

10. Relative costs of different RS approaches

One of the primary attractions of using remotely sensed data is the reduced cost compared to traditional surveying techniques. There are, however, still a number of factors that need to be considered in order to ensure that the data used are the best value and the most suitable for the task at hand.

When comparing prices from different sources it is important to note factors such as the minimum amount of data that have to be purchased at any one time. For instance, Ikonos data is only £11/km² but a minimum of 100km² has to be ordered regardless of the size of the area of interest. This would make it relatively cheaper to buy data for larger areas – if more than 100km² is required then this is not a limitation. Similarly, if aerial photography is the preferred data source it is necessary to consider the distance the aeroplane has to fly to the site in order to collect the data as this will impact on the overall cost.

Another factor that will affect cost is whether or not there is (recent) archived data available. It will generally be significantly cheaper to purchase archived data than to fund the acquisition of a new data set (see Table 19). Of particular note is the cost of lidar data which has proved to be fundamental to this project. If available it costs £300/km² (data are sold in tiles, if there is not a complete tile available only the proportion that is covered is charged for). The basic acquisition cost for these data, however, is £10 000 which would have considerable affects on the feasibility of purchasing it for most applications. It is due to the high cost of commissioning a survey to acquire lidar data that only patchy cover was used in this report for Wedholme Flow (this was all that was available from the archive). The high cost meant that it was not purchased at all for the Cors Caron study (no archived data were available). However, the archive of available lidar data is continually being added to (see Figure 45 for a graphical representation of the current archived lidar data) and even partial coverage of an area has proved to be extremely useful. Although expensive, Lidar is a valuable source of information that can add considerable detail to spectral information and be used to distinguish between features in its own right (as it allows a much more in-depth study of variables such as relief, pattern and context). Thus, while cost comparison of different data sources is important, the relative usefulness of them must also be considered.

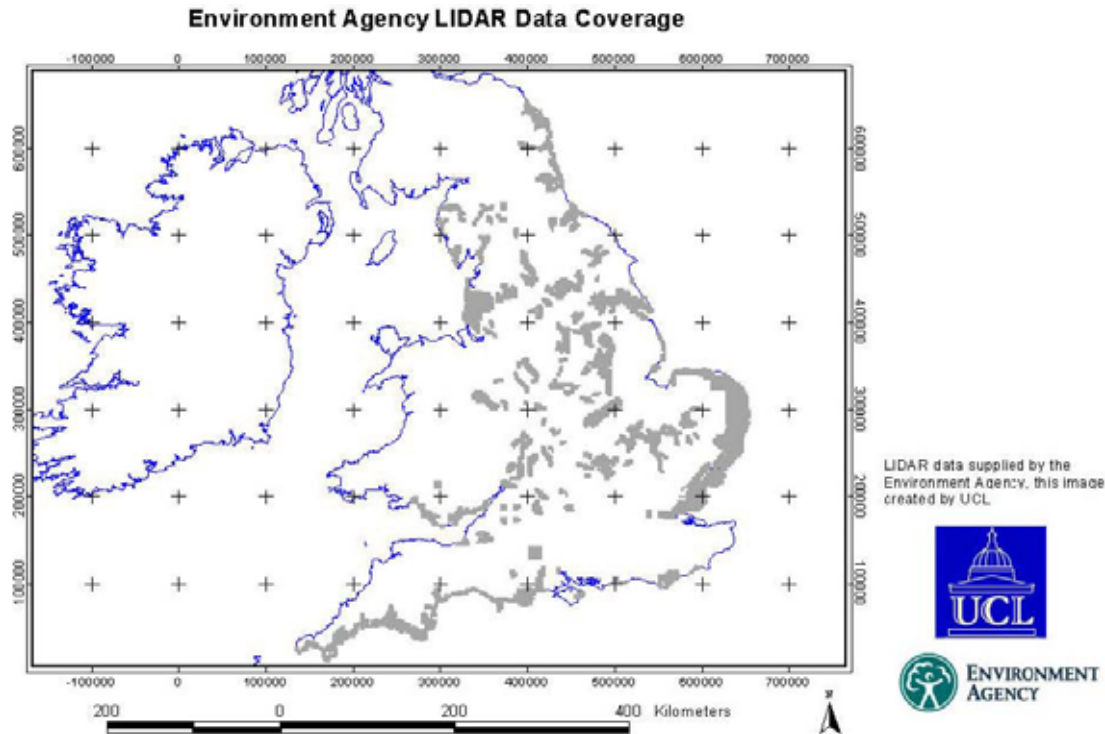


Figure 45. Current Environment Agency lidar coverage of the UK
(source : www.landmap.ac.uk/lidar/lidar.html, 14/2/03)

It is important to note that the prices presented in Table 19 are all estimates of the actual costs of purchasing data. This is especially true where data are being newly acquired. For instance, in the case of aerial photography the flying distance to the area of interest may impact significantly on the overall cost. Also, with CASI data from the EA, details of processing costs will be added on application.

NERC has currently been unable to provide a figure for the acquisition of CASI and ATM data (note that archived ATM data were used for the Cors Caron section of this report). However, from previous experience with this organisation it would be expected that their prices would be competitive with any alternative sources. The method used by NERC is such that there is often a possibility of combining data collection with other survey work. Thus if data are being collected for another purpose in an area close to a site that is of interest, there is potential for the overall acquisition cost (of £10,000) to be reduced.

The amount of data that would be necessary to conduct a nationwide survey of lowland raised peat bogs would be large. It would be advisable to use archived data wherever possible and to carefully plan data acquisition. For example, surveying a number of areas close together on one day would minimise flying distances between sites. This would be more cost-effective than paying for the aircraft to visit the same area repeatedly.

Table 19. Summary of data costs

Data type	Data Type	Source/ provided By	Archived Cost	Acquisition Cost
Satellite	IKONOS (Figure 46 and Figure 47)	Infoterra	£12/km² (min. 100km ²) = £1,125	£12/km² (min. 100km ²) = £1,125
	Quickbird	GIM/ Digital Globe	£16/km² (Min 25km ²)	£16/km² (Min 64km ²)
Aerial Photography	CASI (Figure 48)	EA	£200/km²	£10,000
	CASI (Figure 48)	NERC	£52/ line km	?
	ATM (Figure 48)	NERC	£52/ line km	?
	LIDAR (Figure 45)	EA	£300/ km²	£10,000
	X-band SAR (Figure 50)	Global Terrain (NEXTMap Britain)	Digital Surface Model (0.5m RMSE) £25/km ² (min. 100km ²) = £2500	N/A
			Digital Surface Model (0.5m RMSE) £30/km ² (min. 100km ²) = £3000	N/A
Aerial Photography	Getmapping	1/2km ² £25 1km ² £48	N/A	
Map Data	Digimap (standard)	Edina	Urban: 500m x 500m: £39	N/A
			Rural: 1km x 1km: £18	N/A
			Moorland: 5km x 5km: £37	N/A

If archived data are not available then it will be necessary to determine the acquisition costs of different sources and to establish which would be the most suitable for a particular area. While Table 19 provides a brief summary of acquisition costs for various sources it may be useful to compare the costs of purchasing data for a particular study area. For this purpose Hatfield Moors in Southern Yorkshire (Grid reference 470500E 406500N) was considered. It has been proposed to the European Commission (through Natura 2000) that in recognition of its ecological importance the site should be protected under the European Habitats Directive (<http://www.ipcc.ie>). While peat extraction has ceased on two other lowland raised bogs (Thorne Moor and Wedholme Flow) that were also recognised as areas of international importance for

conservation, extraction will only be phased out on Hatfield Moor by 2004 (<http://www.forests.org>). This is likely to raise some interesting management issues and it is probably an area that will be surveyed in the future. As such it has been chosen as the site on which to base a scenario for data acquisition. The cost of acquiring data for Hatfield Moor for both a 1km² area (or a 1km flightline where appropriate) and 5km² (or a 5km flightline) is shown in Table 20. While it would be necessary to purchase 5km² of data to gain complete coverage of the area, a 1km² subsection may also provide useful information (it may be worth considering purchasing data of parts of the areas of interest rather than whole areas as a means of reducing the overall cost of data).

Table 20. Costs of various scenarios

Data Type	If available from archive		If acquired specifically	
	1km ²	5km ²	1km ²	5km ²
IKONOS	£1,125	£1,125	£1,125	£1,125
IKONOS and Lidar	£1,125	£2,625	£11,125	£11,125
IKONOS and (a) X-band SAR	£3,625	£3,625	£3,625	£3,625
CASI (at full EA cost)	£200	£1,000	£10,000	£10,000

Within the scope of this project there is the possibility of combining different available data sources from which most information can be extracted. This flexibility means that if there are data already available for a particular area of interest, it is likely that this could be usefully incorporated into the study.

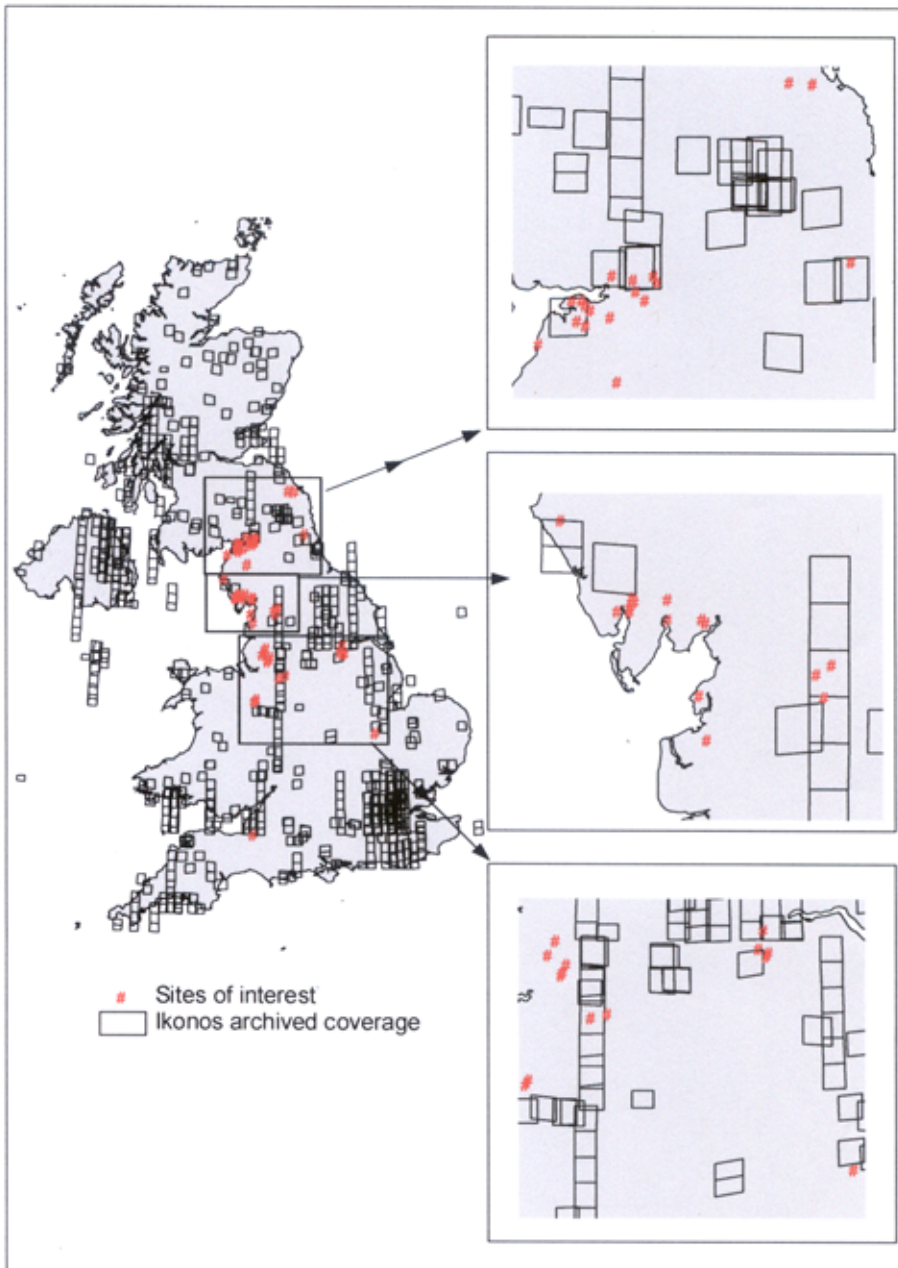


Figure 46. Current UK coverage of Ikonos data with the raised bog SSSI sites shown by red hash symbols (source: pers. Comm., Sheena White, Infoterra, 11/2/03; SSSI sites provided by Dr. Roger Meade, May 2003)

Table 21. Ikonos Coverage of Lowland Raised Bog SSSI in England

Site Name	Ikonos Coverage
Austwick and Lawkland Mosses	Y
Black Moss (Egremont)	Y
Black Snib	Y
Bolton Fell Moss	Y
Bowness Common	Y
Glasson Moss	Y
Gleads Moss	Y
Hesley Moss	Y
Prestwick Carr	Y
Solway Moss	Y
Swarth Moor	Y
Thorne, Crowle and Goole Moors	Y
Walton Moss	Y
Wedholme Flow	Y
Westhay Moor	P

Site Name	Ikonos Coverage
Danes Moss (inc. Moss Head Farm Outlier)	N/E
Drumburgh Moss	N/E
Hatfield Moors	N/E
Oulton Moss	N/E

- This information is based on the central points of the sites of interest.
- Information on Ikonos availability was provided by Infoterra and is for acquisitions with less than 20% cloud.

Y=Coverage

P=Partial coverage

N=No coverage

N/E=No coverage but on the edge of a data collection site

Table 22. Sites for which no Ikonos data are currently available

Arnaby / Shaw Moss	Lower Duddon Mosses
Astley and Bedford Mosses	Meathop Moss
Bowscale Moss	Nichols Moss
Epworth Turbary	Orton Moss
Fenns, Whixall & Bettisfield Mosses	Red Moss
Ford Moss	Risley Moss
Haxey Turbary	Roudsea Moss
Heathwaite Moss	Rusland Valley Mosses
Heysham Moss	Salta Moss
Holburn Moss	Scaleby Moss
Holcroft Moss (remnant)	Wem Moss (inc. Cadney Moss)
Holme Fen	White Moss, Crosbymoore
Ince Moss	White Moss, Duddon
Latter Rigg Moss	Winmarleigh Moss (remnant)
Little Bampton Moss	Wreaks Moss

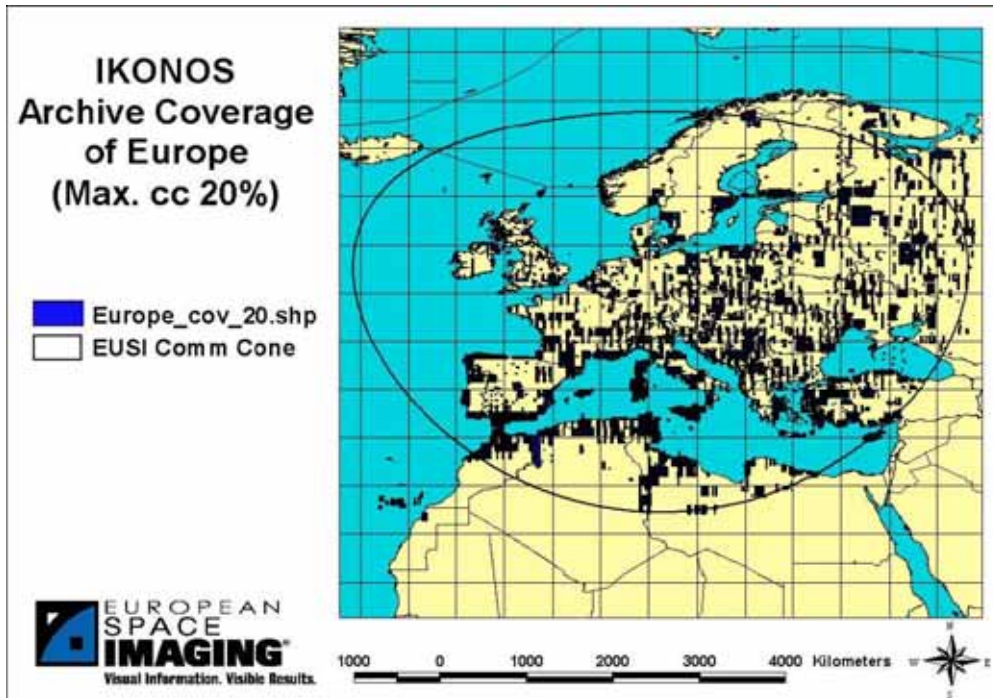


Figure 47. EU coverage of Ikonos data (source pers. comm., Sheena White, Infoterra, 11/2/03)

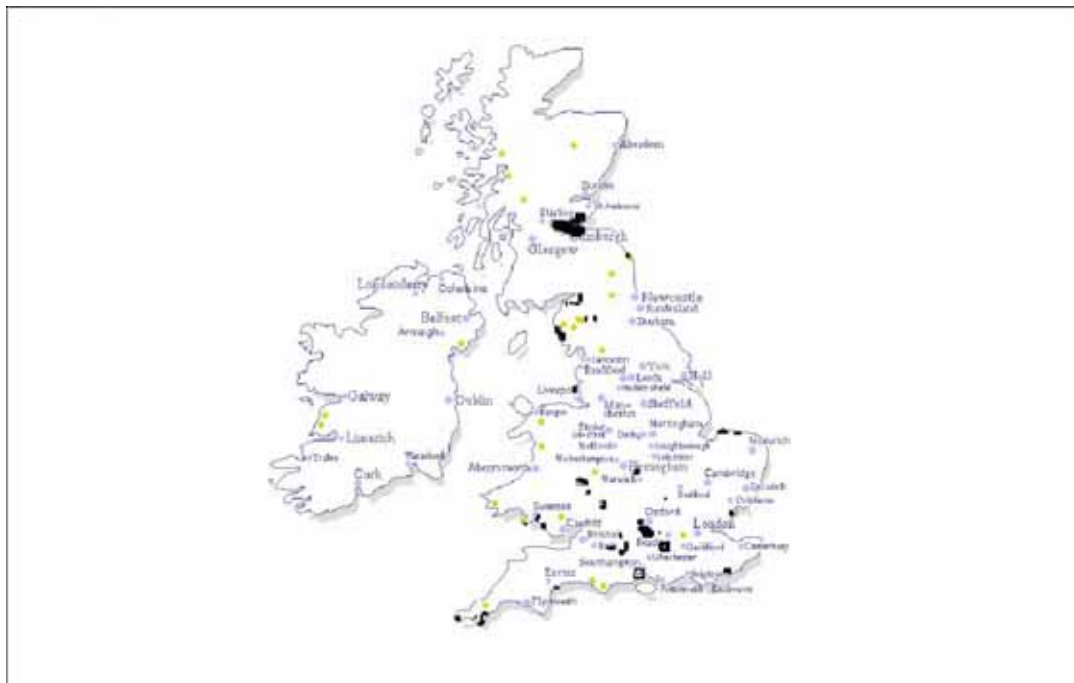


Figure 48. Environment Agency UK CASI coverage (source : pers. comm. Kyle Brown, Environment Agency, 9/1/03)

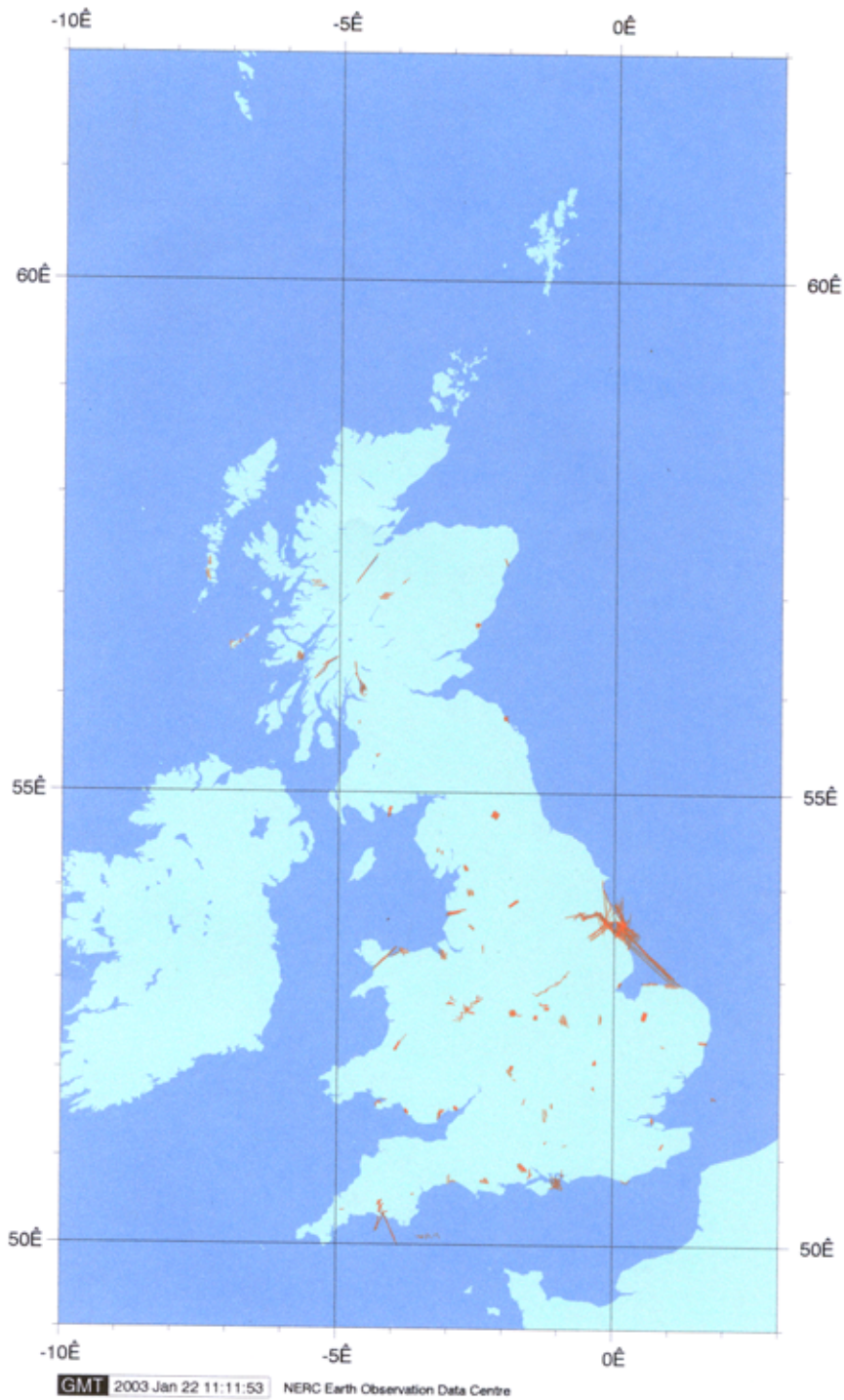


Figure 49. UK coverage of NERC airborne data (source pers. comm. Matt Pritchard, NERC EO Data Centre, 22/1/03)

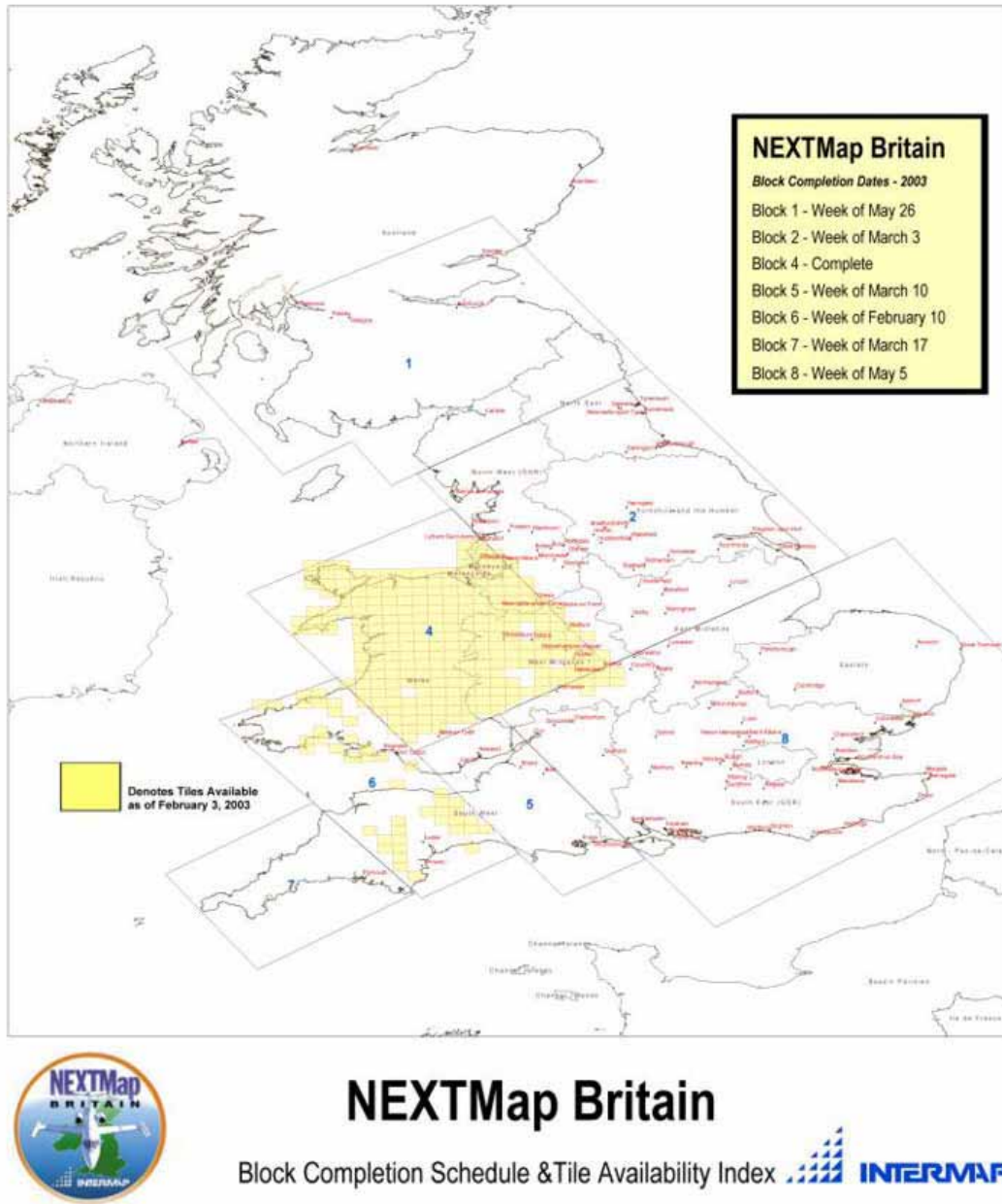


Figure 50. UK coverage of the NEXTMap X-band interferometric SAR
(source : <http://www.globalterrain.com/NEXTMAP/>, 14/2/03)

11. Conclusion

Three very different lowland raised bogs were studied, using a wide range of remotely sensed data and analytical methods. The main conclusion we have drawn from this study is that the identification of bog condition categories using remote sensing is best achieved using the following data sources:

1. High spatial resolution remotely sensed data (4 metre pixel size proved ideal for the bogs we studied)
2. Multispectral data. Unlike most vegetation communities, we found that data in the near infra-red were relatively less important than those in the visible wavelengths. However, we found clear evidence of additional information on bog condition in the short-wave infra-red region (1.55 – 1.75_μm).
3. Information on bog surface microrelief. We found that the most effective way to include these data was visual interpretation of digitally processed lidar images. Fully automated analysis of the lidar data was less effective, possibly because the human interpreter can more easily discriminate between irrelevant detail and those patterns characteristic of disturbance and human interference. Where lidar data were unavailable, as at Ballynahone and Cors Caron, visual interpretation of colour aerial photographs provided an adequate substitute, especially if stereo interpretation was used.

The major drawbacks of aerial photographs were the need to mosaic individual images to achieve the spatial coverage necessary and the lack of radiometric calibration. Scanning the photographs and balancing the colour and contrast sufficiently to allow the classification to proceed was a lengthy process which could be avoided by using Ikonos data and airborne lidar. Although we found it necessary to geometrically correct the Ikonos data, the distortion was much less severe than the aerial photography, and the lidar data were provided in 2km tiles already registered to the OS National Grid.

The final conclusion concerns the creation of the final bog condition classification map. The many subtle combinations of classes present and the different views held by those involved in mapping and managing such communities means that any particular categorisation is rarely final. Digital image processing offers a way to present data in an objective manner which can then be interpreted according to the current understanding and needs of the user. In particular, the rule images produced as a by-product of the maximum likelihood procedure are an ideal starting point for an expert system approach to bog condition classification. They encapsulate the degree to which each pixel is similar in spectral terms to one of several ‘end-member’ communities, which may be precisely defined in spectral terms or may be defined by the user to represent ‘ideal’ classes. The allocation of pixels in the image to a single class could be most intelligently achieved using information from the rule images, constrained by the evidence on surface micro relief provided by the lidar data.

12. Acknowledgements

The authors would like to acknowledge the assistance given by the landowners, tenants and site managers at each of the three sisters visited in the field: Frank Mawby and Alan Todhunter at Wedholme Flow; Paul Culyer and Andy Tolky at Cors Caron; and Dermot Hughes, Director of Programmes, Ulster Wildlife Trust at Ballynahone. Additionally, we thank Peter Jones for assistance in the field at Cors Caron. NERC provided the Airborne Thematic Mapper data of the Cors Caron site, the Environment Agency the lidar data, and Infoterra PLC the Ikonos data for Wedholme Flow.

This report contains maps based upon Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings. Joint Nature Conservation Committee Licence No. 1 000 17855 2005.

13. References

- CAMPBELL, J.B. 1996 Introduction to Remote Sensing. Guildford Publications, New York, 605 pp.
- CCW 1999 *Tir Gofal habitat classification and definitions. Working guidance for project officers in terrestrial habitat recognition*. CCW, Bangor, pp37.
- COUNCIL DIRECTIVE 1992 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, O.J. L206, 22.07.92.
- CORINE Biotopes project 1991 CORINE Biotopes manual, Habitats of the European Community. EUR 12587/3, Office for Official Publications of the European Communities.
- DARGIE, T. C. D. AND MAIER, T. R. 2001 England Inventory for the Wetland Habitat Action Plan: Pilot Project Final Report. English Nature Contract No. CST 30/02/007.
- EUROPEAN COMMISSION 1999 *Interpretation Manual of European Union Habitats – EUR15 /2*, European Commission, Brussels.
- HUGHES, P. D. M. 2000 A reappraisal of the mechanisms leading to ombrotrophy in British raised mires. *Ecology Letters*, **3**, 7-9.
- HUGHES, P. D. M. 2000 Mire development pathways and palaeoclimatic records from a full Holocene peat archive at Walton Moss, Cumbria, England, *The Holocene* **10** (4) 654-479.
- HUGHES, P. D. M. 2002 Coring and assessment of the lagg fen at Cors Caron NNR, Ceredigion, Wales. *Report to Countryside Council for Wales 2002/01*. Southampton pp20.

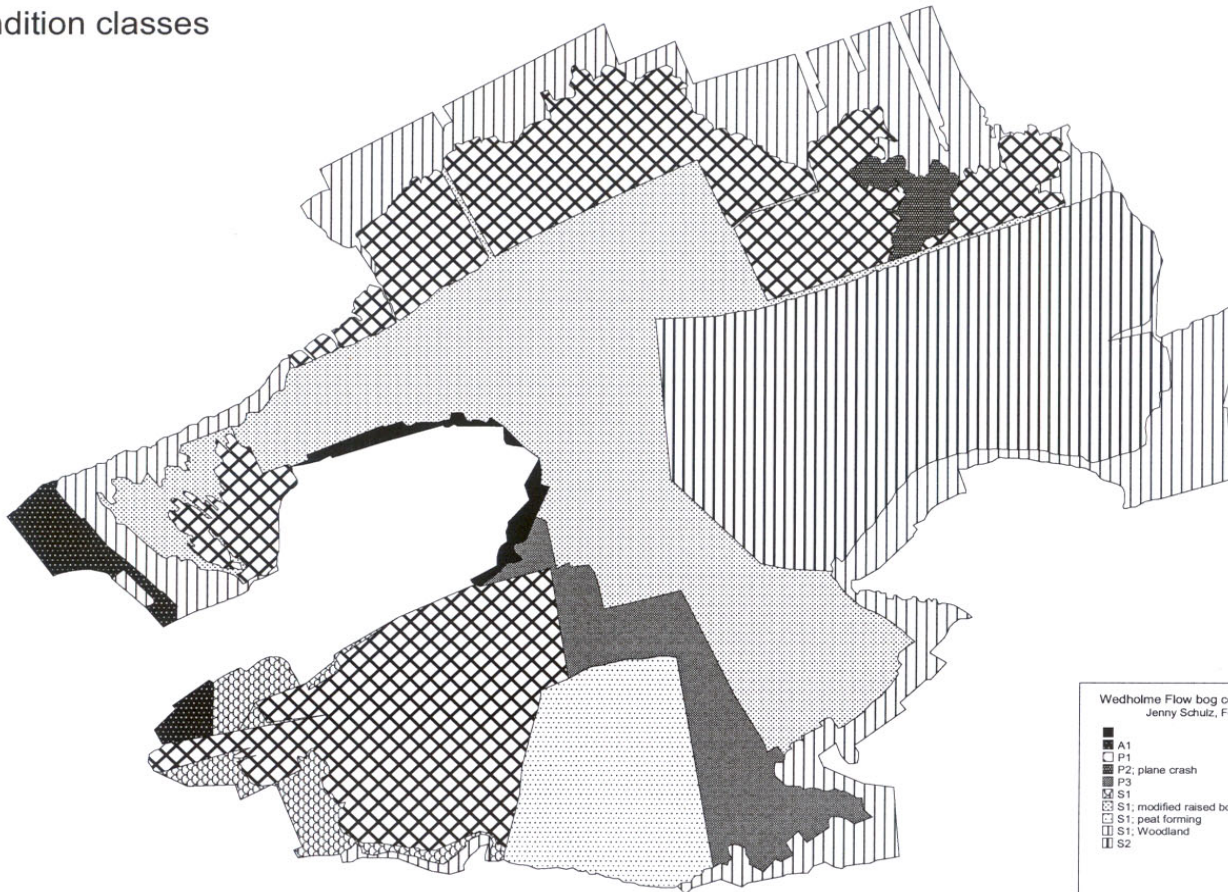
- IVANOV K.E. 1981 *Water movement in mirelands*. (Vodoobmen v bolotnykh landshaftakh). Translated from Russian by Thompson A. and Ingram H.A.P., Academic Press.
- LINDSAY, R. 1995 Bogs: The Ecology, Classification and Conservation of Ombrotrophic Mires. Scottish Natural Heritage. pp119.
- LINDSAY, R. AND IMMIRZI, P. 1996 *An inventory of lowland raised bogs in Great Britain*. *Scottish Natural Heritage research, Survey and Monitoring Report No 78*. Scottish Natural Heritage. pp 84.
- LINDSAY, R.A. AND CAMPAGNA POPOLO, F. 1998 Bog pools - patterns, plants and policies. In: (Eds.) V. Standen, J.H. Tallis and R. Meade. *Patterned Mires and Mire Pools : Origin and Development; flora and fauna*. pp: 127 - 139. Mires Research Group, Durham University.
- LINDSAY, R. A., CHARMAN, D. J., EVERINGHAM, F. O'REILLY, R. M., PALMER, M. A., ROWELL, T. A. AND STROUD, D. A. 1988 *The Flow Country, The peatlands of Caithness and Sutherland*. Nature Conservancy Council. Peterborough. pp174.
- MATHER, P.M., 1999 *Computer Processing of Remotely-Sensed Images: An introduction*. Wiley, Chichester, 292 pp.
- PARKYN, L. & STONEMAN, R. 1997 The Scottish Raised Bog Land Cover Survey. In: L. Parkyn, R.E. Stoneman and H.A.P. Ingram (Eds.) *Conserving Peatlands*. Centre for Agriculture and Biosciences International. Wallingford. pp483.
- PARKYN, L., STONEMAN, R. E. AND INGRAM, H. A. P. eds. 1997 *Conserving Peatlands*. Centre for Agriculture and Biosciences International. Wallingford. pp483.
- QUARMBY, N.A., EVERINGHAM, F. AND REID, E. (1997) *Scottish Blanket Bog Inventory: Lewis and Harris – characterisation of blanket bogs using Landsat Thematic Mapper*. Research, Survey and Monitoring Report No. 85. Scottish Natural Heritage. Perth.
- RODWELL J.S. 1991 *British Plant Communities Volume 2: Mires and Heaths*. Cambridge University Press, Cambridge.
- SCHULZ, J. (in prep.) Palaeoecology and conservation of Tregaron and Borth Bogs, Ceredigion, Wales, Ph.D. thesis, University of Southampton.
- SJÖRS, H. (1948) Myrvegetation I Bergslagen. [Mire vegetation in Bergslagen, Sweden]. *Acta Phytogeographica Suecica*, **21**, 1-299.
- TASK FORCE AGENCY (1992) *Relation between the Directive 92/43/EEC Annex I habitats and the CORINE habitat list 1991 (EUR 12587/3). Version 1*, Task Force Agency.

14. Appendix

Table 23. Vegetation quadrats from Wedholme Flow

	WHF-1	WHF-2	WHF-3	WHF-4	WHF-5	WHF-6	WHF-7	WHF-8	WHF-9	WHF-10	WHF-11	WHF-12	WHF-13	WHF-14	WHF-15	WHF-16	WHF-17	WHF-18	WHF-19	WHF-20
<i>Calluna vulgaris</i>	20	4	1		90	<1			<1	<1	<1		2	90	65		5	70		28
<i>Erica tetralix</i>	25	30	5						4			<1	3				2		7	4
<i>Andromeda polyfolia</i>	2	2	3						2			<1	2						3	2
<i>Oxycoccus palustris</i>												18	6						5	4
<i>Eriophorum. angustifolium</i>	2	2	<1	+				20	2					+		+			10	<1
<i>Erio. vaginatum</i>	4	3	25	25	<1	25	70	<1	7			6	6		15	30	25	15	10	20
<i>Rhynchospora alba</i>	2	25	5		<1				25											
<i>Molinia caerulea</i>					<1	25				25	25	25	30	R	1	2	1			
<i>S. subnitens</i>	43		2										14							
<i>S. capillifolium</i>		3	9																25	30
<i>S. cuspidatum</i>			2	75			25	80	35								25			
<i>S. papillosum</i>	5	6	5						9			8						1		7
<i>S. fallax</i>												4								
<i>S. magellanicum</i>	10	<1	1						1					<1					20	20
<i>S. tenellum</i>	8	20	15																5	15
<i>S. gimbriatum</i>												1								
<i>Sphagnum, total</i>	65	28	30																50	70
<i>Odontoschisma sphagni</i>	10	12	10																15	15
<i>Hypnum cupressiforme</i>						2														
<i>Myrica gale</i>										50	45									
<i>Cladonia unicalis</i>																				
<i>Calypogeia</i>											<1									
<i>Dryopteris spec</i>											<									
<i>Potentilla erecta</i>										2	3									
<i>Betula pubescens</i>	+																			

Wedholme Flow bog condition classes



Wedholme Flow bog condition classes
Jenny Schulz, Feb. 2003

■ A1	(6)
□ P1	(2)
■ P2: plane crash	(9)
■ P3	(1)
■ S1	(6)
■ S1: modified raised bog vegetation	(2)
■ S1: peat forming	(1)
■ S1: Woodland	(6)
■ S2	(1)

Table 24. Vegetation quadrats from Cors Caron

	SE-1	SE-2	SE-3	NE-1	NE-2	NE-3	NE-4	NE-5	NE-6	W-1-2	W-1-8	W-1-18	W-F-6	W-F-10	W-F-16	W-J-2	W-J-12	W-J-14
<i>Calluna vulgaris</i>	4	2	3	2	1			4	10		12	10	10	30	10	30	7	1
<i>Erica tetralix</i>	15	17	17	20	2	<1			12		4	4	8	8	3	6	6	6
<i>Empetrum nigrum</i>											2	2	1	3	1			
<i>Andromeda polyfolia</i>	4	6	6	3	2	2			2		3	2	3	4	3	3	4	2
<i>Oxycoccus palustris</i>						3					2	5	3	3	4	2	6	1
<i>Eriophorum angustifolium</i>	<1	<1	<1	1	<1	<1			<1		+	<1	<1		+	<1		
<i>E. vaginatum</i>	8	8	10	6	1	30			8		18	12	15	20	15	10	5	5
<i>Rhynchospora alba</i>	5	6	3	<1	<1				10		1	<1	1	<1	1	1		
<i>Scirpus cespitosus</i>	3	6	4	5	2				3		2	2	1		4	4		1
<i>Nartheceum ossifragum</i>				<1	<1							1	1	<1	<1			
<i>Molinia caerulea</i>	3	R	1	<1	1	<1	1	80		75							30	30
<i>Sphagnum subnitens</i>				3							<1		1	3				
<i>S. capillifolium</i>					6							4				<1	5	
<i>S. cuspidatum</i>	10	2	1	1	8				2		1		1			1		<1
<i>S. papillosum</i>	12	6	1		6	3			5		3	1	12	2	5	<1		
<i>S. fallax</i>																		
<i>S. angustifolium</i>						65												
<i>S. magellanicum</i>																		
<i>S. tenellum</i>	1	2	4		2				10			4	6	1	1	3		
<i>S. pulchrum</i>												6	3	1	2	28		
<i>S. fimbriatum</i>																		
<i>Sphagnum, total</i>	23	10	6	4	22	68			17			15	23	7	8			
<i>Odontoschisma sphagni</i>	10	10	10	8	<1	<1			6		5	4	6	3	5	6		2
<i>Hypnum cupressiforme</i>	4	5		6	<1	<1		3		3	5	6	4	8	10	10	12	8
<i>Pleurozium schreberi</i>				<1	<1	<1											<1	
<i>Myrica gale</i>																		
<i>Cladonia portentosa</i>	6	6	4	15				1	12		20	9	7	7	15	5	10	20
<i>C. unicalis</i>		<1	<1						<1			1		3				
<i>C. cenotea</i>		<1	<1								<1					1		
<i>C. ciliate</i>			1	3					3			1	1					

Remote Sensing of Bog Surfaces

<i>Potentilla erecta</i>																		
<i>Betula pubescens</i>																		
<i>Leucobryum glaucum</i>			<1							2	<1		1	2	<1			
<i>Cladonia fimbriata</i>		<1	<1						<1		<1				<1			
<i>Drosera rotundifolia</i>	<1	<1	<1	1	<1			<1		<1	<1	<1	<1	<1				
<i>D. intermedia</i>											<1							
Open Waterpools																		
<i>Dicranum c scoparium</i>			<1	2	1													
<i>Vaccinium myrtillus</i>																1		
<i>Polytrichum strictum</i>						3						<1						
<i>P. commune</i>																		
<i>Aulacomnium palustre</i>																		
<i>Salix cinerea</i>								80										
<i>Agrostis canina</i>								40										
<i>Carex canescens</i>								1										
<i>C. lasiocarpa</i>								1										
<i>C. nigra</i>																		
<i>Holcus lanatus</i>								<1										
<i>Juncus effusus</i>								18										
<i>Rhytiadelphus triquetrus</i>								2										
<i>Eurhynchium praelongum</i>								3										
<i>Rumex spec.</i>								<1										
<i>Rumex acetosa</i>																		
<i>Comarum palustre</i>								<1										

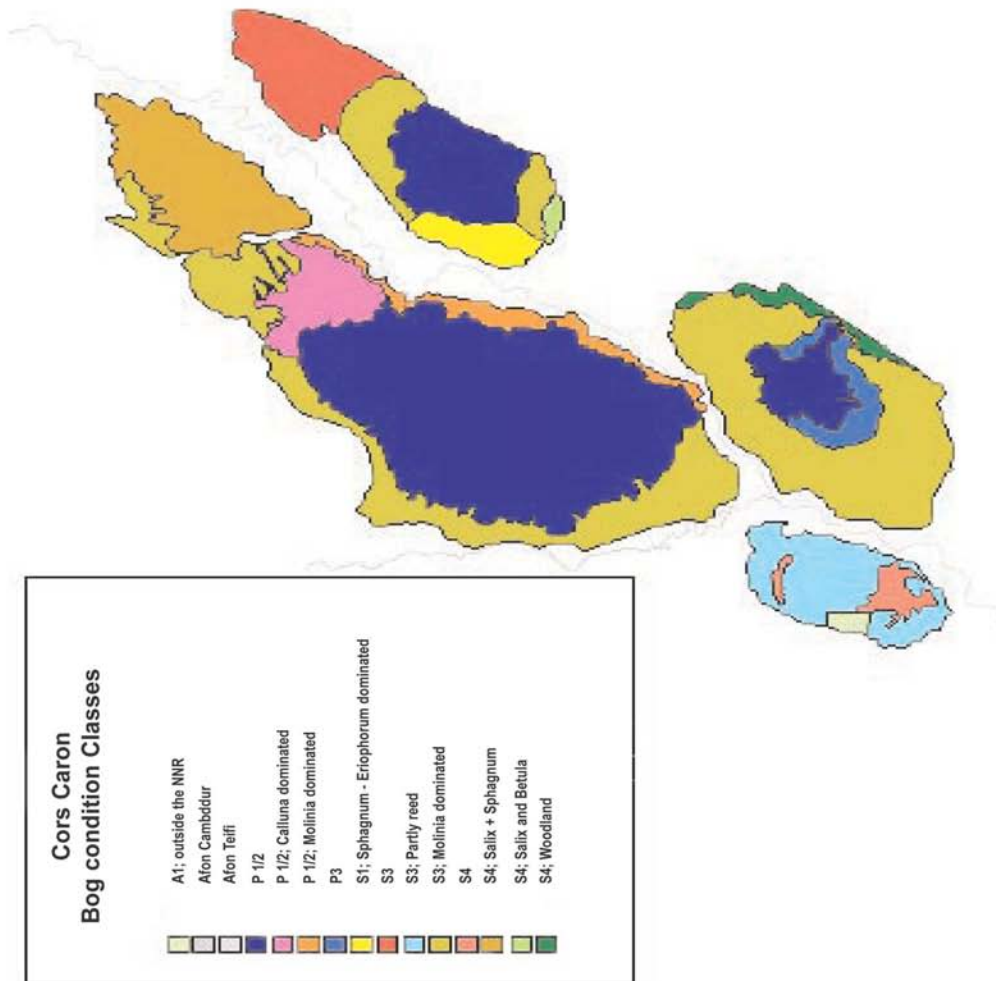
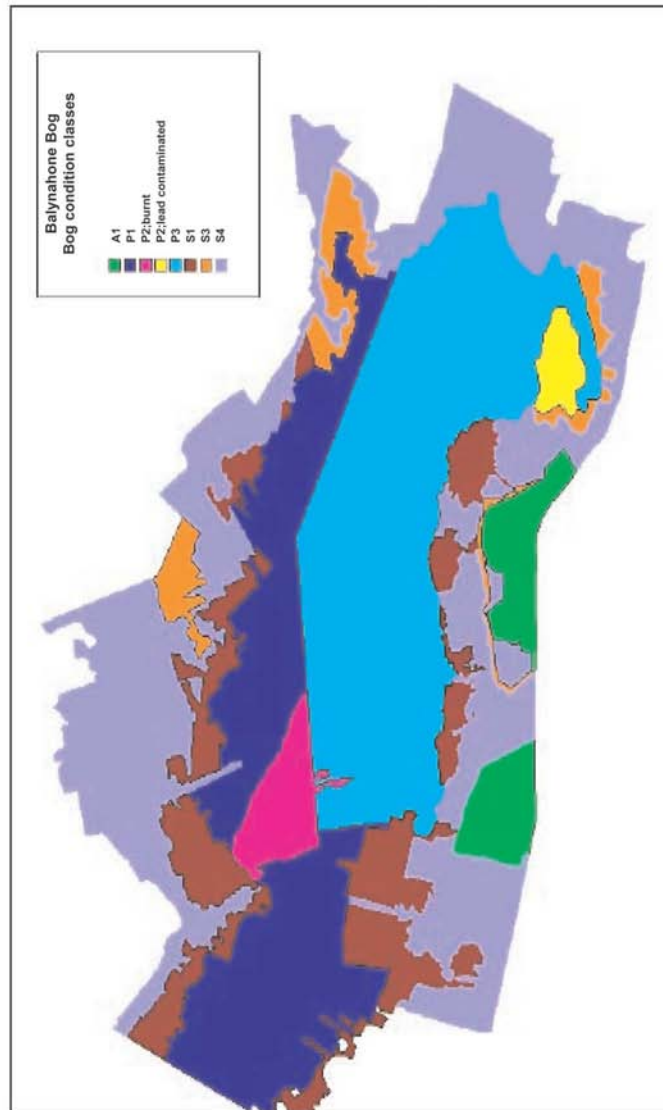


Table 25. Vegetation quadrats from Ballynahone Bog

	BYH-1	BYH-2	BYH-3	BYH-4	BYH-5	BYH-6	BYH-7	BYH-8	BYH-9	BYH-10	BYH-11	BYH-12	BYH-13	BYH-14	BYH-15	BYH-16	BYH-17	BYH-18	BYH-19	BYH-20	BYH-21	BYH-22	
Date	15/10/2002											16/10/2002											
<i>Betula pubescens</i> , tree layer																							50 (tree layer)
<i>Betula pubescens</i> , field layer							<1													1	<1		
<i>Myrica gale</i>								10	<1	<1													
<i>Calluna vulgaris</i>		<1	45	12	70	45	75	65	40	40	30	1	10	5	12	6	50	35	50	30	90		
<i>Erica tetralix</i>		1	10	10	10	10	4		8	8	8		6	20	15	10	6	8	8	3	1		
<i>Vaccinium oxycoccos</i>								4	4	4	1												
<i>Drosera anglica</i>									r														
<i>Drosera rotundifolia</i>				<1		<1					<1					<1	<1		<1				
<i>Eriophorum angustifolium</i>	2	1	<1	<1	3	<1	<1		<1	<1	1	3	<1	1	1	<1	<1	<1	<1	2	<1	<1	
<i>Eriophorum vaginatum</i>		1	5	30		5		8	12	10	3	8	5		1		3	2	<1	6	1		1
<i>Juncus effusus</i>																							1
<i>Narthecium ossifragum</i>		<1		1		1		1		<1	<1			3	4	4	1	<1					
<i>Rhynchospora alba</i>						3				<1			3	3	1	2	2	<1	1				
<i>Scirpus cespitosus</i>			1	3	<1	3	1			2	2		10		2	3	<1	1	1				
Total Sphagnum			8	14	6	20	<1	34	41	61	40	78	36	10	18	10	22	30	31	8		56	
<i>Sphagnum capillifolium</i>			1	4		6		30	20	40	10		15	1	2	1	2	8	8				1
<i>S. fimbriatum</i>																				1			30
<i>S. subnitens</i>			4	2		1		1			2	50	3	3	6	4	3	8	5	2			
<i>S. magellanicum</i>			<1	<1	1	4		2	1	1	10		2	1	2	1	1		1				
<i>S. palustre</i>																							25
<i>S. papillosum</i>			<1	2	1	4		1			10	18	10	3	6	2	11	8	10				
<i>S. angustifolium</i>								<1															
<i>S. cuspidatum</i>												10								1		5	
<i>S. pulchrum</i>																						5	
<i>S. tenellum</i>			3	6	4	5	<1		20	20	8		6	2	2	2	4	6	2				
<i>Aulacomnium palustre</i>									<1														
<i>Campylopus flexuosus</i>		1							<1					3				<1					
<i>Dicranum scoparium</i>													<1						5			5	
<i>Hypnum cupressiforme</i>			4		4	2	6	3	4	6	2		4	1	<1	4	<1	2	1		8	6	



Joint Nature Conservation Committee Report Distribution

Report number 366
Date Received July 2004
Report Title: Remote sensing of bog surfaces
Comments: Review of use of and opportunities for using variety of remote sensing techniques for habitat mapping and classification of lowland bogs
Restrictions: None

This report is also published on JNCC's website: www.jncc.gov.uk

Joint Nature Conservation Committee

JNCC report collection	2 copies
JNCC Committee	1 copy each
Habitats Advice	1 copy + top copy, spares
Ian Strachan, Senior Habitats Advisor	1 copy

English Nature

HQ, Library	2 copies
John Hopkins, Ecological Advisor, Terrestrial Wildlife Team	1 copy
Roger Meade, Senior Peatland Advisor, Environmental Impacts	1 copy
Cumbria Team	1 copy
Humber to Pennines Team	1 copy
Northwest Team	1 copy
West Midlands Team	1 copy
Northumbria Team	1 copy

Scottish Natural Heritage

HQ, Library	2 copies
Andrew Coupar	1 copy
Geoff Johnson	1 copy
Katherine Birdsall	1 copy
Noranne Ellis, Liaison Officer	1 copy

Countryside Council for Wales

HQ, Library	2 copies
Peter Jones	1 copy

Remote Sensing of Bog Surfaces

Environment and Heritage Service

HQ, Library (Mrs R. McKeown) 1 copy
Richard Weyl 1 copy

Department of the Environment, Food and Rural Affairs

Library (Bristol – M. Whellans) 1 copy
Iain Diack, Scientific Advisors' Unit 1 copy
Lucy Toman, Scientific Advisors' Unit 1 copy
Fiona Mettam, Scientific Advisors' Unit 1 copy
Louise Vall, Scientific Advisors' Unit 1 copy

Scottish Executive

Library (Lesley Urquhart) 1 copy
Joanna Drewitt, Rural Affairs Department, Ecological Advisers' Unit 1 copy

National Assembly for Wales

Library (David Allum) 1 copy
Richard Evans 1 copy

Others

Copyright Libraries Agent 5 copies
British Library, Legal Deposit Office 1 copy
TSO Bibliographic Dept 1 copy
Natural History Book Service Ltd. 5 copies
Biological Records Centre, Centre for Ecology & Hydrology (Library) 1 copy
Botanical Society of the British Isles (Sarah Whild, Co-ordinator) 1 copy
Environment Agency (Ann Skinner) 1 copy
Environment Agency (Martin Fuller) 1 copy
Scottish Environment Protection Agency (Brian Clelland) 1 copy
Farming and Rural Conservation Agency (Geoff Radley) 1 copy
Macaulay Land Use Research Institute (Library) 1 copy
English Heritage (David Earle Robinson) 1 copy
RSPB (Ruth Davis) 1 copy
The Wildlife Trusts (Allison Crofts) 1 copy
Yorkshire Wildlife Trust 1 copy
Shropshire Wildlife Trust 1 copy
Cumbria Wildlife Trust 1 copy
Lancashire Wildlife Trust 1 copy