8. Ballynahone Bog

8.1 Aims

Ballynahone Bog was included as a site at the client's request as it presented a more intact bog surface than either Wedholme Flow or Cors Caron. However, a major problem with this site concerned the lack of suitable remotely sensed data. The revised aim of the work at this site was to test the extent to which a meaningful bog condition classification could be obtained using digital image analysis of scanned aerial photographs. This was felt to be a useful exercise because cloud cover in the UK means that the widespread availability of high resolution satellite sensor data, such as Ikonos, cannot be guaranteed. Figure 46 shows the current availability of Ikonos data for raised bog SSSI sites and it is clear that many important sites currently lack coverage.

8.2 Data acquisition

Obtaining suitable remotely sensed data of the area was difficult. No Ikonos data were available in the Infoterra archive and it was not possible to acquire new data during the period of this contract, the main problem being cloud cover. No lidar or any other airborne multispectral data were available. The only existing remotely sensed data for Ballynahone Bog that it was possible to obtain were aerial photographs dated the 5 June 1996 (these were obtained from Keith Stanfield of Department of the Environment for Northern Ireland). Although they were adequate for this section of the study they were not optimum for a number of reasons:

- They were limited to three spectral bands, each of which was in the visible region of the spectrum (that is blue, green and red). As demonstrated through the feature selection carried out on the Cors Caron data, this may mean that some important information present in longer wavelengths is missing;
- The aerial photographs were at a scale that required three photos to encompass the whole of the area of interest. A digital image mosaic was created but the variability in colour and contrast between the individual photographs proved impossible to correct with sufficient accuracy and this introduced uncertainty into the classifications. For this reason it was decided that only the single photograph which contained most of the bog should be used. Although this resulted in a section to the north-west of the Bog being eliminated from the image processing, it was confirmed by Ms Schulz that this area does not contain any additional classes to those present in the photograph used.;
- The photographs were seven years old, and while they can still provide interesting results this should be kept in mind when comparing the classification results to the field survey as the situation on the ground may have changed. For instance, the burnt area near to the centre of the bog was distinct on the aerial photograph but when the fieldwork for this study was carried out the vegetation had recovered substantially. This type of change may be true for other areas of the bog;
- The time of year of the data acquisition was not optimum, the Cors Caron data showed late summer to be the best time of year for spectral discrimination between vegetation classes. The Ballynahone aerial photographs were acquired in early summer.

8.3 Pre-processing the aerial photograph

The photograph was scanned at a resolution of 300 dots per inch, so that it could be used for digital classification. As with the ATM data is was necessary to apply several pre-processing techniques to ensure that the aerial photograph would be suitable for the subsequent analysis.

Firstly, due to geometric distortions (as described in section 7.3.1) the image had to be registered to a geographical co-ordinate system. This proved problematic due to a lack of suitable map data available for the site. A number of sources were considered but the only map at a large enough scale (1:8 000) was provided by Dr A. McMullen courtesy of the Department of the Environment for Northern Ireland (Declaration dated 25 January 1995). However, this map did not contain information on co-ordinates (apart from an Irish grid reference of H 860980), nor did it encompass a complete grid square. For this reason the aerial photograph had to be corrected to an arbitrary co-ordinate system based on this map rather then to the OS national grid. This introduced error into the correction and the result is that the image is only corrected to within 3.9 meters of its true orientation.

There was also a change in the brightness across the image; the easterly section was much darker than the rest of the photograph which would introduce error into any classification (see Figure 30). This could not be corrected for using the standard enhancement options and so it was concluded that a cross-track illumination correction was necessary. This was applied to the whole image but with little effect. It was necessary to create a mask of the bog area (Ms Schulz was consulted as to which areas this should include) and to perform the correction based purely on the pixels contained within the masked area. This produced much more satisfactory results (as shown in Figure 31).

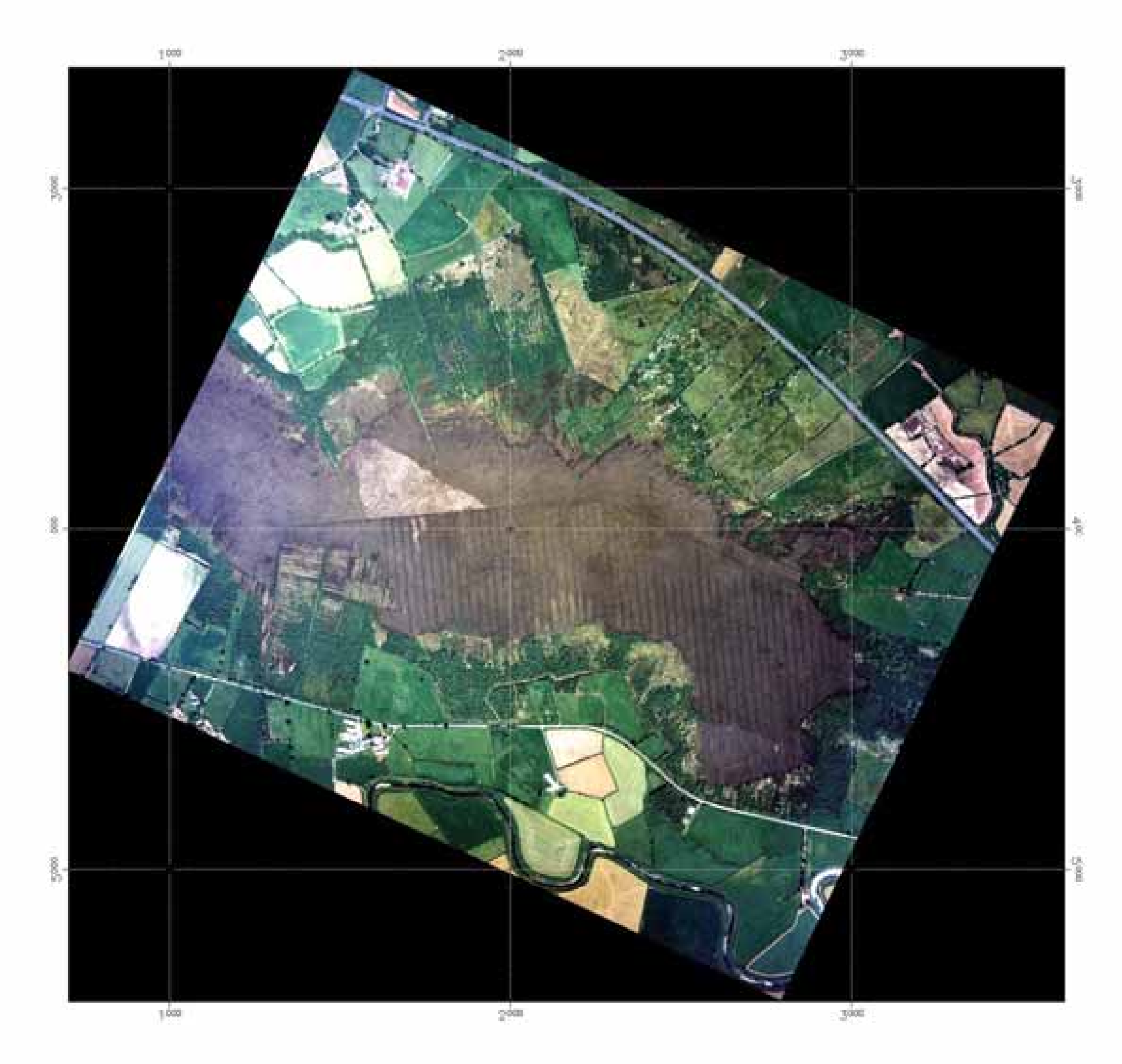

Figure 30. The aerial photograph of Ballynahone bog after geo-correction but before the cross-track shading had been corrected.

The mask that was used for the cross track correction is the same mask that was subsequently used in the classification to eliminate unnecessary data from the processing (as with Wedholme and Cors Caron classifications).

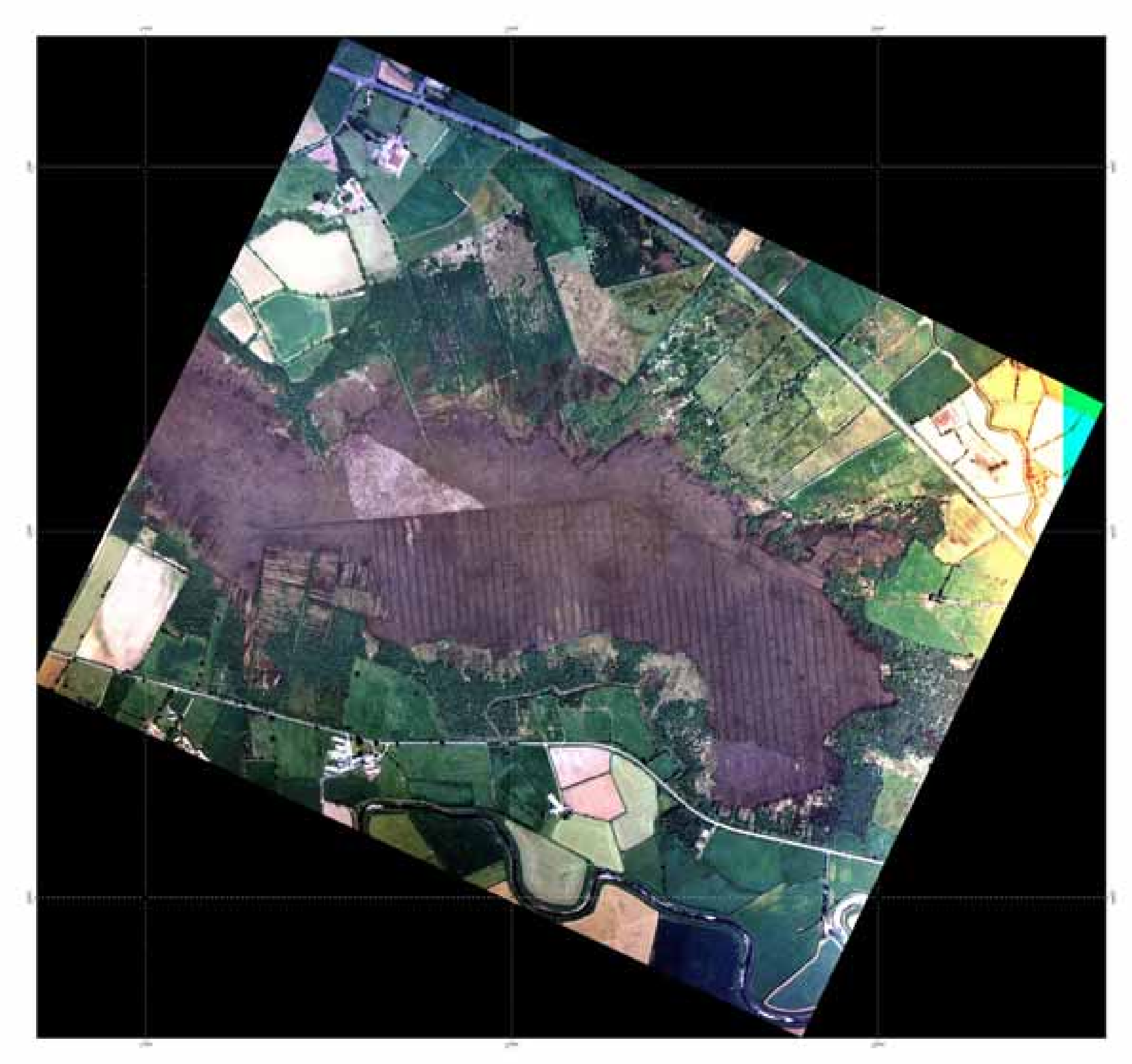

Figure 31. The aerial photograph of Ballynahone bog after the cross-track shading had been corrected.

8.4 Training site location

Once the necessary corrections had been implemented on the aerial photographs, a supervised classification was carried out. This involved the selection of suitable training sites on which the classification would be based. This was carried out in conjunction with Ms Schulz using her classification map (see Figure 32) based upon the surface condition classes presented in Table 17.

As with the Cors Caron training sites, additional sites were used where spectral differences, not separated by the classification map, were evident on the image. The training sites used for the classifications are presented in Table 14.

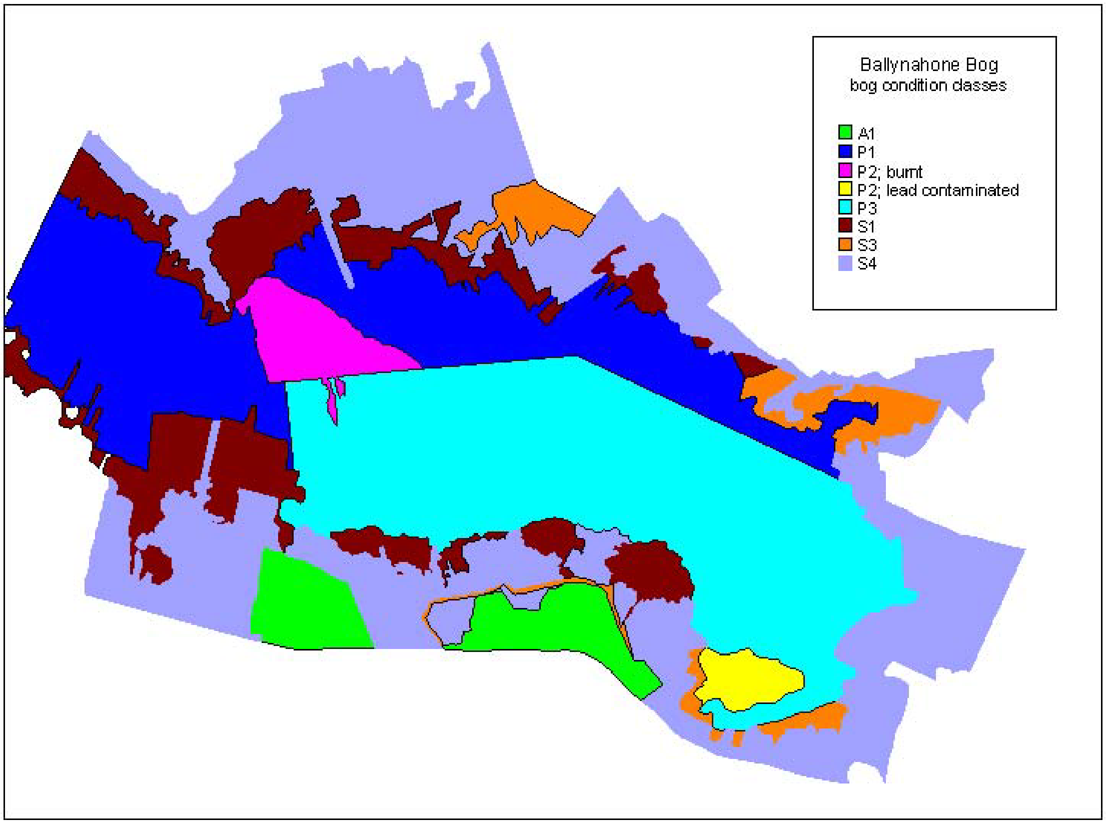

Figure 32. Bog condition map of Ballynahone Bog derived from field survey. Larger version in Appendix, after). Several of the classes identified from the field survey were not included in the automated classification (see Table 14).

Table 14. Training sites used for the Ballynahone classification

Training site name	Number of pixels
B-P2 burnt	237
L-P5	573
B-P1	1186
B-P3	1990
B-S1 cut1	1719
B-S1 cut2	370
B-P2 Pb	575
S3 : transitional class	not included
S4 : cut-over bog now woodland	not included
A1 : agricultural	not included

8.5 Classification

As there were only three bands available there was no choice as to which should be included in the classification. Bands 1, 2 and 3 (red, green and blue) were used in a maximum likelihood classification based upon the training sites shown in Table 14. Once the classification had been completed, regions ‘B-P2 burnt’ and ‘B-P2 Pb’ and regions ‘B-S1 cut1’ and ‘B-S1 cut2’ were merged to conform to the condition classes presented in Table 17. Therefore the final classification (see Figure 33) contains 5 classes that match the desired bog condition categories.

As with the Wedholme classification a 3 x 3 centre weighted majority filter was applied to the classification. This reduced the amount of spatial detail and resulted in a smoother classification (see Figure 34).

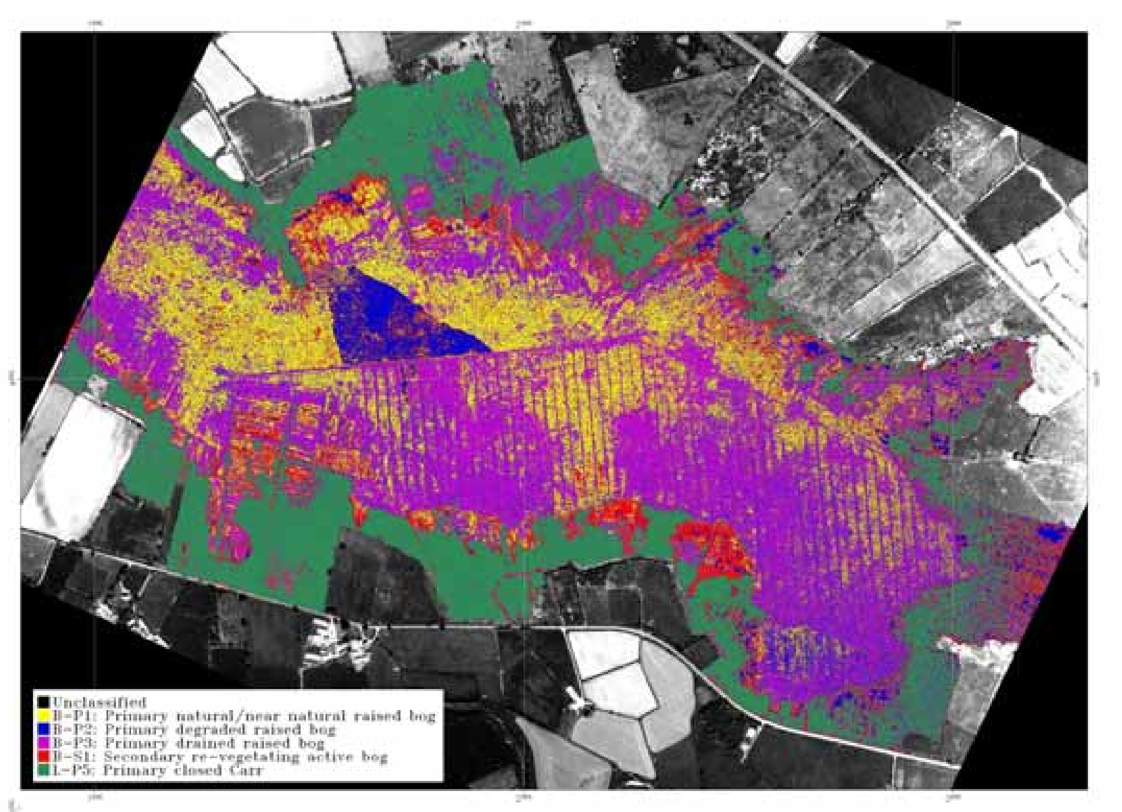

Figure 33. Maximum likelihood classification of Ballynahone Bog

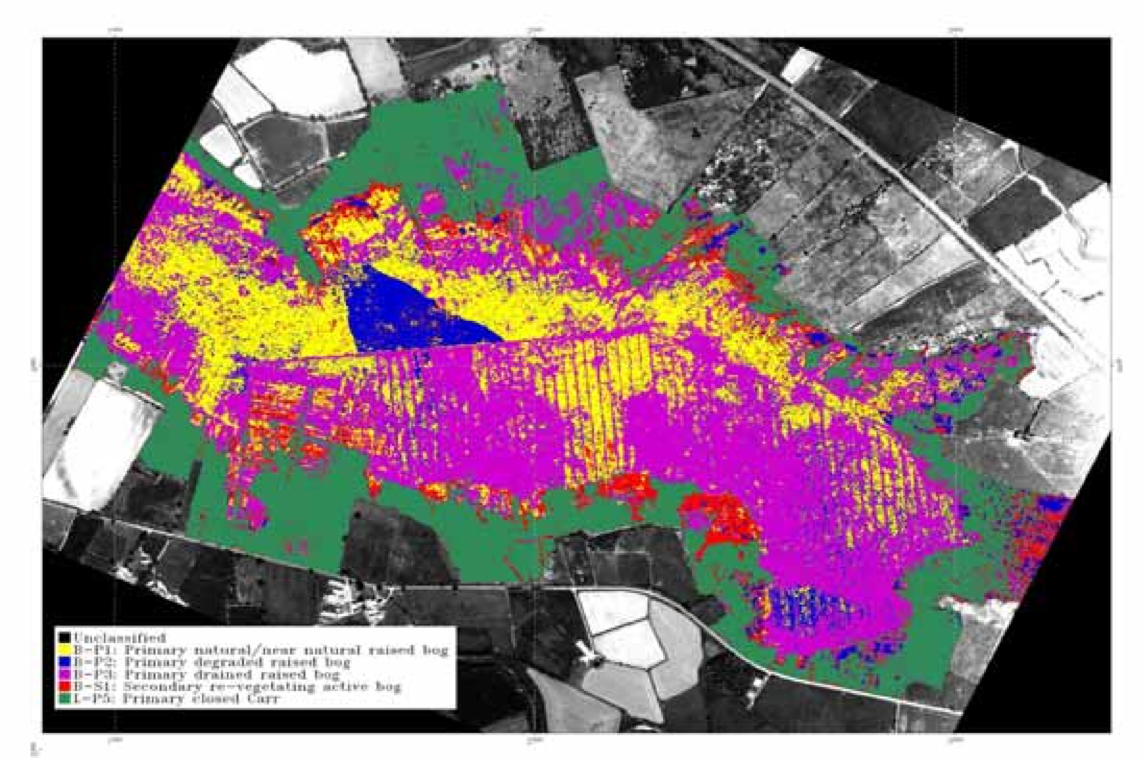

Figure 34. Maximum likelihood classification after the majority filter had been applied.

8.6 Accuracy of the supervised classification

The maximum likelihood classification generally proved successful – i.e. the distinct classes shown on the map based on the surface condition classes (Figure 34) are generally distinguishable. However, there is a lot of spectral confusion, of particular note is the mixing between the ‘B-P1’, ‘B-P3’ and ‘B-S1’ classes. To further investigate this mis-classification, a confusion matrix was used to evaluate the results of the classification. Surrogate ground data in the form of “testing sites” were chosen based upon a second set of regions of interest on the same aerial photograph. The testing sites used in the confusion matrix are shown in Table 15.

Table 15. The testing sites used in the confusion matrix

Testing site name	Number of pixels
Testing P2 burnt	278
Testing L5	543
Testing P1	1214
Testing P3	1962
Testing S1 cut1	2021
Testing S1 cut2	428
Testing P2 Pb	621

The number of pixels used for each training area roughly corresponds to the number of pixels used for each testing site.

The overall accuracy of the spectral classification was less than 50%. While this may initially appear low, most of the mis-classification was due to confusion between very similar classes. The confusion matrix clearly distinguishes which classes were the most difficult to classify on the basis of their spectral response in the visible wavelengths alone.

The category that proved easiest to classify was the L-P5 ‘Primary closed Carr’ which was classified with an accuracy of 98%. This is because the green vegetation is very spectrally distinct from the rest of the area of interest. The burnt area (accuracy of 70%) and the ‘B-S1 cut2’ class (accuracy of 77%) were also well classified. These two classes were fairly bright so therefore contrasted with the rest of the bog. In each case, most of the misclassified pixels were assigned to the other class (i.e. 15.9% of the burnt area was classified as ‘B-S1 cut2’ and 10.27% of ‘B-S1 cut2’ was assigned to the burnt class). It is also possible that bright areas of *Molinia* mixed in with the ‘B-P1’ and ‘B-P3’ classes were assigned to these two classes.

As suspected from the results of the maximum likelihood classification, the ‘B-P1’, ‘B-P3’ and ‘B-S1 cut 1’ classes all have low classification accuracies (57.17%, 58.09% and 7.16% respectively). This is because these classes are all spectrally similar. Figure 35 shows a zoomed in area selected from each of these classes. These are taken from a colour composite of the three visible bands, as such they contain all of the information that is available in this data set. From this it is clear to see just how spectrally similar some of these categories can be.

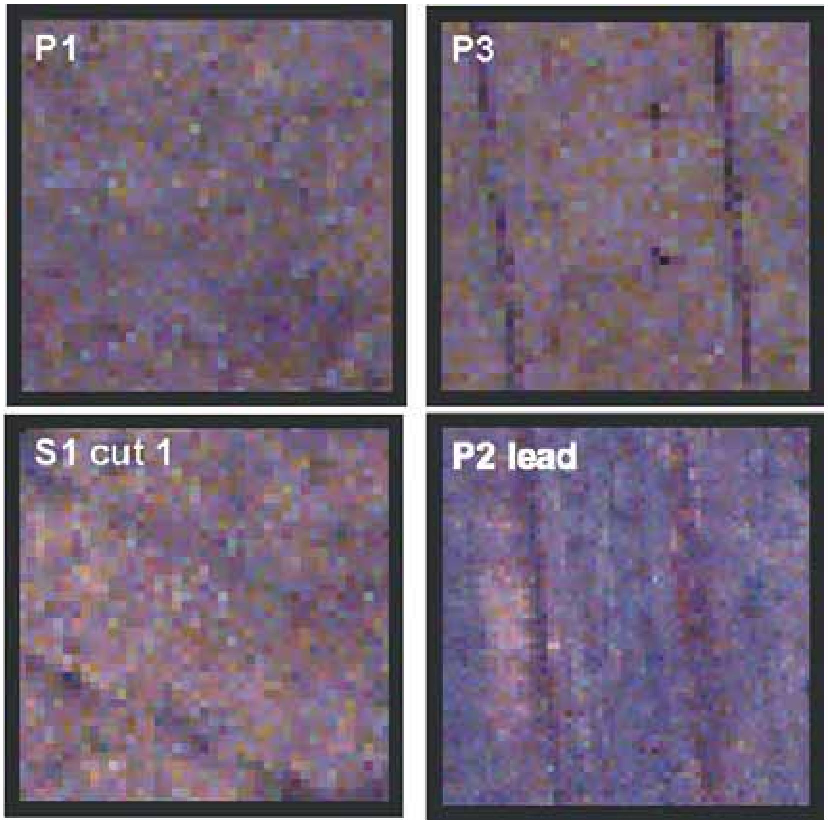

Figure 35. A comparison of the spectral responses of four of the condition classes

The P1, P3 and S1 classes are strikingly similar (note that the spectral response of these classes will vary over the image, these are just examples). It is not surprising, therefore, that a spectrally based classifier, such as the maximum likelihood classifier, would not be able to accurately distinguish between them. Table 16 shows the allocation of pixels per class from the testing sites.

Table 16. Percentage allocation of pixels to classes P1, P2 lead, P3 and S1 cut1

Class	B-P1	B-P3	B-S1 cut1	B-P2 lead
B-P1	**57.17**	17.14	41.94	25.57
B-P3	18.63	**58.09**	23.50	17.22
B-S1 cut1	4.22	1.61	**7.16**	0.70
B-P2 lead	10.29	18.44	8.49	**47.83**
Total (%)	**90.31**	**95.28**	**81.09**	**91.32**

This table shows that almost all of the error in the spectral classification lies in the misclassification between these classes. The numbers underlined are the percentage of pixels within each class allocated to these four condition classes. An original accuracy of 58.09% (‘B-P3’ classified as ‘B-P3’) is compared to 95.28% (‘B-P3’ classified as ‘P-P1’, ‘B-S1 cut1’, ‘B-P2 lead' or 'B-P3'). The error in the classification is primarily due to the misclassification of pixels in these classes to one of the other three classes.

This spectral similarity is due to the homogeneous nature of the surface vegetation. The reason that the vegetation is so similar is because the bog is now a SSSI and drainage and cutting have been stopped. The drains were never fully operational and were blocked up soon after they were created, as such they have had a minimal effect on the vegetation surrounding them. Cutting is no longer taking place and the vegetation starting to recover. Thus, although past management practices have altered the condition of the bog, the vegetation is now recovering. This means that while there are still a number of condition classes on the ground they will be increasingly difficult to see from air or from space. This is especially the case if the only technique that is being used is a spectral classifier.

8.6 Contextual Classification

The evidence of draining and cutting on Ballynahone bog is clearly evident to the human eye as context and pattern can be taken into consideration as well as the spectral response of the surface. For this reason the area of interest has been split into undisturbed bog, disturbed bog and carr woodland. Differentiation between these was possible using the aerial photograph. As with the initial classification, a mask was created for each of these three new areas of interest and the same maximum likelihood classification was run on each area. Again a 3 x 3 centre weighted majority filter was applied to each classification. The following figures show the results of these classifications. (Figures 36 to 38).

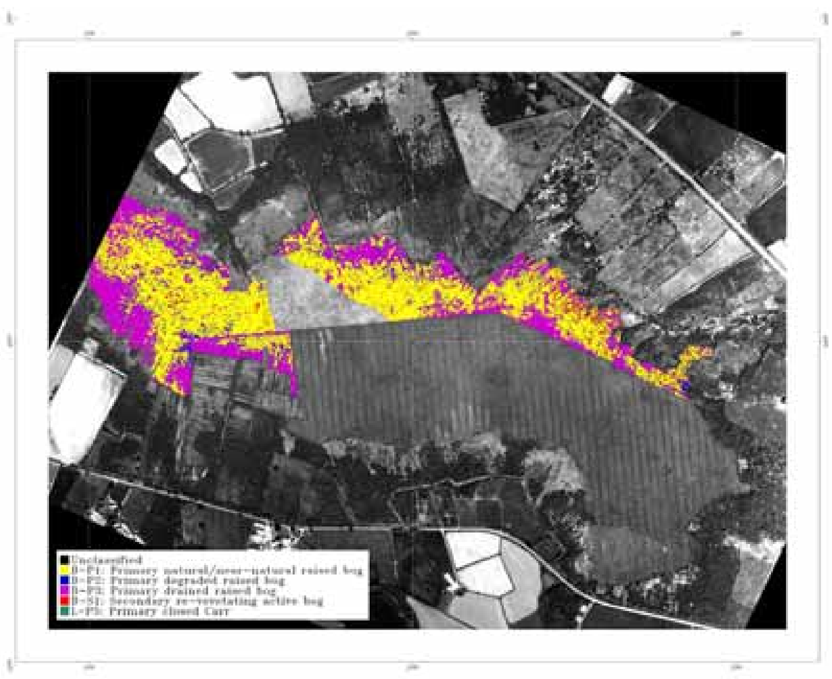

Figure 36. Maximum likelihood classification of the undisturbed areas of Ballynahone Bog

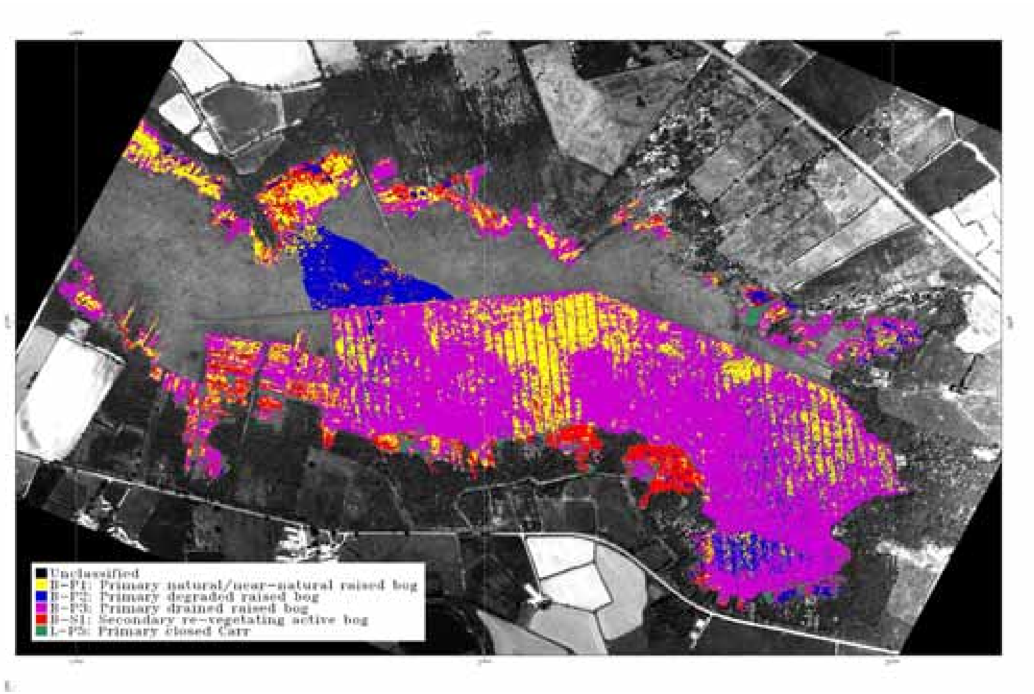

Figure 37. Maximum likelihood classification of the disturbed areas of Ballynahone Bog.

Figure 38. Maximum likelihood classification of the marginal communities on Ballynahone bog

These images are more useful than the classification of the whole bog for management purposes as they show the variation in classes according to the general categories of undisturbed bog, disturbed bog and Carr woodland.

8.7 Probability images

As in the Wedholme section of this report (section 6.8.4), the rule images that are an automated by-product of the maximum likelihood classification are presented here (Figures 39 to 44). They show the probability that each pixel belongs to a particular class (with the brightest white being the highest probability) rather than just a final allocation to a class.

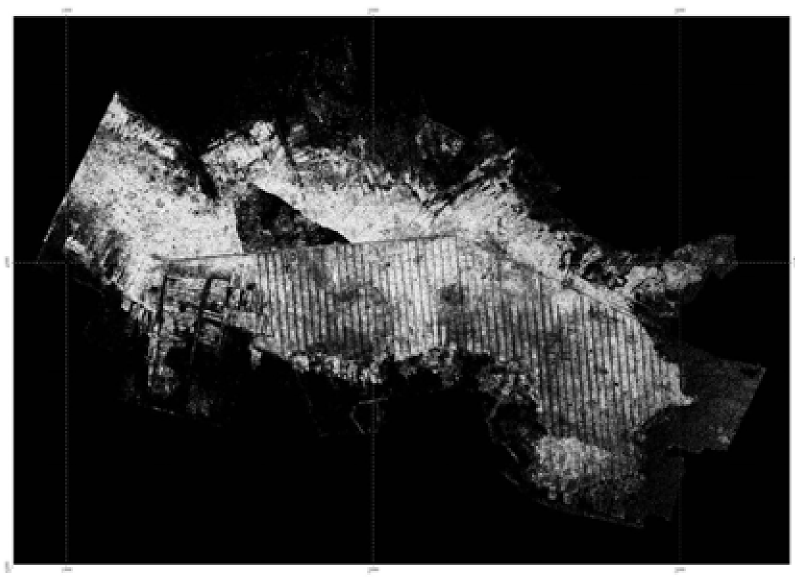

Figure 39. Rule image of the Primary bog (P1) class

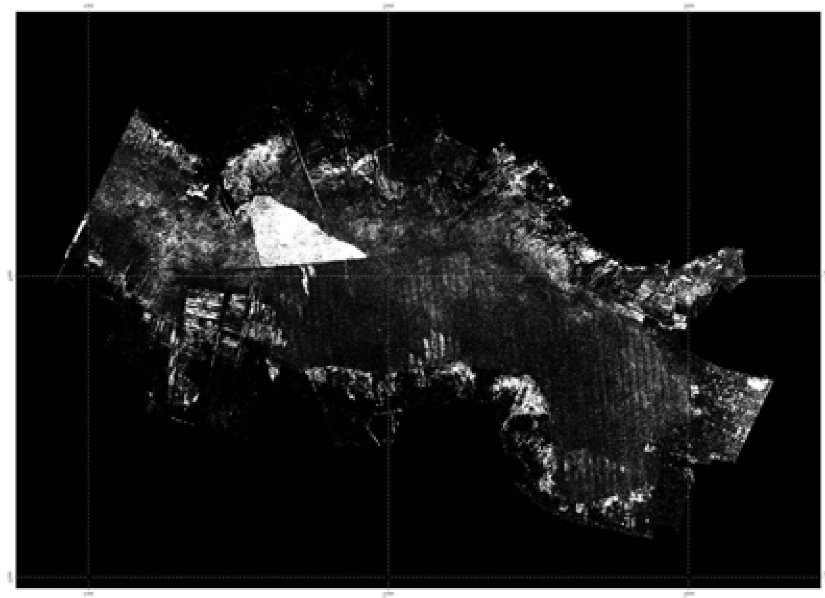

Figure 40. Rule image of the Primary bog (P2 burnt) class

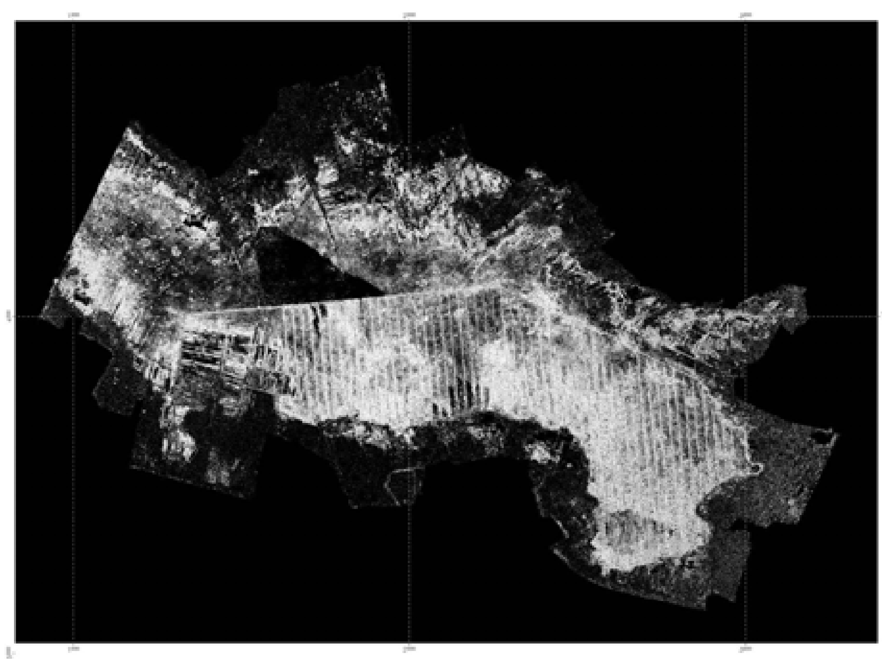

Figure 41. Rule image of the Primary bog (P3) class

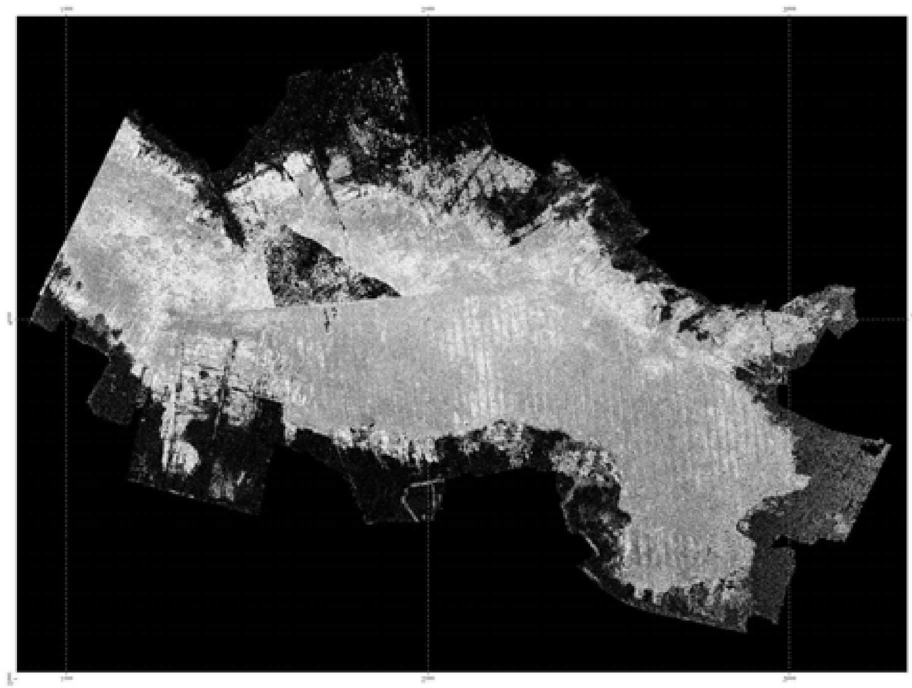

Figure 42. Rule image of the Secondary bog (S1 cut) class

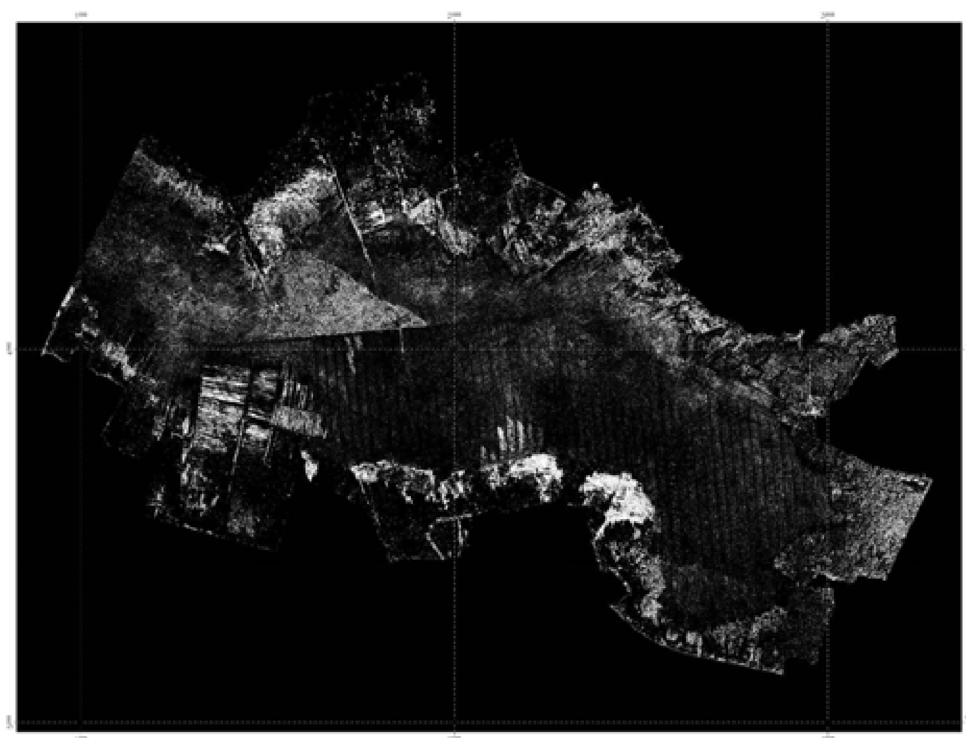

Figure 43. Rule image of the Secondary bog (S2 cut) class

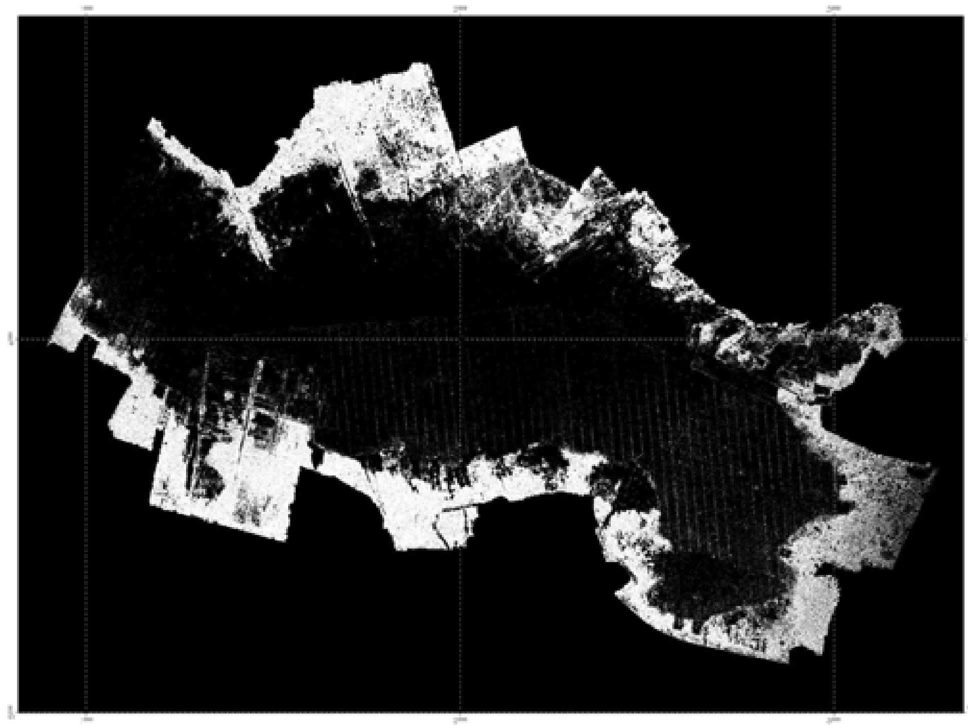

Figure 44. Rule image of Carr woodland class

Not surprisingly, the classes that have clusters of pixels with a very high probability of belonging to them are the classes that were highlighted as having the highest classification accuracies (namely the primary closed carr and the burnt areas). The mixing that was discussed earlier between 'B-P1', 'B-P3' and 'B-S1 cut1' is evident again here. There is a high frequency of white pixels in each of these probability images and there is not always a sharp difference in brightness between the areas separated as different condition classes in Figure 34. This means that although the classifier has separated the area of interest into 'distinct' condition classes there is also a high probability that some of these pixels share characteristics with another class. The spectral similarity within a condition class (such as 'B-P2 burnt' and 'B-P2 lead contamination') can sometimes be less than the spectral similarity between condition classes (for instance 'B-P1' and 'B-P3').

In conclusion, the most successful classification of Ballynahone Bog was achieved by an initial categorisation of the condition of the surface based upon a visual interpretation of the scanned aerial photograph, followed by a more objective spectrally-based classification of the digital data in red, green and blue wavelengths. Although the overall results were comparable in accuracy with those derived from analysis of the Ikonos image of Wedholme Flow, the aerial photographs were much more problematic to work with and better suited to a conventional visual interpretation.

9. Assessment of the remote sensing classification results and proposal for a revised LRBI classification system

9.1 Rationale for a revised LRBI classification system

Lowland raised bogs may be classified using a system based on functional hydrology. Ivanov (1981) described a fourfold system in which a mire complex possibly containing several different mire types is termed a macrotope. The macrotope is regarded as a self contained unit in terms of hydrology and vegetation (Lindsay, et al., 1988). A single raised peat bog dome is termed a mesotope. This unit is sometimes subdivided into the gently-domed central area, termed the mire expanse and the steeply sloping edge to the dome known as the mire margin or rand. Surrounding an intact raised peat bog there are fringing minerotrophic fen or carr communities drained by streams. This hydrologically distinct unit, known as lagg, is regarded as a separate mesotope. The surface of the mesotopes may support patterned features formed from sets of pools and hummocks, known as microtopes. Finally, distinct levels may be recognised within in the hummock / hollow complex and these features are termed microforms or nanotopes (Lindsay & Campagna Popolo 1998).

The classification system designed by Lindsay and Immirzi (1996) for the LRBI was principally concerned with characterising the mire expanse sub-unit, and provided only limited categorisation of conditions on cut-over areas or peat soils now lacking bog vegetation. The various refinements introduced by the Scottish Lowland Raised Bog Inventory - e.g. vegetation modifiers - give more detail across the whole spectrum of bog peat environments. However, neither this nor the original LRBI provided an explicit category for the lagg fen zone.

The classification system designed by Lindsay and Immirzi (1996) for the LRBI was principally concerned with the mire expanse sub-unit. By contrast the current study is concerned with all of the units that form a single raised peat bog. For this reason new classes must be added to the original set of LRBI categories to accommodate certain aspects of the mire margin sub-unit and the lagg mesotope. The modified scheme is presented in Table 17 and Table 18.

9.2 Explanation of the revised condition classes

The first modification to the LRBI system designed by Lindsay and Immirzi (1996) involves the addition of a ‘mesotope prefix’ to distinguish between the raised bog dome and the lagg communities. The prefix B- denotes bog, whereas L- indicates lagg. The letters P and S remain and stand for ‘Primary Mire’ and ‘Secondary Mire’. The term ‘mire’ is used here since it encompasses bogs, fens and swamps. The modified classification is explained below

9.2.1 Modified Condition Classes

B-P1 to B-P5: Primary Near-natural / Primary degraded / Primary drained / Open canopy wooded and closed canopy wooded raised bog

The first five condition classes of the modified scheme are directly equivalent to the primary classes P1 to P5 in the original scheme devised by Lindsay and Immirzi (1996). Definitions for these classes remain unaltered.

B-P6: Rand (raised bog margin)

Structurally intact raised bogs have a slightly domed to near-flat expanse bordered by steeply sloping margins termed ‘rand’. This mire margin (*sensu* Sjörs, 1948) is hydrologically distinct, being defined by faster lateral seepage rates than the main mire dome. The marginal areas are supplied by seepages, which originate from the mire expanse (endotelmic, Lindsay *et al*., 1988). The improved surface drainage across the mire margin zone tends to give rise to a characteristic vegetation zone often dominated by a somewhat drier vegetation type. In typical UK bogs, where the lagg zone has been completely drained, this marginal zone becomes particularly dry towards the edge of the upstanding dome, and is often characterised by a dominance of *Calluna vulgaris* or *Molinia caerulea*. These vegetation types are relatively easy to recognise in remotely sensed images and therefore the rand warrants a separate class in the modified scheme. The different vegetation types found on the rand may be represented in the scheme by the vegetation modifiers ‘L’ for *Calluna* and ‘H’ for *Molinia* (see Table 18).

Most British raised bogs have been damaged by large-scale peat extraction or peripheral domestic peat cutting to the extent that the rand is rarely located in its original position. Nevertheless a rand slope forms at the edge of the cut peat dome and the vegetation that establishes on the primary, steeply sloping surface is somewhat similar to that of an undisturbed rand.

B-S1 and B-S2: Secondary re-vegetated active bog and peat extraction

These classes are directly equivalent to S1 and S2 in the original scheme and their definitions remain unaltered.

B-S3: Secondary re-vegetated degraded bog

Analyses of the field survey results from Wedholme Flow and Cors Caron indicate the need for an additional ‘Secondary’ class. The original LRBI scheme accommodates two situations, (1) cuttings that are active and re-vegetating / re-vegetated and (2) cuttings that are not vegetated. Wedholme Flow in particular, has dry re-vegetated peat cuttings that are not actively accumulating peat. To cover this situation the category B-S3 was added to the scheme. The vegetation cover may contain dwarf shrubs, *Cladonia* spp. and *Molinia caerulea*. Again the SRBLCS vegetation modifiers (Parkyn & Stoneman 1997) can be used to distinguish the different vegetation types.

L-P1: Primary near natural lagg fen

The lagg fen surrounding most raised bogs has been severely damaged by a wide range of land use pressures and now very few remnants of near-natural lagg fen remain. The east margin of Cors Caron supports a narrow band of lagg fen, adjacent to the Teifi river channel. Air photographs and CASI imagery suggest that the mire surface here is structurally intact and recent coring work (Hughes, 2002) and vegetation mapping (Schulz, in prep.) support this interpretation. The vegetation contains a range of fen bryophytes and herbs together with various *Carex* species. L-P1 may be defined as intact, open lagg that has an ability to accumulate peat and supports a typical range of fen species.

L-P3: Primary degraded lagg

This condition class refers to uncut lagg fen communities that have been substantially altered by disturbances such as peat cutting and drainage works. The peat surface may be vegetated but 'dry' in character, supporting few or no typical lagg fen species.

L-P/S4: Primary/secondary open fen carr

Raised bogs are commonly surrounded by a wooded fringe consisting of arboreal species tolerant of at least some waterlogging. Communities consisting of *Salix* and *Alnus* (possibly with some *Quercus*) usually indicate eutrophic to mesotrophic fen carr conditions where they are found growing on peat. In open canopy woodland it may be possible to detect a secondary peat surface using Lidar but the tree canopy may disguise cuttings in some areas. Consequently, the condition class category used in the present study does not distinguish between primary and secondary peat surfaces.

Where the fringing woodland is principally composed of *Betula* with an oligotrophic ground layer it is categorised as either B-P4 or B-P5 (see above). Ground data may be required to distinguish between the bog and lagg woodland categories since remotely sensed imagery contains insufficient data to separate different tree species within the woodland category.

Carr woodland may be designated on the basis of airborne data where it occurs immediately adjacent to sharply rising mineral ground. In this context the woodland is likely to be fen carr because the peat surface will receive a significant amount of slope runoff. This criterion was used in the present project and checked against field data.

L-P/S5: Primary / Secondary closed fen carr

Closed carr woodland may be dominated by *Salix* or *Alnus* with some *Quercus*. The canopy forms an almost complete cover. In this case the primary status of the peat surface may be impossible to establish from airborne data.

L-S: Secondary lagg fen

Secondary lagg fen refers to open lagg communities that are actively regenerating over old peat cuttings. The lagg contains a mix of typical fen species and it is capable of peat accumulation.

A1 Archaic (agriculture), A2 Built development, U Not determined

These classes remain unaltered in the modified classification scheme.

Combinations of classes

The condition of some parts of Cors Caron and Wedholme Flow appear to fall half way between two condition classes. In these cases classes were combined to provide a more accurate description of the surface condition. Two hybrid classes were used; B-P1/2 and B-S1/3.

Hybrid class B-P1/2

This class is defined as primary active bog with a moderately degraded or altered vegetation community. The northern uncut section of Wedholme Flow was included in the B-P1/2 category because the entire surface had been significantly affected by the surrounding cutting and it supported a somewhat reduced *Sphagnum* cover with an abundance of *Cladonia* spp. The vegetation surface could not be considered to be 'near-natural' (B-P1) but equally it was not degraded to the point of being 'inactive' (B-P2).

The original LRBI condition class scheme has no vegetation modifier for a Lichen-dominated community; therefore the new modifier 'LCH', standing for 'lichen-dominated', was added to the list.

Hybrid class B-S1/3

A hybrid 'Secondary' class was also required for the project because some of the regenerating peat cuttings were clearly re-vegetating and contained a small amount of *Sphagnum* but they did not appear to be peat forming. The cuttings therefore fell half way between B-S1 and BS3.

Table 17. Modified scheme for remotely-sensed classification of raised bog and lagg fen mesotopes

Class	Name	Description
B-P1*	Primary natural / near-natural raised bog	A primary peat dome with an extensive cover of colourful Sphagna, with the ability to accumulate peat.
B-P2*	Primary degraded raised bog	Primary surface where the vegetation has been modified by factors other than drainage (e.g. burning / grazing).
B-P3*	Primary drained raised bog	Primary drained bog in which a regular drainage pattern exists.
B-P4	Primary open canopy wooded raised bog	Primary bog supporting open canopy woodland or scrub.
B-P5	Primary closed canopy wooded raised bog	Bogs supporting closed canopy woodland. Trees may have ‘self-seeded’ but often they are present because of deliberate planting. Self-seeding is often a symptom of damage. Tree cover enhances oxidation and drying of the peat surface.
P16†	Raised bog margin	Rand slope of the raised bog, usually supporting *Calluna vulgaris* and / or *Molinia caerulea.*
B-S1*	Secondary re-vegetating active bog	Actively regenerating raised peat cuttings (peat forming).
B-S2	Secondary, commercial / domestic peat extraction	Large expanses of bare peat for modern industrial-scale raised peat extraction or recently abandoned raised peat cuttings.
B-S3	Secondary re-vegetated degraded bog	Dry, re-vegetated raised bog cuttings (non-peat forming).
L-P1*	Primary near-natural lagg fen	A primary open lagg fen surface dominated by sedges and fen herbs with the ability to accumulate peat.
L-P3	Primary degraded lagg fen	Primary lagg fen surface where the vegetation has been modified (e.g. by drainage).
L-P4	Primary open carr	Open carr woodland dominated by *Salix* or *Alnus* with *Quercus.*
L-P5	Primary closed carr	Closed carr woodland dominated by *Salix* or *Alnus* with *Quercus.*
L-S*	Secondary lagg fen	Regenerated or regenerating lagg fen.
A1	Archaic (agriculture)	Bogs drained for agriculture. The peat is oxidised with a lowered surface. Eventually fen peats will be exposed.
A2	Built development	Peatland covered by structures such as buildings, roads or railway lines.
U	Not determined	Condition not yet classified.

* denotes condition classes that are considered to be ‘active’ under Annex I of the EC Habitats Directive.

† This condition class is not usually found in its former natural position

Table 18. Vegetation modifiers used in land cover classification

Drainage Modifiers	Vegetation Modifiers	Erosion Modifiers
I irregular	BP broadleaf plantation	MIC micro-broken
N narrow	CP coniferous plantation	Y gully erosion
M moderate	MP mixed plantation	
W wide	PF plantation felled	
A absent	PFR plantation felled and replanted	
U unknown	BS broadleaf self-sown	
	CS coniferous self-sown	
	MS mixed self-sown	
	GS gorse, bramble etc	
	O or C open or closed canopy	
	L low shrub dominated	
	H herb dominated	
	SPH *Sphagnum* dominated	
	BRY bryophyte dominated	
	BAR bare peat dominated	
	BBA bryophyte / bare peat co-dominant	
	BAS bare peat / *Sphagnum* co-dominant	
	LCH Lichen-dominated	

9.3 Summary

The use of lidar can distinguish between hand-cut and milled bog and fen surfaces and uncut mire. This instrument may be used to determine the major classifications of “Primary” and “Secondary” peat bog. Further classification of bog condition may require a number of data sources including air photographs and multispectral imagery. The study of a complete raised bog macrotope requires the extension of the existing condition class system, produced by Lindsay and Immirzi (1996), to include mire margin (*sensu* Sjőrs, 1948) and lagg fen. The existing Lowland Raised Bog Inventory (LRBI) condition class categories are principally designed for the mire expanse mesotope. Ground-based surveys of the mire vegetation at Cors Caron and Wedholme Flow showed that new primary and secondary bog categories were required as well as additional lagg categories. Furthermore the modified condition class categories can be refined further with the use of hybrid categories (e.g. B-P1/2), which indicate that the mire condition lies between two categories, and with the use of a new a larger range of vegetation modifiers.