Question 11: Where did increases in Fen, Marsh & Swamp occur? What are the possible causes? What are the botanical characteristics of these new areas? What are the wider implications for biodiversity?

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DUE START DATE:

- May 2002

DUE FINISH DATE:

- September 2002

OVERALL PROGRESS

- Completed.

DEFINITIONS

- The Fen, Marsh & Swamp Broad Habitat is defined as "..vegetation that is ground water fed; and permanently, seasonally or periodically waterlogged peat, peaty or mineral soils where grasses do not predominate. It also includes emergent vegetation or frequently inundated vegetation occurring over peat or mineral soils. This type includes neither areas of carr that are greater than 0.25ha which should be included in the "Broadleaved, mixed and yew woodland" Broad Habitat type nor wet grassland (with the exception of purple moor grass, reed, or sweet-grass dominated vegetation) which should be included in the "Neutral grassland" Broad Habitat type." (Jackson 2000).
- 'Botanical characteristics' includes several plot level and parcel level attributes. We include condition measures as analysed in the CS2000 Module 1 report (Haines-Young et al 2000) and species cover codes used for describing mapped parcels of Broad Habitat. In addition plot level botanical data recorded in 1990 and 1998 can be assigned to community units of the National Vegetation Classification and hence, to the three Priority Habitats included in the Broad Habitat.
- Note that plot level data will only apply to a subset of the total parcels mapped while information on change in species mapping codes will often be unavailable for parcels mapped in an unenclosed, upland setting.

POLICY CONTEXT STATEMENT

1 *The Policy Context Statement was drafted in May, and takes account of comments made by attendees at the May FOCUS Workshop.*

Recent changes in area and condition of Fen, Marsh & Swamp(FMS) [1]

Changes in area

2 In 1998 FMS was estimated to make up 2.3% of GB land cover with 66% of this being in Scotland (CS2000 web-tables). CS2000 reported three statistically significant changes in area of FMS between 1990-'98 (Haines-Young et al 2000). A 27% increase in England with Wales, an 18.7% increase in Scotland and an 18.6% decrease in Northern Ireland. As a proportion of the 1990 stock by Environmental Zone, the largest increase was seen in Environmental Zone 1 in England & Wales (123%) although in area terms the estimate was relatively small (13,000ha with a 95%CI of 1,700ha to 27,400ha). In Scotland the national increase in extent was largely a consequence of increases in the upland Environmental Zones 5 and 6. The different landscape locations of these changes suggest that the identity and vegetation condition of Broad Habitats gaining or losing stock to FMS are likely to differ considerably; so too might the causes of these changes.

3 Patterns of flow between Broad Habitats at the GB level indicated that the increase in area amounted to 39% of the 1990 stock. This was largely gained from parcels mapped as Improved, Neutral or Acid Grassland, Bog or Conifer in 1990. These types of shift imply the involvement of increased seasonal flooding, clear-felling and possibly rush expansion in wetter grasslands. Of the 18% of GB stock that was lost from FMS, most was gained by Improved, Neutral or Acid Grassland and Bog (Haines-Young et al 2000). Further exploration of the robustness and causes of parcel-based change in FMS area forms a core component of this topic question.

Change in condition

4 Existing analyses of change in vegetation condition between 1990-'98 were carried out on three subsets of repeat plots and each type of analysis can help address a different type of question about change. 'Stay-same' analyses examined change in vegetation condition in plots that remained in the same Broad Habitat over the eight year period ie. stock carried over. 'Stay-same' results for FMS showed that there had been a statistically significant reduction in light score in Scottish X plots implying reduced disturbance and greater shade in larger stands. In addition, increases in substrate fertility were implied by Ellenberg fertility score increases in Scottish Y plots (ie. small fragments of FMS) and in Y plots in the western, lowland Environmental Zone 2 in England & Wales. No significant changes in wetness score were detected, suggesting an absence of change in patterns of seasonal inundation in FMS stock carried over despite possible change in fertility and disturbance regime (CS2000 web-tables).

5 '90-based' analyses focussed on change from a common Broad Habitat starting point but plots could have changed BH over time. Results for FMS tended to show the same pattern as the 'stay-same' analyses. Most statistically significant changes were seen in

[1] **CS2000 mapping definition (Jackson 2000; CS2000 Field Handbook):** "This habitat occurs on ground that is permanently, seasonally or periodically waterlogged as a result of ground water or surface run-off. It can occur on peat, peaty soils or mineral soils. It covers a wide range of wetland vegetation including fens, flushes, marshy grasslands, rush-pastures, swamps and reed-beds."

smaller habitat fragments (Y plots) and these shifts suggested reduced disturbance and increased fertility. As would be expected if some stock had been lost to typically drier BH, wetness score significantly declined across the GB population but again, only in Y plots (CS2000 web-tables).

6 The 'turnover' analyses contrasted the condition of new stock in 1998 with stock present in 1990 but absent in 1998. For FMS the only significant difference in Ellenberg scores was for higher fertility scores in Y and X plots in 1998 based on the total GB population (CS2000 web-tables).

7 Two further points are worth adding with regard to the additional analyses of FMS vegetation planned under this FOCUS topic. Firstly, profound floristic change can rapidly occur in fen vegetation without this resulting in a change in BH. For example, soligenous rich-fen can change into a species-poor reed-bed following lowering of the groundwater table and lack of management (Harding 1993). Hence, lack of change in BH is not necessarily an indicator of vegetation stability or even of a smaller magnitude change in species richness or ecological conditions. Secondly, FMS incorporates three priority habitats that between them cover a wide range of floristic variation and conservation interest. Indeed, these three PH are each associated with their own particular threats, history of change, threatened biota and geographical extent and these differences are reflected by their separate habitat action plans (see below). Also, the CS sample of parcels and plots may include borderline vegetation such as *Juncus* co-dominated rough grazing, which reflects the difficulty in differentiating clearly between Acid Grassland, Neutral Grassland and FMS in the field. Given this wide range of variation, further characterisation of the FMS sample will be essential in assessing the representation of the three PH and therefore the significance to conservation policy of the detected net increase in extent, patterns of turnover and change in vegetation condition over time.

8 Differentiation between the PH at the plant community level and also the description of most designated fens is typically based on allocation of swards to the communities and sub-communities of the NVC (Rodwell 1991; Jackson 2000). Therefore an assessment of the representation of the PH in the CS sample will be carried out using the NVC.

The policy context for changes in Fen, Marsh & Swamp

DEFRA Public Service Agreement (PSA)[2]

9 The PSA set out the aims and objectives of individual government departments. With the formation of DEFRA in 2001 a new set of PSA statements and targets were drawn up by the ministerial team. The PSA targets are coined as specific actions some of which form relevant policy background to this question. These are:

- PSA Target 6: Bring into favourable condition by 2010 95% of all nationally important wildlife sites compared to 60% of sites currently estimated to be in such condition.
- PSA Target 14: open up public access to mountain, moor, heath and down and registered common land by the end of 2005.
- Remaining CSR 1998 target: Contribute to a more attractive and accessible countryside by increasing the area protected and enhanced under the major agri-environment schemes.

[2] See www.defra.gov.uk/corporate/busplan/01psa.htm

National and international biodiversity policy

10 Most of the largest areas of FMS in Britain are already designated as SSSI and NNR, Special Protection Areas (SPA) or Wetlands of International Importance under the Ramsar Convention. Together these designations under domestic and European driven legislation can cover sites supporting all three of the Priority Habitats that constitute the Broad Habitat.

11 Outside designated sites, obligations for habitat and species conservation fall under the UK Biodiversity Action Plan that sets out a strategy for conservation of specific habitats and species. Under the UK BAP, FMS covers three priority habitats, each covered by their own Habitat Action Plans. These are Purple moor grass and rush pastures (also known as Culm Grasslands), Fens and Reed-beds. The biological interest features differ to some extent between the Priority Habitats and this is reflected in the action plans for each. For example, reed-beds are among the most important habitats for birds in the UK so that variation in importance of reed-bed tends to vary with size of site and geographic coincidence with the range of resident or visiting bird species. Fens, are associated with a range of scarce plants and invertebrates that can vary greatly in their geographic restriction and ecological preferences. Thus the soligenous valley fens of the Norfolk Commons have a different character and associated biota than the topogenous base-poor fens of the Scottish Insh Marshes (Rodwell 1991; Fojt 1994). Purple moor grass and rush pastures also comprise a particular range of plant communities valued for their botanical as well as bird and invertebrate interest. Again, the largest known extents of these tend to have been designated although in many instances this has not guaranteed protection from threats to the condition of the site (UK biodiversity Steering Group 1995)

Environmental Impact Assessment

12 In 2002 the existing government regulations that required EIA to precede planned development and forestry were extended to cover "..the use of uncultivated land or semi-natural areas for intensive agricultural purposes."[3] These extended measures complete the implementation of the European EIA Directive but also contribute to the wider aims of promoting sustainable agriculture. See policy context for T1 – Q2 for further information on the policy background.

Threats to the FMS broad habitat – past and present

13 A more detailed account is available in the UK Steering Group Report (1995) also see Fojt (1994). The following table summarises the main threats by the three constituent PH.

THREAT	***Reed-beds***	***Purple moor grass and rush pasture***	***Fens***
Fragmentation	✓	✓	✓
Drainage (p)	✓		✓
Water abstraction (p)	✓		✓
Catchment eutrophication	✓		✓
Sea level rise	✓		
Lack of management	✓		✓
Afforestation		✓	✓
Agricultural improvement		✓	
Overgrazing		✓	
Peat extraction (p)		✓	✓

[3] See guidelines at http://www.defra.gov.uk/environ/eia/

p = threat more apparent in the past.

Key actions from each Priority Habitat Action Plan[4]

Purple moor grass and rush pastures

- Secure sympathetic management of at least 13,500 ha of purple moor grass and rush pasture by the year 2000, divided between the four countries as follows: Wales 4,000 ha, England 5,000 ha, Northern Ireland 4,000 ha and Scotland 500 ha.
- Initiate experimental attempts to re-create 500 ha of purple moor grass and rush pasture on land adjacent to, or nearby, existing sites, by the year 2005.
- The aim is to secure favourable management for a minimum of 25% of this scarce habitat within the time frame. This is considered to be achievable within the likely resource allocations. Whilst the priority is to secure sympathetic management for the existing resource, where there are real opportunities to reverse fragmentation or to enlarge sites to make management viable, a small figure of 500 ha has been targeted.
- Take account of the conservation requirements of purple moor grass and rush pastures in developing and adjusting agri-environment schemes.
- Consider developing and tailoring new incentive schemes in Scotland and Northern Ireland to benefit purple moor grass and rush pasture, to enable the targets for management and re-creation to be met in these countries.
- Woodland expansion should not be encouraged on the more valuable areas, but some less ecologically valuable sites could be suitable for, for example, new native woodlands.
- Support local initiatives to find and map purple moor grass and rush pasture sites, and seek to protect and conserve them within development plans by 2000.

Reed-beds

- Identify and rehabilitate by the year 2000 the priority areas of existing reed-bed (targeting those of 2ha or more) and maintain this thereafter by active management.
- This target should provide habitat for 40 pairs of bitterns and provide optimum conditions for other reed-bed species and should be targeted primarily in the south-east.
- Create 1,200 ha of new reed-bed on land of low nature conservation interest by 2010.
- The creation of new reed-bed should be in blocks of at least 20 ha with priority for creation in areas near to existing habitat, and linking to this wherever possible. The target should provide habitat for an estimated 60 breeding pairs of bitterns boosting numbers to previous levels. It should be targeted in the south-east of Britain.
- Continue to notify nationally important sites as SSSI/ASSI by 1998.

[4] Actions taken from each plan at www.ukbap.org.uk/species.htm

- Continue the existing programme of designations of internationally important sites as SPA and/or Ramsar and SAC by 2004.
- Develop a clear national strategy for reed-bed creation and management by 1997, cross-relating to coastal management plans, ESAs, set-aside and mineral extraction plans, and ensuring that an effective level of monitoring and inventory is maintained.
- Consider modifying or expanding existing habitat schemes such as Wildlife Enhancement Schemes (WES), Tir Cymen, ESAs, Countryside Stewardship, Nitrate Sensitive Areas and Habitat Scheme to encourage and allow for the creation of 1,200 ha of reed-bed. Priority should be given also to reed-bed creation as a preferred condition of after-use for mineral extraction sites.
- Encourage the development of both sympathetic water abstraction, water level management policies and of appropriate coastal zone management plans in order to protect existing reed-beds.

Fens

- Identify priority fen sites in critical need of, and initiate, rehabilitation by the year 2005. All rich fen and other sites with rare communities should be considered.
- Ensure appropriate water quality and water quantity for the continued existence of all SSSI/ASSI fens by 2005.
- Review water quality and set standards for fens by year 1998 through the appropriate government agencies and departments. Aim to meet these targets by year 2010.
- Review water resource uses by 1998 and aim to meet these targets where they affect fens by year 2010.
- Consider modifying or expand existing habitat schemes and countryside schemes such as the Wildlife Enhancement Scheme (WES), Tir Cymen, ESAs, Countryside Stewardship and Nitrate Sensitive Areas to encourage the protection of fens from agricultural contaminants.
- Prepare and implement water level management plans.

References:

Jackson, D.L. (2000) Guidance on the interpretation of the Biodiversity Broad Habitat Classification: Definitions and relationships with other habitat classifications. JNCC report, no.307. JNCC, Peterborough.

Haines-Young, R.H., Barr, C.J., Black, H.I.J., Briggs, D.J., Bunce, R.G.H., Clarke, R.T., Cooper, A., Dawson, F.H., Firbank, L.G., Fuller, R.M., Furse, M.T., Gillespie, M.K., Hill, R., Hornung, M., Howard, D.C., McCann, T., Morecroft, M.D., Petit, S., Sier, A.R.J., Smart, S.M., Smith, G.M., Stott, A.P., Stuart, R.C., and Watkins, J.W. (2000). Accounting for nature: assessing habitats in the UK countryside. Department of the Environment, Transport and the Regions, London.

Harding, M. (1993) Redgrave & Lopham Fens, East Anglia: A case study of change in flora and fauna due to groundwater abstraction. Biol.Cons. 66, 35-45.

Rodwell, J. (1991) British Plant Communities: Volume 2 Mires & Heaths. CUP.

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The UK Steering Group Report (1995). Vol 2. HMSO. London.

SCIENCE OUTPUTS

The significance of change; Describe new stock and other stock elements in terms of NVC and hence, Priority Habitat (PH) assemblages, where possible.

Introduction

14 Significant increases in area of FMS were detected in three partitions of the GB sampling domain; 1) in Environmental Zone 1 (E&W), 2) across all E&W Environmental Zones and 3) at the GB level. This increase is potentially highly significant given long term losses of wetland in Britain since the1940s (Fojt 1990) and the importance of the habitat for a range of plant and animal species (UK Biodiversity Steering Group 1995). Objectives for the large-scale restoration and conservation of the Broad Habitat break down into specific targets for the three constituent Priority Habitats. Hence a key question is to what extent the detected increase in FMS area includes net gains to plant communities referable to each PH. Addressing this question requires an analysis of botanical data for those plots within parcels that were lost or gained to FMS. However, because not all parcels were sampled, only a partial indication of PH representation in the new stock can be gained.

15 The percentage of the total surveyed area of FMS recorded in 1998 that was attributable to parcels in which plots were located is shown in Table 11.1. Overall, 21% of the total 1998 surveyed area can be linked to plot data via the parent parcel and this differs somewhat between Environmental Zones. An additional caveat, when inferring changes in the botanical characteristics of the wider parcel from plot data, is that parcels are heterogeneous and there may be marked differences in the extent to which the species composition of a plot represents the overall character of the parcel.

Table 11.1. Proportion of the total surveyed area of FMS in 1998 located in parcels that coincided with vegetation plots (X and Y).

Zone	*Proportion of surveyed area comprising parcels with plots*
1	46.3
2	36.2
3	14.8
4	14.0
5	21.7
6	15.6

Methods

16 Repeat plots that were located in FMS in either 1990 or 1998 were selected. Only area plots (X and Y) were selected consistent with the exclusion of the linear Broad Habitats. Only data from the central $4m^2$ nest of each X plot was used so as to match dimensions between X and Y plots.

17 Botanical data were allocated to the units of the NVC (Rodwell 1992) using the MAVIS software. Although widely and justifiably recognised as a poor substitute for expert judgement (eg. Palmer 1992), we implemented an objective and hence repeatable

rule for selecting a single best-fitting community unit. Each plot was assigned to the community unit that appeared most often in the list of top ten coefficients. If tied, then the top coefficient was chosen.

18 Links between Priority Habitats and NVC communities were based on the table in UK Biodiversity Steering Group report (1995) and expert judgement. NVC communities not assigned to PH were grouped under a series of other headings (see Annex 1).

Results

19 Allocations of all plots within parcels mapped as FMS in either 1990 or '98 are shown in Table 11.2. Immediately obvious is the scarcity of plots assigned to the three PHs. As a proportion of the total number of plots, Fen was represented in 3.2% of plots in '90 and 2.8% in '98, Reed-bed in 0.8% in '90 and 0.4% in '98 and Purple Moor Grass & Rush Pasture in 1.2% in '90 and 0.4% in '98.

20 Between 1990 and 1998, there was a change in ranking among the most common groups represented. While 'other' community units ranked first in both years, MG7 and MG1 moved from equal fourth to second and third respectively between '90 and '98. This is consistent with the 'turnover' analyses of change in condition measures carried out for Module 1 where the only signal detected was a GB-level difference in Ellenberg fertility scores; significantly higher scores being associated with the new stock in 1998 compared to the stock lost between 1990 and '98.

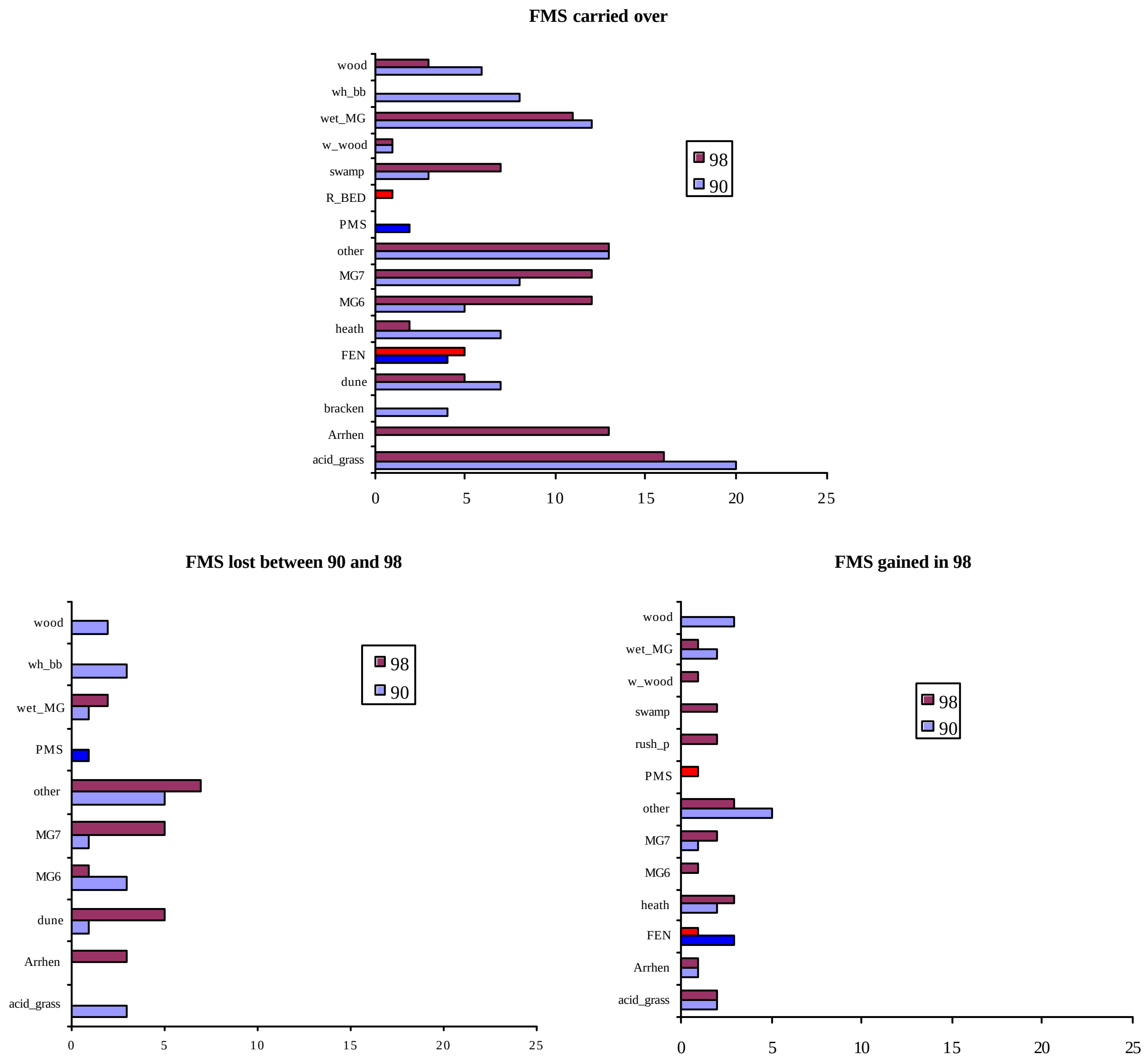
Table 11.2. Counts of repeat plots allocated to Priority Habitats and NVC community groups in 1990 and 1998. All plots were located in the Fen, Marsh & Swamp Broad Habitat in either '90 or '98. Priority Habitats are shaded.

Community groups and Priority Habitats	***1990***	***1998***
Other	**41**	**44**
Acid grassland	**35**	**28**
Wet MG	**27**	**22**
Arrhenatherum (MG1)	**22**	**30**
MG7	**22**	**39**
MG6	16	21
Dune	14	17
Wood	14	10
Heath	13	9
Wet heath & Blanket bog	12	1
Fen	8	7
Bracken	7	2
Swamp	6	16
M23 Rush pasture	4	3
Purple M Grass & Rush Pasture (PMS)	3	1
Reed-bed	2	1
Wet woodland	1	3

21 The increase from 6 to 16 plots in the Swamp category hints at local increases in wetland vegetation but the breakdown by parcel change (see below) shows that this was largely a feature of plots in parcels that remained in FMS over the eight year period rather than newly recruited parcels.

22 When the total number of FMS plots are broken down into those associated with parcels newly recruited to FMS, those lost to other Broad Habitats and those that were mapped as FMS in both years (Figure 11.1), it is apparent that most plots were located in stable parcels. Sample sizes are very small for the plots that saw change from and to FMS and little can be confidently inferred from their patterns of change among NVC groups. However, those plots that were gained to FMS do not show any clear indication of shifts to wetter groups consistent with the GB level increase in area.

Figure 11.1. Priority Habitat and NVC allocation of repeat plots that were located in parcels mapped as FMS in either 1990 or 1998. Priority Habitats are shown in bright blue and bright red. X axis=number of repeat plots (X and Y).



SUMMARY

- A number of aspects of the available botanical data mean that their analysis can give only a weak assessment of the consistency of botanical change with mapped Broad Habitat change.
- However, inspection of the overall pattern of allocation of repeat plots to NVC communities clearly shows that the three Priority Habitats are very scarce in the plot data and therefore likely to be poorly represented within mapped parcels of FMS in both 1990 and 1998.
- The small number of sample of plots located in parcels that were newly recruited to FMS in 1998 did not show any clear indication of having become colonised by wetland vegetation.

Causes of increase and loss of Fen, Marsh & Swamp – part 1; analyses of change in extent

Methods

23 Published estimates of net change in area of FMS took account of both losses and gains within survey squares (Haines-Young et al 2000). Therefore an analysis of the magnitude of national and zonal estimates need to take account of both losses as well as increases in area. The approach taken was to re-evaluate changes in broad habitat allocation by manually checking each and every parcel either lost from or gained to FMS. This re-evaluation deliberately avoided the computation of new national estimates based on putative revisions to parcel allocations. While recognising that a full assessment of the effect of manual revisions on published national estimates necessitates this further step, it was not part of this topic question to provide explicit updates to Haines-Young et al (2000).

24 The possible causes of change in any particular sample square include land-use drivers as well as various types of error. Manual checking of each parcel that changed to or from FMS therefore included scrutiny of surveyors notes and use codes to determine the likely involvement of land management changes. Errors in the processing of survey information could have occurred at each stage. Hence misallocation of parcels to broad habitats could result from incorrect mapping decisions in 1990 and 1998, digitising errors and inappropriate weighting of primary and species codes during the automated allocation of 1990 and 1998 data to broad habitats. In order to fully assess the robustness of change in extent of FMS, each Field Assessment Booklet (FAB) was examined for each square in which change had been attributed. In each FAB the following evidence was examined:

- Broad Habitat change map
- BH map annotated by field surveyors
- The original 1990 field maps
- Changes in field recording codes including clear use of the change codes 702 (amendments to an incorrect BH map) and 701 (real change in BH extent)
- Presence of plot data and plot photographs coinciding with changed parcels

- Presence of U plots for FMS even if FMS had apparently disappeared from the square
- Digitisers and surveyors notes
- The QA survey report (Prosser & Wallace 1999) for CS2000 was also inspected but their sub-sample incorporated only a very small number of FMS parcels (6). 5 of these were however, allocated to FMS by both surveyors and QA assessors.

25 It was suspected that some of the increases in area of FMS resulted from recorded changes in the abundance of *Juncus effusus*. Such effects were important to establish because *J.effusus*-dominated grasslands, though extensive in the British uplands, are explicitly excluded from the the three FMS Priority Habitats. Particular attention was therefore paid to parcel changes that involved this species.

26 After manual assessment a decision was made as to whether each parcel change was real, in error or uncertain; the latter reflecting the fact that insufficient information was available to make a determination either way. Changes in parcel allocation that were obviously attributable to change in abundance of *J.effusus* were considered real even though the vegetation concerned would not have qualified as FMS Priority Habitat.

Case studies of change in condition and extent of FMS

27 Floristic changes in selected vegetation plots have been used to illustrate aspects of the significance and causes of change affecting FMS. Species lists, Ellenberg scores and paired plot photos were assembled as a series of case studies. We believe this to be a useful way of communicating the reality of aspects of change affecting the broad habitat since at this scale vegetation change is more comprehensible and it is possible to use management information in the form of use codes and surveyors notes gathered within the 1km square. However, a degree of caution should be exercised in their interpretation since the detail of each portrait applies only to the square and plot concerned. In all cases though, there is evidence that the type of change illustrated has occurred more widely in the environmental zone.

Results – assessment of parcels ***gained*** to FMS

28 Zones 1, 5 and 6 were most impacted by suggested revisions to parcel allocations. In both cases, manual checks indicated that real gains are much smaller than previously estimated (Fig 11.3). In zones 2 , 3 and 4 the majority of gains in surveyed area to FMS were supported following a review of the evidence. In zone 5 the majority of the ostensible change was in error or remains uncertain through lack of evidence. When expressed as a proportion of the total area of stable FMS in each zone, the verified increases were highest in zones 1 and 4, at 123% and 33% respectively (Fig 11.3b).

29 As suspected, changes in abundance of *Juncus effusus* appeared to have played a pivotal role in the estimated increase in FMS between 1990 and 1998. As a proportion of the area increase suggested to be real based on manual checks, 84% of that seen in zone 4 and 65% in zone 2 involved the appearance of the *Juncus effusus* species code or an increase in its cover value for the parcel (Fig 11.6). Clear evidence for local *Juncus effusus* expansion in vegetation plots is also presented in the selection of case studies.

30 Broad Habitats that saw the largest loss to FMS were, in descending size of the loss, Improved Grassland, Acid Grassland, Neutral Grassland and Bog. After manual checking, high proportions of uncertain parcel changes from Neutral and Acid Grassland meant that the Broad Habitats most likely to have lost area to FMS were

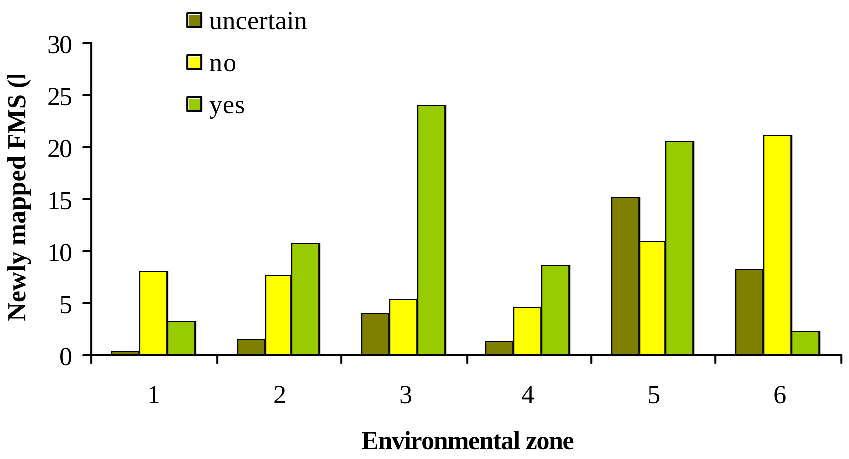
Improved Grassland and Bog. The loss from Bog remains hard to comprehend ecologically although surveyors clearly intended mapping a real change.

31 Within each zone, revised figures indicated that FMS was gained mainly from Improved Grassland in zone 1, from Improved and Neutral Grassland in zone 2, from Improved, Acid Grassland and Conifer in zone 3, from Bog and Improved Grassland in zone 5 and from Improved Grassland in zone 6.

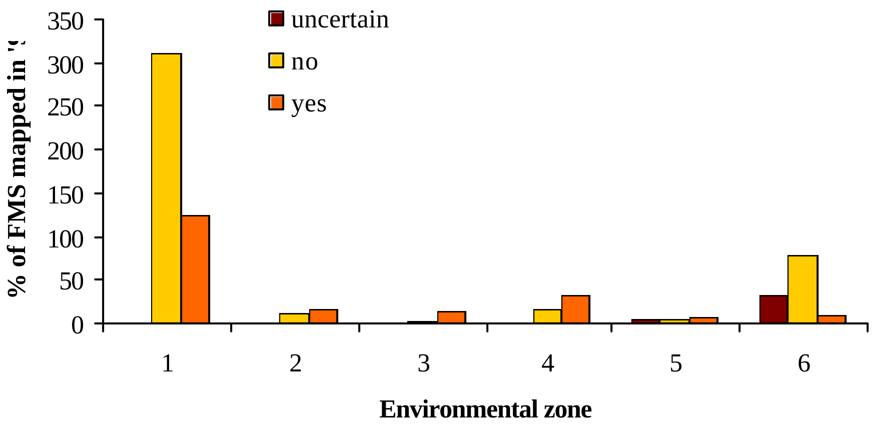
32 The most common reason for uncertain parcel changes was linked to the recording of change straight onto the pre-prepared, unenclosed Broad Habitat map. Problems typically arose where no error codes (either 702 or 701) were used to qualify map annotations. In most situations it was possible to estimate the surveyors intentions by examining the original 1990 field maps. If these maps were inconsistent with the new Broad Habitat map then the surveyor must have been correcting an incorrect map but this still did not guarantee that all the surveyors annotations were map corrections rather than real changes. Uncertain changes were also associated with squares where surveyors seemed to have adopted an understandably but unhelpfully coarser approach to mapping in upland habitats. In these instances small areas of FMS had been subsumed into larger polygons newly coded as mosaics of FMS plus other Broad Habitats. The consequence was an estimated increase in area. However it was suspected that little change had in fact occurred and that the coarser mapping scale in 1998 probably better reflected the area of FMS present in both years than the attempt at a finer scale representation of each broad habitat patch in 1990. Hence the 1990 map probably underestimated FMS extent. Lack of firm evidence either way left such changes as uncertain.

Figure 11.3. Hectareage of newly mapped FMS in 1998 where the increase was either clearly supported by field mapping data (yes), not supported or unreliable (no), referred to parcels where no firm decision could be made (uncertain). Results are given as a) hectares of surveyed land in each zone and b) hectarage as a percentage of the total area of FMS mapped in each zone 1990 that stayed in FMS ie. stable parcels.

a)



b)



33 In 27ha of surveyed FMS largely in zone 6, field mapping records indicated that parcels were already FMS in 1990. Thus, the apparent increase in area followed from the lack of incorporation of this information into the area estimation process. These changes were classified as errors as a result of manual checking and the total area amounted to 60% of the total increase in surveyed area of FMS across GB between 1990 and 1998. Hence, this figure constitutes an addition to the area of stable FMS present in both surveys.

34 A total of 9.9ha of the surveyed land newly recruited to FMS was part of vegetation mosaics. After inspection of these data, 3.9ha was judged to have been allocated in error and the remainder accepted as real change.

Results – assessment of parcels ***lost*** from FMS

35 Suggested revisions to parcels that transferred out of FMS proved more far-reaching than those applying to gains. In all zones except 1, erroneous or uncertain changes

outweighed real change. The largest revision is suggested for zone 3 where 79 ha was allocated to other broad habitats but where the allocation was not supported by field evidence (Fig 11.5). The largest proportion of uncertain allocation change was found in zone 6 where mapping in upland mosaics straight onto pre-prepared BH maps contributed to a lack of evidence one way or the other. In the absence of 702/701 codes it was impossible to determine whether the surveyor intended to correct the BH map or to indicate real change.

36 When conveyed as a proportion of the stable area of FMS in each zone, the largest loss was in zone 1 at 130% of the stable hectarage (Fig 11.5b) while suggested real losses in all other zones amounted to 20% in zone 4 and less than 9% in all other zones (Fig 11.5b). The very high percentage loss in zone 1 reflects the very small area of stable FMS mapped compared to other zones.

37 24% (52ha) of the total estimated area of lost FMS was unlikely to have been FMS in 1990. The vast majority of this was in zone 3 (Fig 11.5) where Improved Grassland was the major beneficiary of the loss. However, an examination of the recorded evidence suggested that the parcels concerned were already improved in 1990.

38 Changes in cover of *Juncus effusus* were implicated in apparent losses from FMS where the rush was no longer recorded in 1998. In one 1km square in zone 4 it could be verified from plot photographs that the parcel was still FMS (unmanaged *Filipendula ulmaria*) in both years despite an apparent reduction in rush cover.

39 In the remaining cases apparently erroneous or uncertain parcel changes were linked to digitising errors or ambiguity surrounding mosaics and incomplete coding of amendments to the pre-prepared broad habitat maps.

40 After manual checking, it was estimated that a total of 38 ha FMS was actually lost across surveyed squares. In some cases surveyors notes and plot data threw light on the reality and causes of the change (Fig 11.4). These figures should be interpreted cautiously because of incomplete data for 50% of the parcels. The majority of lost parcels were less than 0.5ha in size.

Figure 11.4. Causes of FMS loss based on revised and validated loss of parcels in surveyed squares. Evidence for each cause was based on use codes, surveyors notes and plot photographs.

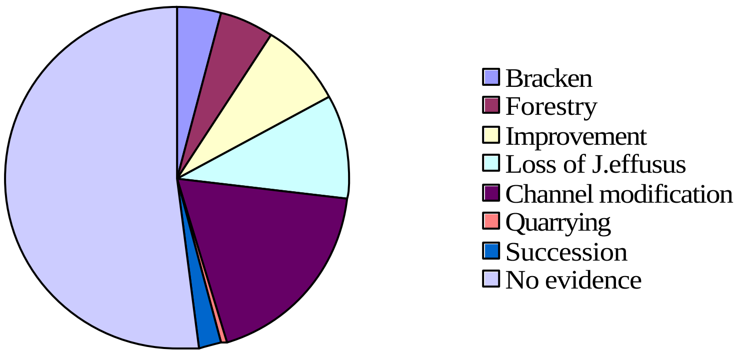
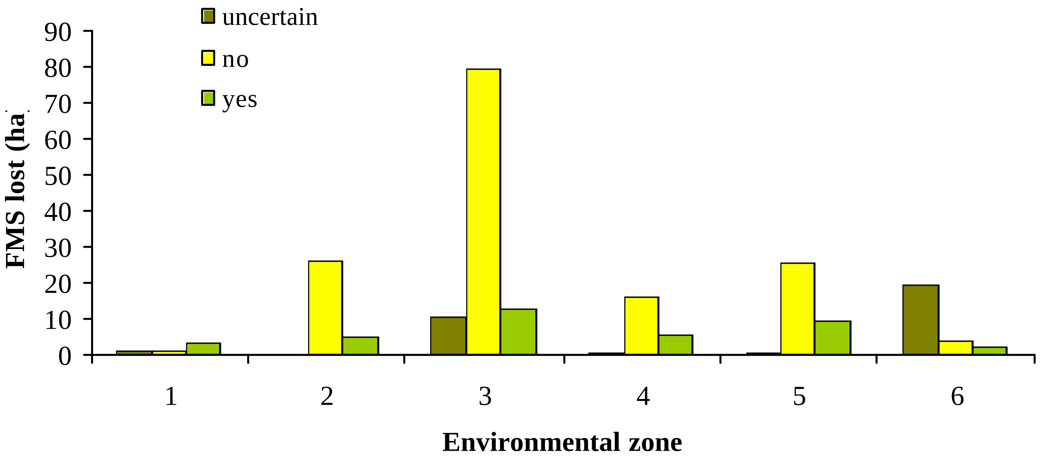


Figure 11.5. Hectarage of FMS that was lost to other BH between 1990 and 1998 where change was clearly supported by field mapping data (yes), not supported (no) or referred to parcels where no firm decision could be made (uncertain). Results are given as a) hectares of surveyed land in each zone and b) hectarage as a percentage of the total area of FMS mapped in each zone in 1990 that stayed in FMS ie. stable parcels.

a)



b)

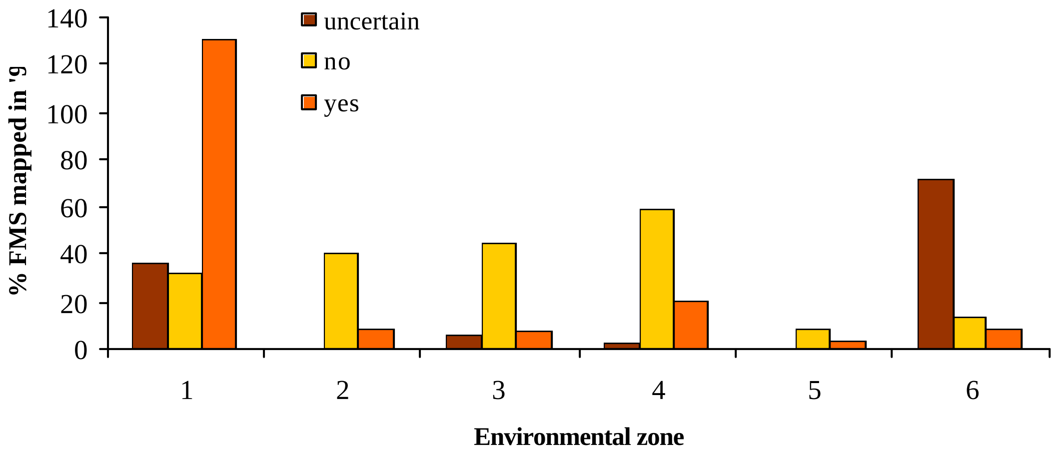
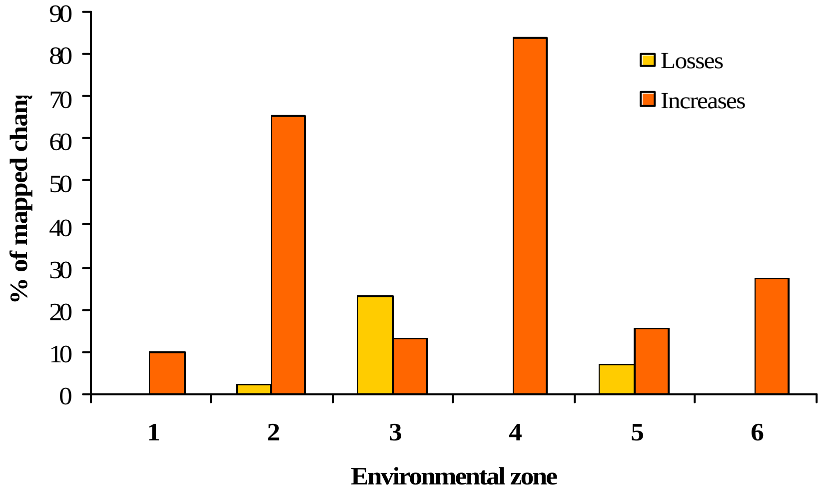


Figure 11.6. Proportion of revised 'real'change in surveyed area in each Environmental Zone that involved changes in presence and cover of *Juncus effusus*.



Summary of revised net change in area of surveyed FMS

41 Original and revised estimates of change in surveyed land are shown in table 11.3. The reason that the original net change shows a reduction in surveyed area rather than an expected increase is due to the influence of two relatively very high losses (33 ha each) in two squares in zone 3. These were the only squares in these Land Classes to see a loss (n=19; LC19e, n=13; LC17e). Therefore when averaged over all squares in the Land Class this translates into a much smaller mean change per Land Class but with very high variation about the mean.

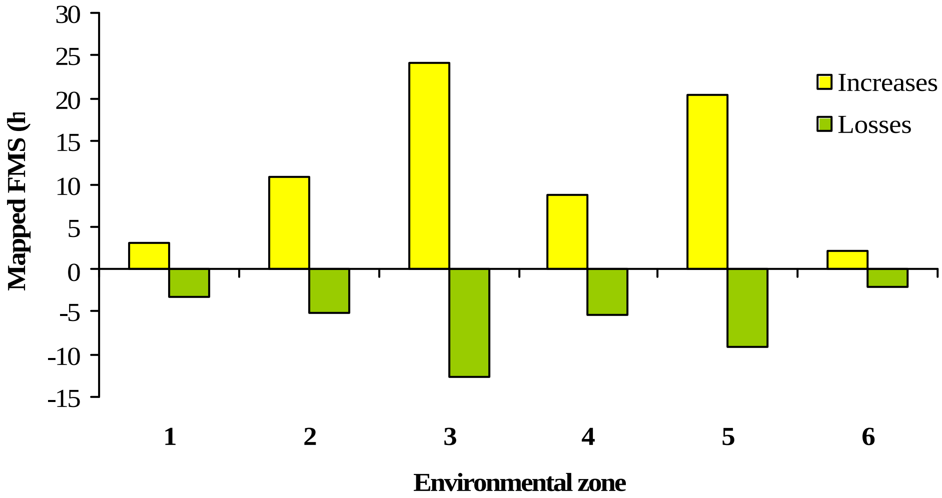
Table 11.3. Differences in change in surveyed area of FMS (ha) between 1990 and 1998 based on a comparison of the original and manually revised parcel allocations.

	Gains to FMS			Losses from FMS			Net change	Net change
Zone	Previous	Revised	Difference	Previous	Revised	Difference	Previous	Revised
1	11.7	3.2	-8.5	6.1	3.4	-2.7	5.6	-0.2
2	22.5	10.8	-11.7	39.0	5.2	-33.8	-16.4	5.6
3	31.9	24.1	-7.9	84.0	12.6	-71.4	-52.1	11.5
E&W	**66.1**	**38.1**	**-28.1**	**129.1**	**21.2**	**-107.9**	**-62.9**	**16.9**
4	18.6	8.7	-10.0	25.5	5.4	-20.1	-6.9	3.3
5	48.8	20.6	-28.3	30.1	9.3	-20.8	18.7	11.3
6	32.4	2.2	-30.1	27.3	2.3	-25.1	5.0	-0.1
Scot	**99.8**	**31.5**	**-68.4**	**82.9**	**17**	**-66**	**16.8**	**14.5**
GB	**165.9**	**69.6**	**-96.5**	**212**	**38.2**	**-173.9**	**-46.1**	**31.4**

42 An important implication of this is that the effects of the manual revision on national estimates are not obvious from this exercise. Suggested follow-up work should therefore include a careful consideration of the desirability for revising previous estimates of change and a strategy for the implementation of revisions.

43 Following manual checking, net increases in surveyed area of FMS are suggested to apply to all zones except 1 and 6. In the latter, net reductions in surveyed area applied although the total areas involved were relatively very small (Fig 11.7).

Figure 11.7. Change in surveyed area of FMS(ha) between 1990 and 1998 based on revised figures following manual checking of all parcel allocation changes.



Causes of increase and loss of Fen, Marsh & Swamp – part 2; analyses of change in condition

Methods

A comparison of the botanical characteristics of FMS that changed or remained stable was carried out so as to determine the consistency of plot and parcel-level changes. Two indicators were analysed across the subset of plots located in parcels that saw change in broad habitat allocation between 1990 and 1998. Firstly, change in cover-weighted Ellenberg wetness score was compared between stock lost, gained or carried over. The expectation being that wetness scores should decrease, increase or remain the same respectively. Secondly, change in total cover of wetland monocots in each plot was compared across the same groups. Species were selected by screening the complete list of plant species recorded in CS data and identifying those known to be associated with wetland vegetation. Monocots were targeted because they formed the basis of a similar indicator of the effects of increased inundation previously applied for ESA wet grasslands (Ref). This reflects the tendency for wetland communities to be dominated by sedges, grasses and rushes (Rodwell 199?). The indicator score for each plot was the total cover summed over all the wetland monocots present in each plot at each time. Again, the expectation was that plots in parcels that were newly recruited to FMS should have seen increased cover and *vice versa*.

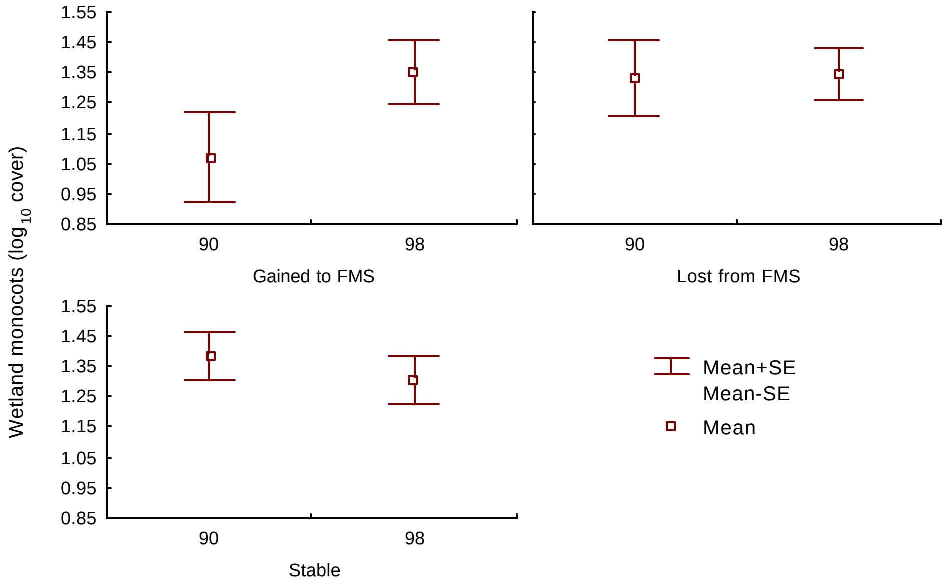
Results

Plots from within a subset of parcels that were gained to FMS did show an expected increase in mean Ellenberg wetness score and an increase in cover of wetland monocots (Fig 11.8). Conversely, plots within a subset of parcels that were lost from FMS showed no change over the eight year interval (Figs 11.8).

The results of the manual check of parcel changes indicated that gains to surveyed FMS at the expense of enclosed broad habitats (Improved and Neutral grassland) were largely substantiated while those that had changed from unenclosed habitats (Dwarf Shrub Heath and Bog) were doubtful. To determine whether the increases in Ellenberg wetness and cover of wetland monocots were restricted to those parcels gained from enclosed Broad Habitats, plots and parcels were divided into these two groups and change in condition measures re-examined (Fig 11.9). Results indeed showed that the consistent signal from the botanical data appeared to be restricted to parcels gained to FMS from enclosed Broad Habitats only. Moreover the relatively higher starting values of plots within unenclosed parcels also supported the indication from manual checking that the majority of these parcels were already in FMS vegetation in 1990 (Fig 11.9).

Figure 11.8. Change in botanical characteristics in plots located within parcels that were either gained to FMS or lost from FMS between 1990 and 1998. a) Change in cover of wetland monocots, b) Change in cover-weighted mean Ellenberg wetness value.

a)



b)

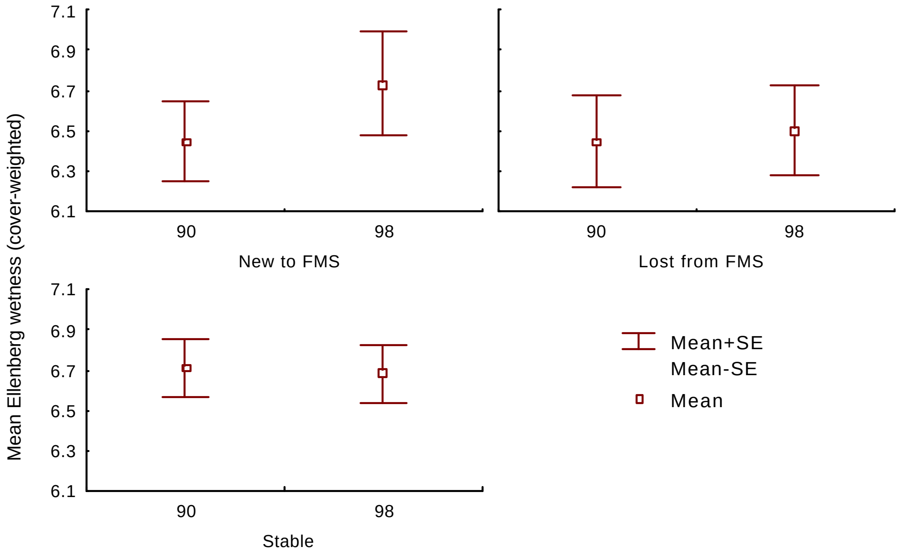
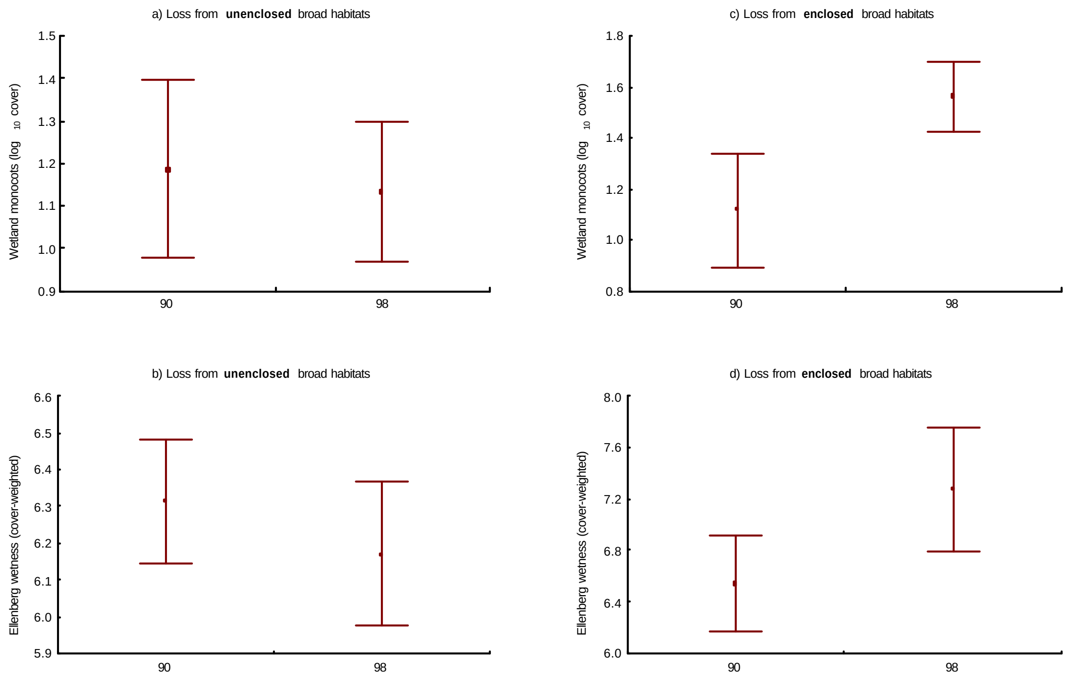


Figure 11.9. Change in botanical characteristics in plots located within parcels that were gained to FMS in 1998. Parcels were divided into two groups on the basis of the donor broad habitat; a) and b) comprise the unenclosed broad habitats Bog, Dwarf Shrub Heath and Acid Grassland, c) and d) comprise the enclosed broad habitats Arable, Improved Grassland and Neutral Grassland. Means +/- SE.



CONCLUSIONS

Lessons/Requirement for further analyses:

- Revision of national estimates of stock and change are required.
- Validated patterns of loss and gain to FMS illustrate continuing attrition of the smallest fragments of wetland particularly in lowland Britain. However it is the lowlands that also seem to have seen the biggest increase in new FMS.
- New areas consisted of increases in *J.effusus* dominated grassland and some areas of riverine swamp. These gains were certainly related to conservation management in several cases but do not constitute gains in area of Priority Habitat.
- In parallel with the patterns of change seen in Dwarf Shrub Heath, it may well be that CS is more capable of detecting the loss of frequent but small fragments rather than expansion in area of FMS around fewer but larger areas of pre-existing wetland. This assumes that funding for conservation management and restoration is more likely to target large existing areas rather than funding maintenance of very small and often already degraded patches.
- Work on integrating the field survey and LCM2000 will be relevant in further exploring the reality and significance of changes in FMS outside CS survey squares and may even be able to help address the issue of patch size distribution and detectability of change raised in the previous bullet point.

- The next CS must consider rigorous enforcement of the mapping codes 702 and 701 to discriminate corrections to an incorrect map as opposed to real change. Adopting electronic mapping systems could make this easier to achieve.
- Further work might usefully include an analysis of change in extent and condition of CS parcels and plots in flood plains known to have suffered from major recent flooding episodes. This would be particularly interesting given that most of the real increase was concentrated in lowland Britain.
- Consider a partial or full re-survey of the Key Habitats waterside squares as part of the next CS. This could help address the obvious lack of coverage of FMS Priority Habitats by the current CS sample and also address the issue of flooding impact raised in the previous bullet.
- In future CS additional characterisation of changes in the botanical resource sampled as FMS will also possible via analysis of the U plot baseline set down in 1998.

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ANNEX 1

Representation of Priority Habitats and corresponding NVC units in the T4, Q11 Fen, Marsh & Swamp Broad Habitats

NVC community lists for each PH taken from the respective HAP[5]

	Fen, Marsh & Swamp		
NVC unit	Reed-beds	Purple moor grass & rush pasture	Fens
M4			✓
M5			✓
M6			✓
M7			✓
M8			✓
M9			✓
M10			✓
M11			✓
M12			✓
M13			✓
M14			✓
M21			✓
M22		✓	
M23			
M24		✓	
M26		✓	
M25		✓	
M27			✓
M28			✓
M29			✓
M30			✓
M31			✓
M32			✓
M33			✓
M34			✓
M35			✓
M36			✓
M37			✓
M38			✓
S1			
S2			
S3			
S4	✓		
S5			
S6			
S7			
S8			
S9			
S10			
S11			
S12			
S13			
S14			
S15			

[5] See action plan text at http://www.ukbap.org.uk/species.htm

NVC community lists for each PH taken from the respective HAP[6] (contd.)

	Fen, Marsh & Swamp		
NVC unit	Reed-beds	Purple moor grass & rush pasture	Fens
S16			
S17			
S18			
S19			
S20			
S21			
S22			
S23			
S24	✓		
S25	✓		
S26	✓		
S27			
S28			
W1			
W2			
W3			
W4			
W5			
W6			

NVC units recorded in plots located in parcels mapped as Fen, Marsh & Swamp Broad Habitat in either 1990 or 1998

Group	NVC
Acid grassland	U1
Acid grassland	U2
Acid grassland	U4
Acid grassland	U5
Acid grassland	U6
Acid grassland	U9
Arrhenatherum	MG1
Bracken	U20
Dune	SD10
Dune	SD17
Dune	SD6
Dune	SD7
Dune	SD8
Dune	SD9
Fen	M27
Fen	M6
Heath	H1
Heath	H10
Heath	H12
Heath	H4
Heath	H7
Heath	H8
Heath	H9

[6] See action plan text at http://www.ukbap.org.uk/species.htm

NVC units recorded in plots located in parcels mapped as Fen, Marsh & Swamp Broad Habitat in either 1990 or 1998 (contd.)

Group	NVC
MG6	MG6
MG7	MG7
Other	A11
Other	CG3
Other	CG4
Other	CG6
Other	MC10
Other	MC11
Other	MC12
Other	MC8
Other	MC9
Other	OV19
Other	OV21
Other	OV23
Other	OV24
Other	OV25
Other	OV26
Other	OV27
Other	OV28
Other	OV9
Other	SM16
Purple M Grass & Rush Pasture	M25
Reed-bed	S26
Rush pasture	M23
Swamp	S18
Swamp	S19
Swamp	S28
Swamp	S5
Wet woodland	W4
Wet woodland	W6
Wet MG	MG10
Wet MG	MG11
Wet MG	MG13
Wet MG	MG9
Wet heath & Blanket bog	M15
Wet heath & Blanket bog	M16
Wet heath & Blanket bog	M17
Wet heath & Blanket bog	M2
Woodland	W10
Woodland	W16
Woodland	W23
Woodland	W25

CASE STUDIES OF CHANGE IN EXTENT AND CONDITION OF FEN, MARSH & SWAMP

Plot location error and seasonality:

Each pair of plot records is thought to illustrate change resulting from effects operating over the eight year interval between surveys rather than seasonal differences in the date of recording or the fact plots were not properly positioned in 1998. Ultimately there is no way of partitioning out any seasonal or delayed climatic effects from each example of change, hence it is a matter of judgement as to their probable influence. There were differences in recording date between plots (Table 11.4) but gaps were relatively small and judged to be less significant than long-term change given the magnitude of observed changes in species composition.

Plot relocation error is also considered to have had relatively little effect. This reflects the weighing of evidence for all possible repeat plot pairs during validation of field data in 1999. All the plot pairs shown here were either known to have been correctly located in 1998 because the buried metal marker was found or, if not recovered, then surveyors had decided that the plot had been correctly repositioned using the 1990 photo, compass bearings and plot location map.

Table 11.4. Dates of survey for each case study.

Case studies	1990 survey	1998 survey	Day difference
1	13/07	18/07	5
2	22/08	01/09	10
4	4/07	23/06	11
5	12/9	28/08	15
6	15/08	24/08	9
7	28/06	17/06	19

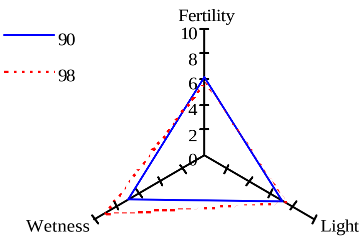
Example 1: Increase in Fen, Marsh & Swamp as a result of conservation management (Zone 2)

A net 30.5% increase in area of Fen, Marsh & Swamp was originally estimated for zone 2 across GB. This change was not statistically significant, however manual checking of parcel allocations suggested that the majority of the estimated loss of surveyed FMS in the zone was probably erroneous while most of the increase was real. An example of real gain to FMS in the zone focuses here on a 1km sample square located in the Ouse Washes. Surveyors noted that in 1990 nature conservation was the primary management objective across the square and by 1998 75% of the square was owned and managed by the RSPB. Between 1990 and 1998 1.5ha transferred to FMS, mainly from the Neutral Grassland Broad Habitat. Examination of the detailed mapping data supported the change and an example of the shifts in plant species composition that occurred in the square is shown here using data from one of the fixed recording plots.

1990

1998

Species	90	98
Agrostis stolonifera	80	0
Glyceria maxima	15	25
Phalaris arundinacea	15	
Senecio aquaticus	15	
Rumex crispus	5	5
Alopecurus geniculatus	1	0
Chenopodium album/polyspermum	1	
Cirsium arvense	1	
Eleocharis palustris	1	30
Elytrigia repens	1	1
Eurhynchium sp.	1	
Galium palustre	1	1
Iris pseudacorus	1	
Mentha aquatica	1	25
Persicaria amphibia	1	1
Plantago major	1	
Poa trivialis	1	
Potentilla anserina	1	1
Ranunculus repens	1	
Rorippa sylvestris	1	1
Thalictrum flavum	1	
Eupatorium cannabinum		1
Lythrum salicaria		1
Lemna minor		1
Oenanthe fistulosa		1



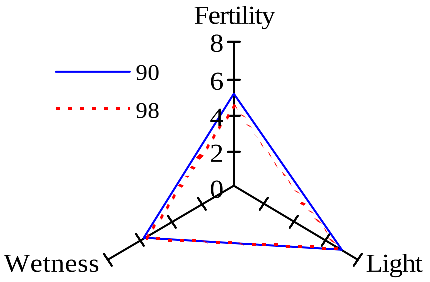
Ellenberg wetness score increased in the eight year interval. Consideration of the change in terms of the NVC indicates movement from S28 *Phalaris* arundinacea tall-herb fen to a mosaic of S19 *Eleocharis palustris* and S5 *Glyceria maxima* swamps.

Example 2: Increase in cover of *Juncus effusus* over neutral grassland (Zone 5)

Manual checking of parcel changes showed that increases in cover of *Juncus effusus* played an influential role in causing parcels to change allocation to FMS, especially in zones 2 and 4. This must partly have reflected the difficulty in keying out the highly variable grasslands in which *Juncus effusus* was found. The example here is typical. Surveyors appear to have taken the cue of a modest increase in cover of *J.effusus* to change the allocation of the wider parcel from Neutral Grassland to FMS. In NVC terms the assemblage has strong affinities with both U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-Trifolium repens* sub-community and MG10 *Holcus lanatus-Junus effusus* rush pasture. The parcel was cattle grazed in both years.

1990

1998



Species	90	98
Holcus lanatus	30	15
Trifolium repens	30	20
Juncus effusus	15	30
Agrostis capillaris	10	50
Poa pratensis sens.lat.	10	
Ranunculus repens	10	1
Prunella vulgaris	5	1
Anthoxanthum odoratum	1	5
Bellis perennis	1	1
Calliergon sp	1	
Carex ovalis	1	1
Cerastium fontanum	1	1
Cynosurus cristatus	1	1
Dactylis glomerata	1	
Lolium perenne	1	1
Plantago lanceolata	1	1
Rhytidiadelphus squarrosus	1	20
Rumex acetosa	1	1
Trifolium pratense	1	1
Agrostis stolonifera		1
Brachythecium sp.		1
Festuca rubra agg.		1
Hypochaeris radicata		1
Luzula campestris/multiflora		1
Poa trivialis		1
Potentilla erecta		1
Ranunculus acris		1
Taraxacum agg.		1
Veronica serpyllifolia		1

Although the parcel changed Broad Habitat allocation, little change is evident in terms of Ellenberg scores for the fixed plot located within the parcel.

Example 3: *Juncus effusus* dominated vegetation allocated to an FMS U plot in the 1998 survey (Zone 6)

Although *Juncus effusus* dominated rush pastures do not fall within either of the three Priority Habitats included in the FMS Broad Habitat, such stands were accommodated within the Broad Habitat as defined in the CS2000 field survey handbook. However, their inherent variability clearly presented great difficulty in mapping boundaries and in differentiating between FMS, Neutral Grassland and Acid Grassland. This reflected the clear dominance of the rush but also its association with grasses and forbs whose variation in joint occurrence are known to define an unbroken continuum from dry and semi-improved (MG6 *Lolium perenne-Cynosurus cristatus* grassland) through to wet, acid situations (M23 *Juncus effusus/a cutiflorus-Galium palustre* rush pasture). The extremes present less of a problem but intermediate vegetation is extensively developed in the marginal uplands and uplands of Britain. In these situations dissimilarity with M23 usually rests on the absence of species such as *Galium palustre*, *Lotus pedunculatus*, *Ranunculus flammula* and *Angelica sylvestris* (Rodwell 1991). However, it is the floristic variability and small-scale patchiness of the intermediate swards that pose the greatest difficulties in parcel allocation and mapping. The example shown here is one example of the kind of soft-rush dominated sward frequently encountered during the field survey and often allocated to FMS. The species composition shows the closest similarity with U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-Trifolium repens* sub-community and MG10 *Holcus lanatus-Junus effusus* rush pasture, typically reflecting base-poor brown earths in the wetter west of Britain, often slightly improved and usually with a long history of sheep grazing. The richness of the assemblage can vary with the dominance of *Juncus effusus* creating additional problems as floristic affinities weaken in very species poor swards. For example, in this 1km square, very high cover of the rush seemed to be linked to extensive enclosure for forestry and hence low grazing pressure.

1998

Species	**1998**
Juncus effusus	80
Agrostis stolonifera	15
Rhytidiadelphus squarrosus	15
Holcus lanatus	10
Rumex acetosa	10
Agrostis capillaris	5
Anthoxanthum odoratum	5
Galium saxatile	5
Mnium hornum	1
Cirsium palustre	1
Cynosurus cristatus	1
Holcus mollis	1
Lophocolea sp.	1
Eurhynchium sp.	1
Poa pratensis sens.lat.	1
Ranunculus repens	1
Viola palustris	1

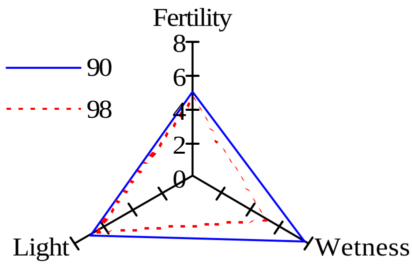
In subsequent surveys, the U plot baseline will play a major role in validating mapped change in Broad Habitat area and will greatly increase the precision of analyses of change in botanical condition.

Example 4: Replacement of lowland FMS by Neutral Grassland (Zone 1)

Loss of FMS as a result of a complete change in land-use did not appear be a widespread phenomenon in surveyed squares but did occur in at least two documented cases. In zone 4, the extension of an existing quarry consumed 0.14ha of fen while in zone 1, 0.3ha of herb-rich *Juncus effusus* dominated vegetation was lost to Golf Course development having clearly been drained and possibly reseeded by 1998 although apparently not with a species poor *Lolium*-dominated mix. As was typical of FMS in lowland zones, the size of the lost parcel was below 0.5ha.

1990

1998



Species	90	98
Juncus effusus	60	
Glyceria notata	20	
Holcus lanatus	10	10
Epilobium parviflorum	5	
Glyceria fluitans	5	
Scrophularia auriculata	5	
Veronica beccabunga	5	
Agrostis stolonifera	1	
Carex pendula	1	
Carex remota	1	
Cerastium fontanum	1	1
Cirsium palustre	1	
Eupatorium cannabinum	1	
Hypericum pulchrum	1	
Lotus pedunculatus	1	
Poa trivialis	1	
Ranunculus repens	1	5
Rumex sanguineus	1	
Agrostis capillaris		35
Anagallis arvensis		1
Anthoxanthum odoratum		1
Cirsium arvense		1
Dactylis glomerata		5
Lotus corniculatus		1
Prunella vulgaris		5
Rhytidiadelphus loreus		1
Senecio jacobaea		5
Stellaria media		1
Taraxacum agg.		1
Trifolium repens		1

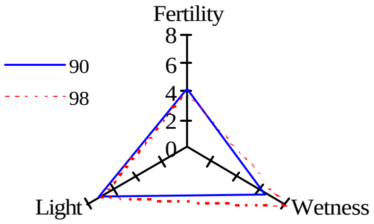
NVC assignment of the vegetation was problematic for both years data. M23b *J.effusus-Galium palustre* rush pasture, *J.effusus* sub-community maybe the best placement for the 1990 record. The 1998 data remain difficult to assign. The change in soil moisture is clearly reflected by the decline in Ellenberg wetness score while fertility and light scores remain largely the same.

Example 5: Lack of management as a precursor to development (Zone 2)

In several cases, lack of management could be inferred as a clear cause of the loss of FMS to woodland and scrub. Typically the parcels affected were small (<0.5ha). The example shown here illustrates a stable parcel mapped as FMS in both years but where marked reductions in species richness had occurred in parallel with lack of management. The parcel was recorded as cattle grazed in 1990 and unmanaged in 1998. Surveyors notes indicated that the majority of the land in the square had been purchased for development, hence farming activity had reduced in anticipation of a complete change of land-use.

1990

1998



Species	90	98
Centaurea nigra	15	
Molinia caerulea	15	25
Festuca rubra agg.	10	
Cirsium palustre	5	1
Holcus lanatus	5	
Juncus effusus	5	
Plantago lanceolata	5	
Senecio aquaticus	5	
Agrostis canina sens.lat.	1	
Anthoxanthum odoratum	1	
Cardamine hirsuta/flexuosa	1	
Cardamine pratensis	1	1
Carex panicea	1	
Filipendula ulmaria	1	10
Galium palustre	1	1
Geranium pratense	1	
Iris pseudacorus	1	25
Juncus articulatus/acutiflora	1	30
Lathyrus pratensis	1	
Lotus pedunculatus	1	1
Luzula campestris/multiflora	1	
Myosotis seedling/sp	1	
Phleum pratense sens.lat.	1	
Potentilla erecta	1	
Pseudoscleropodium purum	1	
Ranunculus acris	1	
Ranunculus flammula	1	
Ranunculus repens	1	
Rhytidiadelphus squarrosus	1	
Rumex acetosa	1	
Stachys officinalis	1	
Succisa pratensis	1	
Vicia cracca	1	
Brachythecium sp.		1

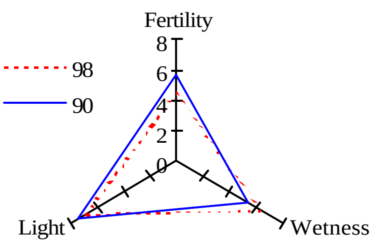
Little change in Ellenberg light and fertility scores occurred, however the loss of a whole range of mesotrophic grassland species left the stand dominated by wetland species hence wetness score increased.

Example 6: Replacement of improved grassland by rush pasture probably expanding from a source area close by (Zone 2)

In eight years this parcel saw a dramatic switch from improved, reseeded grassland (MG6) to *Juncus effusus* dominated rush-pasture (M23b). There was no indication as to whether this remarkable change had occurred as a result of deliberate conservation management, the only information being use-codes for cattle grazing in the parcel in both years. The 1990 field map showed a parcel of about 1.5ha of improved grassland bordered on one side by a 0.15ha strip of pre-existing rush-pasture. Therefore the rapidity of vegetation change may have been related to the close proximity of donor vegetation. The presence at low cover in 1990 of *Cirsium palustre* and *Ranunculus flammula* indicate poor drainage so that it may actually have proven difficult to maintain productive *Lolium* ley in the face of generally unfavourable soil conditions.

1990

1998



Species	90	98
Lolium perenne	40	1
Trifolium repens	20	1
Agrostis capillaris	10	1
Agrostis stolonifera	10	1
Phleum pratense sens.lat.	10	1
Holcus lanatus	1	25
Cynosurus cristatus	1	10
Cerastium fontanum	1	1
Poa annua	1	1
Ranunculus acris	1	1
Ranunculus flammula	1	1
Ranunculus repens	1	1
Taraxacum agg.	1	1
Bellis perennis	1	
Cirsium palustre	1	
Cirsium vulgare	1	
Plantago major	1	
Rumex crispus	1	
Juncus effusus		25
Deschampsia cespitosa		10
Galium palustre		5
Agrostis canina sens.lat.		1
Anthoxanthum odoratum		1
Brachythecium sp.		1
Cardamine pratensis		1
Carex ovalis		1
Glyceria seedling/sp		1
Juncus articulatus/acutiflora		1
Juncus bufonius sens.lat.		1
Lotus corniculatus		1
Lotus pedunculatus		1
Poa pratensis sens.lat.		1

Ellenberg scores convey an expected shift toward less-fertile and wetter conditions.

Example 7: Succession to scrub associated with lack of management (zone 2)

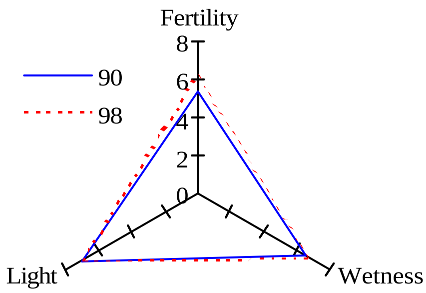
In a number of cases, field survey information offered persuasive evidence for the role of succession as a cause of the loss of FMS. The example here is typical in that the area of fen was small (0.5ha in 1990) and embedded in a wider matrix of farmland in lowland Britain. Surveyors reported that the parcel was unmanaged in both surveys.

The presence at low cover of *Erica tetralix* and *Dactylorhiza* sp in 1990, hint at the existence of wet heath at some point in the past.

1990

Species	90	98
Marchantia spp.	50	
Holcus lanatus	30	40
Salix caprea	20	80
Juncus effusus	15	15
Cirsium arvense	1	
Dactylorhiza sp.	1	
Epilobium montanum	1	1
Erica tetralix	1	
Polytrichum commune	1	1
Rumex acetosella	1	
Rumex obtusifolius	1	
Sagina sp.	1	
Tussilago farfara	1	10
Betula seedling/sp		20
Senecio jacobaea		1
Stellaria media		1

1998



Sampled vegetation had little similarity to any NVC unit, the closest affinity being for MG10a in both years. Clearly the plot in '98 should be allocated to a woodland community but it is not at all clear which. Even though considerable structural change took place, Ellenberg light and wetness scores stayed the same. Fertility score increased reflecting the disappearance of shade-intolerant species associated with less fertile conditions. Since *Salix caprea* can achieve over 45cm growth per annum the canopy development seen here is quite plausible (http://www.msue.msu.edu/msue/imp/modzz/00001292.html).