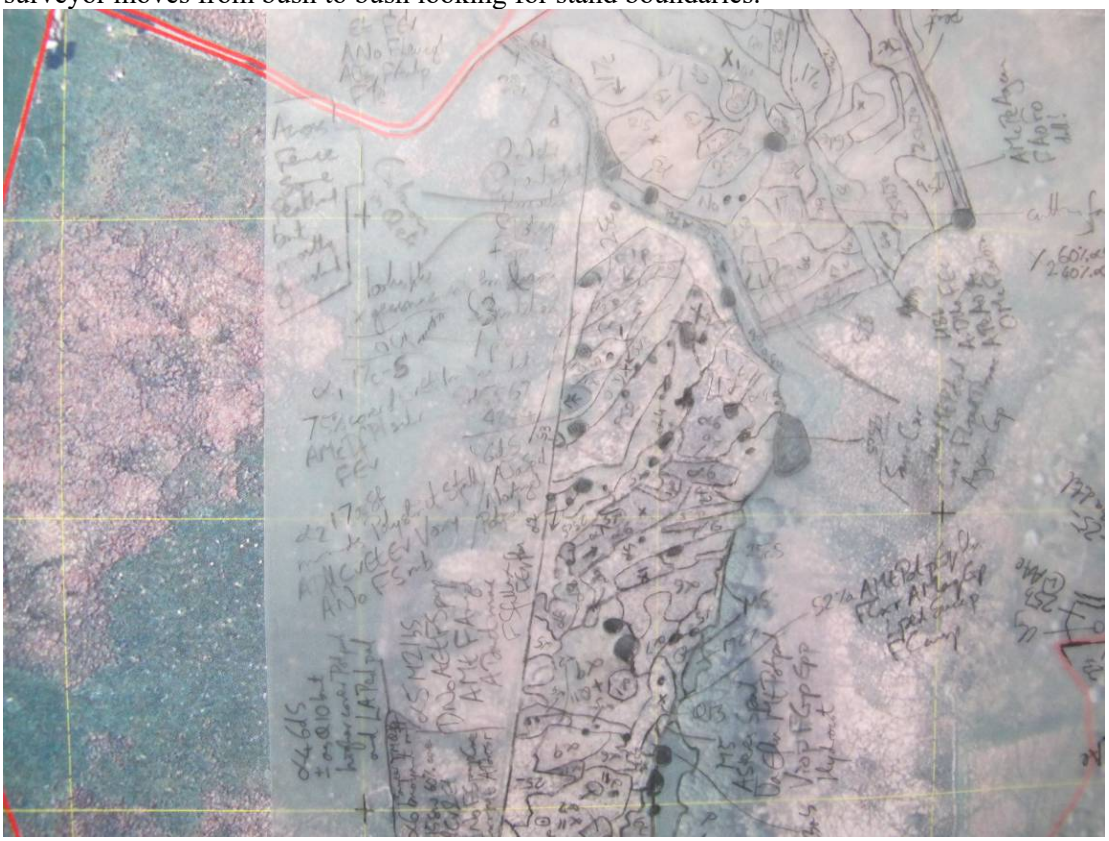


Figure 3.1: a field map on semi-transparent mapping paper attached to a laminated aerial photograph with a 100m grid and SSSI boundary. Two mapping techniques are shown: transect walking and moving from stand to stand. Willow bushes have been shaded.

A very basic map would merely have each polygon assigned to an NVC (sub-)community. In reality, such a map is extremely uninformative because sub-communities can vary enormously both across a site and between sites. Surveyors tend to record stands with a rapidly assessed DAFOR, using abbreviations or two letter species codes. This allows

assessment of the condition of the stand and may be informative about the edaphic factors affecting it. Different forms of a (sub-)community on a site may be assigned different DAFORs using a superscript ($M17a^1$ and $M17a^2$), or may be referred to different variants (M17aSf) or condition classes (M17a-S = M17a Sphagnum-poor) (see 3.5.7 and Annex V). It is common practice for surveyors to drop the S, M, H etc and record "23a" (there is no S23a or H23a, only M23a), but care must be taken to avoid confusion (e.g. M27 and S27 can co-occur). Stands that are not immediately obvious examples of any particular community are usually annotated with a Greek letter (γ1, ζ1 or φ2), with accompanying DAFOR, whilst vegetation mosaics are annotated X1, X2 etc, with a note of what the mosaic components are (X1=60% S27a, 35% S3, 5% S7).

3.5.6. Treatment of non-herbaceous peatland communities and peripheral communities on shallow peat or mineral soil.

The primary emphasis of the current survey programme is upon herbaceous (i.e. non-woody) mire vegeatation Vegetation outwith this broad category should be treated as follows.

- Marshy grassland (including fen meadow) vegetation (M22-M26) on shallow peat. Unless already surveyed as part of the CCW grassland survey, these communities should normally be mapped to community/sub-community level even where present on shallow peat or mineral soils. Probing will probably be necessary to determine which stands are on deep peat and which are not.

- Wet heath (M15-M16) and dry heath (H4, H8, H10, H12 etc) on shallow peat. Wet heath should be mapped in full except on sites where there is no obvious place at which to stop mapping outside the area of deep peat, for example on Waun Afon where inclusion of wet heath would extend the site several hundred metres on to an area of unenclosed upland. Dry heath is usually only mapped to the community level but small stands may be assigned to sub-community.

- Wet woodland (W1-7). Large blocks should be mapped simply as woodland. However, the community composition of the open-mire fringe of such blocks should at least be noted and described in the survey report. This will provide valuable information on the likely successional development of peatland stands in the absence of scrub/woodland management, an issue for which there is relatively little information in the literature. Smaller blocks of woodland occurring within predominantly open-mire contexts should be mapped at least to community level where possible. Existing survey data for wet woodland communities in Wales is summarised as point data on Peatsurv/Data & GIS/ All Wales data / keybase 1. Use of the information tool on indicated points yields extent estimates for the recorded wet woodland communities provided by Dr Jim Latham. A copy of the spreadsheet Woodland NVC records Wales 1985-2000 produced by JL is available at the same directory location.

- Aquatic communities (A1-A24). Floating beds of duckweeds, waterlilies and *Potamogeton* species should be mapped to community level, but submerged aquatic communities will generally be invisible without a boat and should simply be recorded as 'open water' with appropriate notes.

- Dry grassland (U1-U6, MG1-MG10, CG1-CG10). Stands of dry grassland surrounded by peatland or within the same management unit should be mapped to sub-community level where practical. It is particularly important to map the dry grassland on some peatland-dominated SSSI where there has been no previous NVC grassland survey. However, dry grassland is not a key part of the current survey and

sites that are considered to be of importance for their grassland vegetation should ideally be mapped by a grassland specialist.

Flush vegetation (M6 & M10) on shallow peat/mineral soil. All such stands should be mapped routinely as part of the wetland interest of peatland sites. Such vegetation may constitute the primary interest feature on some sites.

3.5.7. Condition mapping and links to site condition monitoring

This refers to the mapping of different condition states within the same NVC community. Some condition classes have been encountered regularly across Wales and are routinely recorded by the Lowland Peatland Survey, for example ericoid-poor or *Sphagnum*-poor **M17**, or *Deschampsia*-infested **M23a**. A full listing of condition classes is provided in Annex V. Flush vegetation (M6 & M10) on shallow peat/mineral soil. All such stands should be mapped routinely as part of the wetland interest of peatland sites. Such vegetation may constitute the primary interest feature on some sites.

Recording condition classes is easily done using rapid field DAFOR scores (see 3.5.5), and different condition classes can then be included in a digital map. A stand may, of course, belong to two or three condition classes, for example being bramble-infested and Phragmites-dominated. Although the mapping of condition classes is no replacement for formal site condition monitoring, it may be of significant use for conservation and monitoring staff by highlighting issues.

3.6. Timing of survey

Waterlogging well into the spring delays the seasonal development of peatland vegetation, and survey prior to mid May is likely to miss some species and under-record cover values. For these reasons, the start of the survey season is usually no earlier than mid May. Bog vegetation exhibits a less striking phenology and early survey is best concentrated on these systems, particularly to take advantage of flowering *Eriophorum vaginatum*. Even so, bog survey in June or earlier may miss or at least underestimate the significance of key phytosociological markers such as *Rhynchospora alba*.

Most fen and swamp vegetation starts to look fairly weathered by late August, and survey beyond the third week of September is generally avoided. Some species, notably *Hydrocotyle vulgaris* and *Menyanthes trifoliata*, are especially susceptible to early air frosts. Bogs can be surveyed with reasonable confidence as late as mid October, and in general it is advisable to survey rich fens and swamps during the middle part of the season, saving bogs for the earlier/later weeks and poor-fens for the later weeks.

3.7. Contributions to local/national recording schemes

Surveyors are strongly encouraged to collect and contribute records to recording schemes, with a natural focus on botanical and bryological records. By 2012 the survey had revealed new sites for a wide range of notable species, including *Apium inundatum*, *Andromeda polifolia*, *Carex acuta*, *C. diandra*, *C. limosa*, *C.* × *elytroides*, *Dactylorhiza incarnata* subsp. *pulchella*, *Drosera intermedia*, *Oenanthe aquatica*, *Pyrola rotundifolia*, *Rhynchospora alba*, *Selaginella selaginoides*, *Trichophorum cespitosum* nothossp. *foersteri*, *Amblystegium radicale*, *Pseudobryum cinclidioides*, *Scapania paludicola* and *Sphagnum riparium*. Recording is particularly important on remote peatlands that county recorders may never have

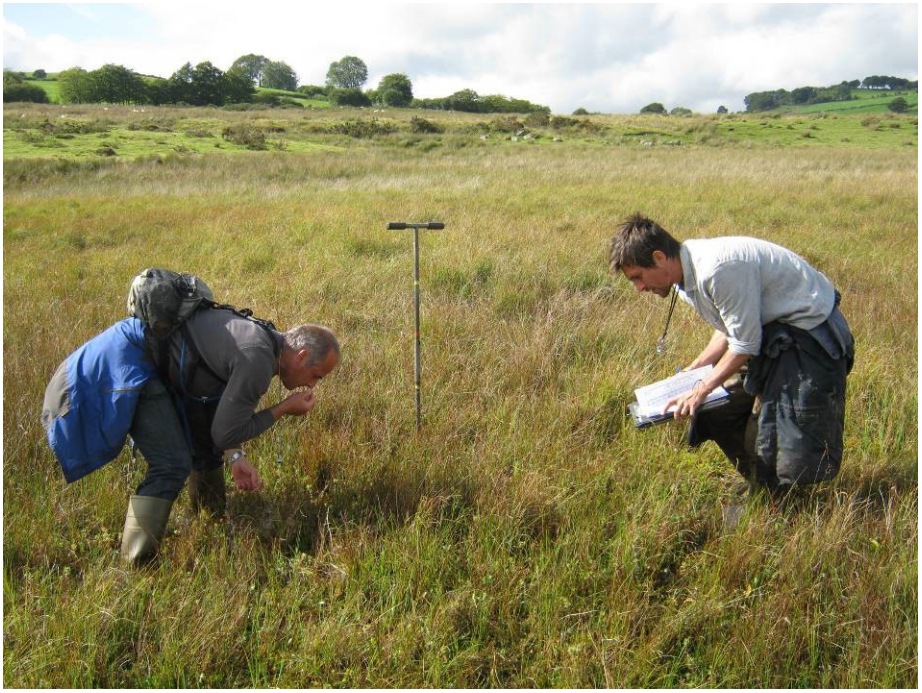
visited. In some counties, active BSBI recorders are keen to join surveyors on sites for which they have no records.

Filling in complete recording cards is unlikely to be practical given the time needed to map and record quadrats on a site. Instead it is more practical to take detailed notes on interesting species and to supply those notes, perhaps accompanied by a partial list based on records from quadrats and DAFORs, to the BSBI and/or BBS recorders. It is sensible to check SSSI citations and Science files prior to survey in case there are known populations of rare plants that might be relocated during the survey.

The quadrat data are composed of high quality, accurately identified species records which have been precisely located. As they have all been incorporated into a Recorder Database (see 5.4) and will appear on the NBN Gateway in the future, it is likely that the entire dataset could be supplied to recorders in some format, ideally at the conclusion of the survey. Of course, quadrats will not include a complete register of all of the plant species present on the site and are likely to miss many of the local rarities, hence the need for detailed recording of rare plants.

3.8. Personal equipment checklist

A check-list of equipment to be employed by surveyors / survey teams is appended as Annex VI.



Dave Reed and Sam Bosanquet recording a quadrat at Clawdd Ddu common, Ceredigion, September 2010

4. Community discrimination

4.1. Introduction - Peatland community recognition

It is vital that the Phase II Lowland Peatland Survey uses consistent rules for community recognition, in order to ensure that surveys of different sites are comparable. The following is a brief summary of the rules used by the team and an initial draft was supplied to the surveyors for reference in 2004. In part, it builds on Yeo *et al.* (1991), which should be referred to for grassland communities. The bog communities are much more thoroughly covered by Turner (2010). Some of the units described in this section fill gaps in the existing NVC scheme and have been notified to JNCC (see Mountford, 2011). Revision of the mires section of the NVC to take account of these and other necessary additions/revisions (including those of Wheeler et al., 2009) is urgently required.

4.2. Topogenous sedge fens

Poor-fen or mesotrophic bog communities, composed of sedges, herbs and, in most cases, abundant bryophytes, are very important vegetation types on Welsh peatlands and form a core part of the Annex I habitat transition mire & quaking bog (H7140). Most of them can be picked out from superficially similar marshy grasslands and flushes by the presence of *Carex rostrata*, *Menyanthes trifoliata* and *Potentilla palustris*. The bryophyte layer is key to identifying **M4**, **M5**, **M9**, **S27** and similar communities, although the very species-poor nature of **M4** is an additional pointer.

M4 has a carpet of *Sphagnum fallax*, one of the least base-tolerant species, below a very sparse cover of *Carex rostrata*, *C. curta* and very few other associates. The total species count for an **M4** quadrat is usually <10. *Menyanthes* may be scattered through **M4**, but is seldom abundant, whilst *Potentilla palustris* is usually absent; in contrast, both tend to be abundant in the other poor-fen communities. **M4** '*Eriophorum vaginatum* variant' has been recorded at a few sites and differs only in the presence of frequent *E. vaginatum* and *Deschampsia flexuosa*, both at low cover.

A base-tolerant *Sphagnum* layer identifies **M5**. Typical forms of the community have dense bryophyte carpets dominated by *S. squarrosum* and/or *S. teres*, often mixed with some *S. flexuosum* and *S. subnitens*. They tend to be fairly species-rich, holding forbs such as *Epilobium palustre*, *Galium palustre*, *Lotus pedunculatus* and *Succisa pratensis*, which are rare in **M4**, as well as constant *Menyanthes* and *Potentilla palustris*. Most **M5** also supports *Equisetum fluviatile* and recognition of a variant marked by that species is unlikely to be practical. **M5** '*Sphagnum inundatum* variant' is almost identical to typical **M5**, but has a carpet of *S. inundatum* in place of the usual **M5** bryophytes; it has been recorded on five sites so far, but is likely to prove to be widespread and should always be mapped separately.

'Species-rich *Carex rostrata* mire' is the name used by the survey team for a widespread *Sphagnum fallax*/*flexuosum* variant of **M5**. This resembles **M4** in having the slender *Sphagnum recurvum* agg. as its principal bryophyte, but is much more species-rich (>15 spp per 2x2 m quadrat). When checked, the *Sphagnum* has almost always proved to be the relatively base-tolerant *S. flexuosum*. At a few sites, *S. fimbriatum* is the principal *Sphagnum* in this vegetation type: this species should not be used as an **M5** marker. Further details of 'Species-rich *Carex rostrata* mire', **M4** and **M5** are given in the Ffynnon/PEATSURV note 'M4 M5 Carex rostrata mire definition' but have not yet been finalised.

The bog pool community **M2** sometimes occurs in topogenous situations. It tends to be very species-poor and lacks *Carex rostrata*, comprising instead a carpet of *Sphagnum fallax* below

an open cover of *Eriophorum angustifolium*. *Vaccinium oxycoccos* is sometimes abundant in such situations, allowing placement in **M2b** (*Sphagnum recurvum* sub-community).

An abundance of *Erica tetralix*, *Narthecium ossifragum* and *Sphagnum papillosum* marks **M21**. This community is sometimes hard to separate from **M2**, not least because *S. fallax* is constant in **M21b** (see Turner, 2010). **M21** 'swampy variant', with constant *Carex rostrata* and *Equisetum fluviatile* among *E. tetralix* and *S. papillosum*, is occasionally encountered and needs to be recorded separately. It appears to be derived from **M4** or **M5** through expansion of *S. papillosum*.

A few other non-NVC vegetation types combining a *Sphagnum* carpet and abundant sedges have been noted in topogenous situations during the survey. '*Potentilla palustris* - *Sphagnum* mire' lacks *Menyanthes* and *Carex rostrata* and has *S. fallax* or *S. fimbriatum* as the principal *Sphagnum*; 'Species-rich *Sphagnum* mire' is essentially identical to 'Species-rich *Carex rostrata* mire' but has *Carex curta* in place of *C. rostrata*; '*Equisetum palustre* mire' holds a remarkable amount of *E. palustre* above a carpet of *S. fallax* and again lacks *C. rostrata*. Whether any of these deserve full recognition as communities remains uncertain, but it is probably best to use one of these names and take a quadrat sample, rather than coming up with yet another non-NVC category (see also Annex V, Table V.4).

S27 holds the same vascular markers as **M5**, but lacks sphagna. In their place, it has a patchy carpet of pleurocarpous mosses, especially *Brachythecium rivulare*, *Calliergon cordifolium* and *Calliergonella cuspidata*. The usual form on poor-fen sites is **S27a** (*Carex rostrata* - *Equisetum fluviatile* sub-community), which is essentially recognised by its lack of reedbed plants. Stands with dominant *E. fluviatile* have been recorded separately in north Wales as **S27** '*Equisetum fluviatile* variant', but the differences between this and typical **S27a** are rather blurred. It is probably best to continue to map them separately where possible. **S27b** (*Lysimachia vulgaris* sub-community) is marked by *Phragmites australis*, *Lythrum salicaria*, *Lysimachia vulgaris*, *Juncus subnodulosus* etc. and is generally restricted to reed-fen sites.

M9 also lacks *Sphagnum* spp., although *S. contortum* may be locally abundant. It is characterised by a basiphilous bryophyte carpet, most notably *Calliergon giganteum*, *Campylium stellatum*, *Drepanocladus cossonii* and *Scorpidium scorpioides*. Although these bryophytes are essential for community recognition, their use in sub-community definition is questionable as they often occur in the 'wrong' sub-community. The sub-community that is usually associated with poor-fens is **M9a** (*Campylium stellatum* - *Scorpidium scorpioides* sub-community), marked by *Carex echinata*, *C. dioica*, *C. viridula* subsp. *oedocarpa*, *Pinguicula vulgaris* and various other species equally typical of **M10**. In contrast, **M9b** (*Carex diandra* - *Calliergon giganteum* sub-community) is often found in association with **M22** and holds locally frequent *Juncus subnodulosus*, as well as *C. diandra* and various marshy grassland forbs, such as *Caltha palustris* and *Mentha aquatica*. In general, wetland herbs and *C. diandra* are considered the best pointers to sub-community placement in **M9**. Wheeler *et al* (2009) offer a revision of **M9** sub-communities which has yet to be adopted in this survey.

Very species-poor *Carex rostrata*-dominated vegetation, sometimes with an admixture of *Equisetum fluviatile* or *Menyanthes trifoliata* is best recorded as **S9**. For details of **S10** see **Swamps** below. Very species-poor '*Menyanthes trifoliata*-dominated vegetation' has been noted on a few sites.

Where two or more of *Carex rostrata*, *Equisetum fluviatile*, *Menyanthes trifoliata* and *Potentilla palustris* are frequent at low cover in otherwise typical *Molinia*-dominated **M25c** (***Angelica sylvestris* sub-community**) or *Sphagnum*-free, *Juncus acutiflorus*-dominated **M23a** (***J. acutiflorus* sub-community**), stands are recorded as 'swampy variant'. **M23a** 'swampy variant' is particularly widespread and is a regular component of mires throughout

Wales. The distinction between **M23a**, **M23a** 'swampy variant' and **S27** is not always clear-cut and all three may co-occur on topogenous deep peat.

4.3. Soligenous Fen and Flush

The calcareous flush community **M13** is readily recognised because of the abundance of *Schoenus nigricans* that characterises it. Otherwise it can be very similar to **M22** or **M9**. Species-rich **M13b** is usually much more open than the other two sub-communities. **M13b** '*Erica tetralix* variant' was recorded on Cors Bodeilio, echoing the **M14** at Cors Castell and Cors Erddreiniog. The latter differs in the presence of a greater range of calcifuge species, such as *Narthecium ossifragum* and *Sphagnum subnitens*.

Rules for identifying **M6** sub-communities follow Yeo *et al.* (1991), but a number of consistent variants have been identified during the Peatland Survey. The majority are found on deep peat and are usually recorded as Soligenous Fen rather than Soligenous Flush. Even typical **M6** is regularly encountered on deep peat, without any indicators of peat depth apparent, and probing may be necessary to determine whether stands belong to Fen or Flush.

M6c '*Eriophorum vaginatum* variant' is very widespread and sometimes occupies large areas of soligenous deep peat. *Juncus effusus* is the dominant species in this variant, as in typical forms of the sub-community, but *E. vaginatum* and *Deschampsia flexuosa* are frequent throughout. *Sphagnum fallax* and *Polytrichum commune* generally dominate the bryophyte layer, although there are sometimes mounds of *Aulacomnium palustre* and *Pleurozium schreberi*, indicating affinities to 'Nodum 19'. There is also an '*Eriophorum vaginatum* variant' of **M6d**, dominated by *Juncus acutiflorus*, but this is much less frequent than its **M6c** equivalent.

M6c 'swampy variant' and **M6d** 'swampy variant' are widespread and combine the tall *Juncus* and the *Sphagnum* carpet of **M6** with frequent *Carex rostrata*, *Equisetum fluviatile*, *Menyanthes trifoliata* and *Potentilla palustris*. **M6a** 'swampy variant' that includes sphagna, *Eriophorum angustifolium*, *M. trifoliata* and *P. palustris* has been encountered occasionally.

A '*Sphagnum flexuosum* variant' of **M6d** was mapped on Cors Gyfelog and Llyn Du a Foel Erw. Other than having a carpet of *S. flexuosum* in place of the usual *S. fallax*, it differs little from the typical form of the sub-community except for having a consistently diverse wetland herb compliment. **M6d** '*Vaccinium oxycoccos* variant', with abundant *V. oxycoccos*, has been recorded once and is probably not worth separating.

Abundant *Hypericum elodes* and *Potamogeton polygonifolius* are usually sufficient to identify **M29**. Both these species can occur in **M5** and 'Species-rich *Carex rostrata* mire', but neither is abundant there. '*Carex rostrata* variants' of **M29** and **M30** indicates that **M5**, **S27, M29** and **M30** can intergrade to some extent.

4.4. Ombrogenous bogs and related poor-fen

Turner (2010) is the essential reference for identifying **M17**, **M18**, **M21** and 'Nodum 19', as well as **M15** 'swampy variant'.

M17 and **M18** are characteristic of established peat surfaces, especially raised and blanket bogs. **M17** is marked by constant *Eriophorum vaginatum*, *Narthecium ossifragum*, *Sphagnum capillifolium*, *S. papillosum* and *Trichophorum cespitosum*, and bog vegetation lacking one or more of these species may be better placed in another community (see Turner, 2010). Degraded bog sometimes supports 'Nodum 19', or at least something that is floristically inseparable from it, although it is more typical of developing bog surfaces.

The same **M17** markers are present in **M18**, but they are joined by a richer array of bog liverworts and by two classic markers: *Andromeda polifolia* and *Sphagnum magellanicum*. It is safe to refer stands where one or both of these are present to **M18a** (*Sphagnum magellanicum* - *Andromeda polifolia* sub-community), but in a few cases referral to **M18** has been through more subtle differences, such as liverwort diversity, abundance of *Sphagnum tenellum*, a very low cover of *Molinia*, or the absence of *Potentilla erecta*. Detailed scrutiny of Turner (2010) is needed before any survey of raised bogs.

'*Sphagnum fallax* variants' of **M17** and **M18** are often mapped separately (see Turner, 2010). They sometimes indicate what is presumed to be atmospheric enrichment, but are equally often indicative of continuing topogenous influences on a developing ombrotrophic surface. Very wet '*Sphagnum cuspidatum* variants' of **M17a** and **M17c** are occasionally encountered on heavily grazed bogs.

'Nodum 19' and **M15** 'swampy variant' appear to be vegetation types associated with a developing ombrotrophic area within a topogenous poor-fen, although they may occur in other situations. **M15** 'swampy variant' has a very high cover of the ericoids *Calluna vulgaris* and *Erica tetralix* occurring in combination with *Sphagnum papillosum* and *S. fallax* (and sometimes *S. palustre*) and a suite of 'swampy' species (*Carex rostrata*, *Equisetum fluviatile*, *Menyanthes trifoliata* and *Potentilla palustris*) more typical of **M5** or **S27**. The same 'swampy' species are frequent in 'Nodum 19a', but they are joined by constant *Eriophorum vaginatum*, which is absent from **M15** 'swampy variant'. They tend to be absent from the species-poor 'Nodum 19b' and the drier 'Nodum 19c', in which *Vaccinium myrtillus* and hypnoid mosses rise to prominence. The lack of *Sphagnum capillifolium* and *Trichophorum cespitosum* and absence or patchiness of *S. papillosum* differentiate 'Nodum 19b & c' from **M17**.

Other forms of **M15** may occur on bogs, especially where peat cutting has taken place. They differ from **M17** and 'Nodum 19' in the absence of *Eriophorum vaginatum*. The commonest are **M15b**, marked by *Sphagnum papillosum*, *Narthecium ossifragum* and *Drosera rotundifolia* amongst others, and **M15d**, identified by constant *V. myrtillus*, near constant *Juncus squarrosus*, and abundant hypnoid mosses. **M15d** is especially characteristic of desiccated baulks on cut-over bog. Preferentials for both sub-communities may co-occur in vegetation recorded as **M15b/d**; some stands of **M15** may lack sub-community preferentials entirely.

Tall, *Molinia*-dominated (cover >8) vegetation is locally abundant on degraded bogs. Despite not occurring in the marshy grassland situations typical of the community, this vegetation is recorded as **M25**. In some cases it is clearly derived from a bog community: **M25** '*Eriophorum vaginatum* variant' is a widely used category. In others, where *E. vaginatum* is absent, peat depth is the only real indication of whether **M25a** or **M25** 'species-poor' represent degraded bog or marshy grassland.

4.5. Reed-fens and reed-beds

Species-poor reed-beds in **S4** are easily recognised, but the various reed-fen communities are often very complicated.

S4b is recognised by constant *G. palustre* and is generally more species-rich than **S4a** (>5 spp, vs 1-2 spp per 4x4 m quadrat). The latter generally lacks any associates apart from sprawling *Solanum dulcamara* or *Calystegia sepium*. **S4c** has standing water below reeds and usually has a very low cover of one or two of *Carex rostrata*, *Equisetum fluviatile*, *Menyanthes trifoliata* and *Potentilla palustris*.

S25 and **S26** are recognised by, respectively, constant *Eupatorium cannabinum* and *Urtica dioica*. *Filipendula* has been used in place of *Eupatorium* at one or two sites, but this is unwise unless other tall herbs, such as *Iris pseudacorus* and *Angelica sylvestris*, are abundant.

S24 is one of the most challenging communities encountered during the survey, because the *Peucedanum palustre* that marks it in East Anglia is totally absent from Wales. Nevertheless, a number of reed beds in both north and south Wales hold frequent to abundant *Lysimachia vulgaris*, *Berula erecta*, *Juncus subnodulosus*, *Ranunculus lingua*, *Thelypteris palustris*, *Typha angustifolia* and *Rumex hydrolapathum* – a suite of rich fen plants that would be highly atypical in **S25**. Generally, stands with two or more of these species were referred to **S24**, whilst those with just *Lysimachia* have been recorded as **S4b** '*Lysimachia* variant' or **S25a** '*Lysimachia* variant'. Most **S24** is not referable to a sub-community, but **S24a** has been recognised at three sites in south Wales and **S24f** at Crymlyn Bog.

M15 'swampy variant' with abundant *Phragmites* was initially recorded as '*Phragmites - Erica tetralix* fen'. This rare form of transition mire is believed to occur when *Phragmites* is invading an area with sphagna and *E. tetralix*, often because of hydrological disturbance. *Phragmites* can also infest *Molinia*-dominated **M25** fen.

4.6. Swamps

Recognition of most swamp communities is fairly straightforward, as one species tends to be overwhelmingly dominant.

S2 is overwhelmingly dominated by *Cladium mariscus*. Otherwise *Cladium* may be occasional in **S1** or **S27b**, or abundant in **S24** (see 4.5). The '*Cladio-Molinietum*' (Wheeler, 1980a), which combines *Cladium* with abundant *Molinia caerulea* and frequent *Erica tetralix*, is present on a few north Wales fens and needs to be recorded separately; elements of it are referable to the Annex I habitat 'Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae'. '*Cladio-Molinietum*' is discussed in more detail in Bosanquet, Jones & Turner (2009).

Tall, tussocky *Carex paniculata* is a prominent marker of species-poor **S3**. It also occurs in abundance below an open canopy of reeds in **S25b** (*Carex paniculata* sub-community): separation of the two depends on whether the *Carex paniculata* tussocks are coalescing into a single dense patch or are scattered through a reed bed.

Care should be taken to separate **S6** from **S7**, as identification of *Carex riparia* and *C. acutiformis* is far from straightforward. Flower or fruit characters should always be used, and it may be necessary to return to a site at an earlier/later date to ascertain which species is/are present. '*Carex acuta* swamp' is abundant at Llangorse Lake.

Much of the **S10** recorded in Wales seems to be too species-rich to fit either **S10a** or **S10b**, although it is dominated by *E. fluviatile* and must therefore be referred to **S10** rather than **S27** or **M23**. These species-rich stands tend to be mapped as **S10**, ie not referred to a sub-community.

Sub-communities of the grassy **S22** swamp are very seldom recorded during the peatland survey. The species-poor, non-NVC '*Holcus - Agrostis* swamp' occurs very widely in Wales and is thought to be a sign of eutrophication, so recording it can help in identification of sources of enrichment.

4.7. Fen Meadow

All four sub-communities of **M22** occur on Welsh peatlands. **M22a** is treated as something of a default category, but is usually markedly species-poor. *Carex elata* needs to be frequent for referral of stands to **M22c**, as does *Iris pseudacorus* for **M22d**. **M22** 'swampy variant', dominated by *J. subnodulosus* and with a sparse admixture of *Carex lasiocarpa* and *C. rostrata*, also occurs on Anglesey.

Separation of **M24** from other marshy grassland communities is covered in Yeo *et al.* (1991). One site in Pembrokeshire supports **M24a** (*Eupatorium cannabinum* sub-community), which is, like **S24**, considered by the NVC to be restricted to East Anglia. The combination of *Molinia caerulea*, *Eupatorium*, *Juncus subnodulosus*, *Phragmites* and the basiphilous sedges *Carex hostiana* and *C. pulicaris* is reminiscent of **S24** or **S25**, but the relatively low cover of *Phragmites* points to **M24**. All of the fen meadow communities can be referred to fen (topogenous) where present on deep peat.

4.8. Scrub & woodland

The survey team generally records woodland and scrub to community level if it is in discrete blocks, but records 'dense scrub' or 'woodland' if stands are too extensive. 'Willow scrub' is another widely used category, especially for small clumps of *Salix aurita* or *S. cinerea* that cannot really be called **W1**. *Galium palustre* is the main marker of **W1**, *Phragmites australis* should generally be present before **W2** is mapped, and *Carex rostrata* and *Potentilla palustris* are key preferentials for **W3** even though *Salix pentandra* is usually absent from such swampy stands.

5. Electronic Data Storage

5.1. Quadrat Data

5.1.1. Community Data Tables

All of the data recorded on quadrat cards is stored electronically in a set of *Excel* spreadsheets, which have columns that allow these data to be sorted into recording card or NVC order. Some cover a single community; others several for ease of comparison. The NVC order for most peatland communities can be found in Community Lists Lowland Peatland Survey quadrata data on Ffynnon/PEATSURV. This table includes all taxa listed in the NVC for these communities apart from those that are not found in Wales (e.g. *Cicuta virosa* or *Pleurozia purpurea*). A number of upland species (e.g. *Vaccinium vitis-idaea*) are included. See 3.3.1 for information on the taxonomy and nomenclature used.

If a table for a new community is needed then please ask the data manager (Sam Bosanquet) to add it to Community Lists Lowland Peatland Survey quadrata data and then copy the required columns into a new spreadsheet.

The species list is essentially the same for every community, allowing easy transfer of quadrat data between spreadsheets (a flaw of many systems). All the taxa on the recording card are included for every community, following which is a block of 124 taxa that occur in at least one NVC table. The 'card' column indicates which block the species belongs to:
1: trees/shrubs
2: dwarf shrubs
3: ferns & fern-allies
4: graminoids

5: forbs
6: mosses
7: liverworts
8: algae
9: lichens
10: non-card species

Species are numbered for each NVC community according to where they appear in the NVC table. Thus, for **M17**, *Vaccinium myrtillus* is coded 46 in the **M17** column. Species that do not appear in the NVC table for that community are coded N1-N9 according to what type of plant they are. These N codes follow the blocks above, with N1 coding for trees & shrubs and N9 coding for lichens.

If a species appears to be absent from a community data table during data entry then check whether it is included in the NVC table for that community. This is unlikely because the NVC was checked when the data tables were made, but is possible. Most species that are not included on the recording card are present in block 10. Additional species should be inserted **at the bottom of the species list** ie after the block of non-card species. They should be coded with N1-N9 according to what type of plant they are and with a 11 in the card column. Please do not insert them amongst the card species or amongst the 10-coded non-card species.

Please **do not use Hide Columns** as it is essential to be able to see all the contents when entering data. Use Freeze Panes instead.

The Grid Reference needs to be entered with spaces "SM 94675 37611"; DAFOR records should be input to the left of the quadrat to which they refer; any blank cells in the water depth & slope blocks should be filled with a "-". Take care to ensure that formatting remains consistent throughout the table, especially with regards to substrate types, water depths etc., so as to avoid tables with a plethora of entries that all mean the same thing.

5.1.2. Site Data Tables

A set of Site Data Tables forms part of the site report (see 6.2). These need to be produced in a consistent way, with standard font, titles and species order. A separate table is produced for each community on each site: by copying & pasting three blocks of columns from a Community Data Table into a new worksheet on a single *Excel* document for the site. The first block comprises the sort order for the relevant community; the second, the species list; and the third, data from the quadrats sampled in that community on the site. Once these are pasted in, the whole table needs to be converted to 10 pt Times New Roman using Select All. Next, the upper heading should be changed to follow the pattern "Site SS79/05aP Pant-y-sais, West Glamorgan & Llanelli", whilst the lower should be amended to "Table of Quadrat (2x2m) Domin values and sub-community DAFOR estimates from M6c mire" (or equivalent). The date "CCW HQ, 20XX" should fill the top right corner of the table.

Unrecorded species within each quadrat need to be removed. This is most easily achieved by sorting all of the data rows by each quadrat/DAFOR column in turn, ensuring each time that everything within each row remains associated. After these have been stripped out, the remaining data should be sorted by NVC order (descending). Blank lines can then be used to indicate breaks in the NVC table and the point where the NVC species end. Non-NVC species should be sorted by plant type (N1-N9, as above) and then alphabetically.

Set the Print Area to include all of the data and headings, but to exclude the sort columns.

Table of quadrat (2x2m) Domin values from S6 swamp

	Q10	Q14
	SM 94675	SM 94482
Grid Reference	37611	37468
Carex riparia	8	7
Filipendula ulmaria		6
Phragmites australis	3	
Galium palustre	6	5
Mentha aquatica		4
Lycopus europaeus	3	
Typha latifolia	1	
Juncus acutiflorus		5
Agrostis stolonifera	5	3
Calystegia sepium	3	4
Rubus fruticosus agg.		3
Rumex crispus	3	
Molinia caerulea		3
Epilobium obscurum	1	
Iris pseudacorus	3	
Lotus pedunculatus		3
Lychnis flos-cuculi	3	
Lythrum salicaria	3	
Myosotis laxa ssp. *cespitosa*	3	
Potentilla palustris		5
Pulicaria dysenterica		3
No of species/sample	13	12
Dwarf Shrub cover	-	-
Graminoid cover	8	8
Forb cover	7	8
Bryophyte (non-*Sphagnum*) cover	0	0
Sphagnum cover	-	-
Dwarf Shrub height (cm)	-	-
Graminoid height (cm)	65-180	40-100
Forb height (cm)	3-55	20-80
Bryophyte (non-*Sphagnum*) height (cm)	-	-
Sphagnum height (cm)	-	-
Litter (% cover)	25	10
Bare substrate (% cover)	100	100
Peat depth (cm)	45	>50
Substrate type	fen peat	fen peat
Water depth	-8	-
Water flow	0	-
Water pH	4.14	-
Water conductivity (µS)	5060	-
Soil pH	-	-
Slope (deg)	0	0
Aspect (deg)	-	-
Management (Burning/Cutting/Grazing/Unmanaged)	U	U
Grazers (Cattle/Horse/Sheep/Unsure)	-	-

5.2. Area Data

Area data are stored in All Wales Peatland Data, which is located on Ffynnon/PEATSURV. This table also includes information on site location and survey dates, together with SSSI status and agri-environment scheme coverage. Data for each site must only be entered after the final version of the Site Report has been released, typically at the end of the write-up season.

5.3. MapInfo Data

Map data are stored in MapInfo in a series of 6 tables: Vegetation polygons, Mosaics, Mosaic Polygons (generated from Mosaic & Vegetation), Quadrats, Photo Locations, Target Notes, and Site Boundaries. Sites need to be digitised as individual sets of tables using the following templates, and then combined into the master tables by the data manager (Sam Bosanquet) once completed and released.

5.3.1. Vegetation and other polygons

Polygon boundaries should be digitised to register, where appropriate, with detail on the OS Landline base maps (until 2007) or OS MasterMap (for sites surveyed in or after 2007 onwards). Where the vegetation boundary follows a feature not present on the OS Landline/MasterMap data but follows a SSSI boundary, the vegetation boundary should be "snapped" to the SSSI boundary. Each polygon should have the following attributes (the data type for each attribute is shown in brackets with the column width given after a comma):

- **vegetation_type** (character, 70) - this will be the vegetation type for each polygon. It will be either a coding to a plant community recognised in the National Vegetation Classification (NVC) (e.g. M5, M15b, S24a) or a text string describing the vegetation or other feature (e.g. Willow Scrub, Carex nigra-dominated vegetation). Where a vegetation mosaic is present the **vegetation_type** should be entered as "Mosaic". Details of the mosaic composition should be recorded in a secondary table, which will contain only text and have no map features (see 5.3.2).

- **condition** (character, 70) - certain vegetation condition categories can be entered (see Annex V).

- **area_ha** (decimal, 6,2) - the area of each polygon will be calculated using the MapInfo Phase II Query tool.

- **poly_ID** (character, 15) - each polygon should be given a unique alpha-numeric label comprising the site code (e.g. SN03/01P for Cwm Dewi) followed by a sequential numeric value, generated using Table, Update Column, "SN03/01P/"+RowID. Thus the first digitised polygon for site SN03/01P would be labelled SN03/01P/1, the next SN03/01P/2 and so on.

- **site_code** (character, 10) - each polygon should be attributed with the site code. Zeros should be used in the site code to ease sorting (e.g. SN03/**01**P).

- **site_name** (character, 70) - each polygon should be attributed with the agreed site name appropriate to the site_code.

5.3.2. Mosaics

The **poly_ID** column in the Mosaic table links this secondary table to the primary vegetation table; the mosaic table has no map features. Each mosaic record should have the following attributes (the data type for each attribute is shown in brackets with the column width given after a comma):

- **vegetation_type** (character, 70) - this will give the vegetation type for a single component part of the mosaic.

- **condition** (character, 20) - certain vegetation condition categories can be entered (see **Vegetation Condition.xls**) on PEATSURV.

- **percentage** (integer) - this will give percentage cover of each component part of the mosaic.

- **area_ha** (decimal, 4,2) - the area of each mosaic component will be calculated by MapInfo.

- **poly_ID** (character, 15) - will match the poly_ID given to the mosaic record in the primary table.

- **site_code** (character, 10) - each mosaic component should be attributed with the site code.

Each component **vegetation_type** within the mosaic will be recorded separately within the secondary table. For example if polygon SN03/01P/54 is a mosaic, consisting of 60 % S6, 35 % S14 and 5 % OV26, then the secondary table will include 3 records, each with a **poly_ID** of SN03/01P/54.

Note: In all instances the summed percentage for each unique Poly_ID in the secondary table will equal 100, equating to 100% vegetation coverage for that polygon. The Phase II Display Tool will refuse to produce mosaic polygons for records that do not add up to 100 %, so should be used as confirmation of accuracy.

5.3.3. Mosaic polygons

Mosaic grids, composed of coloured squares in proportion to the mosaic components, are generated by the Phase II Display tool. Each polygon will have a single attribute:

- **vegetation_type** (character, 70) - this will be the vegetation type assigned by the Display tool.

5.3.4. Quadrat records

Quadrat locations should be shown as point features (8 point stars, from the MapInfo 3.0 Compatible set) and should be positioned to exactly match their location on field maps. Each record should have the following attributes (the data type for each attribute is shown in brackets):

- **quadrat_number** (character, 3) - each point feature should be assigned the quadrat number given to it during the survey. Quadrats should not include the Q prefix that has occasionally been used in the past.

- **vegetation_type** (character, 70) - this will give the vegetation type in which the quadrat was sampled.

- **date** (Date) - the date on which the quadrat was sampled should be entered, formatted as "27/04/2006").

- **quadrat_ID** (character, 15) - each point feature should also be given a unique alpha-numeric value comprising a combination of the site_code and the quadrat_number. Thus Q1 at Cwm Dewi will be SN03/01P/1, Q2 will be SN03/01P/1, and so on.

- **site_code** (character, 10) - each point feature should be attributed with the agreed site code, which will be identical to that entered for the vegetation polygons.

- **site_name** (character, 70) - each point feature should be attributed with the agreed site name appropriate to the site_code.

5.3.5. Photographic records

Photo locations should be shown as point features (8 point triangles, from the Marlett set, pointing in the direction of the camera_orientation; the symbols for N, E, S and W should be rotated through 45 degrees to give the 4 intervening directions) and should be positioned to exactly match their location on field maps. Each record should have the following attributes (the data type for each attribute is shown in brackets):

- **photo_number** (character, 3) - each point feature should be given the photograph number assigned to it during the survey.

- **camera_orientation** (character, 2) - each point feature should be given an approximate orientation based on an 8 point compass (i.e.-N,NE,E,SE,S,SW,W,NW).

- **photo_ID** (character, 15) - each point feature should be given a unique alpha-numeric value comprising the site_code followed by the individual photo_number.

- **site_code** (character, 10) - each point feature should be attributed with the agreed site code, which will be identical to that entered for the vegetation polygons.

- **site_name** (character, 70) - each point feature should be attributed with the agreed site name appropriate to the site_code.

- **photo_caption** (character, 180) - each photograph should be captioned with the same text used on the Photograph sheet (6.2.5).

- **hyperlink** (character, 70) - at present this column is left blank, but it may be used to create hyperlinks to all photographs once photo storage has been finalised

5.3.6. Target note data

Target note locations should be shown either as point features (2 point circles, from the MapInfo 3.0 Compatible set) placed to exactly match their location on the field map, or as polygons with patterning (e.g. black stipples), dotted lines and no background. Each record should have the following attributes (the data type for each attribute is shown in brackets):

- **target_note** (character, 254) - the target note given for each location should be entered as a free-text string such that it matches any significant target notes on the

field map. Use the following format for Mosaic target notes: "Mosaic of: 60% S6, 35% S14, 5% OV26" i.e. check colon, comma and % placement and use lower case for scrub, bracken etc

- **target_ID** (character, 15) - each point feature should be given a unique alpha-numeric value comprising the site_code followed by a sequential numeric value.

- **site_code** (character, 10) - each point feature should be attributed with the agreed site code, which will be identical with that entered for the vegetation polygons.

- **site_name** (character, 70) - each point feature should be attributed with the agreed site name appropriate to the site_code.

5.3.7. Site features

The Site Features table should be produced in MapInfo using the translation button of the Phase II Query Tool. This can be done on a saved copy of the vegetation map on which polygons labelled "Mosaic" have been deleted and replaced with the squares copied from the Mosaic Polygons layer. Translation to features is inexact because some communities represent different features when in different situations, so very careful checking is needed during the production of this layer. Each polygon should have the following attributes (the data type for each attribute is shown in brackets with the column width given after a comma):

- **SSSI_feature** (character, 70) - the 'feature' generated by the Phase II Query Tool, carefully checked to ensure that it is correctly interpreted for the site.

- **vegetation_type** (character, 70) - the vegetation type that matches the polygon in the vegetation map layer.

- **poly_ID** (character, 15) - the polygon ID that matches the polygon in the vegetation map layer.

- **site_code** (character, 10) - the site code for the site.

- **condition** (character, 70) - condition classes to match the polygons in the vegetation map layer.

- **area_ha** (decimal, 6,2) - the area of each polygon from the vegetation map layer.

- **site_name** (character, 70) - the agreed site name.

5.3.8. Site boundaries

Each site boundary should be produced by combining all of the polygons in the vegetation table and should have the following attributes (the data type for each attribute is shown in brackets). This is a useful step at which to identify minor digitising errors:

- **site_code** (character, 10) - each site polygon should be attributed with the agreed site code.

- **site_name** (character, 70) - each site polygon should be attributed with the agreed site name appropriate to the site_code.

- **grid_ref** (character, 8) - the central Grid Reference (6-figures) of each site polygon will be calculated by Mapinfo.

- **area_ha** (decimal, 5,2) - the area of each site will be calculated by MapInfo.

- **glastir_type** (character, 70) - broad wetland type to match Glastir habitats.

- **survey_date_1** (date) - the first date of the survey.

- **survey_date_2** (date) - the last date of the survey.

- **surveyors** (character, 30) - a list of the initials of all surveyors involved in the survey.

- **CCW_team** (character, 30) - the CCW team covering the area within which the majority of the site lies.

- **region** (character, 30) - the CCW region (from 2004) within which the majority of the site lies.

- **area_of_search** (character, 30) - the Area of Search (for evaluating Sites of Special Scientific Interest) within which the majority of the survey site lies (see NCC, 1989, *Guidelines for selection of biological SSSIs*).

- **unitary_authority** (character, 30) - The unitary authority administrative area within which the majority of the site lies.

- **vice_county** (character, 30) - The vice-county within which the majority of the site lies.

- **Digitised_by** (character, 30) - The individual or team responsible for digitising the data for each survey site (e.g. "CCW(SB)").

- **Digitised_to** (character, 15) - "MasterMap" or "Landline", according to which OS map was used during digitising.

5.4. Database

Quadrat and area data (see 5.1 & 5.2) have been uploaded to a Recorder 6 database covering those survey sites that had been completed up to the end of 2010. Further updates of the database are needed in the future, and it will prove most valuable when the final analysis of the survey is carried out (see 6.5).

6. Report Production

6.1. Structuring of reports

Site reports resulting from the Lowland Peatland survey must be produced accurately and consistently. A site pack composed of six elements should be released for each site prior to the start of the following field season.

A complete site pack includes:

- Summary Sheet: with site information, owner/access details and a list of recorded vegetation types, the area each occupies and the quadrat samples recorded within them.
- Site Description: with an introduction, vegetation descriptions, management details and conclusions on the site's conservation value
- Site NVC Map: including vegetation polygons, quadrat locations, photo locations, target notes and legend.
- Site Features Map: translated from the NVC Map and at an identical scale, with a legend.
- Site Data Tables: presenting quadrat Domin data and stand DAFOR data for each vegetation type
- Photograph Sheet: with up to 8 photographs and captions for each.

6.2. Guidance on the contents of individual sections

6.2.1. Summary Sheet

The summary sheet for each site should follow the same format, based on a recent example. The site area should be given to 1 decimal place except on sites of <5ha extent, and community areas should likewise be presented at 1 decimal place, with minor communities given as "<0.1 ha". Broad habitat sub-headings are the same as used in the Site Description. An example summary sheet, with the first two sections completed in full but only two communities listed, is provided below.

CYNGOR CEFN GWLAD CYMRU
COUNTRYSIDE COUNCIL FOR WALES

Lowland Peatland Survey Site Report

Site name	**Site number**	**Grid reference**
Glyn Bog	SN31/08P	SN 381 188
Area of search	**CCW Team**	**Unitary Authority**
Carmarthen & Dinefwr	Carmarthenshire	Carmarthenshire
Status	**Site area (ha)**	**No. of compartments**
-	0.83	1
Date of survey	**Surveyors**	**Altitude (m aOD)**
20 June 2011	S.D.S. Bosanquet	35
No. of photos	**No. of quadrats**	**No. of comm. (DAFOR) lists**
4	5	1

Situation type
Basin wetland

Owners/occupiers, access permission details, and requests for survey information

Owned by Carmarthenshire County Council.
Permission to survey organised by Isabel Macho, CCC Biodiversity Officer.

NVC vegetation types and other features

Code	Type	Quadrats	Area (ha)
<u>Lowland Bog (ombrogenous)</u>			
M2b	*Sphagnum cuspidatum*/*recurvum* bog pool community, *Sphagnum recurvum* sub-community	2	0.02
<u>Fen (topogenous)</u>			
M23b	*Juncus effusus/acutiflorus* - *Galium palustre* rush-pasture, *Juncus effusus* sub-community, swampy variant	-	<0.01

6.2.2. Site Description (majority of sites)

The Site Description should be headed in bold, 11 point Times New Roman:
SN69/09aP Cwm Gwynllyn: site description

Introductory sections should include the following paragraphs:
A description of the location of the site with respect to nearest settlements, A/B roads etc. Compass points should be in lower case and hyphenated in the case of 'eighths' – e.g. south-west. Sixteenths can be abbreviated e.g., NNW. All distances should be in km, or m where more appropriate for smaller distances. Some attempt should be made to describe the physical context of wetland – i.e. in what sort of landform it occurs within the landscape. This is the situation type (see Annex IV), and examples include basin, valley-head and hill-slope. An outline of the catchment characteristics (for sites with a definable catchment) should include the main habitat elements (to Phase I level), slopes (categorised only as gentle, steep etc), presence of outcrops and conspicuous hydrological features such as discrete spring heads, seepage zones, ditches etc. The outline morphology of the wetland should be described – e.g. size (ha), shape in plan (e.g. roughly circular, elliptical or complex), long axis alignment with respect to compass points (for sites with a long axis) and number of compartments.

An outline description of the catchment/underlying site geology (solid and drift) follows in a new paragraph. There is a solid geology layer on Mapinfo (BGS Geology). An overview of the main substratum type/s where known can also be presented here (e.g. peat, silt, clay etc), but any more detailed discussion of variations in relation to vegetation should be saved for the vegetation descriptions. Detailed stratigraphy notes can be included here or, if very detailed, in an appendix. This is probably the best place to describe any obvious variations in surface morphology due to peat cutting. Lack of visible evidence for peat cutting should also be mentioned. Soils cover for sites can be described based on local county memoirs where available or the 1:250,000 scale NatMap soils data-set available on CCW's MapInfo system. Hydrology needs to be described in a non-technical way. Attention should be made to the apparent influence of drainage ditches (with direction of flow noted on vegetation maps), peripheral seeps, spring-heads, general position of water table and whether buoyant rafts are likely to help maintain seasonally constant water levels relative to the mire plane. General observations on site wetness can be very useful – e.g. "the mire was very dry at the time of the survey, with water rarely closer than 25 cm to the surface". WETMECs (see 3.2.2), if apparent, should be discussed here, with indications of why different parts of the site fit different WETMECs. However, defining which WETMECs may be present and their limits could be extremely difficult and time consuming and is not a primary emphasis of the survey. Sites included in the Wetland Framework project (Wheeler et al, 2009) will already have listings of the main WETMECs – PSJ holds a spreadsheet itemising WETMECs by sites.

Habitat elements need then to be tied in to WETMECs or at least broad hydrotopographical units. These habitat elements also form the sub-sections used in the habitat and vegetation descriptions. The major NVC communities represented within each habitat element should be included in parentheses, but there is no need to be exhaustive with these lists of NVC communities. For example: "Numerous runnels of soligenous fen (**M6** & **M29**) cross the bog and fen. Shallow peat and mineral soils support marshy grassland (**M23** & **M25**) and dry grassland (**MG6**, **MG9**, **MG10** & **U4**), and there are scattered trees and blocks of willow scrub".

Ideally some reference should be made to previous survey coverage. It would be useful to note whether mire elements were covered in previous WLPS etc surveys, and whether other components have been included in related strategic survey programmes – e.g. grasslands/heathlands.

Brief reference should be made concerning the geographical relationship of the site to adjacent wetlands or related sites within distinct geographical regions (e.g. the pingo mires of south-west Wales).

Habitat and vegetation descriptions
This section should be split by habitat type, largely corresponding to SSSI features. The key element of the site's vegetation should usually be discussed first, for example fen and bog are usually covered before swamp and woodland. On lake margin wetlands it is usual for open water, swamp, fen and bog to be covered in roughly hydroseral order. A few complexes of basin mires have had their individual basins covered one by one, with all vegetation types in a basin covered together.

Sub-headings should be underlined and not bold. The usual sub-headings are:
Bog (ombrogenous) – ombrotrophic vegetation
Fen (topogenous) – all topogenous vegetation, sometimes subdivided into heathy, marshy grassland or fen meadow, bog and swamp elements.
Fen (soligenous) – soligenous vegetation on deep peat
Swamp – i.e. swamp vegetation on shallow peat/mineral soils
Flush (soligenous) – soligenous vegetation on shallow peat, usually gently sloping
Marshy grassland – on shallow peat
Wet heath – on shallow peat
Dry heath
Dry grassland
Woodland & Scrub
Other features

In describing communities, any obvious associations between communities and readily identifiable hydrotopographic elements should be mentioned – e.g. M29 in soakways, patches of S3 or M37 on spring mounds.

The way in which communities are dispersed/aggregated (i.e. discrete stands, mosaic components etc), their gross physiognomy, key floristic elements, relationship to NVC communities, sward structure and microtopographic features like runnels, hummocks/hollows etc. should all be discussed. An assessment of condition and floristic typicalness is needed for the most important communities on a site.

Uncommon plants
All noteworthy plants, bryophytes and lichens should be discussed, including information on population size and distribution by compartment and community. Bullet points are often a useful way of presenting this information:
"*Empetrum nigrum* is widespread and abundant across much of the bog. It is much more frequent on the bogs of central Carmarthenshire than was previously thought."
"*Vaccinium oxycoccos* is also frequent to abundant in 'Nodum 19c'."

Management
This is an important section as survey visits will sometimes constitute the best source of evidence relating to management requirements. Factors to be borne in mind include grazing, the effect/s of active drainage, any visible evidence for burning, scrub encroachment and evidence of nutrient enrichment (using markers such as advancing *Phragmites*/*Typha* fronts, bright green patches of *Agrostis stolonifera*, *Glyceria* sp. etc). Recommendations for management changes are also best presented here, as this is the section that site managers are most likely to refer to.

Conclusion and conservation summary.
The primary communities of importance need to be summarised here and some attempt to

evaluate the site's conservation value should be made. Without the overview of a full series of wetlands from across an Area of Search this will often prove a difficult section to write, but it is a very important first evaluation.

The principal author's name and the year of production should conclude the main Site Description, but may be followed by References and Addenda (e.g. on recorded fauna).
"Dave Reed
CCW HQ, 2006"

6.2.3. Site Description (National Nature Reserves)

More detail is needed in the introductory section for significant peatland National Nature Reserves and selected other large sites. It is best to refer to an example account, such as those for Crymlyn Bog or Cors Bodeilio.

The Site Description should be headed in bold, 11 point Times New Roman:
SS69/21P Crymlyn Bog: site description

Followed by the subtitles:
1 INTRODUCTION

1.1 Survey background and introduction to Crymlyn Bog
This should include paragraphs on the strategic peatland survey, identified needs for survey on the site, access routes on to large peatlands, and management units, including a map of the site with management units labelled.

1.2 Site location and morphology
This section covers the location of the site in terms of nearby settlements and roads, its overall shape, and surrounding land use.

1.3 Geology
A geological map should be presented along with some interpretation of how the geology influences the wetland's hydrology.

1.4 Wetland stratigraphy and basin morphology
Many National Nature Reserves and other large peatlands will have been subject to at least some stratigraphic sampling. This should be covered and discussed, at least briefly, and links made to current vegetation if applicable. Stratigraphy diagrams may be added here is properly referenced to the original paper in which they were presented. The appendix dealing with Welsh sites in Wheeler et al (2009) is an important source of information for those Welsh sites included in the Wetland Framework Project: PSJ holds a spreadsheet itemising which Welsh sites were included.

1.5 Climate
A brief paragraph on the local climate.

1.6 Hydrogeology, hydrology and water supply mechanisms
Any previous hydrological investigations should be discussed, with reference to the impacts of hydrology on the vegetation at a broad scale. Detailed links between hydrology and vegetation can be made when individual communities are being discussed. WETMECs need to be covered here, and it may be possible to overlay a diagram showing flow routes with the approximate distribution of key WETMECs (Figure 6.1). Springs, seepages and other water supply mechanisms need to be highlighted here, and information should be given as to whether these springs have been observed or assumed from the vegetation.

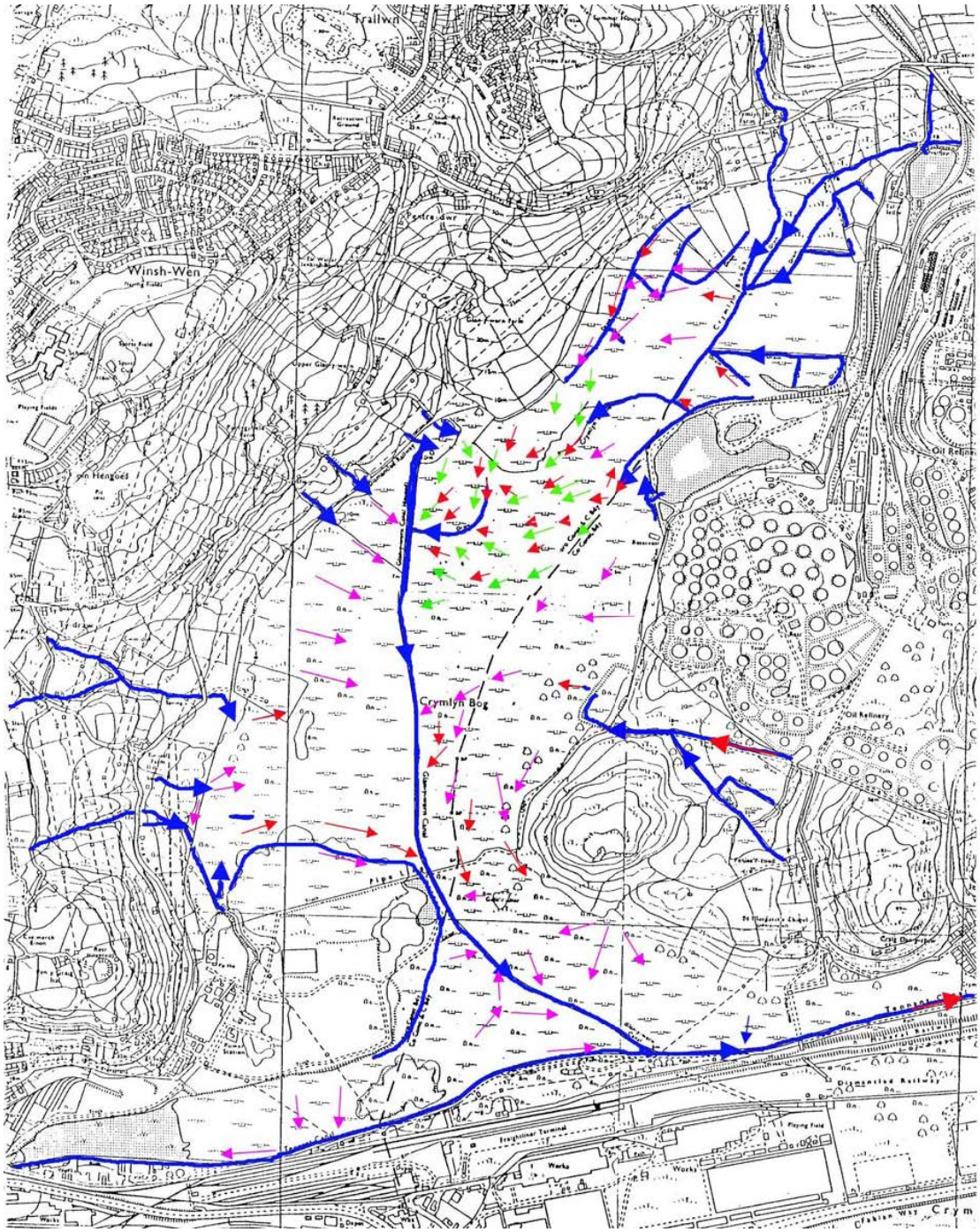


Figure 6.1 (from Crymlyn Bog site account): observed flows at Crymlyn Bog overlain with WETMEC numbers derived from observations of the vegetation and flow pattern.

1.7 Previous survey coverage

Discussion of previous survey coverage should include differences between past and current findings and analysis of floristic change.

1.8 Overview of vegetation cover

The key communities within each broad habitat type should be identified and listed, along with an overview of the distribution of those habitat types across the site. On large sites it may be appropriate to examine patterning on individual management units.

2 SURVEY METHODS

2.1 Methodology

There is a standard set of paragraphs covering the survey methodology, and these can be copied from one of the example sites and modified.

2.2 Nomenclature

Again there is standard wording on species nomenclature and use of Domin and DAFOR scales.

3 HABITAT AND VEGETATION DESCRIPTIONS

3.1 NVC communities

This section needs to be subdivided into features-level habitats, with NVC (sub-)communities covered in separate paragraphs. The usual habitat headings are listed in 6.2.2.

3.2 Annex 1 habitats

An Annex 1 habitat map should be presented here, along with individual discussion of the composition and condition of Annex 1 habitats on the site.

4 UNCOMMON SPECIES

Species need to be discussed in detail, including information on population size and community occupancy, using the following headings.

4.1 Uncommon vascular plants

4.2 Uncommon lower plants

5 MANAGAMENT

This is best covered in individual management units and should include both observations on current management and recommendations on management that might enhance the wetland interest.

6 CONCLUSION AND CONSERVATION SUMMARY

The primary communities of importance need to be summarised here and some attempt to evaluate the site's conservation value should be made. Without the overview of a full series of wetlands from across an Area of Search this will often prove a difficult section to write, but it is a very important first evaluation.

6.2.4. Site Map

Great care is needed to ensure that vegetation maps are consistently produced and are of a high level of accuracy. This guidance should be followed precisely to give a map that looks like the one presented in Figure 6.2.

- Open the Vegetation, Mosaic Polygon, Features, Quadrat, Photo and Target Note Layers.
- Open OS MasterMap and a 1 km grid

- Create a new Blank table with one column or open a stored version
- Make sure you're editing Blank, choose no pattern for polygon style and draw a rough polygon around the site boundary followed by a huge polygon large enough to cover your chosen paper size
- Using Objects - Set Target - Erase cut the smaller polygon out leaving a doughnut
- Delete the small polygon and change the style of the doughnut to solid white fill with no border

- ☐ Use the Phase II Display Tool to Open/Create Legend using the following set-up:
  - Create new Legend Table
  - Create new table: G:\new_legend.tab (default)
  - New Legend For Open Table
  - Primary Table: Vegetation
  - Key Column: vegetation_type
  - Secondary Table: Mosaic
  - Copy the styles from the existing legend Peatland_Master on PEATSURV
- ☐ Use the Display Tool to Edit Legend
- ☐ Re-order the vegetation types to agree with the Summary Sheet
- ☐ Remove Mosaic from the legend
- ☐ While you're working on the Legend get it into a final form by double-clicking on it
  - Change the title to "Key to vegetation types"
  - Change the sub-title to "and other features"
  - Make sure that all fonts are Times New Roman

- ☐ Using layer control, arrange the layers into the following order:
  - TargetNote
  - Photo
  - Quadrat
  - Blank
  - 1km grid
  - os_all
  - Mosaic Polygons
  - Vegetation
  - Features

- ☐ Make the Cosmetic layer editable then find the southern and western ends of any grid lines (where they disappear behind the blind) and type in a 3 figure easting or northing (8pt Times New Roman)

- ☐ Use layer control to label (tick right hand box then click Label…) the target note layer filling in
  - Label with: target_note
  - choose Visibility On
  - tick Allow Duplicate Text
  - tick Allow Overlapping Text
  - Style 8pt Times New Roman with Simple Label Lines
  - Anchor Point in the centre
- ☐ Move the target notes on the Map Layer until they are positioned logically around the map

- ☐ Use layer control to label (tick right hand box then click Label…) the quadrat layer filling in
  - Label with: quadrat_number
  - choose Visibility On
  - tick Allow Duplicate Text
  - tick Allow Overlapping Text
  - Style 8pt Times New Roman black with white halo with No Label Lines
  - Anchor Point top right, offset 2 points

- ☐ Use layer control to label (tick right hand box then click Label…) the photo layer filling in
  - Label with: photo_number
  - choose Visibility On
  - tick Allow Duplicate Text
  - tick Allow Overlapping Text
  - Style 8pt Times New Roman black with red halo with No Label Lines
  - Anchor Point top right, offset 2 points

- ☐ Use the green Template tool to create a layout
- ☐ Choose whichever paper size fits the map whilst leaving sufficient space for a legend and labels
- ☐ Fill in as follows:
  - Title "SN03/01P Cwm Dewi: vegetation map"
  - Scale 1:2500
  - Grid Interval none

- ☐ Click on the outer (thin) border and delete it then click on the inner (thick) border and delete it
- ☐ Double click on the title and make sure the font is 12pt, bold, Times New Roman
- ☐ Select all three bits of writing below the map (holding down shift) and check they are 7pt Times New Roman.
- ☐ Double click on "Produced by CCW on: 3 December 2007" and change text to:
- ☐ "Mapped by Sam Bosanquet & Dave Reed
  CCW HQ, 2006"
- ☐ Use the yellow Frame tool to draw a frame on the Layout in which the Legend (.Legend) goes
- ☐ The following explanatory text needs to be added in 8pt Times New Roman at the bottom of the legend in a separate Text Box.

"Chequered colours indicate vegetation mosaics
Stars and white-edged numbers indicate quadrat locations
Triangles and red-edged number indicate photo locations"

- ☐ **Do not zoom in or out with the Layout Tools Zoom, you can use the Main zoom to zoom in on the layout**
- ☐ Minimise the layout and use the Hand tool on the map window to position the map where desired. The Map window and layout correspond exactly, **do not zoom in or out otherwise the scale on the Layout will be altered**
- ☐ Check that the target notes are positioned correctly, if not then move them (without zooming in) on the Map window

- ☐ Print an initial copy to check that everything is correct
- ☐ Once corrected, print 3 copies for inclusion in site packs

- ☐ Make the Vegetation, Mosaic Polygons, Quadrat, Photo and Target Note layers invisible using Layer Control
- ☐ Use the Phase II Display Tool to Open/Create Legend using the following set-up:
  - Create new Legend Table
  - Create new table: G:\new_legend.tab (default)
  - New Legend For Open Table
  - Primary Table: Features
  - Key Column: SSSI_feature
  - Secondary Table: None
  - Copy the styles from the existing legend FeaturesLegend on PEATSURV

- Reorder the legend categories to match the Summary Sheet
- Double click on the legend Text Box to add this new legend
- Replace the text in the text box about Chequered colours with "This map shows the distribution of SSSI habitat features and has been produced from the NVC community map by employing a mixed generic/site-specific translation of NVC communities to SSSI features. Some feature boundaries may be inexact because of the need for peat depth and hydrological information to determine their nature."

- Print an initial copy of this features map to check that it exactly matches the size and layout of the NVC map
- Print 3 copies for inclusion in site packs

6.2.5. Site Features Map

The production of the Site Features Map is included in section 6.2.4. The production of a Site Features table is described in 5.3.7.

6.2.6. Site Data Tables

Site Data Tables are produced following the pattern set out in 5.1.2. Each should be printed once per copy of the site report. Ideally, they should be produced on Portrait A4 at 80% (Print Preview, Setup, Page) and centred on the page (Print Preview, Setup, Margins); lower zooms (minimum 65%) or A3 may need to be used for large tables. Order the set of Site Data Tables as on the Summary Sheet.

6.2.7. Photograph Sheet

The Photograph Sheet must be formatted to fit in with the rest of the site pack. The title (11 point bold Times New Roman) should include the site code and site name, followed by ": photographs" (e.g. **SS19/1P Cors Penally: photographs**). Each caption should sit immediately below the photo and should be one line long, starting with "Photo 1: ", and giving a brief description of what the photograph shows. Two photographs fit on to a single side of A4, and photo sheets must always be printed double-sided.

6.3. Review and cross-editing

Prior to the final printing of the site report, all sections need to be reviewed by at least one other member of the survey team, preferably by somebody familiar with the site in question. Cross-editing should aim to correct both the factual elements of the report and its grammar. Reports must always be re-read by their author before they are sent for cross-editing. Following acceptance/rejection of suggested edits, the final draft of the Site Description needs to be signed-off by the Peatland Ecologist, who almost always has useful observations on hydrology or ecology to add to an account.

6.4. Issue of reports to District offices and other parties

A single printed copy of the report, comprising all six elements described above, will be distributed to the district office once it has been signed-off by the Peatland Ecologist. Any other relevant parties may request copies of the reports, as may site owners. Care should be taken over releasing site owner data, and the owner's names and contact details need to be removed from the Summary Sheet prior to printing.

6.5. Final analysis and report output

Once the survey is complete (see 1.3), a final analysis of the Welsh Lowland Peatland

resource will be needed, including identification of the key sites for peatland conservation. Given the detailed assessment of so many sites, *de novo* evaluation of a number of current SSSI and also non-statutory wetlands, and documentation of novel communities of wetland plants, a treatment similar to *Grasslands of Wales* is surely justified. Individual reports for Areas of Search are unlikely given the limited staff time available and, for some AoS at least, the relatively modest number of sites.

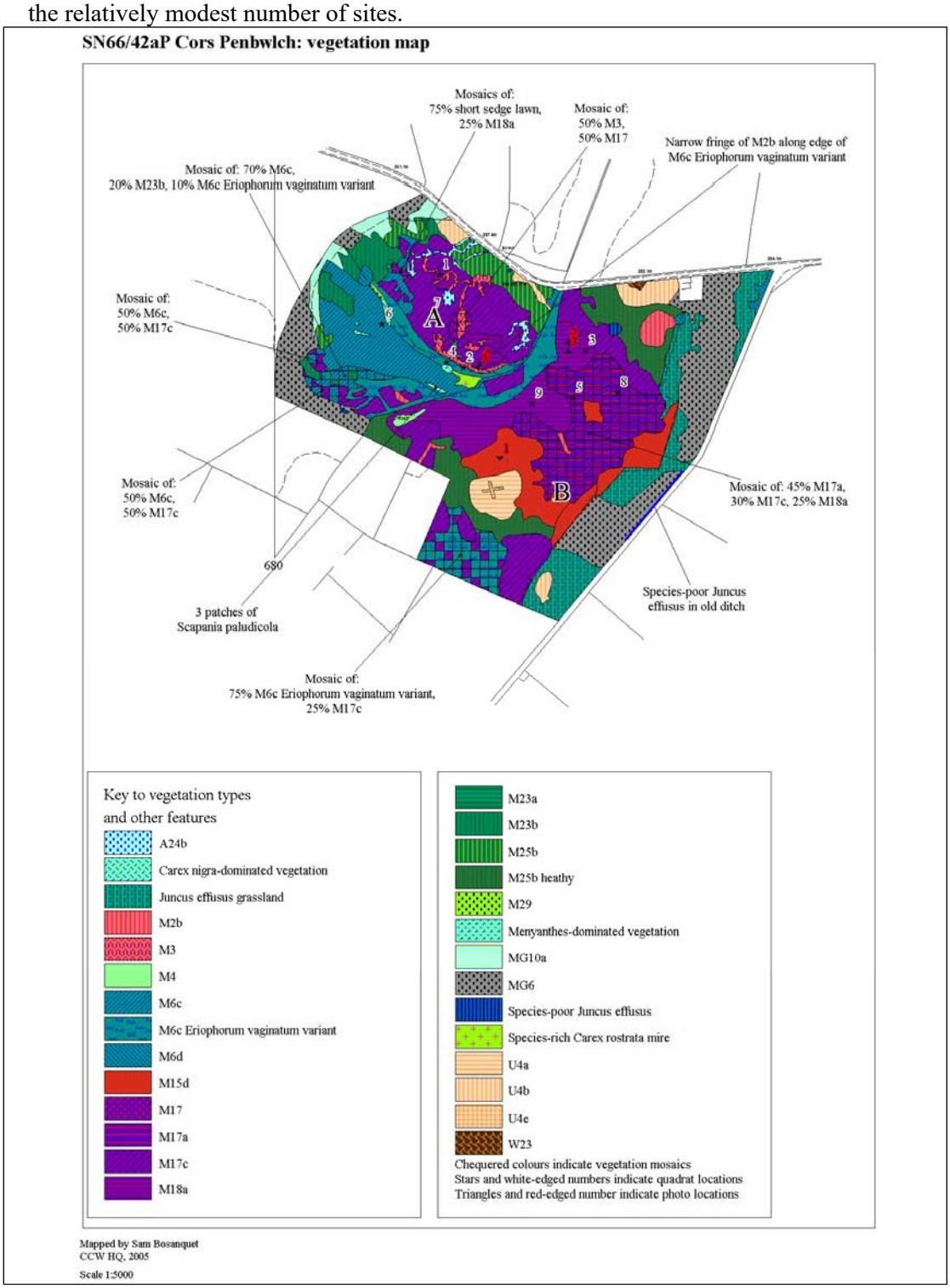
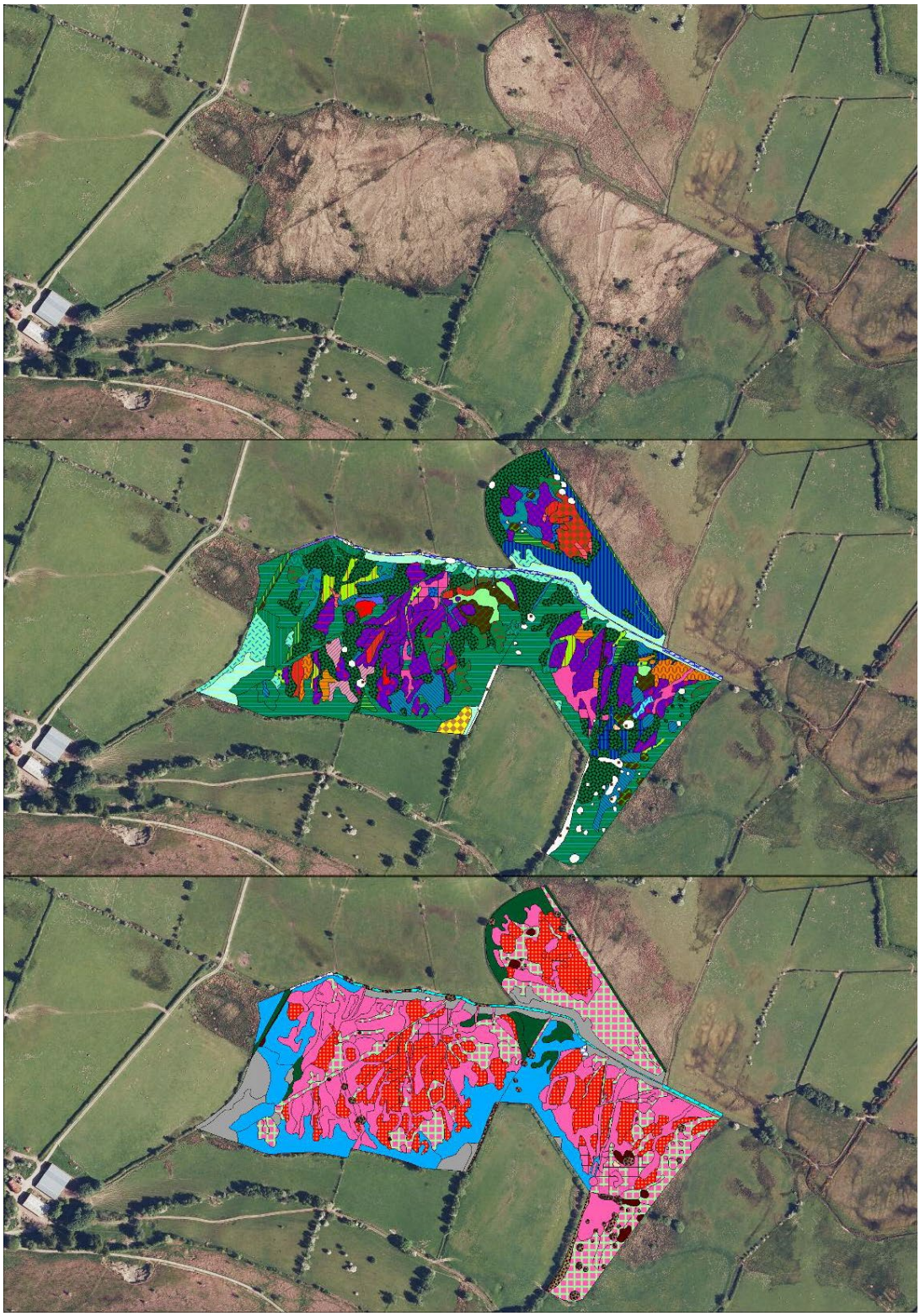


Figure 6.2: a typical vegetation map, with compartment letters, quadrat and photo numbers, target notes and a legend. Note that this site was presented at 1:5000 scale because it was mapped in 2005; almost all sites are now presented at 1:2500 scale.



Figures 6.3-6.5: an aerial photograph, NVC map and translated features map for Cors Cae'r Neuadd SSSI; the legends are too complex for inclusion on these small diagrammatic maps, which merely illustrate the complexity of mapping and relatively lower number of categories on the translated map. Aerial Imagery © COWI/Vexcel.

7. Heath & Safety Precautions

7.1. Risk assessment

The generic risk assessment for field survey covers all feasible situations. Specific assessments will not usually need to be written for individual sites, but surveyors should consult local regional staff and site files to ensure that hazards of particular reference to a site have been identified. Site-specific assessments should be used where already written or where the specific hazards on a site dictate their requirement. Additional points of especial importance are noted below.

Staff are individually responsible for ensuring they are appraised of H&S advice updates issued centrally by CCW.

7.2. Lone working

Paired working is always preferable and on some sites may be mandatory subject to the assessment under 7.1. Lone workers must:

- carry a charged mobile phone,
- have a designated buddy for the day,
- leave the buddy with a six figure NGR centroid of where they are working,
- identify a return home time,
- leave the buddy with clear instructions of who to ring in the event of an ETA 'no-show'. This can be PSJ or a regional staff member. Where the latter is used, ensure they are equipped with PSJ's contact details (Home 01248 470223, Mobile 07769960932, office 01248 387261).
- If you leave the site and move to another location you must notify your buddy that you are doing so and give them an updated NGR and ETA.

7.3. Lightning strike

Weather forecasts should be checked the morning before a site visit and fieldwork avoided where lightning is forecast. If thunderstorms develop when on site, leave the site if it is safe to do so; if not, distance yourself from any metal objects (particularly soil corers) and assume a hunched posture as close to the ground as possible.

7.4. Exposure to sun

The risk of sun exposure cannot be overstated. Minimise the exposure of skin, wear a hat and use a high factor sub-block (min. 20) on exposed parts. CCW will reimburse the cost of sun-block.

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Main lowland peatland communities (bold = rare) occurring in Wales are:
M1, M2, M4, M5, M6, **M9**, M10, M13, **M14**, M15, M16, M17, M18, M20, M22, M23, M24, M25, M27, M28, M29, **M30, M37**
S1, **2**, S3, S4, S5, S6, S7, **S8**, S9, S10, **S11**, S12, **S13**, S14, **S18**, S19, S20, S21, S22, S23, **S24**, S25, S27, S27, S28.

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ANNEXES.

Annex I. Summary of correspondence between vegetation noda resulting from the Welsh Lowland Peatland Survey (Ratcliffe & Hattey, 1982; Ratcliffe, 1983) and the National Vegetation Classification Scheme.

Ratcliffe & Hattey scheme		***NVC***
1.	*Glyceria maxima* association	S5
2.	*Sparganium erectum* - *Glyceria fluitans*	S14a / S22?
3.	*Cladium mariscus* swamp	S2 pp
4.	*Cladium mariscus* - *Rubus fruticosus*	**S2** pp
5.	*Schoenus nigricans* - *Juncus subnodulosus*	M13, M22pp
6.	*Acrocladium cuspidatum* - *Carex diandra*	M9
7.	*Potentilla palustris* - *Carex rostrata* association	S27a
7a.	*Lemna minor* variant	**S27**a
7b.	Typical variant	**S27**a
8.	*Carex rostrata* reedswamp	S9
9.	*Phragmites australis* reedswamp	S4
10.	*Molinia caerulea* - *Myrica gale*	M25pp
11.	*Hypericum elodes* - *Potamogeton polygonifolius*	M29
12.	Wet Meadow Complex	M23 pp / M27 pp
12a.	*Molinia caerulea – Juncus* spp. variant	M23 / M25 pp
12b.	*Agrostis canina – Juncus effusus* variant	M23 / M25 pp
12c.	*Molinia caerulea* mire variant	M25 pp
12d.	*Molinia – Eupatorium cannabinum* community	M25c
12e.	*Molinia caerulea – Juncus squarrosus*	M25 pp
13.	*Iris pseudacorus – Mentha aquatica*	M27?
14.	*Carex paniculata – Rubus fruticosus*	S3
15.	*Phalaris – Phragmites – Epilobium hirsutum* tall fen community	
15a	*Angelico – Phragmitetum* subassociation	**S26 / S28** / S25?
15b.	*Carex riparia* subassociation	S6
16.	Fen meadow community	M23 pp / M27 pp
17.	*Sphagnum recurvum – Juncus effusus*	M6
18.	*Sphagnum – Carex nigra*	~ M6
19.	*Vaccinium oxycoccus – Sphagnum recurvum*	~M2
20.	*Carex rostrata – Sphagnum recurvum*	M4 pp, M5 pp
21.	*Erica tetralix – Sphagnum magellanicum*	
21a.	*Andromeda polifolia – Rhynchospora alba* complex	M18 pp
21b.	*Sphagnum papillosum – Erica tetralix*	M18 pp
21c.	*Trichophorum caespitosum – Eriophorum angustifolium*	M15 pp, M17 pp
22.	*Molinia caerulea – Pohlia nutans*	M25?

Key: ~ Poor fit; pp *pro parte* (some overlap only); emboldened codes = translations provided by Rodwell (1995; Swamps vol.).

Based in part on Shaw, S.C. & Wheeler, B.D. (1998). *An inventory and conservation audit of lowland fens in Wales.* CCW Contract Science Report No. 298. CCW, Bangor. DRAFT ONLY.

Annex II. Summary of previous survey information available for Welsh lowland peatlands excluding the Welsh Lowland Peatland Survey. Surveys are listed by CCW District in alphabetical order. References accompanied by bibliographic details in the reference list are only given for those surveys which yielded a written report. Most reports are held on file by the CCW Peatland Ecologist in Bangor. (incomplete)

Site / focus of survey/ status	***NGR***	***District***	***Date***	***Mapping (yes/no, characteristics)***	***Quadrats***	***Reference. I = in-house, C = commissioned***
Cors Erddreiniog / rich fen / SAC	SH 472820	Angl.	1980	No. Quadrat loci marked and assigned to Wheeler (1980a, b & c) units	> 50	Meade (1981). I
Cors Goch / rich fen / SAC	SH 500815	Angl.	1980	No. Quadrat loci marked and assigned to Wheeler (1980a, b & c) units	> 50	Meade (1981). I
Cors y Farl	SH 490778	Angl.	1988	Yes, NVC	?	Yeo (1988)
Llangorse lake / marginal swamps / SAC	SO 122265	Breck.	?	Y, NVC and additional units	None?	Not written up. I. Mapped by Dawn Gray and Graham Motley.
Waen Rydd	SN 875449	Breck.	2000	Y, NVC	?	Dawn Parry and Sam Bosanquet. Map not digitised.
Laugharne Burrows / tall-herb fen, swamp, dunes, wet woodland / SSSI part SAC	SN 284076	Carms	1984	No. Sketch map of main locally defined communities.	68	Smith (1984). I
Cors Caron / floodplain wetlands / SAC	SN 690640	Cered.	1998/9	Y, NVC	> 50	Averis (1999). C
Cors Caron / raised mire / SAC	SN 690640	Cered.	1998-2000	Y, NVC	> 50	Averis (2001). C
Cors Prysau / wet woodland, fen / non - stat.	SJ 165724	Flints.	2004	Y, NVC	8	Ecotech (undated). C
Flint Mountain / woodland, fen meadow, swamp, flush / non-stat	SJ 244709	Flints	2004	Y, NVC	17	Ecotech (undated). C
Cors Geirch / rich fen / SAC	SH 313366	Gwynedd	1990	Y, NVC (only approximate)	> 50	Not written up. I. Survey coordinated by Fiona Evans.

Cors y Sarnau /poor fen, wet woodland / SSSI	SH 972390	Gwynedd	1994.	Y, NVC	17	Evans (1994). C.
Caer Ysgol Bog / blanket bog (lowland) / pSSSI	ST 020875	M & S Glam		Y, NVC	?	I
Cors Bryn y Gaer / raised bog / SAC	SN 946064	M & S Glam	1999	Y, NVC	26	Westwood (1999). I.
Cors Cefn Llwyd / wet woodland / SSSI*	SJ 122094	Monts	1998	No. Sketch map of Q locations only	3	Incomplete write-up. I
Cors Lawnt*	SJ 047122	Monts	1996	Y, NVC units	6	Leach (1997a). I
Cors Llanllugan / basin fen / SSSI	SJ 063030	Monts	1996	Y, NVC units	10	Leach, (1997b). I
			1983	No, sketches only – partly to WLPS nodum level. Q's assigned to WLPS noda	11	Smith (1983). I.
Cors Llyn Coethlyn / valley head fen / SSSI	SJ 012142	Monts	1983	No, sketches only – partly to WLPS nodum level. Q's assigned to WLPS noda	13	Smith (1983). I.
Cors Ty-Gwyn / basin mire	SJ 103111	Monts	1983	No, sketches only – partly to WLPS nodum level. Q's assigned to WLPS noda	5	Smith (1983). I.
Llyn Mawr / lakeside wetland / SSSI	SO 008971	Monts	1996	No, sketch map only with no community areas.	19	Leach (1997c). I.
Mawnog Gwaunynog / wet woodland with some open mire / SSSI	SJ 075113	Monts	1983	No, sketches only – partly to WLPS nodum level. Q's assigned to WLPS noda	8	Smith (1983). I.
Cors y Llyn / basin fen / SSSI	SO 015553	Rads	1994	NVC sketch map.	None	No write up, just map & list of communities compiled by Dave Drewett.
Rhos Goch Common / raised bog and lagg fen / SAC	SO 196484	Rads	1993	Y, NVC units	23	Moscrop *et al* (1993). I.
Sontley Marsh / SSSI	SJ 339478	Wrexham	1990	Y, NVC units	29	Osley (199?). Incomplete write up, but map complete and Q results well tabulated. I.

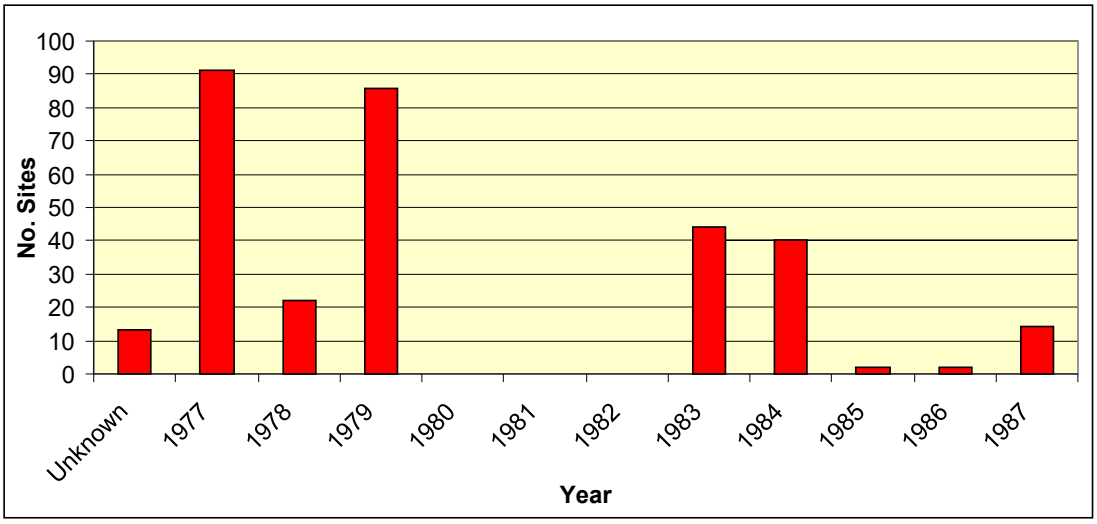

Figure A2.1. Number of sites surveyed during and after the Welsh Lowland Peatland Survey (Ratcliffe & Hattey, 1982) which employed the methodology of that survey.

References – Annex II.

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Annex III. Lowland Peatland Survey Quadrat Recording Card.
Electronic copy available on request.

CYNGOR CEFN GWLAD/ COUNTRYSIDE COUNCIL FOR WALES

LOWLAND PEATLAND VEGETATION RECORDING FORM

SURVEY TITLE		SURVEYOR/S	
SITE NAME		COMMUNITY OR QUADRAT?	
SITE NUMBER		QUADRAT NUMBER	
WLPS NUMBER		COMMUNITY NAME	
DATE OF SURVEY		QUADRAT AREA (sq.m)	

COMMUNITY/QUADRAT DESCRIPTION

If DAFOR/DACFOR recorded, to what area does it refer

CONDITION ASSESSMENT (signs of eutrophication, drainage, neglect etc.)

NOTES ON MANAGEMENT ACTIVITIES

GRAZING	
NONE	
UNDER / VERY LIGHT	
LIGHT	
OK	
HEAVY	
OVER / VERY HEAVY	

GRAZERS	
UNSURE	
CATTLE	
SHEEP	
HORSE	
OTHER (specify)	

MANAGEMENT IMPACTS	
BURNING	
SCRUB CONTROL	
POACHING	
DITCHING	
EUTROPHICATION	
CUTTING	

WATER DEPTH (cm) (relative to soil/veg)	
WATER DEPTH (cm) (on compression)	
WATER FLOW (Yes/No/Subsurface)	
WATER pH	
WATER CONDUCTIVITY (µS)	
SOIL pH	

GRID REFERENCE	
ALTITUDE (m)	
SLOPE (flat, gentle, moderate, steep)	
ASPECT (N, NE, E, SE, S, SW, W, NW)	
PHOTOS TAKEN (Y/N)	
NUMBER TAKEN	
REFERENCE NUMBERS	

GPS USED (Y/N)	
NO of SATS	
ACCURACY / EPE (metres)	
DOP	
LOCATION NUMBER	

SITE NAME:			DATE:			QUADRAT NUMBER:			NVC COMMUNITY:		

W	L	+/-D	TREES		W	L	+/-D			W	L	+/-D			W	L	+/-D			W	L	+/-D		
			Alnus	glutinosa (c)				Carex	lasiocarp				Calystegia	sepium				Samolus	valerand				Polytrichum	formos*
			Betula	pendula (c)					limosa				Cardamine	flexuos				Scrophularia	auricul					strictum
				pubescens (c)					magellan					pratensis				Scutellaria	galericul				Pseudobryum	cincl*
			Fraxinus	excelsior (c)					nigra				Carum	verticill					minor				Pseudotaxiph	eleg
			Quercus	petraea (c)					otrubae				Centaurea	nigra				Senecio	aquatic				Rhizomnium	pseud*
				robur (c)					ovalis				Cerastium	fontanum					jacobea					punct
			Salix	caprea (c)					panicea				Cirsium	arvense				Serratula	tinctor				Rhytidiadelph	loreus
				cinerea (c)					paniculata					dissectum				Solanum	dulcamara					squar
				viminalis (c)					pilulifera					palustre				Sonchus	oleraceus				Scleropodium	purum
			Sorbus	aucupar (c)					pseudocyp				Crepis	paludosa				Sparganium	erectum				Scorpidium	scorpid
W	L	+/-D	SAPLINGS & SHRUBS						pulicaris				Drosera	anglica				Stachys	palustris				Sphagnum	affine*
			Alnus	glutinosa (s)					remota					intermedia				Stellaria	alsine					angustif*
			Betula	pendula (s)					riparia					rotundifolia					graminea					austinii*
				pubescens (s)					rostrata				Epilobium	hirsutum					palustris					capillif
			Fraxinus	excelsior (s)					vesicaria					obscurum				Succisa	pratensis					compac
			Quercus	petraea (s)					virid ssp brach					palustre				Taraxacum	offic agg.					contort
				robur (s)					virid ssp oedo					parviflor				Trifolium	pratense					cuspid
			Salix	aurita				Cladium	mariscus				Epipactis	palustris					repens					denticul*
				caprea (s)				Cynosurus	cristatus				Eupatorium	cannab				Triglochin	palustre					fallax
				cinerea (s)				Dactylorhiza	fuchsii				Euphrasia	sp.				Tussilago	farfara					fimbriat
				repens					incarn				Filipendula	ulmaria				Urtica	dioica					flexuos*
				viminalis (s)					macul				Galeopsis	tetrahit				Utricularia	austrlais*					inundat*
			Sorbus	aucupar (s)					praete				Galium	aparine					interm*					magell*
W	L	+/-D	TREE & SHRUB SEED'Gs						purpur					palustre					minor					palustre*
			Alnus	glutinosa (sd)					traunst					saxatile					vulgaris*					papill
			Betula	pendula (sd)				Danthonia	decumb					uliginosum				Vaccinium	oxycoce					platyph*
				pubesc (sd)				Descham	cesp cesp				Gymnadenia	conop				Valeriana	dioica					pulchrum*
			Fraxinus	excelsior (sd)					flexuosa				Hammarbya	palud					officinalis					squarr
			Quercus	petraea (sd)				Eleocharis	multicaul				Hydrocotyle	vulgaris				Veronica	anag-aqu					subniten
				robur (sd)					palustris				Hypericum	elodes					beccabun					subsec*
			Salix	aurita (sd)					quinquef					pulchrum					chamaed					tenellum
				caprea (sd)					uniglumis					tetrapt					scutellat					teres
				cinerea (sd)				Eleogiton	fluitans				Iris	pseudacor				Vicia	cracca					warnstf*
				repens (sd)				Eriophorum	angustif				Lathyrus	pratensis				Viola	palustris				Thuidium	delicatul*
				viminalis (sd)					gracile				Lemna	minor				Wahlenbergia	heder					tamarisc
			Sorbus	aucupar (sd)					latifolium					trisulca				MOSSES					Tomentypnum	nitens*
			DWARF SHRUBS						vaginat				Leontodon	autumnal				Aulacomnium	palus				Warnstorfia	exann
			Calluna	vulgaris				Festuca	arundin				Linum	cathartic				Brachythecium	rivul					fluitans
			Empetrum	nigr nigr					ovina				Lonicera	periclym					rutab				LIVERWORTS	
			Erica	tetralix					pratensis				Lotus	corniculatus				Breutelia	chrysocom				Aneura	pinguis
			Genista	anglica					rubra					pedunculat				Bryum	pseudotriq sl				Barbilophozia	floer
			Myrica	gale				Glyceria	declinat				Lychnis	flos-cucul				Calliergon	cordifolium				Calypogeia	arguta
			Ulex	europae					fluitans				Lycopus	europae					giganteum					fissa
				gallii					maxima				Lysimachia	vulgaris					sarment					muell
			Vaccinium	myrtill					notata				Lythrum	salicar					stramin					nees*
			FERNS					Holcus	lanatus				Mentha	aquatic				Callierg'la	cuspidata					sphag*
			Athyrium	filix-fem					mollis				Menyanthes	trifoliat				Camp'delphus	elodes*				Cephalozia	bicusp
			Dryopteris	affinis				Isolepis	setacea				Myosotis	laxa cesp				Campylium	stell v proten*					conniv*
				carthus				Juncus	acutiflor					scorpioid					stell v stell				Cephaloziella	hamp*
				dilatata					articulatus					secunda				Campylopus	atrov					sp.*
				filix-mas					bufonius				Oenanthe	crocata					flexuos*				Chiloscyphus	palles
			Equisetum	arvens					bulbosus					fistulos					introfl				Cladopodiella	fluit*
				fluviatile					conglomer					lachenal					pyrifor*				Diplophyllum	albic
				palustre					effusus				Oxalis	acetosell				Climacium	dendroid				Gymnocolea	inflata
				pratense					inflexus				Parnassia	palustris				Cratoneuron	filicinum				Kurzia	pauciflora*
				sylvatic					squarrosus				Pedicularis	palustris				Ctenidium	molluscum					sylvatica*
				telmateia					subnodulos					sylvatica				Dicranella	heterom				Lophocolea	biden sl
			Lycopodiella	inund				Luzula	campestr				Persicaria	amphibia					palustris				Lophozia	ventricosa
			Oreopteris	limbos					multiflora					hydropip				Dicranum	bonjeani*				Marchantia	poly poly
			Osmunda	regalis				Molinia	caerulea					maculos					scoparium				Mylia	anomala
			Pilularia	globulif				Nardus	stricta				Pinguicula	lusitanic				Drepanocl	aduncus*					taylorii*
			Pteridium	aquilinum				Narthecium	ossifrag					vulgaris					cossonii				Odontosch	denudat
			Selaginella	selagin				Phalaris	arundinac				Plantago	lanceolat					revolv ss					sphagni
			Thelypteris	palustris				Phragmites	australis				Platanthera	bifolia				Eurhynchium	prael				Pellia	endiviifolia
			GRAMINOIDS					Poa	humilis				Polygala	serpyllif				Fissidens	adianth					epiphylla
			Agrostis	canina					pratensis				Potamogeton	color					osmund*					neesiana
				capillaris					trivialis					natan				Hamatocaulis	vern*				Preissia	quadrata*
				stolonifera				Rhynchospora	alba					polyg				Hylocomium	splend				Ptilidium	ciliare
			Alopecurus	geniculat				Schoenoplec	lacust				Potentilla	anserin				Hypnum	cupressif ss				Riccardia	chamed*
			Anthoxanth	odorat					tabernae					erecta					jutlandicum					latifrons*
			Arrhenather	elatius				Schoenus	nigrican					palustris				Leucobryum	glaucum					multifida*
			Briza	media				Trichophorum	cespit					reptans				Mnium	hornum				Scapania	irrigua
			Carex	acuta				Typha	angustif				Prunella	vulgaris				Palustr	comm v comm					undulata
				acutiformis					latifolia				Pulicaria	dysenter					comm v falcat				Trichocolea	toment
				aquatilis				HERBS					Ranunculus	acris				Philonotis	calcarea				STONEWORTS	
				binervis				Achillea	ptarmic					ficaria					fontana				Chara	sp
				curta				Alisma	plant-aqu					flammu				Plagiomnium	elatum*				LICHENS	
				diandra				Anagallis	tenella					heder					ellipt*				Cladonia	arbuscula
				dioica				Andromeda	polifol					lingua					rostr*					chlorophaea
				disticha				Angelica	sylvestr					omioph					undul					furcata
				echinata				Apium	inundat					repens				Plag'thecium	dentic*					portentosa
				elata					nodiflorum				Rhinanthus	minor					latebr*					pyxidata
				flacca				Baldellia	ranuncul				Rubus	fruti agg.					undul					uncialis
				hirta				Betula	erecta				Rumex	acetosa				Pleurozium	schreber					
				hostiana				Callitriche	stagnal					hydrolap				Pohlia	nutans					
				laevigata				Caltha	palustris				Sagina	nodosa				Polytrichum	comm					

* indicates taxa requiring microscopic confirmation

VEGETATION STRUCTURE

ELEMENT	COMBINED COVER (DOMIN)	HEIGHT (cm)
DWARF SHRUB		
GRAMINOID		
FORB		
BRYOPHYTE (non-Sphag)		
SPHAGNUM		
LITTER (% cover)		
BARE SUBSTRATE (% cover)		
PEAT DEPTH (cm)		
SUBSTRATE TYPE		

ADDITIONAL SPECIES

Annex IV. Main topographical situations in which British wetlands occur ('Situation Types') – after Wheeler (2002). Names in bold/italics have been added by PSJ. Names in italics – Welsh examples listed in original account.

Situation-type	Description	Examples
Basin wetlands	Associated with discrete basins and ground hollows	Delamere Forest Mires, Border Mires (e.g. Beanrig Moss), ***Cors Graianog (Gwynedd), Cors Cairns (Carms).***.
Lakeside wetlands	Associated with lakes	Slapton Ley (Devon); Windermere (Cumbria). ***Llyn Helyg (Clwyd***).
Coastal- / Flood-plain wetlands	Associated with river flood-plains and coastal plains, including active examples and inactive ones (when their inactivity is largely a product of drainage and water management)	Suffolk and Norfolk Broadland; Somerset Levels; Ouse Washes; *Cors Fochno* (Ceredigion); Thorne Moors (S. Yorks.); Dersingham Bog (Norfolk); Woodwalton Fen (Cambs.); Wicken Fen (Cambs.), ***Teifi Marshes (Ceredigion)***
Plateau-Plain wetlands	On flat or slightly undulating ground without close association with lakes, rivers; or discrete, shallow basins; kept wet by high rainfall, impermeable substratum, high groundwater level etc.	Flanders West Moss (complex) (Stirling); Wedholme Flow (Cumbria); Haxey Grange Meadows (Lincs.); *some Rhos Meadows (Dyfed)*
Valleyhead wetlands	Associated with the upper reaches of valleys	New Forest valley mires; Redgrave and Lopham Fens (East Anglia); Roydon Common (Norfolk); Chippenham Fen (Cambs.), ***Cors Erddreiniog (Anglesey).***
Valley bottom (trough) wetlands	Associated with valleys, but not on obvious stream or river flood plains or within enclosed valley-head	Fen Bogs (N. Yorkshire); Rusland Valley Mosses (Cumbria) (?)
Hillslope wetlands	On sloping ground and hillslopes	Numerous soligenous fens; blanket bog, ***Brynberian Moor (Pembs).***

Annex V. Listing of all 'extra-NVC' mapping units employed to-date (2013) by the Welsh Lowland Peatland Survey.

Although the NVC is a useful framework for assessing the composition of vegetation on sites, and variation between sites, it is considered to be only partly complete. There are four main departures from the NVC:

- Some of the vegetation seen on Welsh lowland peatlands can be assigned to an NVC (sub-)community but is atypical of the NVC concept of that (sub-)community: these have been recorded as 'variants' of NVC (sub-)communities and have been mapped as new phytosociological units. The characteristics of 19 distinct variants are presented in Table V.1, and the (sub-)communities for which those variants have been identified are listed in Table V.2.
- Some vegetation is considered to belong to an NVC (sub-)community but is in an unusual condition, for example because of a high cover of *Phragmites* or abundance of brambles. This variation is covered using 'condition classes' (Table V.3), and most of the 'conditions' identified are indicative of the vegetation being less than ideal from a conservation standpoint.
- Some vegetation simply will not fit into the NVC framework and has to be given a new, descriptive name. Potentially new communities of this kind need to be formally described and the names are therefore provisional and unofficial. All of the additional communities recorded are listed in Table V.4, although it is likely that further analysis would reduce their number somewhat by synonymising them with current vegetation noda.
- Buildings, bare ground, rock and some broad categories such as open water and bracken were used on a number of sites. These additional categories are listed in Table V.5.

Table V.1. Characteristics of variants of NVC sub-communities recorded on Welsh lowland peatlands.

Variant	**Characteristics**
acid	Usual grass component replaced by *Deschampsia flexuosa* and *Festuca ovina*
Carex rostrata	Abundant *Carex rostrata* in a community in which that species does not typically occur
Equisetum fluviatile	Unusually high cover of abundant *Equisetum fluviatile*
Erica tetralix	Unusually high cover of abundant *Erica tetralix*
Eriophorum vaginatum	Abundant *Eriophorum vaginatum* in a community in which that species does not typically occur
flushed	Abundant indicators of base-rich soligenous flows
heathy	A high cover of *Juncus squarrosus* and/or *Vaccinium myrtillus*
Juncus subnodulosus	Unusually high cover of abundant *Juncus subnodulosus*
Lysimachia	Abundant *Lysimachia vulgaris*, suggesting affinities to **S24**
Persicaria	Abundant *Persicaria amphibian*
Sphagnum contortum	Abundant *Sphagnum contortum* in **M5**; perhaps not distinct
Sphagnum cuspidatum	Unusually high cover of abundant *Sphagnum cuspidatum*
Sphagnum fallax	Unusually high cover of abundant *Sphagnum fallax*
Sphagnum flexuosum	Abundant base-tolerant sphagna in **M6d**
Sphagnum inundatum	Abundant *Sphagnum inundatum* in **M5**
Sphagnum papillosum	Unusually high cover of abundant *Sphagnum papillosum*
Sphagnum riparium	Unusually high cover of abundant *Sphagnum riparium*
swampy	Abundant *Carex rostrata*, *Equisetum fluviatile* and/or *Potentilla palustris*
Vaccinium oxycoccos	Unusually high cover of abundant *Vaccinium oxycoccos*

Table V.2. Variants of NVC sub-communities recorded on Welsh lowland peatlands.

	Variant																		
	acid	Carex rostrata	Equisetum fluviatile	Erica tetralix	Eriophorum vaginatum	flushed	heathy	Juncus subnodulosus	Lysimachia	Persicaria	Sphagnum contortum	Sphagnum cuspidatum	Sphagnum fallax	Sphagnum flexuosum	Sphagnum inundatum	Sphagnum papillosum	Sphagnum riparium	swampy	Vaccinium oxycoccos
M1																		X	
M2a					X														
M2b					X												X	X	
M4					X												X		
M5											X				X				
M6a					X													X	
M6c					X													X	
M6d					X									X				X	X
M13a				X															
M15																		X	
M17												X	X						
M17a		X										X	X						
M17a/c													X						
M17c													X						
M18a													X						
M20b													X			X			
M21																		X	
M21b																		X	
M22																		X	
M23a						X												X	
M23b																		X	
M24																		X	
M25					X		X											X	
M25a					X		X											X	
M25b	X				X													X	
M25c					X													X	
M27																		X	
M29		X																	
M30		X																	
S4a									X										
S4b									X										
S4c									X										
S25a		X						X	X										
S25b									X										
S27			X																
S28										X									

Table V.3. Condition classes recorded on Welsh lowland peatlands and the (sub-) communities they have been used with.

Condition	(Sub-)Community
Abundant Carex acuta	S4a
Abundant Carex acutiformis	M22a
Abundant Carex acutiformis	M23a
Abundant Carex acutiformis	M9
Abundant Carex curta	M4
Abundant Carex curta	M5
Abundant Carex curta	M6a
Abundant Carex curta	M6d
Abundant Carex curta	Species-rich Carex rostrata mire
Abundant Carex lasiocarpa	M29
Abundant Carex lasiocarpa	M4
Abundant Carex lasiocarpa	M5 Sphagnum inundatum variant
Abundant Carex lasiocarpa	S27a
Abundant Carex lasiocarpa	Species-rich Carex rostrata mire
Abundant ferns	S4a
Abundant Filipendula	M22b
Bidens frondosa	OV30
Bidens frondosa	S10
Bracken-infested	H12
Bracken-infested	H21a
Bracken-infested	M13a
Bracken-infested	M13c
Bracken-infested	M15
Bracken-infested	M15d
Bracken-infested	M23a swampy variant
Bracken-infested	M25 Eriophorum vaginatum variant
Bracken-infested	M25 species-poor
Bracken-infested	M25a
Bracken-infested	MG10a
Burnt	Dense scrub
Burnt	H12
Burnt	M15
Burnt	M15d
Burnt	M17c
Burnt	M21
Burnt	M25 Eriophorum vaginatum variant
Burnt	M25 heathy variant
Burnt	M25 species-poor
Burnt	M25b
Burnt	M25c
Burnt	M25c swampy variant
Burnt	Mosaic
Burnt	Nodum 19c
Burnt	S2a
Burnt	Species-rich Carex rostrata mire
Burnt	W23
Calluna-dominated	M15d
Calluna-dominated	M17
Calluna-dominated	Nodum 19c
Carex aquatilis	S9a
Carex nigra-dominated	M23a
Carex nigra-dominated	M23a swampy variant
Carex nigra-dominated	M4
Chamerion-infested	M25 species-poor
Chamerion-infested	M27
Chamerion-infested	S4a
Cladium	Carex elata - Molinia vegetation a
Cladium	M13a
Cladium	M13a Erica tetralix variant
Cladium	M22a
Cladium	M25 species-poor

Cladium	M25a
Cladium	M25c
Cladium	M27
Cladium	M9
Cladium	S24
Cladium	S24a
Coarse	M23b
Dactylis-dominated	U4b
Damp	MG5a
Deep water	S4a
Deschampsia-infested	M23a
Deschampsia-infested	M23b
Deschampsia-infested	M23b swampy variant
Deschampsia-infested	M25 species-poor
Deschampsia-infested	M25c
Deschampsia-infested	MG10a
Disturbed	M17
Dry	M23a
Dry	M23b
Dry	M25 Eriophorum vaginatum variant
Dry	M6c
Enriched	Iris-dominated vegetation
Enriched	M22 swampy variant
Enriched	M22a
Enriched	M23a swampy variant
Enriched	M9b
Enriched	S27a
Enriched	S28
Enriched	S4c
Epilobium-infested	M22a
Erica tetralix	M4
Ericoid-poor	M15b
Ericoid-poor	M15d
Ericoid-poor	M17
Ericoid-poor	M17a
Ericoid-poor	M17c
Ericoid-poor	M21 swampy variant
Ericoid-poor	Nodum 19c
Eriophorum angustifolium-dominated	M2b
Eriophorum angustifolium-dominated	M4
Eriophorum angustifolium-dominated	S27
Filipendula-dominated	S27a
Flushed	M25b
Glyceria fluitans	M23a
Glyceria fluitans	S4a
Glyceria maxima	S4a
Grassy	M23a
Grassy	M23b
Grassy	S10a
Grassy	S10b
Grassy	S12a
Grassy	S14a
Grassy	S4b
Grassy	S4d
Impatiens	M23a
Impatiens	M23a swampy variant
Impatiens	S10
Impatiens	S12a
Impatiens	S4a
Impatiens	Tall ruderal vegetation
Iris pseudacorus	M23a
Juncus inflexus	M22a
Juncus subnodulosus	M9b
Juncus-infested	Improved grassland

Juncus-infested	M15
Juncus-infested	M17c
Juncus-infested	M25 heathy variant
Juncus-infested	M25 species-poor
Juncus-infested	M25a
Juncus-infested	M25b
Juncus-infested	M25c
Juncus-infested	M4 Eriophorum vaginatum variant
Juncus-infested	M5
Juncus-infested	MG6a
Juncus-infested	Nodum 19b
Juncus-infested	S27a
Juncus-infested	S28
Juncus-infested	U20a
Juncus-infested	U4a
Juncus-infested	U4b
Lichen-rich	M16d
Low quality	M15d
Low quality	M23a
Low quality	M23b
Low quality	M23b swampy variant
Low quality	M24b
Low quality	M25b
Low quality	M2a
Low quality	MG5a
Low quality	MG5c
Low quality	S27a
Low quality	SD8
Menyanthes-dominated	S12d
Menyanthes-dominated	S27a
Molinia-dominated	H4
Molinia-dominated	M15
Molinia-dominated	M15a
Molinia-dominated	M15d
Molinia-dominated	M16d
Molinia-dominated	M17
Molinia-dominated	M17a
Molinia-dominated	M17c
Molinia-dominated	M17c Sphagnum fallax variant
Molinia-dominated	M21
Molinia-dominated	M21b
Molinia-dominated	M23a
Molinia-dominated	M29
Molinia-dominated	M2b
Molinia-dominated	M4
Molinia-dominated	M5 Sphagnum inundatum variant
Molinia-dominated	M6c
Molinia-dominated	M6c Eriophorum vaginatum variant
Molinia-dominated	M6d
Molinia-dominated	M6d swampy variant
Molinia-dominated	Neutral flush
Molinia-dominated	Nodum 19c
Molinia-dominated	S27a
Molinia-dominated	S27b
Molinia-dominated	Species-rich Carex rostrata mire
Molinia-dominated	Species-rich Sphagnum mire
Mown	Dense bracken
Mown	Improved grassland
Mown	M23a
Mown	M25a
Mown	W25
Myrica	Carex elata - Molinia vegetation b
Myrica	M13a
Myrica	M13a Erica tetralix variant

Myrica	M15
Myrica	M22a
Myrica	M22c
Myrica	M23a
Myrica	M25 species-poor
Myrica	M25a
Myrica	M25c
Myrica	M25c swampy variant
Myrica	M27
Myrica	S13
Myrica	S27a
Myrica	S27b
Myrica	S2a
Myrica	S3
Myrica	Short sedge lawn
Oenanthe-dominated	M23a swampy variant
Oenanthe-dominated	M25c
Oenanthe-dominated	S14
Oenanthe-dominated	S4a
Osmunda	S24
Osmunda	S25a
Osmunda	S25b
Osmunda	S3
Osmunda	S4a
Phalaris	M22a
Phalaris	M23a
Phalaris	M25b
Phalaris	M25c
Phalaris	S25c
Phalaris	S27a
Phalaris	W1
Phalaris	W5
Phragmites	Carex elata - Molinia vegetation a
Phragmites	Damp semi-improved grassland
Phragmites	Eriophorum-dominated vegetation
Phragmites	M10a
Phragmites	M13
Phragmites	M15
Phragmites	M15 swampy variant
Phragmites	M21
Phragmites	M22a
Phragmites	M22c
Phragmites	M23a
Phragmites	M23a swampy variant
Phragmites	M23b
Phragmites	M23b swampy variant
Phragmites	M24b/c
Phragmites	M24c
Phragmites	M25 species-poor
Phragmites	M25 swampy variant
Phragmites	M25a
Phragmites	M25a swampy variant
Phragmites	M25b
Phragmites	M25c
Phragmites	M25c swampy variant
Phragmites	M27
Phragmites	M29
Phragmites	M5
Phragmites	M6a
Phragmites	M6c
Phragmites	M6d
Phragmites	MG10a
Phragmites	Narthecium-dominated vegetation
Phragmites	Nodum 19c

Phragmites	S1
Phragmites	S10
Phragmites	S10a
Phragmites	S10b
Phragmites	S12b
Phragmites	S13
Phragmites	S14c
Phragmites	S27a
Phragmites	S3
Phragmites	S6
Phragmites	S7
Phragmites	S9a
Phragmites	SD15
Phragmites	W24
Pioneer	S3
Poached	M22 swampy variant
Poached	M23a
Polytrichum commune-dominated	M4
Rank	H12
Rank	M13a
Rubus-infested	Cleared scrub
Rubus-infested	M22a
Rubus-infested	M23a
Rubus-infested	M23b
Rubus-infested	M24b/c
Rubus-infested	M25 Eriophorum vaginatum variant
Rubus-infested	M25 species-poor
Rubus-infested	M25c
Rubus-infested	M25c swampy variant
Rubus-infested	M27
Rubus-infested	M6c
Rubus-infested	MG1a
Rubus-infested	S10
Rubus-infested	S12d
Rubus-infested	S25a
Rubus-infested	S26a
Rubus-infested	S26b
Rubus-infested	S26d
Rubus-infested	S28a
Rubus-infested	S3
Rubus-infested	S4a
Rubus-infested	S6
Rubus-infested	Species-poor Juncus acutiflorus
Rubus-infested	Species-poor Juncus effusus
Rubus-infested	W23
Species-poor	Carex elata - Molinia vegetation a
Species-poor	Carex elata - Molinia vegetation b
Species-poor	Cladio-Molinietum a
Species-poor	Cladio-Molinietum b
Species-poor	M13b
Species-poor	M18b
Species-poor	M22c
Species-poor	M22d
Species-poor	M23a
Species-poor	M25c
Species-poor	Nodum 19b
Species-poor	Nodum 19c
Species-poor	OV30
Species-poor	S24
Species-poor	S24a
Species-poor	S24f
Species-poor	S25a
Species-poor	S25b
Species-poor	S25c

Species-poor	S27a
Species-rich	S1
Species-rich	S12b
Species-rich	S13
Species-rich	S3
Species-rich	S7
Sphagnum papillosum	M2b
Sphagnum-poor	M15
Sphagnum-poor	M15b/d
Sphagnum-poor	M15d
Sphagnum-poor	M17c
Sphagnum-poor	M17c Sphagnum fallax variant
Sphagnum-poor	M18a
Sphagnum-poor	M18a/b
Sphagnum-poor	M18b
Sphagnum-poor	M21
Sphagnum-rich	S12
Sphagnum-rich	S13
Sphagnum-rich	S24
Sphagnum-rich	S25a
Sphagnum-rich	S25b
Sphagnum-rich	S3
Sphagnum-rich	S4a
Tall	M22a
Tall	M22c
Tall	M23a
Thelypteris palustris	M22a
Thelypteris palustris	S2a
Typha	M15
Typha	M15 swampy variant
Typha	M25a
Typha	Menyanthes-dominated vegetation
Typha	S27
Typha	S27a
Typha	S9b
Ulex gallii-dominated	M15
Ulex gallii-dominated	M15b

Table V.4. Novel phytosociological units recorded during the Welsh Lowland Peatland Survey and their characteristics.

Community	**Characteristics**	**Sites**
Agrostis canina - Carex spp. grassland	A grassland community described in *Grasslands of Wales*.	7
Agrostis stolonifera-dominated vegetation	Eutrophic grassy swamp.	5
Apium nodiflorum - Potamogeton polygonifolius runnel	A species-poor runnel community.	1
Carex acuta swamp	Species-poor C. acuta.	1
Carex disticha vegetation	Fen-meadow related to **M22** but dominated by C. disticha.	5
Carex elata - Molinia vegetation a	Herb-rich fen dominated by C. elata and Myrica.	1
Carex elata - Molinia vegetation b	Ericoid-rich fen dominated by C. elata and Myrica.	1
Carex nigra - Calliergonella cuspidata vegetation	Inundation vegetation with a high cover of C. cuspidata.	1
Carex nigra - Hamatocaulis inundation vegetation	Inundation vegetation with a high cover of H. vernicosus.	1
Carex nigra - Hydrocotyle inundation vegetation	Inundation vegetation with abundant Hydrocotyle vulgaris.	1
Carex nigra-dominated vegetation	Related to **M23** and **S27** with dominant C. nigra.	18
Carex rostrata - Sphagnum papillosum mire	Transition mire with C. rostrata and S. papillosum.	1
Cladio-Molinietum a	See Bosanquet et al., 2009.	4
Cladio-Molinietum b	See Bosanquet et al., 2009.	3
Damp semi-improved grassland	Like **MG10a** but with dominant Juncus acutiflorus.	22
Dense Calamagrostis	Species-poor C. epigejos.	1
Empetrum-dominated vegetation	Species-poor E. nigrum on a bog.	1

Equisetum palustre mire	Species-rich fen with sphagna and abundant E. palustre.	3
Eriophorum-dominated vegetation	Species-poor E. angustifolium related to **M3**.	7
Fern-dominated vegetation	Dense Athyrium, Dryopteris or Osmunda.	12
Hippurus-dominated vegetation	Species-poor Hippurus swamp.	2
Holcus - Agrostis swamp	Eutrophic grassy swamp.	9
Iris-dominated vegetation	Tall, dense Iris beds without Filipendula or Oenanthe.	15
Juncus acutiflorus grassland	Juncus acutiflorus above acid grassland akin to **U4**.	6
Juncus articulatus - Potamogeton polygonifolius runnel	Soligenous, seasonal runnel vegetation with J. articulatus.	1
Juncus articulatus vegetation	Inundation vegetation with abundant J. articulatus.	1
Juncus compressus-dominated vegetation	Inundation vegetation with abundant J. compressus.	1
Juncus effusus grassland	Juncus effusus above acid grassland akin to **U4**.	13
Juncus inflexus-dominated vegetation	Akin to **M22** but with J. inflexus rather than J. subnodulosus.	4
Myrica-dominated vegetation	Dense, species-poor Myrica gale.	6
Narthecium-dominated vegetation	Extensive clonal patches of Narthecium.	10
Neutral flush	A neutral Sphagnum mire described in Grasslands of Wales	14
Nodum 19a	Swampy Nodum 19; See Turner (2010).	26
Nodum 19a/c	Intermediate Nodum 19; See Turner (2010).	4
Nodum 19b	Species-poor Nodum 19; See Turner (2010).	30
Nodum 19c	Dry heathy Nodum 19; See Turner (2010).	48
Nymphoides peltata vegetation	Beds of N. peltata.	2
Oenanthe - Filipendula vegetation	Akin to **M28** but without Iris.	1
Oenanthe-dominated vegetation	Dense, species-poor O. crocata.	8
Polytrichum commune-dominated vegetation	Dense clonal patches of P. commune.	4
Potamogeton lucens bed	Semi-emergent beds of P. lucens.	1
Potentilla palustris - Carex nigra mire	Related to **S27** but with C. nigra in place of C. rostrata.	2
Potentilla palustris - Eriophorum angustifolium mire	Species-poor, co-dominant P. palustris and E. angustifolium.	1
Potentilla palustris - Menyanthes trifoliata mire	Very wet swampy mire like **S27** but without C. rostrata.	1
Potentilla palustris - Sphagnum mire	Like **M5** but without C. rostrata and with abundant P. palustris.	3
Ranunculus lingua-dominated vegetation	Species-poor stands of R. lingua.	2
Short sedge lawn	Species-poor C. nigra, C. panicea and C. viridula.	9
Species-poor Juncus acutiflorus	Dense J. acutiflorus.	6
Species-poor Juncus effusus	Dense J. effusus.	48
Species-rich Carex rostrata mire	Species-rich mire like **M5** but without Sphagnum squarrosum.	36
Species-rich Sphagnum mire	Species-rich mire like **M5** but without Carex rostrata.	7

Table V.5. Other recording categories used on Welsh Lowland Peatland Survey sites.

Arable	Conifers	Poached ground
Bare mud	Dense Reynoutria japonica	Running Water
Bare peat	Dense scrub	Seasonal pool
Bare rock	Dense Ulex gallii	Spoil
Bare/disturbed ground	Disturbed grassland	Tall ruderal vegetation
Boardwalk	Ditch	Track
Bryophyte-dominated springhead	Garden	Trees
Building	Improved grassland	Willow scrub
Cleared scrub	Inundation vegetation	Woodland
Conifer plantation	Open water	

Annex VI. Personal Equipment checklist
(* indicates items which can be used on a 'per-team' basis, but only on occasions where two or more surveyors are working together at the same time on the same site and within voice-hailing distance of each other; ** indicates discretionary equipment to be used only where circumstances dictate and only where a co-worker is present)

Health and Safety

- Charged mobile phone*
- High factor good quality sun-block
- UV opaque hat
- Insect repellant
- Watch
- Throw line **
- Inflatable life-jacket **
- Waders
- First-aid kit*
- Whistle
- Standard PPE clothing issue
- Wellingtons
- Drinking water

Recording equipment

- Digital camera *
- GPS unit with charged batteries*
- Clipboard / weather-writer
- Quadrat recording sheets, including some printed on water-proof paper
- 2 pens or pencils
- Aerial photographs, film overlays (where used)
- Fibre-glass peat depth pole
- pH and conductivity meters and probes*
- Wash bottle with deionised water*
- Pen-knife
- Specimen bags
- Pocket tape-measure (metric)
- Hand-lens, preferable including a x20 element.

Other

- Contact details for all o/o's of site and local regional office
- Mobile phone numbers of all other surveyors
- CCWs Code of Conduct
- O/o map

Optional

- Peat corer (dutch pattern) with T handle, total minimum length *c*. 120 cm..