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Conservation Assessment of Lowland Heathland in the Upland Fringes (Ffridd Zone) of the Snowdonia National Park

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Yn ystod y cyfnod o dair blynedd, fe arolygwyd 158 o flociau rhostir yn cwmpasu ardal o 941.9 hectar o fewn y 48 cilomedr sgwâr. Fe ddadansoddwyd cyfanswm o 2367 cwadrad. Gan ddefnyddio cyfansymiau ardal Cyfnod 1 a gyflenwyd gan CCGC, gellir gweld fod 28.2% o'r arwynebedd o rostir mewn Cyflwr Ffafriol o'i gymharu â 71.8% sydd mewn Cyflwr Anffafriol. Cafwyd, yn gyffredinol, fod rhostiroedd gwlyb mewn cyflwr gwell na rhostiroedd sych.

Roedd y rhesymau yr ystyrid yn gyffredinol fod rhostiroedd mewn Cyflwr Anffafriol yn niferus. Fodd bynnag, roedd yn amlwg mai'r prif reswm yw nad yw rhostiroedd bellach yn cael yr un reolaeth dymhorol gylchdro ag yr oedden nhw, mae'n debyg, yn y gorffennol. O ganlyniad, mae cyflwr clystyrau o *Calluna vulgaris* yn dirywio, gan eu bod yn cynnwys planhigion Dirywiedig a Heneiddiol gan fwyaf. Anaml iawn y daethpwyd o hyd i blanhigion Arloesi/Adeiladu. Cafwyd fod llawer o'r rhostiroedd â phrysg yn ymledu drostyn nhw yn enwedig â *Sorbus* a *Betula.*

Mae'n amlwg hefyd fod dirywiad rheolaeth gylchdro (llosgi cylchol yn arbennig) wedi golygu lledaeniad *Ulex gallii* yn ddireolaeth a daethpwyd o hyd i sawl ardal o rostir lle bu'n rhaid peidio â phori'n gyfan gwbl oherwydd dryswch y llystyfiant. Gallai'r rheswm am ledaeniad *Ulex* fod yn rhannol oherwydd dyddodiad nitrogen a/neu'r Newid Hinsawdd, er na ddadansoddwyd mecanwaith hyn o fewn yr astudiaeth bresennol.

Cafwyd fod yna amrywiaeth o resymau eraill yn peri dirywiad yng nghyflwr rhostir yr iseldir. Gorbori, tanbori, mathru gan stoc, ynysiad rhostiroedd o fewn coetir (planhigfeydd conifferaidd a llydanddail), llosgi Molinia caerulea mewn rhostir gwlyb yn rhy aml, tanbori yn enwedig ar dir serth a garw, difrod Chwilen y Grug (*Lochmaea suturalis*) a lledaeniad y *Rhododendron ponticum* ymledol yn ddireolaeth.

Caiff data a oedd yn codi o gyfweliadau â ffermwyr a haneswyr ei drafod hefyd. Ffaith sydd o ddiddordeb arbennig ydi bod *Ulex europaeus* (ac *U. Gallii,* o bosib) wedi ei blannu bron yn sicr fel cnwd porthi i geffylau ac y gadawyd i brysg ymledu dros ffriddoedd yn gylchol yn fwriadol i ddarparu coed tân, porthiant *(Ulex)* a deunydd gwely i anifeiliaid (Rhedyn) yn y dyddiau pan oedd yna lawer mwy o lafur ar gael ar ffermydd tir uchel.

Fe fforir sawl senario a allai fynd i'r afael â'r tueddiad yma yn nirywiad cyflwr rhostir yr iseldir yn y Parc. (Fe'i hystyrir yn debygol fod y tueddiad yma'n ffenomen Cymru gyfan). Mae'r rhain yn cynnwys yr agwedd 'gwneud dim' ac ail-gyflwyniad gofalus rheolaeth gylchdro mewn gwahanol ffurfiau, er y gallai'r olaf fod ymhell y tu hwnt i gwmpas (ariannol) arferion fferm cyfredol oni bai y defnyddir cyfran cynllun amaeth-amgylcheddol Glastir a dargedwyd.

EXECUTIVE SUMMARY

During the summer survey seasons of 2009 - 2011, the condition of ffridd (upland margin) heathlands within 48 kilometre squares of the Snowdonia National Park were studied using CCW's Phase 1 maps and a modified Common Standards Monitoring protocol. Only farms within the Tir Gofal agri-environment scheme were visited and none of those surveyed were within a designated site. This represents some 52% of the lowland heaths in the National Park

Over the three-year period, 158 heathland blocks were surveyed, covering an area of 941.9 hectares within the 48 square kilometres. A total of 2367 quadrats were analysed. Using the Phase 1 area totals supplied by CCW, it can be seen that in the Park, 28.2% by area of heath is in Favourable Condition compared with 71.8% which is in Unfavourable Condition. Generally, wet heaths were found to be in better condition than dry heaths.

The reasons why heaths were generally considered to be in Unfavourable Condition were numerous. However, it was evident that the main reason is because heaths are no longer being subjected to the same rotational seasonal management as they probably had been in the past. As a result, the condition of stands of *Calluna vulgaris* is deteriorating, being largely composed of Degenerate and Senescent plants. Pioneer/Building plants were only very rarely found. Many of the heaths were found to be scrubbing over particularly with *Sorbus* and *Betula.*

It is also clear that the decline of rotational management (particularly cyclical burning) has resulted in the uncontrolled spread of *Ulex gallii* and several heathland areas were found where grazing has had to be ceased altogether because of the impenetrability of the vegetation. The spread of *Ulex* may be in part also due to nitrogen deposition and/or Climate Change, though the mechanism for this was not analysed within the present study.

A variety of other reasons were also found to be the cause of the decline in lowland heath condition. Overgrazing, under grazing, stock trampling, isolation of heaths within woodland (both coniferous plantations and broadleaved), over-frequent burning of *Molinia caerulea* in wet heath, under grazing particularly on steep and broken ground, Heather Beetle (*Lochmaea suturalis*) damage and the uncontrolled spread of invasive *Rhododendron ponticum.*

Data that emerged from interviews with both farmers and historians is also discussed. Of particular interest is the fact that *Ulex europaeus* (and possibly *U. gallii*) was almost certainly planted as a fodder crop for horses and that ffriddoedd were possibly deliberately allowed to scrub over on a cyclical basis to provide firewood, fodder (*Ulex*) and animal bedding (Bracken) in the days when there was a great deal more labour available on upland hill farms.

Several scenarios are explored which might address this trend in the decline of lowland heath condition in the Park. (It is considered likely that this trend is an all-Wales phenomenon). These include a 'do nothing' approach and the careful re-introduction of rotational management in a variety of forms, though the latter may well be beyond the (financial) scope of current farm practices unless the targeted element of the Welsh Government's Glastir agri-environment scheme is utilised.

INTRODUCTION

The Phase 1 Habitats Survey of Wales (1979-1997) shows that the Snowdonia National Park supports over 1800 hectares of lowland heathland, the largest area of this priority habitat in any National Park or Unitary Authority in Wales (see **Table 1**). This represents 47% of the total Welsh lowland heathland resource. However, little is known about the condition of the lowland heathland resource in Snowdonia as the vast majority lies outside designated sites. Previous work on lowland heathlands has targeted the coastal and truly lowland heathland sites whilst much of the Snowdonia resource is found within the upland fringes within or just below the ffridd and has, therefore, been excluded from such work.

Table 1: Habitat area data for heathland in ffridd 1km squares summarised from the Phase 1 1km square database. These data include 50% of the area of appropriate heath/grass mosaic habitats. (Data supplied by CCW).

	Area (ha) SNP*			**Area (ha) all Wales**		
	Lowland	Upland	**Total**	Lowland	Upland	**Total**
Heathland						
Dry acid heath	1,351	11,104	**12,456**	2,752	38,484	**41,236**
Dry basic heath	0	0	**0**	0	0	**0**
Wet heath	470	2,803	**3,273**	1,132	6,074	**7,206**
Lichen/bryophyte heath	0	1	**1**	0	7	**7**
Total	1,822	13,908	**15,730**	3,883	44,564	**48,448**
* includes area data for 1 km squares with centroids inside the SNP boundary						

The upland fringe is recognised as being particularly important for connectivity and has a high degree of habitat diversity with heathland forming part of a mosaic of semi-natural habitats. There is a significant association of birds with Gorse (*Ulex*) and Bracken and far less in acid grassland.

The 2007 Snowdonia National Park Local Biodiversity Action Plan (BAP) found the habitat to be in unfavourable condition stating: "*We do not have a clear picture of what is happening to lowland heathland in the National Park most of which is within the ffridd zones. It is likely that the encroachment of scrub and Bracken is reducing the overall area of lowland heath, whilst inappropriate burning and grazing management (too little as well as too much) is reducing the quality of the heath. Of particular concern is the increasing dominance of* Ulex gallii *at the expense of other dwarf-shrub species which is probably the result of changing management although issues such as climate change and nitrogen deposition may also contribute to the problem*".

As this represents such a large proportion of the Welsh lowland heathland resource, it is essential that we start to understand the pressures affecting the habitat and take action before much of it has deteriorated beyond our ability to restore it to Favourable Condition Status (FCS). Experience in Wales and elsewhere in the UK has shown that it is particularly difficult to restore heathlands once they have become *Ulex* dominated with poor ericoid cover. Failure to do so will mean it will not be possible to meet UK and Wales BAP and FCS targets.

OBJECTIVE OF STUDY

The aim of this three-year project is to survey the condition of lowland heath in a proportion of the Snowdonia National Park with the aim of identifying positive action which can be taken forward by the Countryside Council for Wales (CCW) and the Snowdonia Biodiversity Partnership. This will be achieved through:

- Mapping the condition of heathland communities within the upland fringe.
- Identifying factors impacting on heathland communities.
- Identifying conservation priorities and potential conservation actions and solutions (Tir Gofal, Glastir, National Park Management Agreements etc, direct management work assisted by other grants; Section 15 etc).
- Highlighting sites of particularly high conservation value which may require further detailed vegetation survey (potential SSSIs etc.).

METHODS

16 1Km squares lying within the Snowdonia National Park were selected as a random stratified sample by CCW each year during 2009 to 2011, so a total of 48 kilometre squares were surveyed over the three year study period. To reduce travel costs, the 2009 survey cohort was centred around the centre of the Park, 2010's around the southern end and the 2011 around the northern end. Kilometre squares were selected from farms that were currently in a Tir Gofal agreement but outside of any designated site. (There were a few exceptions to this where farms were visited with the landowner's permission but which were not subject to a Tir Gofal agreement). Under the Phase 1 protocol, heathlands are divided into six basic categories but only four of these are found within the upland fringes of Snowdonia. These are:

D.1.1 Dry acidic dwarf shrub heath communities
D2 Wet dwarf shrub heath
D5 Dry heath/acid grassland mosaic
D6 Wet heath/acid grassland mosaic

(Species-poor so called humid heath, where *Molinia caerulea* may be fairly abundant, is usually mapped as dry heath under the Phase 1 protocols but such heaths occasionally appeared to overlap between wet and dry heath). Kilometre squares were also selected so that by and large they contained a representative number of each of these four heathland types.

Surveys were carried out during September and October each year. This is somewhat later in the season than recommended under the Common Standards Monitoring (CSM) protocols but two important factors were used to decide on this later survey period. Firstly, it proved entirely possible to identify all the relevant plant species later in the season. Secondly, by this time, Bracken (*Pteridium aquilinum*) was senescing and much easier to walk through. It must be appreciated that surveys such as these rarely involve the luxury of walking along footpaths. Indeed, on several occasions, it proved completely impossible to walk through very dense stands of *Ulex gallii*, for example. Conducting surveys later in the season at least gave the surveyor a small advantage where dense vegetation was concerned.

CCW supplied aerial photographs and the Phase 1 maps of each of the kilometre squares. Using these references, each site was visited and the extent of each of the heathlands identified within each square were remapped and their Phase 1 categories altered if they had changed. For example, D5 dry heath/acid grassland mosaic might have changed to D.1.1 dry acidic dwarf shrub heath.

Prior to visiting each square, farm landowners/tenants were contacted for both access permission as well as to conduct a brief interview. Generally, this was conducted over the phone but in several very useful occasions, farmers accompanied the surveyor onto the land to discuss both past management as well as future aspirations for their holding. Information on grazing stock and levels, past history of burning or cutting, as well as vegetation utilisation management was determined wherever possible.

Once on site, photographs of each area of heathland within each kilometre square were taken. Then, on smaller areas of heath (< approximately 50 x 50 metres)

ten quadrats were randomly selected, and 20 on larger areas of heath along a W-shaped path walked through each area. Clearly, where topography allowed, the W-walk was usually possible but on very steep ground this was often too dangerous to accomplish. Whatever the line walked, quadrat locations were selected according to the degree of similarity and homogeneity of the vegetation within the heath area. This frequently proved problematic. Areas of dense *Ulex gallii* were often impenetrable, for example, and a W-walk impossible. In the case of mosaic vegetation (D5 and D6), quadrats were selected within the heathland (dry and/or wet) rather than the acid grassland in between, which was avoided.

Within each quadrat, the condition of the heath was assessed using JNCC's CSM methodology. (Examples of Dry and Wet Heath CSM Field Assessment forms can be seen in **Appendices 1a + 1b** and **2a + 2b**). CSM was used in all the 16 kilometre squares visited during 2009. However, once the results of the surveys were analysed, it was quickly realised that this approach was inappropriate as a tool for assessing the condition of the heaths. For example, it is somewhat puzzling that *Cytisus scoparius* is considered a negative attribute in the original CSM forms. It is understood that *Cytisus* can be a problem on coastal heaths where it has escaped from nearby gardens and can be quite invasive. However, in inland heaths of the kind surveyed in the present study this is most unlikely to be an issue. Only one or two bushes were found growing in two D5 stands. Additionally, *Juncus squarrosus* is considered a negative attribute "which can diminish the conservation value" of the heath. While it is accepted that a high cover of the species can indicate a negative trend, small amounts (say DOMIN up to 3) can be very much the norm in Snowdonian wet and dry heaths without being thought of as a negative attribute.

However, it is not the intention within this report to discuss the short-comings of this approach for Snowdonian heathlands. Suffice it to say, after the 2009 season, none of the 41 heaths monitored were classed as being in Favourable Conservation Status according to the CSM methodology, despite clear evidence on the ground which suggested the contrary. The CSM approach clearly needs to be used in conjunction with the judgement of skilled field Ecologists *who can set local targets for attributes.*

Accordingly, with the agreement of the CCW Project Manager, new forms were devised which were considered to be much more relevant in a Snowdonian context. (Examples of the revised monitoring forms can be seen in **Appendices 3a + 3b** and **4a + 4b**). For each form, a grid reference of each heathland block, its Phase 1 status, date of survey and surveyor were given; and, for each quadrat within a **dry heath** area (D.1.1 and D5), the following assessments were made:

1. Presence/absence of bare ground (not rock).
2. Total % cover of dwarf heath shrubs.
3. Condition of *Calluna vulgaris* (Pioneer/Building, Mature, Degenerate, Dead).
4. Vegetation composition: Dwarf Heath Shrubs, Graminoids, desirable forbs, Bryophytes and lichens.
5. Negative indicators: signs of disturbance, *Rhododendron ponticum*, *Cirsium arvense,* coarse grasses etc (quantified as DOMINS), presence of encroaching scrub, cover of Bracken and *Ulex europaeus.*

6. Presence of *Campylopus introflexus*.

Once all 10 or 20 quadrats had been completed, a final assessment was made of the condition of the site (Favourable/Unfavourable/Partially Destroyed/Destroyed) and notes on past and present management added.

As well as specific site details, for each quadrat within a **wet heath** area (D2 and D6), the following assessments were made:

1. Presence/absence of bare ground (not rock).
2. Total % cover of dwarf heath shrubs.
3. Condition of *Calluna vulgaris* (Pioneer/Building, Mature, Degenerate, Dead).
4. Vegetation composition: Dwarf Heath Shrubs, Graminoids and desirable forbs.
5. % cover of *Sphagnum* species.
6. Presence/Absence of lichens.
7. Negative indicators: signs of disturbance (drains, burning, trampling), presence of species such as *Rhododendron ponticum, Chamerion angustifolium* etc (quantified as DOMINS), presence of encroaching scrub, cover of Bracken and *Ulex europaeus.*
8. Presence of *Campylopus introflexus*.

As with dry heaths, once all 10 or 20 quadrats had been completed, a final assessment was made of the condition of the site (Favourable/Unfavourable/Partially Destroyed/Destroyed) and notes on past and present management added.

All data collected during the 2009 season were transposed onto the new forms from the original CSM forms. The new forms were used for both the 2010 as well as the 2011 seasons.

Once the three years' data were collected (48 kilometre squares), a simple analysis was made to assess the overall condition and observable trends of the different heathland types. In addition, using area data derived from CCW's digitised Phase 1 map coverage, a quantitative assessment was made of the areas of different heathland types in the Park in relation to their condition. This analysis made it possible to put heathland condition in Snowdonia into an all-Wales context. A range of future management recommendations will be discussed in a later section of this report.

RESULTS

Over the three-year survey period, 158 heathland blocks were monitored, covering an area of 941.9 hectares within the 48 square kilometres. A total of 2367 quadrats were analysed. **Table 2** further breaks down these results.

Table 2: Condition of different heathland types studied

	Heath Condition				
Heath Type	Favourable	Unfavourable	Partially Destroyed	Destroyed	Total
D.1.1	6	25	7	2	40
D2	18	14	3	0	35
D5	19	38	2	3	62
D6	9	11	1	0	21
Total	52	88	13	5	158

Using the figures above, it can be calculated that 32.9% of the heaths monitored can be considered to be in Favourable Condition, the remaining 67.1% are either in Unfavourable Condition, Partially Destroyed or Destroyed entirely.

Table 3 shows the data in a slightly different way. Here it can be seen that aggregating wet heaths together (D2 and D6) and dry heaths together (D.1.1 and D5) shows that a higher percentage of dry heaths are in unfavourable condition than wet (assuming that Unfavourable also includes Destroyed and Partially Destroyed). This is largely to be expected since grazing is such an influential force as far as vegetation condition and composition is concerned and sheep, the most frequently used stock, tend to avoid wetter areas, favouring dry ground instead. In addition, wet heaths tend to be very infrequently managed by burning.

Table 3: Condition of different heath types, data aggregated together.

Heath type	Favourable (%)	Unfavourable (%)	Total
D.1.1 & D5	25 (24.5%)	77 (75.5%)	102
D2 & D6	27 (48.2%)	29 (51.8%)	56
Total	52 (32.9%)	106 (67.1%)	158

Table 2 and **Table 3** simply utilise figures based on the numbers of different heaths studied. However, using the Phase 1 area totals supplied by CCW (**Table 1**), it can be seen that 28.2% by area of heath is in Favourable Condition compared with 71.8% which is in Unfavourable Condition.

It should be noted here that no geographical trends in heath condition were noted. In other words, there appeared to be no trend in heath condition noted between the three year-class survey areas.

These figures give a somewhat crude quantitative overview of the condition of lowland heaths within the area studied. However, it is the qualitative condition assessments based on observation (monitoring) as well as interviews with farmers that proved to be the most revealing. The following sections of this report summarise the main reasons that heaths failed in their condition assessment. This will be followed by an analysis as to why heaths were found to be in FCS.

Results: reasons for condition failure

1. Lack of routine management (burning or cutting) of *Calluna vulgaris.*

Lack of routine management of heather is a common cause of the deterioration of lowland heath, usually resulting in a skewed cover of 'leggy' Mature, Degenerate and Senescent plants (See **Photo 1**). Previous experience has shown that land managers often failed to burn their heath even when given consent to do so within their Tir Cymen/Gofal schemes. It is evident throughout all but a very few sites surveyed that pioneering *Calluna* is a very rare occurrence indeed. It will be interest to speculate as to why this is the case.

Photo 1: D.1.1 dry heath showing Degenerate and Senescent *Calluna vulgaris.* Note also encroaching tree saplings and ferns.

Lack of burning could be attributable to two separate factors. Firstly, that the area requiring a burn is too close to a forestry stand (see **Photo 2**). Landowners are frankly too nervous to burn in these situations. Secondly, insistence on small patch burns is unrealistic when there are so few people able to supervise such burning regimes. Of some interest is that many of the farmers interviewed remembered discussing burning programmes with Park Ecologists and Tir Gofal Field Officers. In almost all cases, consent was granted to allow appropriate patch burns on an annual basis. However, land managers were reluctant to undertake burns with so few people available to assist them. In addition, cutting fire breaks is a costly and often difficult operation.

Photo 2: D.1.1 Degenerate and Senescent dry heath. An area surrounded by forestry and so considered too dangerous to manage by burning.

2. Lack of routine management of *Ulex gallii.*

There were very many examples of areas of dense *Ulex gallii* that were completely impenetrable to stock, for example on the north and south bank of the Mawddach estuary, where entire ffriddoedd were affected (see **Photo 3**).

Photo 3: Impenetrable *Ulex gallii* in D.1.1 dry heath. Note encroaching scrub trees and *Rhododendron ponticum.*

It is quite evident that the abundance of *Ulex* is increasing throughout the study area and indeed the whole of the National Park. Even more commonly found were smaller discrete stands of Gorse, often associated with broken or steeper rocky ground. Dense *Ulex* was frequently accompanied by an associated undergrowth of Bramble (*Rubus fruticosus*), Bracken (*Pteridium aquilinum*) and encroaching *Sorbus aucuparia.* The graminoid, forb, bryophyte and bare earth component of such dense sites was usually very impoverished. The main concern expressed by interviewees was obviously the loss of grazing land. Sheep simply can no longer get into these compartments and, on the rare occasions that a few hardier individuals were able to gain access, farm dogs were unwilling or unable to gather them. Two farmers interviewed were still claiming their IACS payments despite it being quite obvious that the compartments were not being grazed at all and hadn't been for some years. In addition, several farmers interviewed were concerned at the high incidence of Orf (Contagious Pustular Dermatitis) that occur when sheep have been attempting to graze ffriddoedd that are dominated by *Ulex gallii.*

Such sites require managing but interviews with farmers revealed that this is fraught with three main difficulties. Firstly, as with heather burning, it is often very hard to limit the extent of the burn if only small patches are to be reduced. Secondly, stock tend to congregate on areas that have been recently burned in order to eat the

soft young shoots of *Ulex* (and other dwarf heath shrub seedlings as they emerge). Complete removal of grazing for several years after such a burn would be desirable but impracticable, especially since such stands of *Ulex* are often small and isolated within much large areas of reasonable grazing. Thirdly, most of the sites studied that were in this condition were usually on steep and rocky terrain that was impossible to manage by cutting. There is simply no means of access for the appropriate farm machinery.

In addition, it is worth noting that where there was a long history of persistent gorse burning, *Ulex* tended to be by far the most dominant dwarf heath shrub. In some situations where *Ulex* bushes were able to be parted, diminutive sprigs of *Vaccinium* were still evident inside and at the base of the bushes. These were absent from areas outside of the 'protection' of the gorse and hence disappearing, presumable due to grazing by sheep. Heath monocultures of gorse, however, were not invariably the result of a long history of burns. Some areas which were subjected to a similar history of burns also contained a high frequency of *Erica cinerea, E. tetralix, Calluna vulgaris* and *Vaccinium myrtillus.* It is not clear how (and exactly what) past management has resulted in both monocultural *Ulex* stands and stands with a good balance of different dwarf heath shrubs. Interviews with farmers have proved quite fruitless in this respect. It may well be due to the soil moisture content at the time of the burn or perhaps the speed with which the burn occurred or, more likely, that burning management was employed too frequently. In any event, maintaining the same grazing regime after a burn as previously may be the culprit. Sheep tend to ignore emergent *Ulex* at the expense of other dwarf heath shrubs.

Photo 4: Recently burned D5 dry heath. Note *Agrostis capillaris* and *Vaccinium myrtillus* which is likely to be suppressed as the *Ulex gallii* grows in size and density, especially if the area is soon to be grazed.

Many D5 sites where *Ulex gallii* was the dominant heath species had the appearance of **NVC:U4** grassland that was being invaded by *Ulex* rather than the other way round. Again, it proved impossible to tease out how this was occurring from any analysis of past management or study of the Phase 1 data. It may become more comprehensible if this work is repeated in, say, ten years time.

The absence of regular cyclical management of both *Ulex* and *Calluna vulgaris* must be considered to be the main cause of the deterioration of lowland heath in Snowdonia. However, there are several other factors that must be taken into account.

3. Severe overgrazing by stock (usually sheep).

Severe overgrazing by sheep, often clearly over many years, has reduced *Calluna* within the sward to a few 'drumstick' plants or merely dead stems (see **Photo 5**).

Photo 5: Severe overgrazing in D.1.1 dry heath. Note 'drum stick' *Calluna vulgaris* in centre foreground.

This was most prevalent in dry heaths but several wet heaths were seen in the same condition. (Indeed, huge areas of the Snowdonian uplands have been reduced to poor grazing quality acid grassland as a result of such practices. *Calluna* has often been almost obliterated from the sward, leaving only vestigial remains of heath). There were also a few examples of over-grazing by mixed stock of cattle and sheep. It was often easy to gain the impression that such overgrazing is carried out as a deliberate policy by graziers in order to remove the heath component of the sward and replace it with acid grassland. In some instances, this overgrazing policy was accompanied by a deliberate over-burning policy, a management that again favours the transition of, say, D5 swards into acid grassland. Overgrazing and frequent burns, especially of *Ulex*, were sometimes accompanied by intensive stocking levels during the few months immediately following a burn. Germinating heath (*Calluna, Erica, Ulex* and *Vaccinium*) was especially targeted by stock resulting in encroachment of acid grassland graminoids.

One D5 site had been subjected to reseeding improvements of the acid grassland component of the mosaic. Grazing stock inevitably concentrated their feeding onto the improved swards but this increased grazing pressure also had a deleterious edge effect on associated stands of *Calluna* (close to impenetrable stands of *Ulex* which remained untouched). The heath was shrinking in extent as a result.

Overgrazing was often exacerbated by default due to the Tir Gofal agreement prescriptions. Some aspects of this will be discussed late in the **Discussion** section of this report. Suffice it to say here that stocking rates within D5 and D6 mosaics are often set by Field Officers based on the total area of the (ffridd) compartment. In mosaics where the acid grassland component is small, stocking levels resulted in undue grazing pressure being exerted on the heath component. Heaths are demonstrably deteriorating in condition as a result of this inappropriate management. Clearly, Tir Gofal prescriptions are too rigid in such cases.

4. Long term grazing and overgrazing by horses.

Overgrazing by horses (see **Photo 6**) shows a rather curious edge effect whereby the heath is diminishing at the edges leaving good quality heath in the centre of the stands. The horses clearly do not like entering into dense D.1.1/D5 heaths especially when there is a large component of *Ulex* in the sward. Acid grassland is taking over. The horses seem to avoid the deep heather areas and consistently nibble away at the edges, thus reducing the overall cover of heath.

Photo 6: D5 dry heath . Long term stocking by (mainly) horses which graze the acid grassland at the expense of the heath which is becoming leggy and diminishing in extent.

5. Severe trampling.

The impact of trampling by horses, and more particularly by cattle, has resulted in often severe damage to wet heath areas (see **Photo 7**). *Sphagnum* lawns

are especially badly affected. This was not a frequent occurrence but especially noticeable where small ffridd areas were used for concentrating stock.

Photo 7: A D2 wet heath. Note heavy cattle trampling in the foreground.

6. Isolation of heaths within woodland enclosures.

Several examples of this phenomenon were noted during the surveys (see **Photo 2**). Most commonly encountered were small blocks of heath confined to rocky outcrops which had been too difficult to plant within a conifer block. The heaths (D.1.1 and D5) were becoming rank and scrubby, often affected by encroaching *Sorbus* and *Betula* saplings. One broadleaved woodland site in the Lledr valley had been fenced out from grazing under the landowner's Tir Gofal scheme. Five species-rich D2 wet heaths had been isolated within the woodland and clearly ungrazed. Encroaching *Salix* and *Betula* saplings provided evidence that the heaths had not been grazed for several years and, though they were all in Favourable Condition, would clearly revert to scrub in the not too distant future (see **Photo 8**).

Photo 8. A D2 wet heath isolated from grazing within a broadleaved woodland enclosure. Note encroaching *Betula pubescens* saplings.

7. Heath compartments (ffriddoedd) being used as 'sacrifice' areas.

Several examples were encountered of ffriddoedd being used to 'dry' out ewes. Heavy stocking during the late summer/autumn on poor grazing allows the ewes to dry out but such heavy grazing pressure, concentrated over only a few weeks, often results in a severe deterioration of the heath component. However, the bryophyte component is often extensive and diverse since the shading effect of the taller (heath) vegetation has been removed.

8. Dominance of *Molinia caerulea* in wet heaths.

Areas of D2 and D6 wet heaths were sometimes encountered with a dominance of extremely tussocky *Molinia* (see **Photo 9**). This is the species-poor **NVC: M25b *Anthoxanthum odoratum*** sub-community and is often considered to be a so-called plagioclimax due to the maintenance of a high sheep grazing intensity combined with a regular often annual burning regime. Wet heaths dominated by tussocky *Molinia* are not an uncommon occurrence in Wales. *Molinia* is a truly deciduous grass (with an abscission layer) and the dead leaves (*sffeg*) accumulating over the winter months are easy to burn which results in the development of soft new growth. Despite their high silicon content, the young (forced) shoots are much more palatable to sheep. Such swards are usually typical of *Molinia* dominated wet heaths that are only sheep grazed.

Photo 9: D2 wet heath dominated by tussocky *Molinia caerulea.*

9. Under grazing of heaths on steep ground.

As a generality, heaths located on steep ground tended to be under grazed (see **Photo 10**). Both the steepness and often boulder scree conditions inhibit grazing by sheep. The heath component was often leggy and large numbers of encroaching (particularly) *Sorbus* were noted. Once the heath develops into this condition, the sward becomes even more difficult to access by stock. Such sites are extremely difficult to subject to a controlled burn as the fire tends to 'run away' uphill whatever the prevailing wind conditions.

Photo 10: D.1.1 dry heath on very steep ground. Such areas receive little grazing and the *Calluna vulgaris* etc is Degenerate. Note encroaching *Sorbus* saplings. The presence of *Hedera helix*, in the foreground, a species highly palatable to sheep, confirms the limited grazing pressure.

10. Encroachment of *Rhododendron ponticum*.

Several heath sites were noted where the invasive *Rhododendron ponticum* is increasing and also several sites where the heath has been all but obliterated by dense *Rhododendron* stands (see **Photo 11**). Some control programmes, particularly by the National Trust and the Park Authority are making inroads into the problem but successful eradication is the exception rather than the rule. Whilst initial cutting and subsequent herbicide control, or direct stem injection appear to be solving the problem, it is the subsequent re-invasion by seedling germination and spread that indicates just how difficult it is to completely eradicate the species, especially from difficult heath terrain (see **Photo 12**).

Photo 11: A dense *Rhododendron ponticum* stand all but obliterating a D.1.1 dry heath.

Photo 12: Pale bushes in a D.1.1 dry heath are *Rhododendron ponticum* that have been controlled by stem injection. Note other *Rhododendron* bushes invading the heath as well as several tree sapling species..

11. Heather Beetle (*Lochmaea suturalis*)

Only two sites were noted during the surveys where extensive damage had occurred to *Calluna vulgaris* stands due to the feeding of Heather Beetle. Whilst the appearance of infected plants is dramatic, it is understood that no long term damage occurs. However, the impact of the Beetle in Snowdonia is poorly understood and one site, above the Aberglaslyn Gorge, suggested the damage to *Calluna* may have been permanent. Only a return visit over the next few years will allow the full extent of the Beetle's impact to be determined (see **Photo 13**).

Photo 13: Heather Beetle damage (pale *Calluna vulgaris* bushes) in a small D2 wet heath.

12. Frequent topping.

The heath component of one small D2 wet heath area was disappearing due to over-zealous annual topping of Bracken. It is considered that this is not a major threat to lowland heath in Snowdonia.

13. Bracken.

Somewhat unexpectedly, Bracken did not appear to be a problem in any of the heaths surveyed. There was no evidence that Bracken encroachment was deleterious to the heath component of a sward. Little Bracken was found in wet heaths, this species not appearing to be tolerant of very wet conditions. In dry heaths, Bracken tended to form dense stands on the deeper soils in between stands of heath. In these circumstances, the heath remains more or less confined to the shallower soils where Bracken rarely colonises. Heath and Bracken appear to co-exist as a mosaic, rarely competing with each other directly (see **Photo 14**).

Photo 14: A large area of D.1.1 dry heath. The Bracken is confined to the deeper soils in the foreground and is not encroaching into the heath where the soils are shallower.

Results: reasons why heath was in FCS

1. Good burning regime.

The overriding reason why dry heaths in particular were found to be in FCS was that they are subject to effective rotational burning regimes. The size of the areas burned is usually small, allowing burns to be conducted safely, under control and involving only a few people to attend to the fires. Once heaths are divided into such compartments, burning is very much more straight forward. Once the burning cycle is interrupted for whatever reason, a large area of heath becomes leggy and controlling the burn of small patches becomes problematic. A good rotational burning regime is invariably linked to a sympathetic grazing regime. In practice, only two of the farms visited demonstrated a good burning and grazing regime, one of these is under National Trust ownership (see **Photo 15**).

Photo 15: Good re-establishment of *Calluna, Erica cinerea* and *Vaccinium* following a burn 2-3 years previously in a D.1.1 dry heath. Note presence of a bare ground component.

Two (small) wet heaths were found to be in FCS as a result of effective burning. However, far fewer attempts were made to manage wet heaths in this way. Occasionally, effective patch burns of dense *Ulex gallii* were noted but these were sometimes conducted in an endeavour to obliterate the Gorse (see **Photo 16**).

Photo 16: Patch burning of *Ulex gallii* in a D5 dry heath/acid grassland mosaic.

2. Appropriate grazing management.

Based on the present surveys, generalities about grazing regimes as effective management tools for lowland heaths are far more difficult to make. Much depends on the topography of the land, the size of the ffridd enclosure and the past grazing and burning management. Suffice it to say, a mixture of grazing stock, ideally cattle, sheep as well as horses, appears to result in heaths being in FCS, provided that the grazing levels are appropriate as well as the timing of the grazing (see **Photo 17** and **18**). This is particularly the case with wet heaths, where cattle preferentially graze the *Molinia.* The effective management of dry heaths must be tied to a sensitive cyclical burning (or, where possible, cutting) regime. Not one heath in Favourable Condition was surveyed where only grazing was the optimal management tool.

It is worth noting that none of the heaths surveyed was subjected to cutting (topping) as a management as, for example, the RSPB management of their Llyn Vyrnwy reserve.

Photo 17: An example of an appropriate grazing regime in a D5 dry heath. A good diversity of dwarf heath shrub species is present (which does not appear to be expanding) as well as a good component of graminoids.

Photo 18: A species rich and appropriately managed D2 wet heath. There is a good diversity of forbs as well as graminoids where *Molinia caerulea* is not dominating the sward.

Results: *Ulex europaeus*

Several farms were noted where discrete stands of *Ulex europaeus* were found close to the farm house, often about half to one hectare in size. *U. gallii* was usually a minor component of these stands (see **Photo 19**) or entirely absent These farm complexes occasionally had ancient leats cut from nearby streams taking water as a power source to small water wheel driven chaff cutters. It was understood that *U. europaeus* was ground up in these chaff cutters and mixed with oats as an important food supply for horses in the days before tractors. Names such as *Cae Eithin Tew, Cae Eithin* and *Bryn Eithin,* suggest these 'fields' may have been deliberately planted with *U. europaeus* as a food supply for horses. Indeed, gorse was planted on Enlli (Bardsey Island) in the 1870s (E. Evans *pers. com.*) for the same reason and the horse-driven chaff cutter is still present and well-preserved (see **Photo 20**).

Photo 19: The Gorse in the centre of the picture is a stand of almost entirely *Ulex europaeus*, probably planted as a fodder crop for horses.

Photo 20: A well-preserved gorse chaff cutter in a building on Bardsey Island. This particular cutter was powered by horses rather than by a water wheel.

During the course of the present surveys, landowners who had stands of *U. europaeus* were asked if they had any knowledge of deliberate plantings in the past. This was confirmed by only one elderly farmer who remembered his father planting gorse for their horses. In fact, it was soon realised how invasive *U. europaeus* can be and the farmer's father grubbed out all the gorse (with horses!) and paid his son to remove any seedlings as they emerged. It is assumed that *U. europaeus* seeds must have been commercially available for such plantings.

DISCUSSION

The upland fringe habitat is quite uniquely Welsh. It is not seen in England and only a little in Scotland. Known as *ffridd* in North Wales and sometimes as *coedcae* in South Wales, reflecting its woodland (often *Crataegus*) component, it must be considered as a very important habitat.

This three-year survey of what amounts to 52% of the lowland heathland habitat in the Snowdonia National Park upland fringe (ffridd) has shown that 71.8% of the areas surveyed are in Unfavourable condition. This is an underestimate since many of the heaths that were classified as being in Favourable condition will require some management within a matter of only two to three years time.

The main reason heaths, particularly dry heath, were found to be in Unfavourable condition was due to lack of management. There is no doubt that lowland heaths in the Park were once subjected to a regular cyclical burning programme. It is understood that in 1976, some 1600 holdings were known in the Park. By 2008, this number had diminished to less than 1000. Farms have tended to amalgamate and the number of people managing them has declined considerably. Far fewer people are able to be called upon to manage small patch burning which is a one of the heathland management prescriptions available under the Tir Gofal scheme.

Personal knowledge of the Park and a long involvement in advising the Tir Gofal Field Officers confirms that almost all requests by farmers in the scheme to burn discrete areas of their heath (or gorse) was met with approval. However, by the time farmers asked permission to carry out these burns, almost all their heath areas had become more or less uniformly leggy and rank. Trying to undertake small patch burns in order to re-establish a cyclical network of heath in different age conditions has proved impossible with a) so few people on the land and b) the necessary skills to undertake these burns safely and within the areas specified. Interviews with farmers revealed several occasions when they had tried to burn only small patches but the fires had got out of hand and much larger areas than intended had been burned. Those farmers had been penalised by having a proportion of their Tir Gofal payments withheld.

As a result of the decline in (burning) management, it is not only *Calluna vulgaris* which has become degenerate and senescent. The spread of *Ulex gallii* has been quite dramatic. (There is some debate as to whether this is in part due to nitrogen deposition and/or Climate Change but it is considered that it is beyond the scope of this report to investigate this here). Stock, sheep being the main grazing animal, are usually able to force their way even into the densest rank *Calluna* (and *Erica, Vaccinium* etc). However, when the growth of *U. gallii* becomes dense, stock are unable to penetrate it and nor do the dogs who are sent out to retrieve the few sheep that are. While burns to dense *Ulex* stands were more common than to *Calluna* heath, the aftercare was often inappropriate. Grazing areas soon after they had been burned, especially where large areas had been burned, often caused more damage to emergent *Calluna, Erica* and *Vaccinium* seedlings than to *Ulex.* This may go some way to explain why stands of *Ulex* are often almost monocultures of the shrub. However, this was not invariably the case and further detailed research needs to be carried out to determine why some burns are successful and others not, as far as the continued diversity of dwarf heath shrubs are concerned.

It is abundantly clear that *Ulex gallii*, wherever it is present, is expanding throughout the study area. Many of the D5 areas where the shrub is abundant are trending towards D.1.1 heaths, in other words the intervening grassland is shrinking in extent. Lack of burning, changes in grazing patterns, the influence of nitrogen deposition and Climate Change may all contribute to this often problematic expansion.

But there may be another reason for this. It is known that *Ulex europaeus* was planted and cultivated as a fodder crop for horses (and cattle) (Taylor, Penrose & Rotherham (2003), Nash, G. (2003, 2004)). Anecdotal evidence during this study also confirms this. It is also worth quoting a short piece from the 1834 edition of The Gardener's Magazine by Mr J. C. Lowden entitled 'The Irish Furze (Ulex europaeus *var* stricta) as a forage plant':

"It has recently been found in Caernarvonshire, and other parts of North Wales, that this variety of the common furze may be more profitably cultivated in the field than the species. The reason is, the branches, when cut for use, do not require bruising before being given to horses or cattle. As this variety very rarely produces flowers, or seeds, it is propagated by cuttings, which, however, strike in a bed of sandy soil as readily as willows. The cuttings should be taken off in the autumn, of the present year's wood, and they need not be above 3 in. long. They will be fit to transplant in the March or April following, and in the succeeding autumn they may be cut over with the scythe for the first time. We consider this a very interesting fact, and one which shows that it is from varieties, and hybrids, and even from monstrosities, which this is, that we are to procure the most valuable plants of culture".

It is clear that *U. europaeus* and its varieties were considered a valuable resource for feeding horses – the most important 'machinery' on a farm before the advent of the tractor. It also seems clear that the cultivation and treatment of the shrub received a great deal of attention, at least in North Wales. (See the National Museum of Wales list of known 'gorse mills' in Wales. See also **Photo 20**). Would it not be possible that *Ulex gallii* was also harvested (and possibly cultivated) as a fodder crop too before *U. europaeus* became the preferred resource? (There is, indeed, some anecdotal evidence that this was the case in Pembrokeshire). If that is the case, *U. gallii* would have been a very carefully managed resource on the farm and this may well have kept its expansion in check. Looking at a dense stand of *U. gallii* it is difficult to imagine how it was harvested but The Gardener's Magazine article suggests it would have been scythed when it was only one year old. Such labour-intensive practices would also have been used to harvest Bracken as a bedding material. The reduction in the number of people (reduced family sizes) available for such work, together with modern mechanisation, may well have contributed to the expansion of both *Ulex* and Bracken.

Almost all the farms surveyed are within the Tir Gofal agri-environment scheme. Apart from the variety of possible reasons suggested above for the deterioration in the condition of lowland heaths in Snowdonia, it is perhaps worthwhile to speculate as to whether Tir Gofal itself may be in part responsible. However, as has already been mentioned, almost all requests by farmers in the

scheme to undertake burns were granted, albeit with stringent conditions. But one frequent criticism voiced by farmers within the scheme against Tir Gofal was its relative inflexibility as regards grazing dates and levels. It was not unusual to see D5 and D6 heaths where all the stock had been removed in the autumn which were under grazed, at least in terms of the grassland component of the sward. While it is mainly the grassland component which shows under grazing most readily, such practices must also have a tangential effect on the adjacent heath component too. A more flexible approach within the scheme would be to allow farmers to graze their stock for slightly longer periods if there is sufficient bite still on the land.

The few examples of overgrazing, on the other hand, should have been prevented under the scheme's compliance monitoring. Some of these examples suggest a long history of overgrazing where it was abundantly clear from the condition of the heath that this was occurring.

The woodland at SH7251 that has been enclosed as part of the owner's Tir Gofal agreement contains a number of rich wet heath sites. These are currently not being grazed and it would be valuable if the landowner's Tir Gofal agreement could be made flexible enough to allow the additional fencing and stock movements that would allow these D2 sites to be periodically grazed.

CONCLUSION AND RECOMMENDATIONS

Lowland heaths in the upland fringe (ffridd) in Snowdonia are an important Biodiversity habitat but the present surveys showed that 71.8% by area are in Unfavourable, Partially Destroyed or Destroyed condition. The area of heath surveyed (941.9 hectares) represents some 52% of this habitat in the Park and there is no reason to suggest that the remaining 48% is in better condition. Although much of the remainder must be in Designated Sites and, therefore, be assumed to be in better condition, this still represents a substantial area. Note also that these figures are based on the Phase 1 digitised data supplied by CCW (see **Table 1**) and while the proportions will be accurate, the total areas of heath might not since it has been assumed that only 50% of land defined as D5 and D6 is considered as being covered with heath. In fact, these surveys suggest a far larger proportion of D5 and D6 heaths are actually covered with heath, especially *Ulex gallii.*

The main reason heaths surveyed fell into the Unfavourable category is due to the cessation of management. It is useful here to suggest possible future scenarios to rectify this situation.

Do nothing

This scenario allows the heaths that are slowly reverting to scrub to continue to do so (see **Photo 3** and **12**) but to allow the grazing *status quo* to remain. There are several cogent reasons why this could be considered the best option. Firstly, the alternative to undertake some sort of intervention management (see below) will be difficult and very costly at the very least. Secondly, CCW's Upland Framework goes some way to suggest an increase in Biodiversity will be achieved by allowing a proportion of land in Wales (effectively ffriddoedd) to either scrub over naturally or by allowing this to happen deliberately by the cessation of grazing (and burning) management. Thirdly, the Forestry Commission's (FC) Woodland Strategy for Wales suggests a large increase in the area of woodland in Wales. Apart from the increase in recreational, scenic and cropping potential (wood fuel etc), the increased carbon sequestration will go some way to help the Welsh Government to achieve their ambitious carbon reduction targets. This would also help in water management since it is well understood that heavy grazing results in a far higher proportion of rainfall to run off the land than if grazing levels were low.

There are two main reasons why this option will not be received well. Firstly, the farming community (as evidenced by the interviews conducted during this survey) will strongly resist what they see as losing their land to scrub. However, it must be said here that there is no evidence that upland Welsh agriculture as a whole is currently suffering from the reversion of large areas of ffridd into scrub woodland. Secondly, leaving large areas of ffridd to become choked with heath and gorse will pose a major fire threat – potentially a danger in its own right as well as to forestry.

Allow ffridd to revert to scrub woodland

This is effectively the same as the do nothing approach. However, under this scenario, large areas of ffridd would be deliberately isolated from grazing (and burning) and allowed to revert to scrub. Under the FC's plans, much of this land could also be planted though this might be problematic in its current over-grown

condition. The pros and cons of this scenario have already been outlined in the do nothing scenario above.

Re-establishment of heath into FCS

From the farming community's point of view, this would be the preferred option. This could be achieved under Glastir's habitat restoration category but would be extremely costly. While bringing wet heath back into FCS is more difficult than dry heath, either will involve a very complicated re-introduction of a cyclical management programme, followed by an appropriate programme of selective grazing management. For farmers unwilling to enter Glastir, one option would be for a consortium of bodies (CCW, SNPA, NT) to fund the employment of teams of individuals to help farmers cut or burn their heaths and to cut fire breaks where necessary . In other words, to restore 'neglected' ffriddoedd into FCS.

It must be stated here that the key aims of lowland heathland management must be effectively three-fold. Firstly, to reduce the dominance of *Ulex gallii* and *Molinia caerulea*, secondly to control scrub and Bracken (where necessary) and, thirdly, to encourage the regeneration of the ericoid component of the sward. In the first case, reducing the dominance of *Ulex* and *Molinia* should, wherever possible, be carried out by cutting rather than burning (or in the case of *Molinia* by cattle grazing). Indeed, in an ideal situation, regenerating Degenerate and Senescent *Calluna* should be carried out in the same way. However, it must be appreciated that this procedure is rarely possible, certainly in the ffridd habitats studied. It must be said that the only practicable option is to re-establish an appropriate rotational burning programme. An 11-year rotation should break the dominance of *Ulex* in the sward. CCW's advice to the Welsh Government in the Glastir Contract Manager's Handbook suggested a 12-year rotation of burning over patches of 0.25 – 0.5 hectares in small area sites and up to 1 hectare on larger sites. In severely degenerated sites, a programme of cutting, stripping the arisings followed by the re-establishment of a rotational burning regime would be the ideal solution. If the *Calluna* component is vestigial, the reintroduction of seed directly as heather brash may be a last solution. However, it must be stated that these are 'ideal' solutions to a difficult problem and may well be beyond the resources of most landowners, however much (grant) assistance is made available.

In the few examples noted during the survey of severe overgrazing, removing stock entirely for several years might give vestigial heath the chance to re-establish. This might be easier said than done since landowners would have to find alternative land to remove their stock onto.

Another option which still needs some exploration is the possible use of 'wild' horses which it is claimed would graze even the rankest Gorse and degenerate heath. There is some anecdotal evidence that such horses, being currently bred in Spain, would make ideal 'jungle busters' but this may be an expensive and complex solution. It would be difficult to justify such an approach except in heaths that are under SAC designation where failure to maintain then in FCS may result in harsh penalties to the UK Government.

Additional recommendations

1. All the raw data and photographs generated by this research are lodged with CCW. This is a large data set and it would be very interesting to repeat the surveys in, say, five or ten year's time to see what changes have occurred over that period.

2. It would be interesting to study in more detail how areas are being successfully maintained within a regular cyclical burning regime. For example, the land around Llynnau Cregennen (SH6614) is a classic example of successful burning. A good example of wet heath burning can be seen at Mynydd Craig Goch in SH4848. But it must be emphasised here that these examples are few and far between. There must be a lot of relevant publications about the subject and it would be valuable to determine how relevant others' research is to the problem in Snowdonia.

3. No sites were found during these current surveys that would benefit from SSSI designation.

4. Arrange a more flexible Tir Gofal agreement for the enclosed wet heaths in SH7251 to be periodically grazed.

5. During the course of this study, some intriguing, albeit largely anecdotal (probably unpublished) evidence was found concerning the history of ffridd management, particularly in what is still known as Old Meirionnydd (*Hen Feirionnydd)* but also most likely elsewhere in Wales. It seems very probable that ffriddoedd themselves were managed on a cyclical basis. Parts were allowed to revert to scrub woodland (hence the Pembrokeshire term *coedcae*) and the arising timber (*Sorbus, Betula* and even *Ulex*) utilised on the farm directly or as firewood. Once cleared, Gorse (*Ulex europaeus*) was planted as a fodder crop for horses, and possibly sheep and cattle. *Ulex gallii* may well have been utilised in the same way. Bracken was also managed by cutting and the arisings used as bedding for over-wintering stock and the compost/manure later spread on the hay fields. Thus, what appears to be a modern trend in the degeneration of ffridd heaths may have been deliberately undertaken in the past as profitable, if not rather labour-intensive management. Such management, incidentally, fits in with recently resurrected Permaculture principles and its proponents would advocate that this would be the most suitable management for ffridd habitats in the future. It would be very interesting and valuable to research the background history to this notion and possibly to pursue a modern Permacultural solution to our degenerating lowland heaths.

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APPENDIX 1a
CSM Dry Lowland Heath Condition Assessment Form (Side 1)

Issue date: March 2009

Annex 2.

DRY Lowland Heathland - Condition Assessment field form

Site Name: **Grid reference (if known):** **Assessed by:**
Date: **Time:** **Photographs taken - Film and Frame Nos.** **NVC type (if available)**

Condition (please circle): Favourable maintained / Favourable recovered / Unfavourable improving / Unfavourable no change / Unfavourable declining / Partially destroyed / Destroyed

Recommended visiting period: May-October, see Figure 1 in guidance for each NVC
Recommended frequency of visits: Every six years for national reporting

Key management activities affecting condition to discuss with manager:		**Other activities likely to have an impact (tick + or - if appropriate)**	
Grazing intensity/stocking rate	Burning / presence of fire-breaks	Farming/agriculture	Military activities
Stock type	Rolling and chain harrowing	Conservation activities	Mineral extraction
Grazing period	Bracken management	Urban development	Natural events
Supplementary feeding	Other (specify)	Forestry	Recreation/tourism
Scrub and weed control	Manag. agreement/scheme/grant Yes/No	Infrastructure/transport	Water abstraction
Cutting	Agri-env. schemes/grants Yes/No		

Structured walk Frequencies: totals out of 20 stops. 1-2 = **rare,** 3-6 = **occasional,** 7-12 = **frequent,** most stops (<50% cover) = **abundant,** most stops (>50% cover) = **dominant.** An A4 is appr. 1.5% of a 2x2m quadrat.

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	**Targets (for the entire feature)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Estimate for attribute**
***Extent of habitat**	No un-consented loss of area	(Describe and refer to map)																				
***Bare ground (not rock)** % cover of ephemerally exposed bare ground in intimate mosaic with vegetation or in tracks/paths	'Undisturbed' 1-10% 'Heavily disturbed' <1%																					
***Vegetation structure**																						
TOTAL % cover shrubs	Cover of dwarf shrubs between 25-90% refer to Figure 1 for range figures.																					
Ulex europaeus & U. gallii cover	<50%																					
Calluna vulgaris/Erica (pseudo) Pioneer %	10-40%																					
(when possible to Building/ Mature %	20-80%																					
differentiate) Degenerate %	<30%																					
Dead %	<10%																					
***Vegetation composition**	Lists to be tailored to each site																					
Dwarf shrubs Frequency of any of the following species: *Arctostaphylos uva-ursi, Calluna vulgaris, Erica ciliaris, Erica cinerea, Erica tetralix, Erica vagans, Ulex minor, Vaccinium myrtillus, V. vitis-idaea, Genista anglica, Empetrum nigrum.*	At least 2 species at least **frequent** excluding *U. gallii* (see guidance for species-poor sites),																					
Graminoids Frequency of any of the following species: *Agrostis* spp., *Ammophila arenaria, Carex* spp., *Danthonia decumbens, Deschampsia flexuosa**, *Festuca* spp., *Molinia caerulea*§, *Nardus stricta**, *Trichophorum cespitosum.*	At least 1 species at least **frequent** and 2 species at least **occasional** throughout the sward (see guidance for species-poor/rich sites) except *, which should be not more than frequent & <50% cover and § which should be not more than 30% cover.																					

APPENDIX 1b
CSM Dry Lowland Heath Condition Assessment Form (Side 2)

Issue date: March 2009

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	Targets (for the entire feature)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Estimate for attribute
Desirable forbs Frequency of any of the following species *Armeria maritima, Galium saxatile, Genista anglica, Hypochaeris radicata, Lotus corniculatus, Plantago lanceolata, Plantago maritima, Polygala serpyllifolia, Potentilla erecta, Rumex acetosella, Scilla verna, Serratula tinctoria, Thymus praecox, Viola riviniana.* Limestone heath only: *Filipendula vulgaris, Galium verum, Helianthemum nummularium, Sanguisorba minor.* Dune heath only: *Aira praecox, Corynephorus canescens, Phleum arenarium, Erodium cicutarium, Filago minima, Sedum acre, Peltigera*	At least 2 species at least **occasional** (see guidance for species-poor/rich sites).																					
Bryophytes and lichens Cover of all spp. (except dense acrocarpous spp.) eg *Cladonia* spp., *Dicranum scoparium, Hylocomium splendens, Hypnum cupressiforme, Pleurozium schreberi, Polytrichum* spp., *Racomitrium lanuginosum.*	Site-specific target to be set (see guidance).																					
***Negative indicators**	List to be tailored to each site.																					
Signs of disturbance Record presence of erosion.	<1% of habitat showing signs of erosion.																					
Species (-ve if over target threshold) % cover of any of the following species:	(% of entire feature)																					
Rhododendron ponticum, Gaultheria shallon, Fallopia japonica.	*Rhododendron* and exotic species <1%.																					
Cirsium arvense, Digitalis purpurea, Epilobium spp. (excl. E. palustre), Chamerion angustifolium, Juncus effusus, J. squarrosus, Ranunculus spp., *Senecio* spp., *Rumex obtusifolius, Urtica dioica*, "coarse grasses".	< 1 % *Senecio* spp., *Urtica dioica, Cirsium* spp. and other herbaceous, in clumps.																					
Betula spp., *Prunus spinosa, Pinus* spp., *Rubus* spp., *Cytisus scoparius, Quercus* spp., *Hippophae rhamnoides*	< 15% trees, tree seedlings or other species of scrub. <1% *Rubus* spp. (see guidance 12.6).																					
Pteridium aquilinum.	< 10% *P. a.* in dense canopy.																					
Ulex europaeus.	<25%																					
Dense mats of acrocarpous mosses (*C. introflexus*).	Acr. mosses < occasional.																					
Indicators of local distinctiveness	List to be tailored to each site.																					
Rare species, pools, edges Eg *Cladonia arbuscula, Cladonia incrassata, Cornicularia* spp., *Viola lactea*, birds, etc.	Monitor and set targets according to conservation objectives or management plan.																					

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APPENDIX 2a
CSM Wet Lowland Heath Condition Assessment Form (Side 1)

Issue date: February 2009

Annex 3.

WET Lowland Heathland - Condition Assessment field form

Site Name:
Date: **Time:**
Grid reference (if known):
Photographs taken - Film and Frame Nos.
Assessed by:
NVC type (if available)

Condition (please circle): Favourable maintained / Favourable recovered / Unfavourable recovering / Unfavourable no change / Unfavourable declining / Partially destroyed / Destroyed

Recommended visiting period: May-October, see Figure 1 in guidance for each NVC

Recommended frequency of visits: Every six years for national reporting

Key management activities affecting condition to discuss with manager:

Grazing intensity/stocking rate
Stock type
Grazing period
Supplementary feeding
Scrub and weed control
Cutting
Burning / presence of fire-breaks
Rolling and chain harrowing
Bracken management
Other (specify)
Manag. agreement/scheme/grant Yes/No
Agri-env. schemes/grants Yes/No

Other activities likely to have an impact (tick + or - if appropriate)

Farming/agriculture
Conservation activities
Urban development
Forestry
Infrastructure/transport
Military activities
Mineral extraction
Natural events
Recreation/tourism
Water abstraction

Structured walk Frequencies: totals out of 20 stops. 1-2 = **rare**, 3-6 = **occasional**, 7-12 = **frequent**, most stops (<50% cover) = **abundant**, most stops (>50% cover) = **dominant.** A4 is appr. 1.5% of 2mx2m quadrat.

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	**Targets (for the entire feature)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Estimate for attribute**
***Extent of habitat**	No un-consented loss of area	(Describe and refer to map)																				
***Bare ground (not rock)** % cover of ephemerally exposed bare ground in intimate mosaic within vegetation and in tracks/paths.	'Undisturbed' 1-10% 'Heavily disturbed' <1%																					
***Vegetation structure**																						
TOTAL % cover shrubs	Cover of dwarf shrubs: 25-90% , refer to Fig 1 for range figures																					
Calluna vulgaris	Presence of heather in all stages of growth. No one growth form should be dominant.																					
***Vegetation composition**	Lists to be tailored to each site																					
Dwarf shrubs Frequency of any of the following species: *Calluna vulgaris, Empetrum nigrum, Erica ciliaris, E. cinerea, E. tetralix, E. vagans, Myrica gale, Salix repens, Ulex gallii, Ulex minor, Vaccinium* spp.	At least **2** species at least **frequent**																					
Graminoids Frequency of any of the following species: *Carex panicea, Carex pulicaris, Eleocharis* spp., *Eriophorum angustifolium, Juncus acutiflorus, Juncus articulatus, Molinia caerulea*, Rhynchospora alba, Schoenus nigricans!, Trichophorum cespitosum.*	At least **1** species at least **frequent** and **2** species at least **occasional** throughout the sward (except *, which should be not more than occasional, and !, which should be >20% when naturally present)																					
Desirable forbs Frequency of any of the following species *Anagallis tenella, Drosera* spp., *Galium saxatile, Genista anglica, Narthecium ossifragum, Pinguicula* spp., *Polygala serpyllifolia, Potentilla erecta, Serratula tinctoria, Succisa pratensis.*	At least **2** species at least **occasional**																					

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APPENDIX 2b
CSM Wet Lowland Heath Condition Assessment Form (Side 2)

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	**Targets (for the entire feature)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Estimate for attribute**
Bryophytes and lichens % cover and frequency of : *Sphagnum* spp	when naturally present >10% cover of Sphagna																					
Locally occurring lichens	>5% of lichens																					
***Negative indicators**	List to be tailored to each site																					
Signs of disturbance - Drains	Artificial drainage channels adversely affecting hydrology are absent.																					
- Obvious visual pollution.	No signs of silt or leachate.																					
- Trampling	<1% trampling signs/paths (eg on Sphagnum)																					
Species (-ve if over target threshold) % cover of any of the following species:	(% of entire feature)																					
Rhododendron ponticum	*Rhododendron* and exotic species <1%.																					
Apium nodiflorum, Cirsium arvense, Digitalis purpurea, Epilobium spp. (excl. *E. palustre), Glyceria fluitans, Juncus effusus, J. squarrosus, Oenanthe crocata, Phragmites spp., Ranunculus repens, Fallopia japonica, Senecio jacobaea, Rumex obtusifolius, Typha* spp., *Urtica* spp	<1% undesirable herbaceous/forb spp.																					
Alnus glutinosa, Betula spp., *Pinus* spp., *Prunus spinosa, Quercus* spp., *Rubus* spp., *Salix* spp.	< 10% trees, tree seedlings or other species of scrub.																					
Pteridium aquilinum.	< 5% *P. aquilinum*																					
Ulex europaeus.	<10% *U. europaeus*																					
Dense mats of acrocarpous mosses (*Campylopus introflexus*).	Acr. mosses < occasional																					
Indicators of local distinctiveness	List to be tailored to each site																					
Rare species, pools, edges Monitor and set targets according to conservation objectives or management plan. *Cicendia filiformis, Gentiana pneumonanthe, Hammarbya paludosa, Lycopodiella inundata, Radiola linoides, Rhynchospora fusca…*																						

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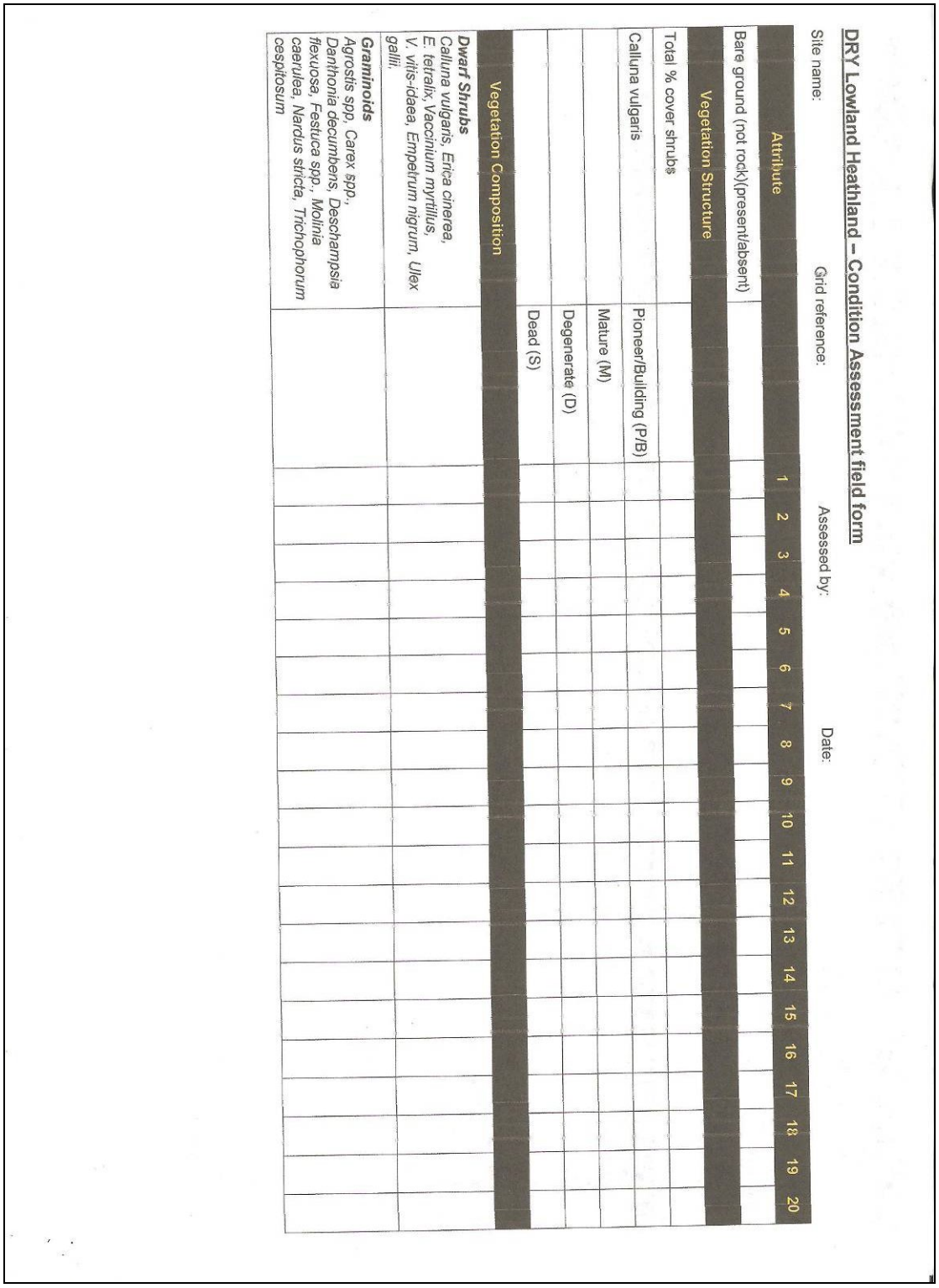
APPENDIX 3a
New Dry Heath Condition Assessment Form (Page 1)

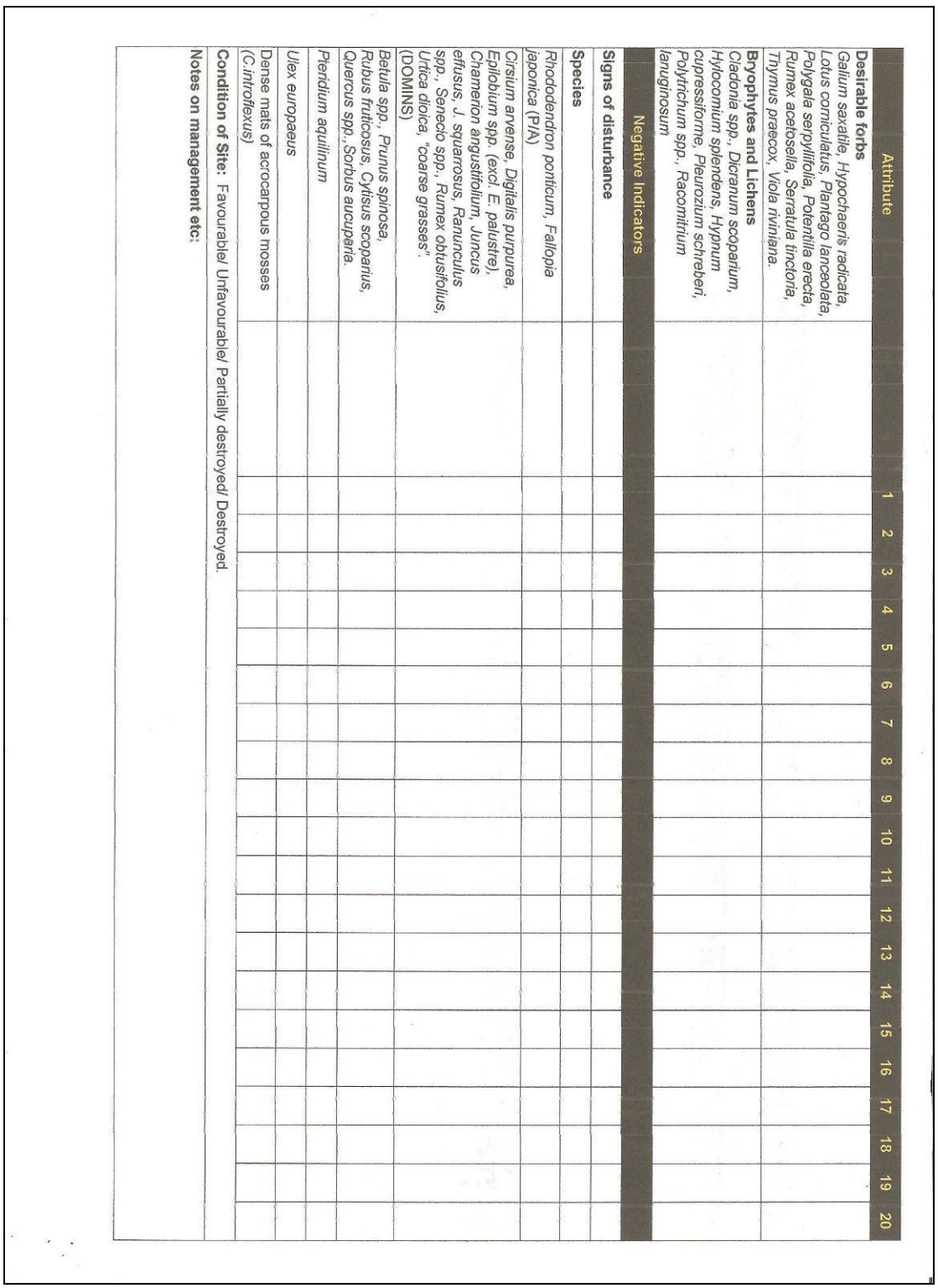


DRY Lowland Heathland – Condition Assessment field form

Site name: Grid reference: Assessed by: Date:

Attribute			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Bare ground (not rock)(present/absent)																						
Vegetation Structure																						
Total % cover shrubs																						
Calluna vulgaris	Pioneer/Building (P/B)																					
	Mature (M)																					
	Degenerate (D)																					
	Dead (S)																					
Vegetation Composition																						
Dwarf Shrubs *Calluna vulgaris, Erica cinerea, E. tetralix, Vaccinium myrtillus, V. vitis-idaea, Empetrum nigrum, Ulex gallii.*																						
Graminoids *Agrostis spp, Carex spp., Danthonia decumbens, Deschampsia flexuosa, Festuca spp., Molinia caerulea, Nardus stricta, Trichophorum cespitosum*																						

APPENDIX 3b
New Dry Heath Condition Assessment Form (Page 2)



Attribute	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Desirable forbs *Galium saxatile, Hypochaeris radicata, Lotus corniculatus, Plantago lanceolata, Polygala serpyllifolia, Potentilla erecta, Rumex acetosella, Serratula tinctoria, Thymus praecox, Viola riviniana.*																				
Bryophytes and Lichens *Cladonia spp., Dicranum scoparium, Hylocomium splendens, Hypnum cupressiforme, Pleurozium schreberi, Polytrichum spp., Racomitrium lanuginosum*																				
Negative Indicators																				
Signs of disturbance																				
Species																				
Rhododendron ponticum, Fallopia japonica (P/A)																				
Cirsium arvense, Digitalis purpurea, Epilobium spp. (excl. E. palustre), Chamerion angustifolium, Juncus effusus, J. squarrosus, Ranunculus spp., Senecio spp., Rumex obtusifolius, Urtica dioica, "coarse grasses" (DOMINS)																				
Betula spp., Prunus spinosa, Rubus fruticosus, Cytisus scoparius, Quercus spp.,Sorbus aucuparia.																				
Pteridium aquilinum																				
Ulex europaeus																				
Dense mats of acrocarpous mosses *(C.introflexus)*																				
Condition of Site: Favourable/ Unfavourable/ Partially destroyed/ Destroyed.																				
Notes on management etc:																				

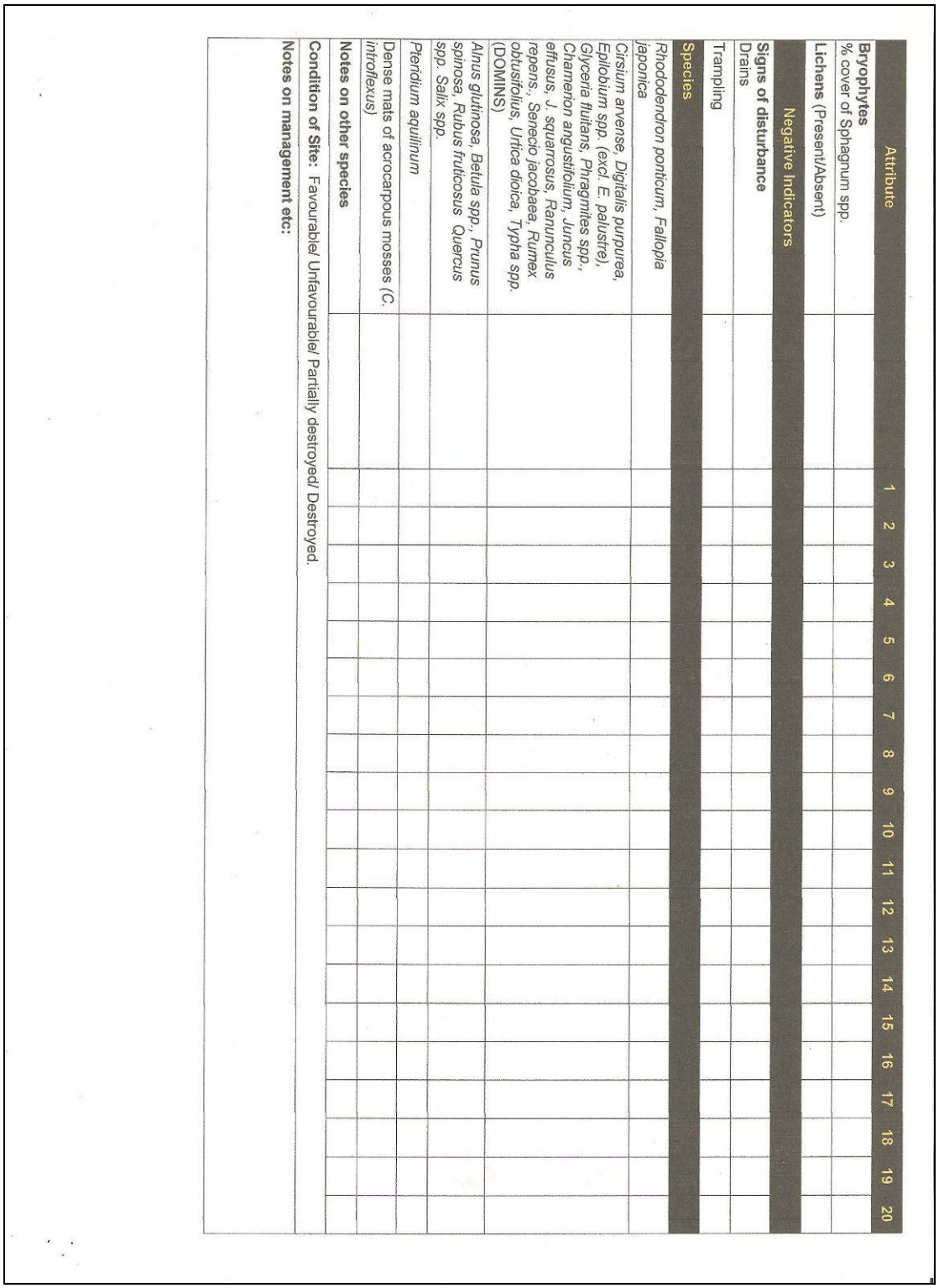
APPENDIX 4a
New Wet Heath Condition Assessment Form (Page 1)

WET Lowland Heathland – Condition Assessment field form

Site name: Grid reference: Assessed by: Date:

Attribute		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Bare ground (present/absent)																					
Vegetation Structure																					
Total % cover shrubs																					
Calluna vulgaris	Pioneer/Building (P/B)																				
	Mature (M)																				
	Degenerate (D)																				
	Dead (S)																				
Vegetation Composition																					
Dwarf Shrubs *Calluna vulgaris, Erica cinerea, E. tetralix, Vaccinium myrtillus, V. vitis-idaea, V. oxycoccos, Empetrum nigrum, Ulex gallii, Myrica gale.*																					
Graminoids *Carex panicea, C. pulicaris, Eleocharis spp., Eriophorum angustifolium, E. vaginatum, Juncus acutiflorus, J.articulatus, Molinia caerulea (%), Rhynchospora alba, Trichophorum cespitosum*																					
Desirable Forbs *Anagallis tenella, Drosera spp., Galium saxatile, Narthecium ossifragum, Pinguicula vulgaris, Polygala serpyllifolia, Potentilla erecta, Serratula tinctoria, Succisa pratensis, Ranunculus flammula*																					

APPENDIX 4b
New Wet Heath Condition Assessment Form (Page 2)



Attribute	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Bryophytes % cover of Sphagnum spp.																				
Lichens (Present/Absent)																				
Negative Indicators																				
Signs of disturbance Drains																				
Trampling																				
Species																				
Rhododendron ponticum, Fallopia japonica																				
Cirsium arvense, Digitalis purpurea, Epilobium spp. (excl. E. palustre), Glyceria fluitans, Phragmites spp., Chamerion angustifolium, Juncus effusus, J. squarrosus, Ranunculus repens., Senecio jacobaea, Rumex obtusifolius, Urtica dioica, Typha spp. (DOMINS)																				
Alnus glutinosa, Betula spp., Prunus spinosa, Rubus fruticosus Quercus spp. Salix spp.																				
Pteridium aquilinum																				
Dense mats of acrocarpous mosses (*C. introflexus*)																				
Notes on other species																				
Condition of Site: Favourable/ Unfavourable/ Partially destroyed/ Destroyed.																				
Notes on management etc:																				