

National sample survey of SSSI fens

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National sample survey of SSSI fens

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Summary

The national SSSI sample survey programme was initiated in 1992 to provide a strategic overview of the state of selected habitats within the SSSI series as a whole. The sample surveys would also explore the links between habitat condition and the interests, management activities and priorities of owners and occupiers. This report is the fourth in this series, following studies of lowland grasslands (Sketch 1995), lowland heathland (Brown *et al.* 1998) and woodland (Solly *et al.* 1999).

This sample survey considered fens, a broad habitat which was taken to include valley mires, basin and floodplain mires, fen meadows and flushes.

150 SSSI units¹ were randomly selected from the 1180 units identified to consist of one or more of these habitats. Conservation Officers in Local Teams were asked to contact the managers of these units and to complete a questionnaire detailing ownership, land use and management. Conservation Officers were also asked to visit each unit and to assess the condition of the fen communities present using the procedures defined in *A statement on common standards monitoring*.

Surveys were completed between September 1998 and September 1999 for 122 of the 150 units originally selected. Two thirds of the fens sampled were less than 5ha in extent and fen habitats frequently constituted only a small proportion of each unit. Only six of the units sampled for this survey contained extensive (>20ha) areas of fen.

By number, 47.9% of fens sampled were in favourable condition; 13.45% were unfavourable but recovering; 20.17% were unfavourable and declining; and 17.65% were in an unfavourable state and neither improving or declining. Eleven hectares of fen habitat within one unit had been partially destroyed by drainage and conversion to arable use.

By area, only 32.5% of fens were in favourable condition; 19.14% were recovering; 17.4% were declining; and 29.23% were in an unfavourable but stable state. In assessments based on area, the largest sites have a disproportionately large influence; in the current survey, for example, a single unit contained an estimated 100ha of fen habitat, comprising more than 15% of the total area estimated.

Grazing was the most common management activity, occurring on 57.5% of units sampled. It was also one of the factors most strongly associated with favourable fen condition. Mowing and scrub control, which each occurred on more than a third of the units sampled, also had a positive influence on fen condition; the primary effect of these activities was to reduce the proportion of sites which were unfavourable and declining.

¹ A sub-unit of the SSSI with a single feature of interest and a single management regime.

Factors which constrained these activities accordingly had a negative influence on site condition. Such constraints were identified on almost three quarters of the sites included in the current survey.

Practical constraints, primarily concerning lack of appropriate livestock and difficult site access, affected more than 40% of the units sampled, or more than 60% of fens by area. Traditional low-intensity grazing by beef cattle has been much reduced due to the post-BSE collapse of the beef market. The decline in the beef industry has implications not just for the management of fens, but also for other valuable wildlife habitats where extensive grazing is required.

Other factors which had a significant negative influence on fen condition were financial constraints, constraints imposed by lack of time or labour, and lack of interest in managing sites. Whether arising from these constraints, or for other reasons, more than a quarter of the fens assessed (by number) were judged to be suffering from neglect. By area, some 46% of the fens assessed were suffering from neglect.

Overall, current management was thought to be appropriate on only 55% of the sites surveyed, and inappropriate on 31% of sites. The management prognosis was “unknown” (i.e. uncertain) for the remaining fens. In terms of area, only 48.5% of the fens assessed had a favourable management prognosis, whilst 42.9% of the area assessed was judged to have inappropriate management.

Measures considered necessary to secure the sustainable management of fens within SSSIs and to ensure the delivery of the Habitat Action Plan targets for these habitats are detailed in Section 6 of this report. In brief, these include:

- Changes to agricultural policy and funding, particularly the adoption of an Environmental Beef Scheme as advocated by English Nature in its submission to MAFF's consultation on *A New Direction for Agriculture*.
- Additional protection for SSSIs, including measures to prevent sites deteriorating from neglect or inappropriate management and to deter owners or third parties from deliberately damaging SSSIs, as identified in the proposed changes to SSSI legislation. The effectiveness of these measures would be dependent on the resources available to implement them.
- A much greater allocation of resources to agri-environment schemes. Priorities include positive management incentives for designated sites and sites of local nature conservation importance for which agricultural management is essential; expansion of Countryside Stewardship to meet UK BAP targets for priority habitats; reduction of diffuse pollution resulting from agricultural management; and higher enhancement tiers to be more widely adopted within ESAs, especially for the management of wet grasslands. The Government's announcement in December 1999 of a £1.6 billion package of measures over seven years, including £580m for the Countryside Stewardship Scheme, is particularly welcome; efforts must now concentrate on ensuring that this money delivers the intended environmental outcomes.

- Targeted support by English Nature through the provision of grants which are complementary to those offered through agri-environment schemes. The greatest benefits are likely to arise through targeting positive payments on activities such as scrub clearance and fencing, and on encouraging grazing on those fens for which agri-environment schemes are not available.
- Assistance to those managers who are ill-equipped to manage sites appropriately, by promoting networking among managers, graziers and contractors offering specialist services such as scrub clearance. Initiatives of this sort which are already under way include *Eco-Ads*, the *Machinery Rings Information Pack* and the *Grazing Animals Project*.
- Efforts should be made to raise awareness of the wildlife value and management needs of fen habitats, through increased and better-targeted communication with land managers and others involved in land use and planning.

Acknowledgements

This report is the culmination of work which was largely carried out by staff in English Nature's Local Teams, to whom I am particularly grateful. Rob Cooke, Wanda Fojt, George Hinton, Roger Meade and Keith Porter also provided valuable assistance and comments at various stages of the survey. Special thanks are also due to the owners and managers of the sites involved in the survey for their cooperation.

1. Introduction

1.1. The national SSSI sample survey programme

Sites of Special Scientific Interest (SSSIs) form a nationally important series which contributes to the conservation of natural wildlife habitats, geological features and landforms. They constitute an essential component of the overall approach to nature conservation in England. Ensuring that these sites are appropriately managed and protected depends on a clear understanding of which features are important on each SSSI and of the long-term objectives for those features. This relies upon a wider understanding of the context of each site.

In 1992, English Nature's Management Board approved a monitoring strategy for SSSIs. This strategy (Felton 1992) identified four priorities for the organisation:

- production of site objective and site management statements for all SSSIs;
- a strategic sample survey of SSSIs;
- a quality assurance or validation monitoring programme for SSSIs; and
- an SSSI information system to support site safeguard.

The monitoring strategy recommended that each sample survey should focus on a nationally selected sample of sites supporting a particular broad habitat type, thus providing an overview of the state of that habitat within the SSSI series as a whole. The sample surveys would also explore the links between habitat condition and the interests, management activities and priorities of owners and occupiers. This would be distinct from, but complementary to, the routine assessments of condition or recording of activities on individual sites carried out by conservation officers in Local Teams. Information gathered by the sample surveys would help English Nature to improve service and advice to owners and managers; the surveys would also provide information on whether existing legal, administrative and incentive measures were proving effective for the conservation of the selected habitats.

The sample survey programme was initiated in 1992, with a pilot study of lowland grasslands (Sketch 1995). Sample surveys have also been completed for lowland heathland (Brown *et al.* 1998) and woodland (Solly *et al.* 1999). The sample survey described in this report is the fourth in this programme of studies.

1.2. Fens and fen conservation

British fen types and their conservation have been reviewed by Fojt (1994), whilst detailed descriptions of fen, swamp and reedbed communities are provided by Wheeler (1984) and Rodwell (1991b, 1995). The following comments have been derived from Fojt (1994) and the UK Biodiversity Action Plan (UK Biodiversity Steering Group 1995). Communities considered in the present report are listed in Appendix 1.

Fens are minerotrophic mires which receive water and nutrients from the soil, rock and groundwater as well as from rainwater. Two types of fen, topogenous and soligenous, can broadly be distinguished on the basis of hydromorphology. Topogenous fens are those in which water movements in the peat or soil are predominantly vertical; examples include basin and floodplain fens. In contrast, water movements in soligenous fens are generally lateral; examples include valley mires and mires associated with springs, flushes and water tracks. However, these categories may overlap and intergrade and it may be difficult to allocate some sites to a particular hydromorphological type.

Fens may also be described as 'poor' or 'rich' fens. Poor-fens are fed by acidic ($\text{pH} < 5$) water, derived from base-poor rock such as sandstones and granites. This fen type is more common in the uplands, but may also be associated with lowland heaths. Poor-fens are characterised by short vegetation with a high proportion of bog mosses (*Sphagnum* spp.). Rich-fens are associated with areas of base-rich geology such as the chalk and chalky-boulder clay of southern and eastern England; they may also develop where there are localised occurrences of base-rich rocks, such as limestone, in central and northern England.

Swamp is a particular type of fen that may develop where water-table levels are at or above the surface for most of the year. Swamp vegetation is typically species-poor and is often dominated by tall, bulky monocotyledons. Reedbeds are fens or swamps dominated by stands of the common reed, *Phragmites australis*.

Fen meadows do not show a close association with a particular hydromorphological fen type. These communities may be intermixed with, or adjacent to, other fen vegetation, usually on drier land, but may be isolated if the adjoining fen vegetation has been lost.

Fens are scattered throughout England, but the extent of fen vegetation has declined dramatically in the past century. The greatest reduction in the area of fen habitat has occurred in the lowlands, as a result of drainage and intensive land-use. Many of the fens which remain also have been affected by qualitative changes in their composition and structure. Open-fen and fen meadow communities are dynamic semi-natural systems and appropriate management is needed to maintain these habitats and their associated species.

By 1997, significant areas of fen habitat were notified within 235 SSSIs in England (English Nature 1997). Many other SSSIs contain this habitat type, although fen communities are not necessarily the most extensive habitats within all of these, and in some cases may not be a feature of interest². Gardiner (1996) has provided an overview

² *Features of interest* (or *interest features*) are the features for which the site has been notified. They can be earth heritage features, habitats or species (Nature Conservancy Council 1989).

of the distribution and significance of different fen types within the SSSI series in the context of Natural Areas³.

Some fens are recognised as having international importance on the basis of their botanical, invertebrate, ornithological or habitat conservation interest. Six fen habitat types are listed in Annex I of the European Habitats and Species Directive (Council Directive 92/43/EEC):

- *Molinia* meadows on chalk and clay (*Eu-Molinion*)
- Transition mires and quaking bogs
- Depressions on peat substrates (*Rhynchosporion*)
- Calcareous fens with *Cladium mariscus* and *Carex davalliana*
- Petrifying springs with tufa formations (*Cratoneurion*)
- Alkaline fens.

There is not an exact correspondence between these fen types and the classifications normally used in Britain, such as the National Vegetation Classification (NVC) or the hydromorphological classifications described above.

Fens are identified as Priority Habitats in the UK Biodiversity Action Plan (UK Biodiversity Steering Group 1995). Habitat Action Plans have been prepared for fens, reedbeds and those fen meadows characterised as “purple moor grass and rush pastures”. Throughout the UK, these Action Plans aim to secure appropriate management for 1200ha of fen, 5000ha of reedbed and 13,500ha of lowland purple moor grass and rush pasture by 2010.

³ Natural Areas are biogeographic zones which reflect the geological foundation, the natural systems and processes and the wildlife in different parts of England.

2. Methods

The methodology used in the present study was adapted from that employed in the three previous sample surveys (Sketch 1995; Brown *et al.* 1998; Solly *et al.* 1999).

2.1. Site selection

Fens include a wide variety of habitats and this is reflected in the diversity of associated vegetation communities. The National Vegetation Classification recognises 28 swamp and tall-herb fen communities, 32 mire communities (including two wet-heath communities and several communities dominated by *Sphagnum* spp.) and six fen-carr communities (Rodwell 1991a,b, 1995; Fojt 1994). The sample survey described in this report was restricted to three broad fen types and their associated NVC communities, as listed in Table 1.

Table 1. Fen types and associated NVC communities considered in the sample survey of SSSI fens. NVC communities are listed in Appendix 1.

Fen type	NVC types (from Rodwell 1991b, 1995)
Valley mires	M6, M10, M11, M13, M14, M21, M29
Basin and floodplain mires (including swamp and reedbeds)	M4-6, M9, S1-4, S24-28
Fen meadows	M22-24

Wet-heath (NVC types M15 and M16) and carr woodland (NVC types W1-6) were included in previous sample surveys (Brown *et al.* 1998 and Solly *et al.* 1999, respectively); these habitats were therefore excluded from the present survey. Communities particularly associated with springs and rills (NVC types M31-38) were also excluded; they are typically limited in extent and would not normally be the main focus of management in a particular site unit.

A list of SSSIs supporting the selected fen communities was compiled by searching English Nature's information system, ENSIS. SSSIs were only included if conservation objectives (see definition below) were specified for the fen communities within the site. The ENSIS database was also used to identify the particular site units, within these SSSIs, associated with the above fen types. Sites were excluded if fen communities were not specifically associated with any site units. The list of SSSIs and site units was checked by Conservation Officers from English Nature's Local Teams and amended as necessary. This selection process produced a list of 1180 site units, on 451 SSSIs, for which the selected fen communities were listed as a feature of interest.

Site units identified above were stratified according to Government Regions, and were further stratified on the basis of whether sites fell within 'upland' or 'lowland' Natural Areas. A sample of 150 site units was randomly selected from the stratified population, with the number of units selected from each stratum being proportional to the total

number of units within that stratum. This process of stratification ensured that the range of variation within the SSSI network was adequately represented within the sample.

2.2. Data collection

Conservation Officers from English Nature's Local Teams were asked to complete a Questionnaire and a site unit recording (SUR) form for each selected unit. The Questionnaire (Appendix 2) was completed with the assistance of the site's manager and collected contextual information concerning the ownership and management of the selected site unit. The SUR form (Appendix 3) was completed following a visit to the specified site unit. Conservation Officers were asked to record the condition of the feature(s) of interest (see below) and the occurrence of any activities affecting the feature(s) of interest. They were also asked to state whether current management was likely to maintain or enhance the features of interest on the site. Site surveys were conducted between September 1998 and September 1999.

2.2.1. Condition assessments

The condition of the fen communities within each unit was assessed using the categories defined in *A statement on common standards monitoring* (Joint Nature Conservation Committee 1998). These categories are:

- *Favourable, maintained.* An interest feature should be recorded as [favourable] *maintained* when its conservation objectives were being met at the previous assessment, and are still being met.
- *Favourable, recovered.* A feature of interest can be recorded as having *recovered* if it has regained favourable condition, having been recorded as unfavourable on the previous assessment.
- *Unfavourable, recovering.* A feature of interest can be recorded as *recovering* after damage if it has begun to show, or is continuing to show, a trend towards favourable condition.
- *Unfavourable, no change.* An interest feature may be retained in a more-or-less steady state by repeated or continuing damage; it is unfavourable but is neither declining or recovering. In rare cases, an interest feature may not be able to regain its original condition following a damaging activity, but a new stable state may be achieved.
- *Unfavourable, declining.* Decline is another possible consequence of a damaging activity. In this case, recovery is possible and may occur either spontaneously or if suitable management input is made.
- *Partially destroyed.* It is possible to destroy sections or areas of certain features or to destroy parts of sites with no hope of reinstatement because part of the feature itself, or the habitat or processes essential to

support it, has been removed or irretrievably altered.

- *Destroyed.* The recording of a feature as *destroyed* will indicate that the entire interest feature has been affected to such an extent that there is no hope of recovery, perhaps because its supporting habitat or processes have been removed or irretrievably altered.

The categories of “favourable maintained” and “favourable recovered” have been combined into a single category (“favourable”) for the purposes of this report.

The condition of each feature of interest is assessed against the nature conservation objectives which have been set for that feature. These objectives describe targets which should be met if the condition of the interest feature is to be judged as favourable. Nature conservation objectives for the communities considered in this study were still in preparation when the survey was conducted and were not available to all surveyors. In the absence of these nature conservation objectives, surveyors were provided with information on the character of each community (Appendix 4) and were asked to assess condition against the broader objectives for the site as a whole.

Using the monitoring methodology defined above, the condition of a feature of interest is reported as “unfavourable” if it departs significantly from the long-term desired state specified in the nature conservation objectives. However, features which are assessed as “unfavourable, recovering” are showing a trend towards favourable condition; in most cases, the management of these features will achieve the nature conservation objectives.

Three points to consider when interpreting condition assessment figures are that:

- i. the definition of “favourable” condition is not necessarily the same as the condition of the feature at the time that the site was notified as an SSSI;
- ii. an assessment of “unfavourable” condition does not necessarily imply any recent loss or damage to the features of interest; and
- iii. an assessment of “unfavourable, no change” or “unfavourable, declining” does not necessarily indicate that current management is inappropriate or unacceptable; the condition of a feature of interest may be assessed as unfavourable due to factors associated with past management (perhaps pre-dating notification), or due to factors beyond immediate control, e.g. long-distance air pollution or climate change.

The application of condition assessment monitoring for features of interest in designated sites is discussed further in Kirby and Solly (*in press*).

2.3. Analysis

Data from the questionnaires were collated to provide summary information on:

- the occupier groups involved in the management of fens;
- the use and management of fens within SSSIs; and
- the proportion of SSSI fens managed with the aid of grant schemes and/or management agreements.

Similarly, data from the site unit recording forms were collated to provide information on:

- the overall condition of fens assessed in the sample survey;
- the occurrence of activities likely to influence the condition of the features of interest; and
- the extent to which current management will maintain or enhance the features of interest.

In addition to providing a national overview for each of these issues, the data were analysed to provide information on the geographic variation in occupier categories, land use, management and condition. For the purposes of this exercise, the survey area was divided into three broad regions: northern, eastern and western England. The northern region comprises the Government Regions for Yorkshire and the Humber, the North East and the North West, together with the Peak District; the eastern region comprises the Government Regions for the East Midlands (excluding the Peak District), East of England, London and the South East; and the western region comprises the South West and West Midlands Government Regions. Analysis of the results for smaller areas would be of little merit as each area would then have too few sites from the overall sample to give a reliable estimate of the condition and management of the fens within it.

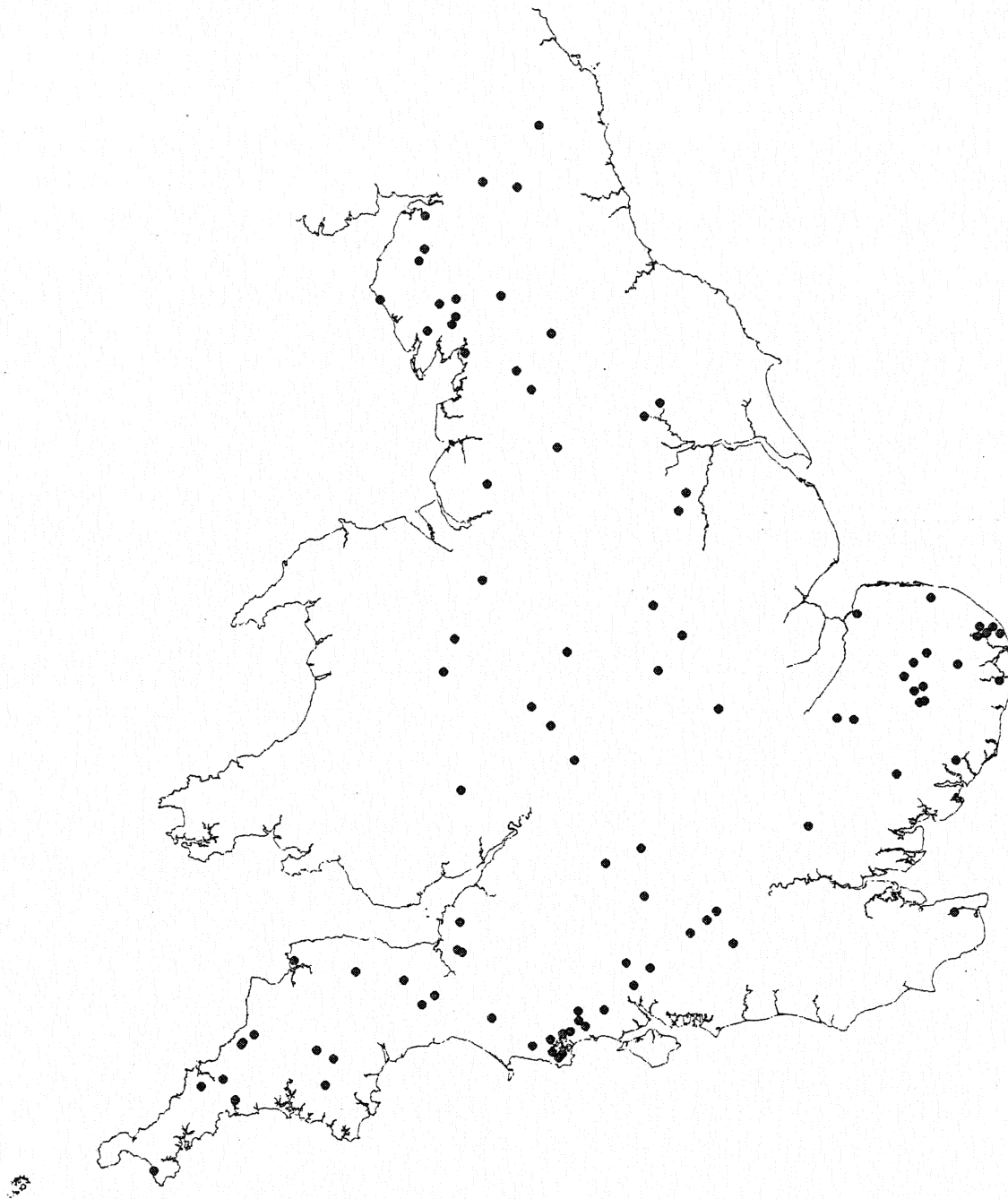
The relationships between fen condition and other characteristics of the site and its management were explored by multivariate analysis. This form of analysis compensates for correlations between variables and thus gives a more reliable indication of relationships than that provided by single-factor analyses. “Best subsets” regression analysis, an application within the statistical analysis programme “Minitab”, was used to identify the best “predictors” for each condition class. The predictors were the factors recorded on the questionnaire, such as ownership, property type, grant schemes and management activities.

3. Ownership, land use and management

3.1. Initial and actual sample size

Survey returns were received for 122 of the 150 site units originally selected, these being within 99 SSSIs. Two of these were “null” returns, i.e. the selected units did not support habitats within the categories described above. The distribution of sites included in the sample survey is shown in Figure 1.

Figure 1. Distribution of sites included in the national sample survey of SSSI fens. Two or more units were sampled within some SSSIs.



3.2. Size of fens sampled

Estimates of the area of fen habitat were given for 102 of the units included in the survey. The average area of fen habitat within these units was 6.37ha. However, two thirds of the fens sampled in the survey were less than 5ha in extent and nearly one in five was smaller than 1ha. Fen habitats frequently constituted only a small proportion of each unit; indeed, fens, as defined above, comprised less than 50% of the area in nearly half of the units surveyed.

The average fen area varied considerably between eastern, northern and western parts of the country. The average area of fen habitat within units in eastern England was 9.59ha; in northern England it was 4.18ha; and in western England 4.08ha. This disparity is largely attributable to the inclusion within the survey of several large areas of fen within East Anglia, notably within the Norfolk Broads, where such habitats are particularly extensive. In other areas, the selected units were commonly within mosaics of bog, heath and grassland, where fen habitats (as defined above) are less extensive and more fragmented.

As area data were not available for all the fens sampled in the survey, the majority of the following analysis and discussion is based on the number of site units assessed. However, comparisons based on area are also used where these differ substantially from those based on the number of units. It should be noted that comparisons based on area are disproportionately influenced by the condition and management of the largest sites. In the current survey, for example, a single unit contained an estimated 100ha of fen habitat, comprising more than 15% of the total area estimated. This single management unit contained a greater area of fen than that of the 61 smallest units combined.

3.3. Ownership

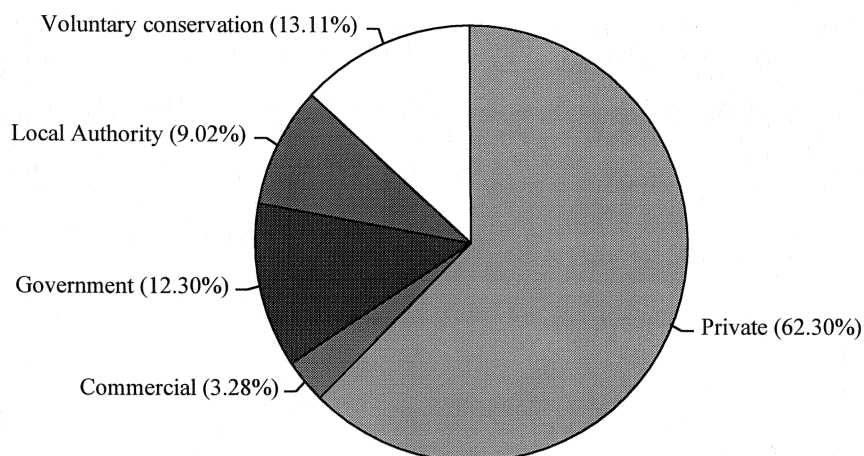
The managers of each unit were grouped into the following occupier categories:

- Private individual or estate
- Commercial enterprise
- Government Department or Agency
- Local Authority
- Voluntary conservation organisation

Further details of the ownership categories are given in Appendix 2.

The proportion of site units in each occupier category is shown in Figure 2. Two units were associated with two occupier categories, giving a total of 122 occupier-unit links. Private individuals and estates comprised the largest occupier group, managing 76 units; four of these units had multiple ownership, although all within the same occupier category.

Figure 2. Percentage of site units within each occupier category. $N = 122$ site units, with two units being managed by more than one occupier group.



3.4. Main land uses within the units sampled

The main land uses within each unit were defined in terms of the following categories:

- Arable
- Grazing
- Forestry/woodland
- Recreation (other than shooting)
- Shooting
- Nature conservation.

Table 2 summarises land uses within the units surveyed. More than one of the land use categories could apply to each unit, particularly where habitats other than fen were also present. Grazing and nature conservation were the most common land uses, occurring on 57.5% and 49.2% of units, respectively. Overall, 55 units (45.8%) had more than one use and the mean number of uses per unit was 1.60. The maximum number of land uses for any unit was four.

For those units where the area of fen was estimated, 55.4% of the area was grazed, but some 73.6% of the area assessed had a nature conservation use. This latter figure is influenced by the inclusion within the survey of large areas of fen within the Norfolk Broads and other parts of East Anglia.

Table 2. Main land uses within the units sampled. Units may have more than one use, but uses may not necessarily relate to the fen habitats within each unit.

Land use	Number of units	Percentage of units (n=120)	Percentage of area (total = 649.5ha)†
Grazing	69	57.5	55.4
Nature conservation	59	49.2	73.6
Recreation	25	20.8	31.5
Shooting	25	20.8	28.6
Forestry	12	10.0	11.3
Arable	1	0.8	1.7

† Based on 102 units for which the area of fen habitat was estimated.

3.5. Land management

Management activities likely to be associated with fen habitats were listed in the questionnaire (see Appendix 2) and owners / occupiers (or Conservation Officers) were asked to specify the management occurring within each unit. These responses are summarised in Table 3; grazing is included as a management activity, although it was also specified as a land use.

In terms of unit numbers, grazing, mowing, scrub control and ditch maintenance were the most common activities, each occurring on more than a third of the units surveyed. Considering only those units in which the area of fen was estimated, mowing, scrub control and ditch maintenance were each associated with more than 60% of the fen area assessed, whilst 55% of fens, by area, were grazed. Management for (or of) particular species, seasonal flooding and other hydrological management also affected a greater proportion of the area of fen habitat than a simple count of units would suggest. These area assessments are biased by the management of the relatively large areas of fen occurring within a few units sampled within East Anglia.

Table 3. Management activities on units within the sample survey of SSSI fens. More than one management activity may occur on each unit, but the specified management activities do not necessarily involve the areas of fen habitat within each unit. Water levels (other) refers to other management likely to affect water table levels within the site. Species refers to management for (or of) particular species.

Land use	Number of units	Percentage of units (n=120)	Percentage of area (total = 649.5ha)†
Grazing	69	57.5	55.4
Scrub control	55	45.8	63.1
Ditch maintenance	44	36.7	65.8
Mowing	43	35.8	64.4
Seasonal flooding	27	22.5	52.0
Water levels (other)	22	18.3	31.7
Species	17	14.2	36.2
Burning	14	11.7	7.5
Open water management	13	10.8	16.0
Tree planting	3	2.5	1.0
Peat extraction	3	2.5	2.6
Other	30	25.0	18.6
None	7	5.8	4.0

† Based on 102 units for which the area of fen habitat was estimated.

3.6. Neglect

Only seven units, comprising 25.7ha, were recorded with no active management. However, whether arising from any of the constraints above, or for other reasons, some 33 units (27.5% of the total) were judged to be suffering from neglect. By area, these amounted to 46% of the total assessed.

3.7. Water abstraction and water quality

The impact of water abstraction on SSSIs has been reviewed in *Water abstraction and Sites of Special Scientific Interest in England* (English Nature and the Environment Agency 1999). In the current survey, problems associated with water abstraction were only explicitly noted for four units; three of these were within SSSIs included in the above review and remedial action was already being undertaken for two of the sites thus affected. However, other fens included within the survey were within SSSIs where the effects of water abstraction are still being evaluated. Pollution or enrichment of water supplies were explicitly noted as issues on another four units.

3.8. Grants and management agreements

Sixty-nine (57.5%) of the 120 units surveyed were subject to one or more management agreements or incentive schemes. On an area basis, management agreements covered 68% of the area assessed. Agreements with English Nature were the most common: 20 units were subject to an agreement under the Wildlife Enhancement Scheme (WES); 11 units were subject to an agreement under the Reserve Enhancement Scheme (RES); and 20 units had other English Nature agreements (e.g. a Section 15 Management Agreement). Some units had more than one agreement type so that, in total, 49 units were subject to one or more English Nature management agreements. Other grant schemes or management agreements affected relatively few sites: 11 units were managed under ESA agreements; nine units were included within Countryside Stewardship schemes; and 11 units had some other form of management agreement (e.g. a management plan).

3.9. Geographical analyses of ownership, land use and management activities

The geographical composition of the sample survey is summarised in Table 4. The areas included within each geographic region were described in Section 2.3 (above). The northern part of the country was relatively less well represented within the sample. As previously noted (Section 3.2), fens assessed in northern and western regions were generally smaller in extent than those in eastern England.

Table 4. Number of units within each geographic region and area of fen assessed (where estimated)

	Eastern	Northern	Western
Number of units in original sample (n = 150)	49	41	60
Number of units for which completed survey forms were received	45	27	48
Number of units for which area of fen habitat was estimated	42	21	39
Area of fen assessed (ha)	402.6	87.8	159.1

3.9.1. Ownership

The percentage of units within each region that were managed by each occupier group is shown in Table 5. The occupier categories are described in Section 3.3, above.

Table 5. Percentage of units within eastern, northern and western England managed by each occupier group. Figures in brackets are the number of units assessed within each geographic region.

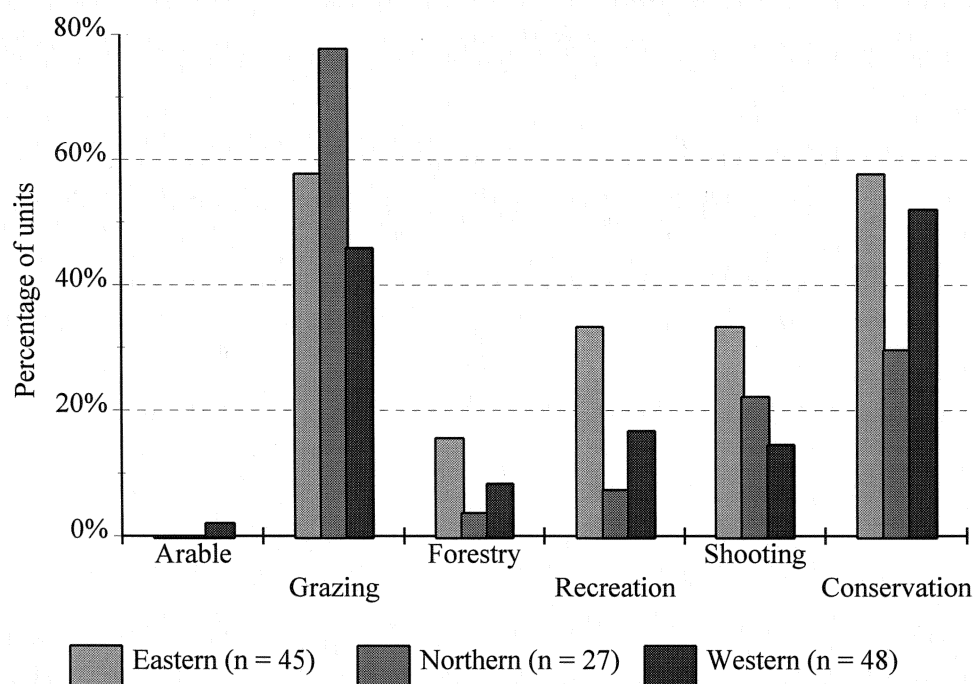
	Eastern (45)	Northern (27)	Western (48)
Private individual or estate	60.0%	78.8%	58.3%
Commercial enterprise	4.4%	3.7%	2.1%
Government Agency or Department	15.6%	3.7%	14.6%
Local Authority	4.4%	7.4%	14.6%
Voluntary Conservation Organisation	20.0%	7.4%	10.4%

Private individuals or estates were the largest occupier group in all three regions, but managed a larger proportion of sites in northern England than in the eastern and western regions. Government Agencies or Departments managed approximately 15% of units in eastern and western England, but only 3.7% of the units in the northern region. Voluntary conservation organisations managed a higher proportion of sites in eastern England than in northern or western parts of the country.

3.9.2. Land use

Geographic variation in land use is shown in Figure 3. The most common land uses in each geographical region were for grazing and nature conservation. Grazing was specified as a land use on more than 75% of units in northern England, but was less common in eastern and western regions. In contrast, nature conservation was given as a land use on less than 30% of units in the northern region, but applied to more than 50% of units in the east and west. These uses are not mutually exclusive, however, as management for nature conservation could include grazing. Forestry, recreation and shooting were all more common in eastern England than in the northern or western regions.

Figure 3. Percentage of units within eastern, northern and western England with each land use. Units may have more than one land use.



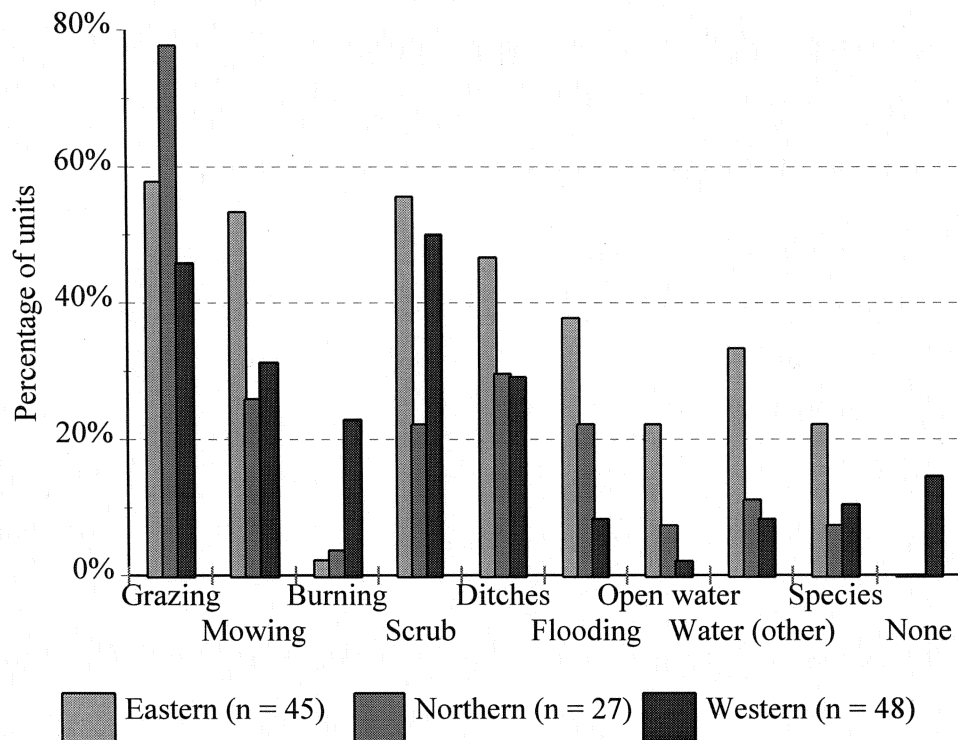
3.9.3. Management

Geographic differences in the management of units containing fen habitats are illustrated in Figure 4. The majority of management activities showed some geographical variation. Grazing was discussed in the section on land uses, above; mowing, burning, scrub control and hydrological management are briefly considered below.

- Mowing occurred on more than 50% of units in eastern England, but was less common elsewhere. Mowing includes activities such as the topping of rushes or thistles, as well as cutting tall fen vegetation for fodder, or reedbeds for thatch.
- Burning affected more than 20% of units in western England but was uncommon in other regions. This management activity was usually associated with areas of heath within the specified units, rather than the fen habitats which were the subject of this survey. Wet valley mires were sometimes used as firebreaks when burning adjacent heathlands.
- More than half the units in eastern and western England were subject to management to control scrub; in contrast, scrub control occurred on fewer than a quarter of the units in northern England.
- Management affecting hydrology (e.g. ditch management and seasonal flooding) was most common in eastern England and least common in the western part of the country.

On an area basis the regional variation in mowing, scrub control and hydrological management was even greater, reflecting the inclusion within the sample of large areas of fen within relatively few units in East Anglia.

Figure 4. Percentage of units within eastern, northern and western England subject to selected management activities. More than one management activity may occur in each unit. Scrub: scrub control; Ditches: ditch management; Flooding: seasonal flooding; Open water: management of open water within unit; Water (other): other management likely to affect water table levels within the unit; Species: management of (or for) particular species. Management activities affecting less than 5% of units in every region have been omitted.

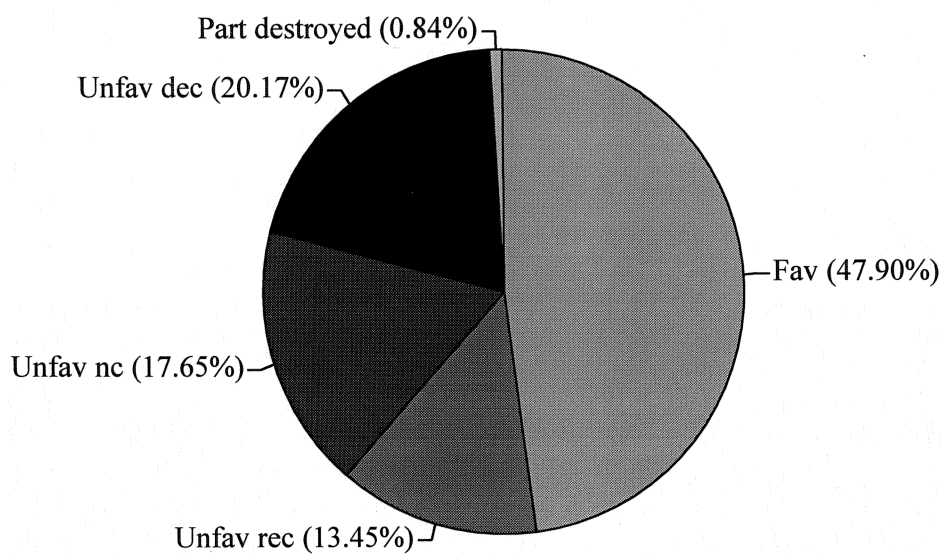


4. Condition assessment and management prognosis

4.1. Condition assessments

Condition assessments were made for 119 of the 120 units surveyed, using the condition categories described in Section 2.2. Figure 5 illustrates the percentage of this sample within each category.

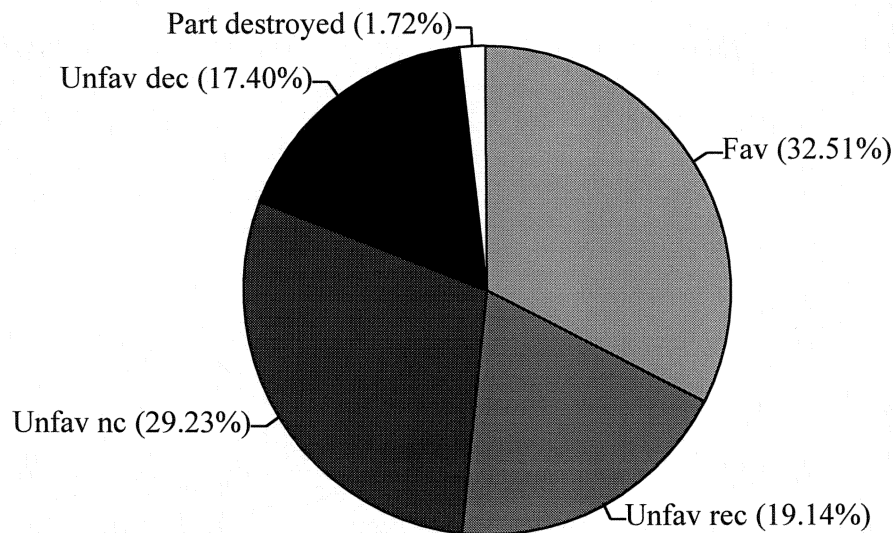
Figure 5. Condition of fens assessed in the national SSSI sample survey (n = 119 site units). Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining.



Nearly half of the fens surveyed were judged to be in favourable condition, and those within a further 16 units were recovering towards a favourable state but still unfavourable. However, 20% of the fens surveyed were thought to be unfavourable and declining, and the fen habitat within one unit had been partially destroyed through drainage and conversion to arable use.

Figure 6 shows condition assessed in terms of area. Area estimates were given for 101 of the fens for which condition assessments were made, comprising a total of 640.5ha; this figure is the area of fen habitat assessed, not the total unit area. By area, a smaller proportion of fens were in favourable condition, and a greater proportion were in an unfavourable, but stable, condition.

Figure 6. Condition of fens assessed in the national SSSI sample survey, by area. The percentages given are from a total area of 640.5ha, from 101 site units. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining.



Condition assessments based on area are disproportionately influenced by the condition of the largest sites. The disparity between Figures 5 and 6, above, is thus largely attributable to the condition of the six largest (>20ha) areas of fen assessed in the survey. All of these were in unfavourable condition; two were recovering, two were unfavourable but stable and two unfavourable and declining.

Of those fens considered to be neglected, 24.2% by number, or 46.2% by area, were in an unfavourable but stable condition; and 51.5% by number, or 31.4% by area, were unfavourable and declining.

4.2. Comparison with data from ENSIS for BAP broad habitat

Condition assessments for units containing the BAP Broad Habitat “Fen, Marsh and Swamp” are shown in Figure 7, whilst Figure 8 shows the proportional area within each condition category for those units for which area data were available. Data were extracted from ENSIS for assessments up to 7/12/99. Whilst the habitats included within the BAP Broad Habitat are not identical to those selected for the sample survey, these data provide a reasonable basis for comparison.

Differences between the sample survey and ENSIS data for the BAP Broad Habitat were not statistically significant in relation to the proportion of units within each condition category (χ^2 test, $P > 0.05$). On an area basis, however, there was a significant difference between the two datasets (χ^2 test, $P < 0.05$). The proportion of the area assessed which was classified as “unfavourable recovering” was lower in the sample survey than for the BAP Broad Habitat, whilst the proportion judged to be “unfavourable, no change” was correspondingly greater. However, the caveats on interpreting area data, mentioned above, are also relevant here; the overall assessment is strongly biased by the condition of the largest site(s) included in each sample. Furthermore, area data from the sample survey refer to the area of fen habitats within the selected units, not to the unit area, whilst data for the BAP Broad Habitat refer to the total area of the units assessed; thus, the two datasets are not necessarily analogous.

Figure 7. Condition of units with BAP Broad Habitat Fen, Marsh and Swamp (n = 693 units). Data extracted from ENSIS on 7/12/99.

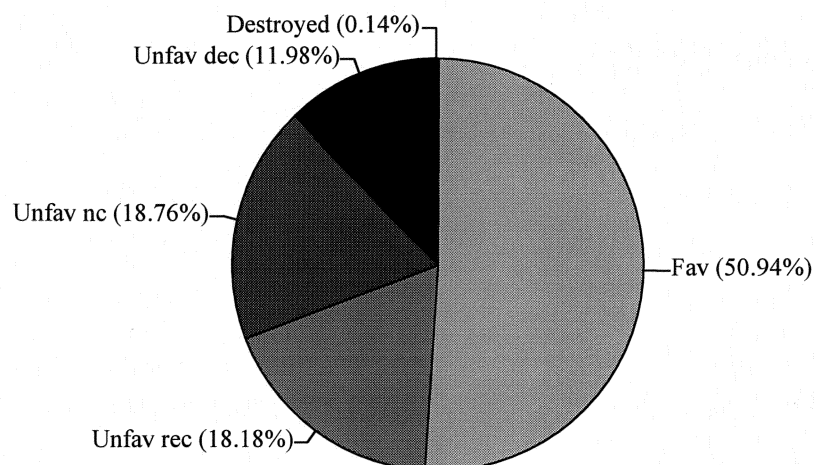
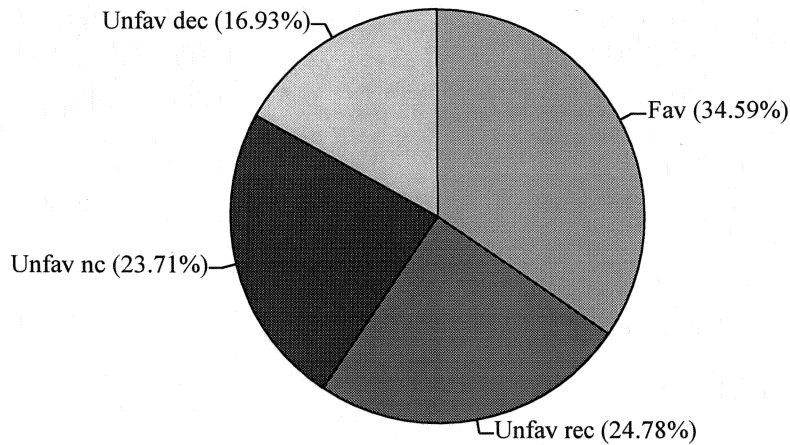


Figure 8. Condition of units with BAP Broad Habitat Fen, Marsh and Swamp, by area. Only includes units for which area measurements were available at 7/12/99. Total area of units assessed = 4230ha.



4.3. Geographical comparison of fen condition

Geographical variation in the condition of fens assessed for this survey is shown in Figure 9. The proportion of units in favourable condition was lower in eastern England than in the northern or western regions, but differences between the regions were not statistically significant (χ^2 test, $P > 0.05$).

In terms of area, however, there were significant differences in the condition of fens within each region (Figure 10).

- Only a quarter of the area of fen assessed in eastern England was in favourable condition; in northern England, the proportion in favourable condition was even lower, but in western England more than half the area was judged to be favourable. A further quarter of the area in eastern England was thought to be recovering, but still unfavourable; only 6% of the area assessed in northern and western parts of the country fell within this condition category.
- More than 40% of the fen habitat assessed in northern England was thought to be in an unfavourable condition and declining; in contrast, only 18% of the area in the western region, and 12% of that in eastern England, were in this category.

National sample survey of SSSI fens

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L.D. Solly

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Appendix 1. Fen and swamp communities considered in the national sample survey of SSSI fens

Appendix 2. Questionnaire

Appendix 3. Site unit recording form

Appendix 4. Notes on the character of fen communities considered in the national sample survey of SSSI fens

Summary

The national SSSI sample survey programme was initiated in 1992 to provide a strategic overview of the state of selected habitats within the SSSI series as a whole. The sample surveys would also explore the links between habitat condition and the interests, management activities and priorities of owners and occupiers. This report is the fourth in this series, following studies of lowland grasslands (Sketch 1995), lowland heathland (Brown *et al.* 1998) and woodland (Solly *et al.* 1999).

This sample survey considered fens, a broad habitat which was taken to include valley mires, basin and floodplain mires, fen meadows and flushes.

150 SSSI units¹ were randomly selected from the 1180 units identified to consist of one or more of these habitats. Conservation Officers in Local Teams were asked to contact the managers of these units and to complete a questionnaire detailing ownership, land use and management. Conservation Officers were also asked to visit each unit and to assess the condition of the fen communities present using the procedures defined in *A statement on common standards monitoring*.

Surveys were completed between September 1998 and September 1999 for 122 of the 150 units originally selected. Two thirds of the fens sampled were less than 5ha in extent and fen habitats frequently constituted only a small proportion of each unit. Only six of the units sampled for this survey contained extensive (>20ha) areas of fen.

By number, 47.9% of fens sampled were in favourable condition; 13.45% were unfavourable but recovering; 20.17% were unfavourable and declining; and 17.65% were in an unfavourable state and neither improving or declining. Eleven hectares of fen habitat within one unit had been partially destroyed by drainage and conversion to arable use.

By area, only 32.5% of fens were in favourable condition; 19.14% were recovering; 17.4% were declining; and 29.23% were in an unfavourable but stable state. In assessments based on area, the largest sites have a disproportionately large influence; in the current survey, for example, a single unit contained an estimated 100ha of fen habitat, comprising more than 15% of the total area estimated.

Grazing was the most common management activity, occurring on 57.5% of units sampled. It was also one of the factors most strongly associated with favourable fen condition. Mowing and scrub control, which each occurred on more than a third of the units sampled, also had a positive influence on fen condition; the primary effect of these activities was to reduce the proportion of sites which were unfavourable and declining.

¹ A sub-unit of the SSSI with a single feature of interest and a single management regime.

Factors which constrained these activities accordingly had a negative influence on site condition. Such constraints were identified on almost three quarters of the sites included in the current survey.

Practical constraints, primarily concerning lack of appropriate livestock and difficult site access, affected more than 40% of the units sampled, or more than 60% of fens by area. Traditional low-intensity grazing by beef cattle has been much reduced due to the post-BSE collapse of the beef market. The decline in the beef industry has implications not just for the management of fens, but also for other valuable wildlife habitats where extensive grazing is required.

Other factors which had a significant negative influence on fen condition were financial constraints, constraints imposed by lack of time or labour, and lack of interest in managing sites. Whether arising from these constraints, or for other reasons, more than a quarter of the fens assessed (by number) were judged to be suffering from neglect. By area, some 46% of the fens assessed were suffering from neglect.

Overall, current management was thought to be appropriate on only 55% of the sites surveyed, and inappropriate on 31% of sites. The management prognosis was “unknown” (i.e. uncertain) for the remaining fens. In terms of area, only 48.5% of the fens assessed had a favourable management prognosis, whilst 42.9% of the area assessed was judged to have inappropriate management.

Measures considered necessary to secure the sustainable management of fens within SSSIs and to ensure the delivery of the Habitat Action Plan targets for these habitats are detailed in Section 6 of this report. In brief, these include:

- Changes to agricultural policy and funding, particularly the adoption of an Environmental Beef Scheme as advocated by English Nature in its submission to MAFF’s consultation on *A New Direction for Agriculture*.
- Additional protection for SSSIs, including measures to prevent sites deteriorating from neglect or inappropriate management and to deter owners or third parties from deliberately damaging SSSIs, as identified in the proposed changes to SSSI legislation. The effectiveness of these measures would be dependent on the resources available to implement them.
- A much greater allocation of resources to agri-environment schemes. Priorities include positive management incentives for designated sites and sites of local nature conservation importance for which agricultural management is essential; expansion of Countryside Stewardship to meet UK BAP targets for priority habitats; reduction of diffuse pollution resulting from agricultural management; and higher enhancement tiers to be more widely adopted within ESAs, especially for the management of wet grasslands. The Government’s announcement in December 1999 of a £1.6 billion package of measures over seven years, including £580m for the Countryside Stewardship Scheme, is particularly welcome; efforts must now concentrate on ensuring that this money delivers the intended environmental outcomes.

- Targeted support by English Nature through the provision of grants which are complementary to those offered through agri-environment schemes. The greatest benefits are likely to arise through targeting positive payments on activities such as scrub clearance and fencing, and on encouraging grazing on those fens for which agri-environment schemes are not available.
- Assistance to those managers who are ill-equipped to manage sites appropriately, by promoting networking among managers, graziers and contractors offering specialist services such as scrub clearance. Initiatives of this sort which are already under way include *Eco-Ads*, the *Machinery Rings Information Pack* and the *Grazing Animals Project*.
- Efforts should be made to raise awareness of the wildlife value and management needs of fen habitats, through increased and better-targeted communication with land managers and others involved in land use and planning.

Acknowledgements

This report is the culmination of work which was largely carried out by staff in English Nature's Local Teams, to whom I am particularly grateful. Rob Cooke, Wanda Fojt, George Hinton, Roger Meade and Keith Porter also provided valuable assistance and comments at various stages of the survey. Special thanks are also due to the owners and managers of the sites involved in the survey for their cooperation.

1. Introduction

1.1. The national SSSI sample survey programme

Sites of Special Scientific Interest (SSSIs) form a nationally important series which contributes to the conservation of natural wildlife habitats, geological features and landforms. They constitute an essential component of the overall approach to nature conservation in England. Ensuring that these sites are appropriately managed and protected depends on a clear understanding of which features are important on each SSSI and of the long-term objectives for those features. This relies upon a wider understanding of the context of each site.

In 1992, English Nature's Management Board approved a monitoring strategy for SSSIs. This strategy (Felton 1992) identified four priorities for the organisation:

- production of site objective and site management statements for all SSSIs;
- a strategic sample survey of SSSIs;
- a quality assurance or validation monitoring programme for SSSIs; and
- an SSSI information system to support site safeguard.

The monitoring strategy recommended that each sample survey should focus on a nationally selected sample of sites supporting a particular broad habitat type, thus providing an overview of the state of that habitat within the SSSI series as a whole. The sample surveys would also explore the links between habitat condition and the interests, management activities and priorities of owners and occupiers. This would be distinct from, but complementary to, the routine assessments of condition or recording of activities on individual sites carried out by conservation officers in Local Teams. Information gathered by the sample surveys would help English Nature to improve service and advice to owners and managers; the surveys would also provide information on whether existing legal, administrative and incentive measures were proving effective for the conservation of the selected habitats.

The sample survey programme was initiated in 1992, with a pilot study of lowland grasslands (Sketch 1995). Sample surveys have also been completed for lowland heathland (Brown *et al.* 1998) and woodland (Solly *et al.* 1999). The sample survey described in this report is the fourth in this programme of studies.

1.2. Fens and fen conservation

British fen types and their conservation have been reviewed by Fojt (1994), whilst detailed descriptions of fen, swamp and reedbed communities are provided by Wheeler (1984) and Rodwell (1991b, 1995). The following comments have been derived from Fojt (1994) and the UK Biodiversity Action Plan (UK Biodiversity Steering Group 1995). Communities considered in the present report are listed in Appendix 1.

Fens are minerotrophic mires which receive water and nutrients from the soil, rock and groundwater as well as from rainwater. Two types of fen, topogenous and soligenous, can broadly be distinguished on the basis of hydromorphology. Topogenous fens are those in which water movements in the peat or soil are predominantly vertical; examples include basin and floodplain fens. In contrast, water movements in soligenous fens are generally lateral; examples include valley mires and mires associated with springs, flushes and water tracks. However, these categories may overlap and intergrade and it may be difficult to allocate some sites to a particular hydromorphological type.

Fens may also be described as 'poor' or 'rich' fens. Poor-fens are fed by acidic ($\text{pH} < 5$) water, derived from base-poor rock such as sandstones and granites. This fen type is more common in the uplands, but may also be associated with lowland heaths. Poor-fens are characterised by short vegetation with a high proportion of bog mosses (*Sphagnum* spp.). Rich-fens are associated with areas of base-rich geology such as the chalk and chalky-boulder clay of southern and eastern England; they may also develop where there are localised occurrences of base-rich rocks, such as limestone, in central and northern England.

Swamp is a particular type of fen that may develop where water-table levels are at or above the surface for most of the year. Swamp vegetation is typically species-poor and is often dominated by tall, bulky monocotyledons. Reedbeds are fens or swamps dominated by stands of the common reed, *Phragmites australis*.

Fen meadows do not show a close association with a particular hydromorphological fen type. These communities may be intermixed with, or adjacent to, other fen vegetation, usually on drier land, but may be isolated if the adjoining fen vegetation has been lost.

Fens are scattered throughout England, but the extent of fen vegetation has declined dramatically in the past century. The greatest reduction in the area of fen habitat has occurred in the lowlands, as a result of drainage and intensive land-use. Many of the fens which remain also have been affected by qualitative changes in their composition and structure. Open-fen and fen meadow communities are dynamic semi-natural systems and appropriate management is needed to maintain these habitats and their associated species.

By 1997, significant areas of fen habitat were notified within 235 SSSIs in England (English Nature 1997). Many other SSSIs contain this habitat type, although fen communities are not necessarily the most extensive habitats within all of these, and in some cases may not be a feature of interest². Gardiner (1996) has provided an overview

² *Features of interest* (or *interest features*) are the features for which the site has been notified. They can be earth heritage features, habitats or species (Nature Conservancy Council 1989).

of the distribution and significance of different fen types within the SSSI series in the context of Natural Areas³.

Some fens are recognised as having international importance on the basis of their botanical, invertebrate, ornithological or habitat conservation interest. Six fen habitat types are listed in Annex I of the European Habitats and Species Directive (Council Directive 92/43/EEC):

- *Molinia* meadows on chalk and clay (*Eu-Molinion*)
- Transition mires and quaking bogs
- Depressions on peat substrates (*Rhynchosporion*)
- Calcareous fens with *Cladium mariscus* and *Carex davalliana*
- Petrifying springs with tufa formations (*Cratoneurion*)
- Alkaline fens.

There is not an exact correspondence between these fen types and the classifications normally used in Britain, such as the National Vegetation Classification (NVC) or the hydromorphological classifications described above.

Fens are identified as Priority Habitats in the UK Biodiversity Action Plan (UK Biodiversity Steering Group 1995). Habitat Action Plans have been prepared for fens, reedbeds and those fen meadows characterised as “purple moor grass and rush pastures”. Throughout the UK, these Action Plans aim to secure appropriate management for 1200ha of fen, 5000ha of reedbed and 13,500ha of lowland purple moor grass and rush pasture by 2010.

³ Natural Areas are biogeographic zones which reflect the geological foundation, the natural systems and processes and the wildlife in different parts of England.

2. Methods

The methodology used in the present study was adapted from that employed in the three previous sample surveys (Sketch 1995; Brown *et al.* 1998; Solly *et al.* 1999).

2.1. Site selection

Fens include a wide variety of habitats and this is reflected in the diversity of associated vegetation communities. The National Vegetation Classification recognises 28 swamp and tall-herb fen communities, 32 mire communities (including two wet-heath communities and several communities dominated by *Sphagnum* spp.) and six fen-carr communities (Rodwell 1991a,b, 1995; Fojt 1994). The sample survey described in this report was restricted to three broad fen types and their associated NVC communities, as listed in Table 1.

Table 1. Fen types and associated NVC communities considered in the sample survey of SSSI fens. NVC communities are listed in Appendix 1.

Fen type	NVC types (from Rodwell 1991b, 1995)
Valley mires	M6, M10, M11, M13, M14, M21, M29
Basin and floodplain mires (including swamp and reedbeds)	M4-6, M9, S1-4, S24-28
Fen meadows	M22-24

Wet-heath (NVC types M15 and M16) and carr woodland (NVC types W1-6) were included in previous sample surveys (Brown *et al.* 1998 and Solly *et al.* 1999, respectively); these habitats were therefore excluded from the present survey. Communities particularly associated with springs and rills (NVC types M31-38) were also excluded; they are typically limited in extent and would not normally be the main focus of management in a particular site unit.

A list of SSSIs supporting the selected fen communities was compiled by searching English Nature's information system, ENSIS. SSSIs were only included if conservation objectives (see definition below) were specified for the fen communities within the site. The ENSIS database was also used to identify the particular site units, within these SSSIs, associated with the above fen types. Sites were excluded if fen communities were not specifically associated with any site units. The list of SSSIs and site units was checked by Conservation Officers from English Nature's Local Teams and amended as necessary. This selection process produced a list of 1180 site units, on 451 SSSIs, for which the selected fen communities were listed as a feature of interest.

Site units identified above were stratified according to Government Regions, and were further stratified on the basis of whether sites fell within 'upland' or 'lowland' Natural Areas. A sample of 150 site units was randomly selected from the stratified population, with the number of units selected from each stratum being proportional to the total

number of units within that stratum. This process of stratification ensured that the range of variation within the SSSI network was adequately represented within the sample.

2.2. Data collection

Conservation Officers from English Nature's Local Teams were asked to complete a Questionnaire and a site unit recording (SUR) form for each selected unit. The Questionnaire (Appendix 2) was completed with the assistance of the site's manager and collected contextual information concerning the ownership and management of the selected site unit. The SUR form (Appendix 3) was completed following a visit to the specified site unit. Conservation Officers were asked to record the condition of the feature(s) of interest (see below) and the occurrence of any activities affecting the feature(s) of interest. They were also asked to state whether current management was likely to maintain or enhance the features of interest on the site. Site surveys were conducted between September 1998 and September 1999.

2.2.1. Condition assessments

The condition of the fen communities within each unit was assessed using the categories defined in *A statement on common standards monitoring* (Joint Nature Conservation Committee 1998). These categories are:

- *Favourable, maintained.* An interest feature should be recorded as [favourable] *maintained* when its conservation objectives were being met at the previous assessment, and are still being met.
- *Favourable, recovered.* A feature of interest can be recorded as having *recovered* if it has regained favourable condition, having been recorded as unfavourable on the previous assessment.
- *Unfavourable, recovering.* A feature of interest can be recorded as *recovering* after damage if it has begun to show, or is continuing to show, a trend towards favourable condition.
- *Unfavourable, no change.* An interest feature may be retained in a more-or-less steady state by repeated or continuing damage; it is unfavourable but is neither declining or recovering. In rare cases, an interest feature may not be able to regain its original condition following a damaging activity, but a new stable state may be achieved.
- *Unfavourable, declining.* Decline is another possible consequence of a damaging activity. In this case, recovery is possible and may occur either spontaneously or if suitable management input is made.
- *Partially destroyed.* It is possible to destroy sections or areas of certain features or to destroy parts of sites with no hope of reinstatement because part of the feature itself, or the habitat or processes essential to

support it, has been removed or irretrievably altered.

- *Destroyed.* The recording of a feature as *destroyed* will indicate that the entire interest feature has been affected to such an extent that there is no hope of recovery, perhaps because its supporting habitat or processes have been removed or irretrievably altered.

The categories of “favourable maintained” and “favourable recovered” have been combined into a single category (“favourable”) for the purposes of this report.

The condition of each feature of interest is assessed against the nature conservation objectives which have been set for that feature. These objectives describe targets which should be met if the condition of the interest feature is to be judged as favourable. Nature conservation objectives for the communities considered in this study were still in preparation when the survey was conducted and were not available to all surveyors. In the absence of these nature conservation objectives, surveyors were provided with information on the character of each community (Appendix 4) and were asked to assess condition against the broader objectives for the site as a whole.

Using the monitoring methodology defined above, the condition of a feature of interest is reported as “unfavourable” if it departs significantly from the long-term desired state specified in the nature conservation objectives. However, features which are assessed as “unfavourable, recovering” are showing a trend towards favourable condition; in most cases, the management of these features will achieve the nature conservation objectives.

Three points to consider when interpreting condition assessment figures are that:

- i. the definition of “favourable” condition is not necessarily the same as the condition of the feature at the time that the site was notified as an SSSI;
- ii. an assessment of “unfavourable” condition does not necessarily imply any recent loss or damage to the features of interest; and
- iii. an assessment of “unfavourable, no change” or “unfavourable, declining” does not necessarily indicate that current management is inappropriate or unacceptable; the condition of a feature of interest may be assessed as unfavourable due to factors associated with past management (perhaps pre-dating notification), or due to factors beyond immediate control, e.g. long-distance air pollution or climate change.

The application of condition assessment monitoring for features of interest in designated sites is discussed further in Kirby and Solly (*in press*).

2.3. Analysis

Data from the questionnaires were collated to provide summary information on:

- the occupier groups involved in the management of fens;
- the use and management of fens within SSSIs; and
- the proportion of SSSI fens managed with the aid of grant schemes and/or management agreements.

Similarly, data from the site unit recording forms were collated to provide information on:

- the overall condition of fens assessed in the sample survey;
- the occurrence of activities likely to influence the condition of the features of interest; and
- the extent to which current management will maintain or enhance the features of interest.

In addition to providing a national overview for each of these issues, the data were analysed to provide information on the geographic variation in occupier categories, land use, management and condition. For the purposes of this exercise, the survey area was divided into three broad regions: northern, eastern and western England. The northern region comprises the Government Regions for Yorkshire and the Humber, the North East and the North West, together with the Peak District; the eastern region comprises the Government Regions for the East Midlands (excluding the Peak District), East of England, London and the South East; and the western region comprises the South West and West Midlands Government Regions. Analysis of the results for smaller areas would be of little merit as each area would then have too few sites from the overall sample to give a reliable estimate of the condition and management of the fens within it.

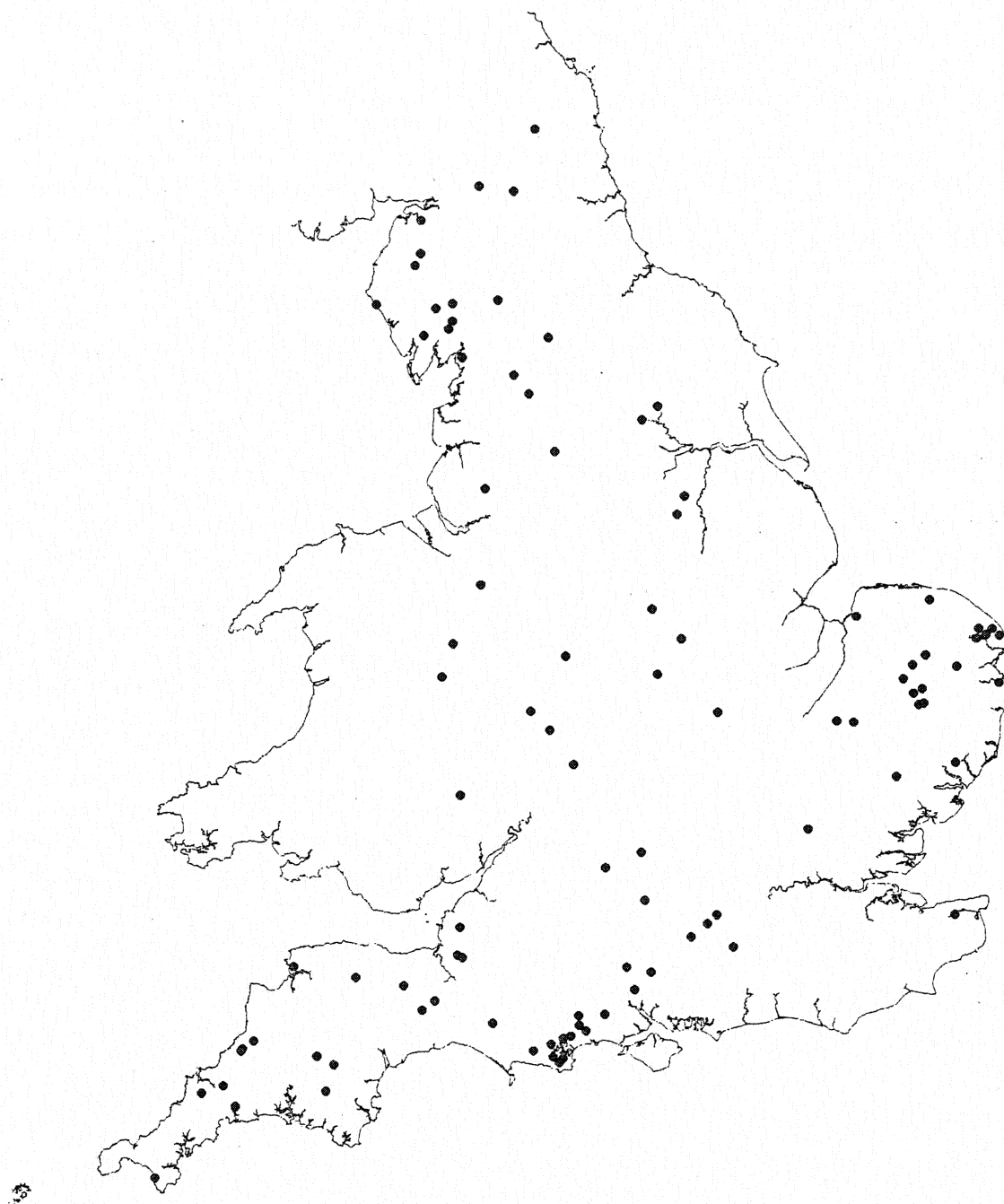
The relationships between fen condition and other characteristics of the site and its management were explored by multivariate analysis. This form of analysis compensates for correlations between variables and thus gives a more reliable indication of relationships than that provided by single-factor analyses. “Best subsets” regression analysis, an application within the statistical analysis programme “Minitab”, was used to identify the best “predictors” for each condition class. The predictors were the factors recorded on the questionnaire, such as ownership, property type, grant schemes and management activities.

3. Ownership, land use and management

3.1. Initial and actual sample size

Survey returns were received for 122 of the 150 site units originally selected, these being within 99 SSSIs. Two of these were “null” returns, i.e. the selected units did not support habitats within the categories described above. The distribution of sites included in the sample survey is shown in Figure 1.

Figure 1. Distribution of sites included in the national sample survey of SSSI fens. Two or more units were sampled within some SSSIs.



3.2. Size of fens sampled

Estimates of the area of fen habitat were given for 102 of the units included in the survey. The average area of fen habitat within these units was 6.37ha. However, two thirds of the fens sampled in the survey were less than 5ha in extent and nearly one in five was smaller than 1ha. Fen habitats frequently constituted only a small proportion of each unit; indeed, fens, as defined above, comprised less than 50% of the area in nearly half of the units surveyed.

The average fen area varied considerably between eastern, northern and western parts of the country. The average area of fen habitat within units in eastern England was 9.59ha; in northern England it was 4.18ha; and in western England 4.08ha. This disparity is largely attributable to the inclusion within the survey of several large areas of fen within East Anglia, notably within the Norfolk Broads, where such habitats are particularly extensive. In other areas, the selected units were commonly within mosaics of bog, heath and grassland, where fen habitats (as defined above) are less extensive and more fragmented.

As area data were not available for all the fens sampled in the survey, the majority of the following analysis and discussion is based on the number of site units assessed. However, comparisons based on area are also used where these differ substantially from those based on the number of units. It should be noted that comparisons based on area are disproportionately influenced by the condition and management of the largest sites. In the current survey, for example, a single unit contained an estimated 100ha of fen habitat, comprising more than 15% of the total area estimated. This single management unit contained a greater area of fen than that of the 61 smallest units combined.

3.3. Ownership

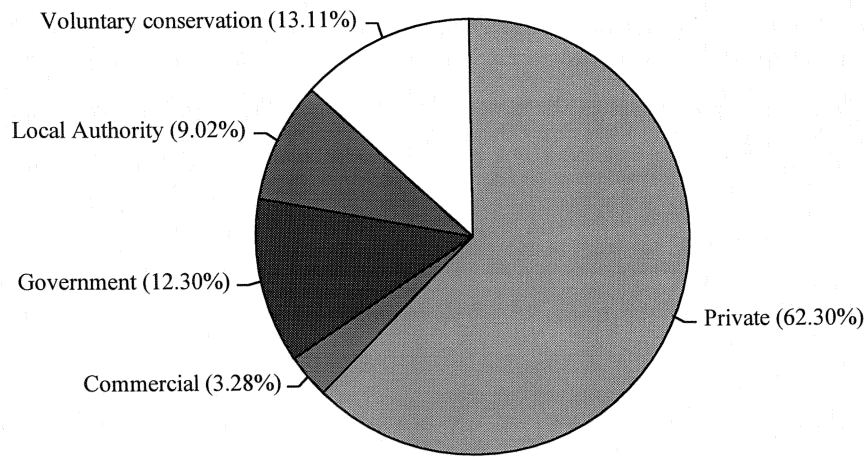
The managers of each unit were grouped into the following occupier categories:

- Private individual or estate
- Commercial enterprise
- Government Department or Agency
- Local Authority
- Voluntary conservation organisation

Further details of the ownership categories are given in Appendix 2.

The proportion of site units in each occupier category is shown in Figure 2. Two units were associated with two occupier categories, giving a total of 122 occupier-unit links. Private individuals and estates comprised the largest occupier group, managing 76 units; four of these units had multiple ownership, although all within the same occupier category.

Figure 2. Percentage of site units within each occupier category. $N = 122$ site units, with two units being managed by more than one occupier group.



3.4. Main land uses within the units sampled

The main land uses within each unit were defined in terms of the following categories:

- Arable
- Grazing
- Forestry/woodland
- Recreation (other than shooting)
- Shooting
- Nature conservation.

Table 2 summarises land uses within the units surveyed. More than one of the land use categories could apply to each unit, particularly where habitats other than fen were also present. Grazing and nature conservation were the most common land uses, occurring on 57.5% and 49.2% of units, respectively. Overall, 55 units (45.8%) had more than one use and the mean number of uses per unit was 1.60. The maximum number of land uses for any unit was four.

For those units where the area of fen was estimated, 55.4% of the area was grazed, but some 73.6% of the area assessed had a nature conservation use. This latter figure is influenced by the inclusion within the survey of large areas of fen within the Norfolk Broads and other parts of East Anglia.

Table 2. Main land uses within the units sampled. Units may have more than one use, but uses may not necessarily relate to the fen habitats within each unit.

Land use	Number of units	Percentage of units (n=120)	Percentage of area (total = 649.5ha)†
Grazing	69	57.5	55.4
Nature conservation	59	49.2	73.6
Recreation	25	20.8	31.5
Shooting	25	20.8	28.6
Forestry	12	10.0	11.3
Arable	1	0.8	1.7

† Based on 102 units for which the area of fen habitat was estimated.

3.5. Land management

Management activities likely to be associated with fen habitats were listed in the questionnaire (see Appendix 2) and owners / occupiers (or Conservation Officers) were asked to specify the management occurring within each unit. These responses are summarised in Table 3; grazing is included as a management activity, although it was also specified as a land use.

In terms of unit numbers, grazing, mowing, scrub control and ditch maintenance were the most common activities, each occurring on more than a third of the units surveyed. Considering only those units in which the area of fen was estimated, mowing, scrub control and ditch maintenance were each associated with more than 60% of the fen area assessed, whilst 55% of fens, by area, were grazed. Management for (or of) particular species, seasonal flooding and other hydrological management also affected a greater proportion of the area of fen habitat than a simple count of units would suggest. These area assessments are biased by the management of the relatively large areas of fen occurring within a few units sampled within East Anglia.

Table 3. Management activities on units within the sample survey of SSSI fens. More than one management activity may occur on each unit, but the specified management activities do not necessarily involve the areas of fen habitat within each unit. Water levels (other) refers to other management likely to affect water table levels within the site. Species refers to management for (or of) particular species.

Land use	Number of units	Percentage of units (n=120)	Percentage of area (total = 649.5ha) [†]
Grazing	69	57.5	55.4
Scrub control	55	45.8	63.1
Ditch maintenance	44	36.7	65.8
Mowing	43	35.8	64.4
Seasonal flooding	27	22.5	52.0
Water levels (other)	22	18.3	31.7
Species	17	14.2	36.2
Burning	14	11.7	7.5
Open water management	13	10.8	16.0
Tree planting	3	2.5	1.0
Peat extraction	3	2.5	2.6
Other	30	25.0	18.6
None	7	5.8	4.0

[†] Based on 102 units for which the area of fen habitat was estimated.

3.6. Neglect

Only seven units, comprising 25.7ha, were recorded with no active management. However, whether arising from any of the constraints above, or for other reasons, some 33 units (27.5% of the total) were judged to be suffering from neglect. By area, these amounted to 46% of the total assessed.

3.7. Water abstraction and water quality

The impact of water abstraction on SSSIs has been reviewed in *Water abstraction and Sites of Special Scientific Interest in England* (English Nature and the Environment Agency 1999). In the current survey, problems associated with water abstraction were only explicitly noted for four units; three of these were within SSSIs included in the above review and remedial action was already being undertaken for two of the sites thus affected. However, other fens included within the survey were within SSSIs where the effects of water abstraction are still being evaluated. Pollution or enrichment of water supplies were explicitly noted as issues on another four units.

3.8. Grants and management agreements

Sixty-nine (57.5%) of the 120 units surveyed were subject to one or more management agreements or incentive schemes. On an area basis, management agreements covered 68% of the area assessed. Agreements with English Nature were the most common: 20 units were subject to an agreement under the Wildlife Enhancement Scheme (WES); 11 units were subject to an agreement under the Reserve Enhancement Scheme (RES); and 20 units had other English Nature agreements (e.g. a Section 15 Management Agreement). Some units had more than one agreement type so that, in total, 49 units were subject to one or more English Nature management agreements. Other grant schemes or management agreements affected relatively few sites: 11 units were managed under ESA agreements; nine units were included within Countryside Stewardship schemes; and 11 units had some other form of management agreement (e.g. a management plan).

3.9. Geographical analyses of ownership, land use and management activities

The geographical composition of the sample survey is summarised in Table 4. The areas included within each geographic region were described in Section 2.3 (above). The northern part of the country was relatively less well represented within the sample. As previously noted (Section 3.2), fens assessed in northern and western regions were generally smaller in extent than those in eastern England.

Table 4. Number of units within each geographic region and area of fen assessed (where estimated)

	Eastern	Northern	Western
Number of units in original sample (n = 150)	49	41	60
Number of units for which completed survey forms were received	45	27	48
Number of units for which area of fen habitat was estimated	42	21	39
Area of fen assessed (ha)	402.6	87.8	159.1

3.9.1. Ownership

The percentage of units within each region that were managed by each occupier group is shown in Table 5. The occupier categories are described in Section 3.3, above.

Table 5. Percentage of units within eastern, northern and western England managed by each occupier group. Figures in brackets are the number of units assessed within each geographic region.

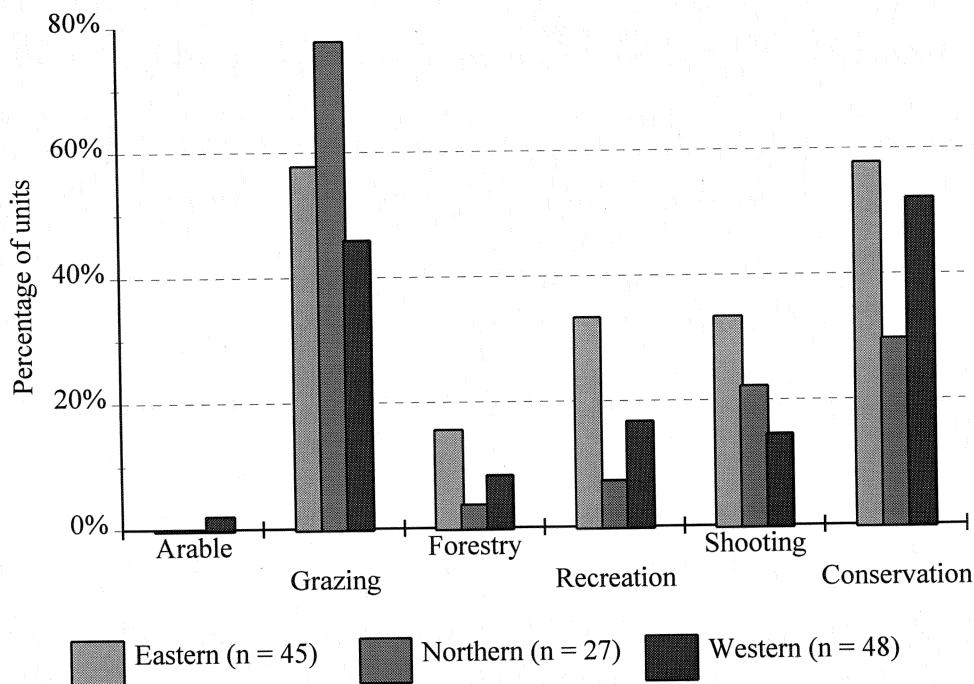
	Eastern (45)	Northern (27)	Western (48)
Private individual or estate	60.0%	78.8%	58.3%
Commercial enterprise	4.4%	3.7%	2.1%
Government Agency or Department	15.6%	3.7%	14.6%
Local Authority	4.4%	7.4%	14.6%
Voluntary Conservation Organisation	20.0%	7.4%	10.4%

Private individuals or estates were the largest occupier group in all three regions, but managed a larger proportion of sites in northern England than in the eastern and western regions. Government Agencies or Departments managed approximately 15% of units in eastern and western England, but only 3.7% of the units in the northern region. Voluntary conservation organisations managed a higher proportion of sites in eastern England than in northern or western parts of the country.

3.9.2. Land use

Geographic variation in land use is shown in Figure 3. The most common land uses in each geographical region were for grazing and nature conservation. Grazing was specified as a land use on more than 75% of units in northern England, but was less common in eastern and western regions. In contrast, nature conservation was given as a land use on less than 30% of units in the northern region, but applied to more than 50% of units in the east and west. These uses are not mutually exclusive, however, as management for nature conservation could include grazing. Forestry, recreation and shooting were all more common in eastern England than in the northern or western regions.

Figure 3. Percentage of units within eastern, northern and western England with each land use. Units may have more than one land use.



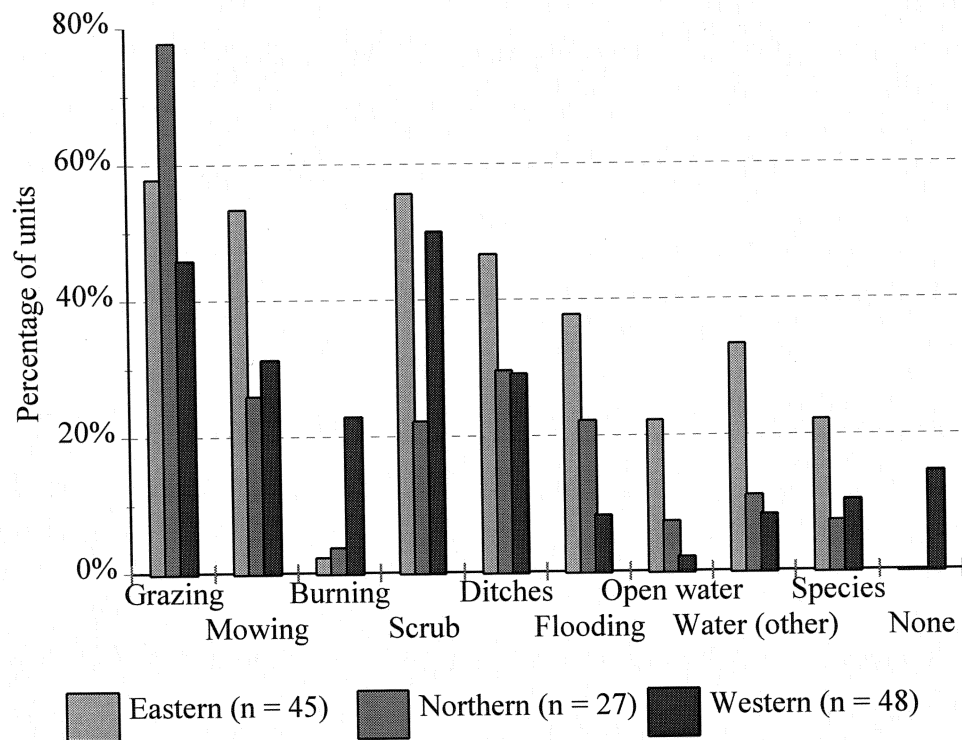
3.9.3. Management

Geographic differences in the management of units containing fen habitats are illustrated in Figure 4. The majority of management activities showed some geographical variation. Grazing was discussed in the section on land uses, above; mowing, burning, scrub control and hydrological management are briefly considered below.

- Mowing occurred on more than 50% of units in eastern England, but was less common elsewhere. Mowing includes activities such as the topping of rushes or thistles, as well as cutting tall fen vegetation for fodder, or reedbeds for thatch.
- Burning affected more than 20% of units in western England but was uncommon in other regions. This management activity was usually associated with areas of heath within the specified units, rather than the fen habitats which were the subject of this survey. Wet valley mires were sometimes used as firebreaks when burning adjacent heathlands.
- More than half the units in eastern and western England were subject to management to control scrub; in contrast, scrub control occurred on fewer than a quarter of the units in northern England.
- Management affecting hydrology (e.g. ditch management and seasonal flooding) was most common in eastern England and least common in the western part of the country.

On an area basis the regional variation in mowing, scrub control and hydrological management was even greater, reflecting the inclusion within the sample of large areas of fen within relatively few units in East Anglia.

Figure 4. Percentage of units within eastern, northern and western England subject to selected management activities. More than one management activity may occur in each unit. Scrub: scrub control; Ditches: ditch management; Flooding: seasonal flooding; Open water: management of open water within unit; Water (other): other management likely to affect water table levels within the unit; Species: management of (or for) particular species. Management activities affecting less than 5% of units in every region have been omitted.

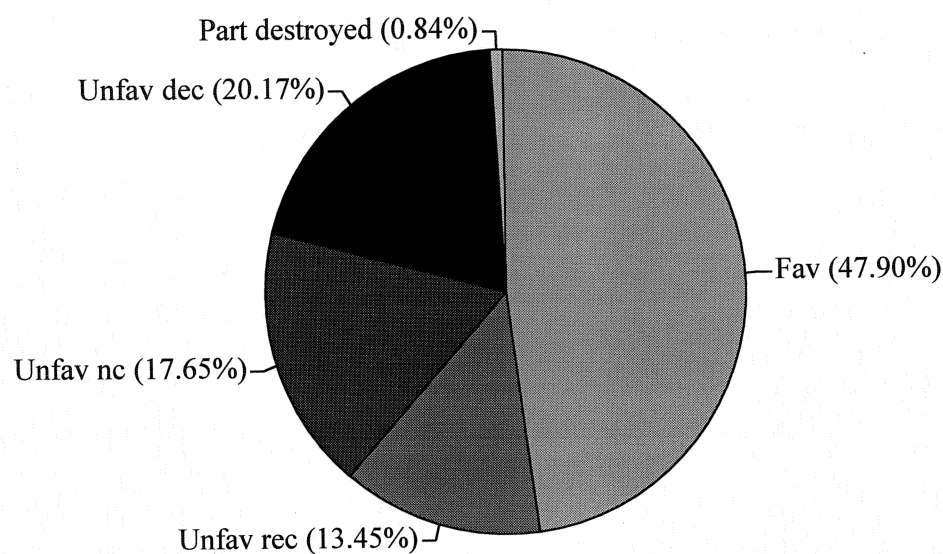


4. Condition assessment and management prognosis

4.1. Condition assessments

Condition assessments were made for 119 of the 120 units surveyed, using the condition categories described in Section 2.2. Figure 5 illustrates the percentage of this sample within each category.

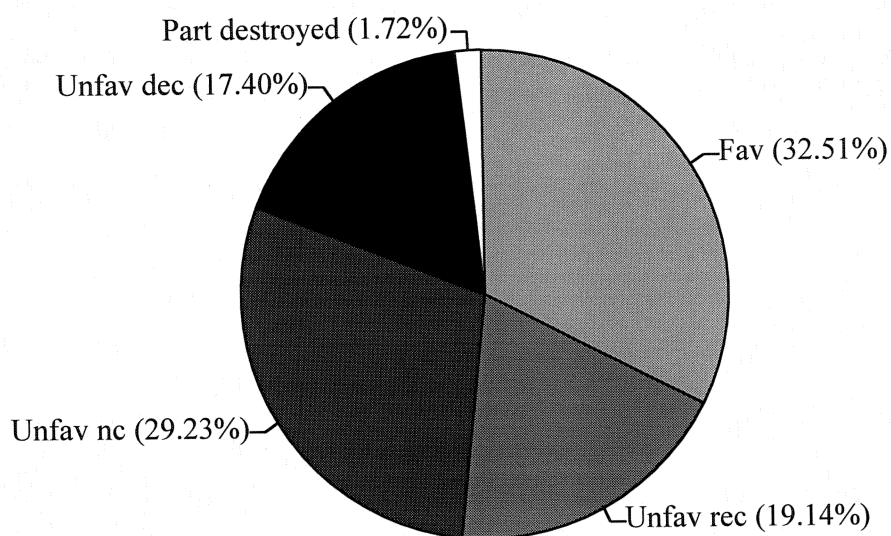
Figure 5. Condition of fens assessed in the national SSSI sample survey (n = 119 site units). Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining.



Nearly half of the fens surveyed were judged to be in favourable condition, and those within a further 16 units were recovering towards a favourable state but still unfavourable. However, 20% of the fens surveyed were thought to be unfavourable and declining, and the fen habitat within one unit had been partially destroyed through drainage and conversion to arable use.

Figure 6 shows condition assessed in terms of area. Area estimates were given for 101 of the fens for which condition assessments were made, comprising a total of 640.5ha; this figure is the area of fen habitat assessed, not the total unit area. By area, a smaller proportion of fens were in favourable condition, and a greater proportion were in an unfavourable, but stable, condition.

Figure 6. Condition of fens assessed in the national SSSI sample survey, by area. The percentages given are from a total area of 640.5ha, from 101 site units. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining.



Condition assessments based on area are disproportionately influenced by the condition of the largest sites. The disparity between Figures 5 and 6, above, is thus largely attributable to the condition of the six largest (>20ha) areas of fen assessed in the survey. All of these were in unfavourable condition; two were recovering, two were unfavourable but stable and two unfavourable and declining.

Of those fens considered to be neglected, 24.2% by number, or 46.2% by area, were in an unfavourable but stable condition; and 51.5% by number, or 31.4% by area, were unfavourable and declining.

4.2. Comparison with data from ENSIS for BAP broad habitat

Condition assessments for units containing the BAP Broad Habitat “Fen, Marsh and Swamp” are shown in Figure 7, whilst Figure 8 shows the proportional area within each condition category for those units for which area data were available. Data were extracted from ENSIS for assessments up to 7/12/99. Whilst the habitats included within the BAP Broad Habitat are not identical to those selected for the sample survey, these data provide a reasonable basis for comparison.

Differences between the sample survey and ENSIS data for the BAP Broad Habitat were not statistically significant in relation to the proportion of units within each condition category (χ^2 test, $P > 0.05$). On an area basis, however, there was a significant difference between the two datasets (χ^2 test, $P < 0.05$). The proportion of the area assessed which was classified as “unfavourable recovering” was lower in the sample survey than for the BAP Broad Habitat, whilst the proportion judged to be “unfavourable, no change” was correspondingly greater. However, the caveats on interpreting area data, mentioned above, are also relevant here; the overall assessment is strongly biased by the condition of the largest site(s) included in each sample. Furthermore, area data from the sample survey refer to the area of fen habitats within the selected units, not to the unit area, whilst data for the BAP Broad Habitat refer to the total area of the units assessed; thus, the two datasets are not necessarily analogous.

Figure 7. Condition of units with BAP Broad Habitat Fen, Marsh and Swamp (n = 693 units). Data extracted from ENSIS on 7/12/99.

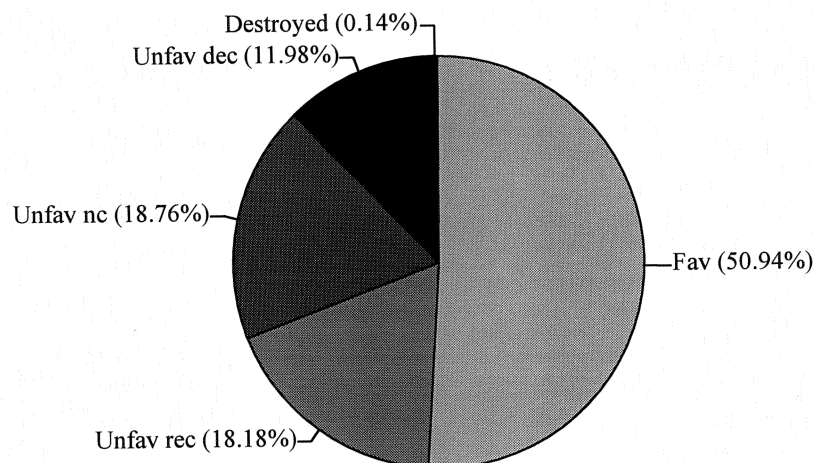
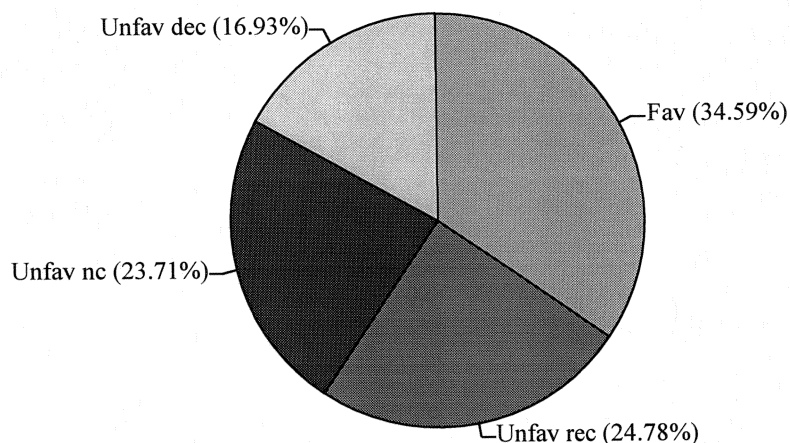


Figure 8. Condition of units with BAP Broad Habitat Fen, Marsh and Swamp, by area. Only includes units for which area measurements were available at 7/12/99. Total area of units assessed = 4230ha.



4.3. Geographical comparison of fen condition

Geographical variation in the condition of fens assessed for this survey is shown in Figure 9. The proportion of units in favourable condition was lower in eastern England than in the northern or western regions, but differences between the regions were not statistically significant (χ^2 test, $P > 0.05$).

In terms of area, however, there were significant differences in the condition of fens within each region (Figure 10).

- Only a quarter of the area of fen assessed in eastern England was in favourable condition; in northern England, the proportion in favourable condition was even lower, but in western England more than half the area was judged to be favourable. A further quarter of the area in eastern England was thought to be recovering, but still unfavourable; only 6% of the area assessed in northern and western parts of the country fell within this condition category.
- More than 40% of the fen habitat assessed in northern England was thought to be in an unfavourable condition and declining; in contrast, only 18% of the area in the western region, and 12% of that in eastern England, were in this category.

Figure 9. Percentage of units in eastern, northern and western England within each condition assessment category. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; PD: Part destroyed.

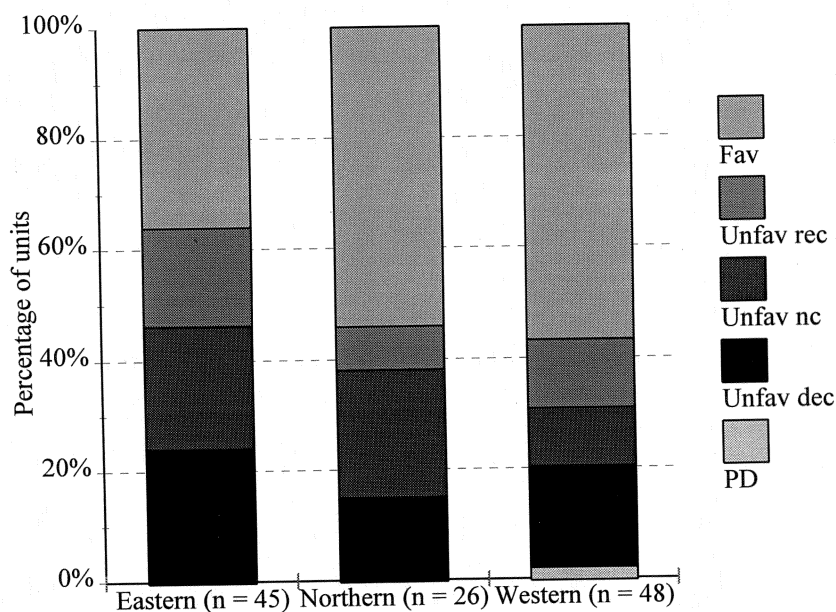
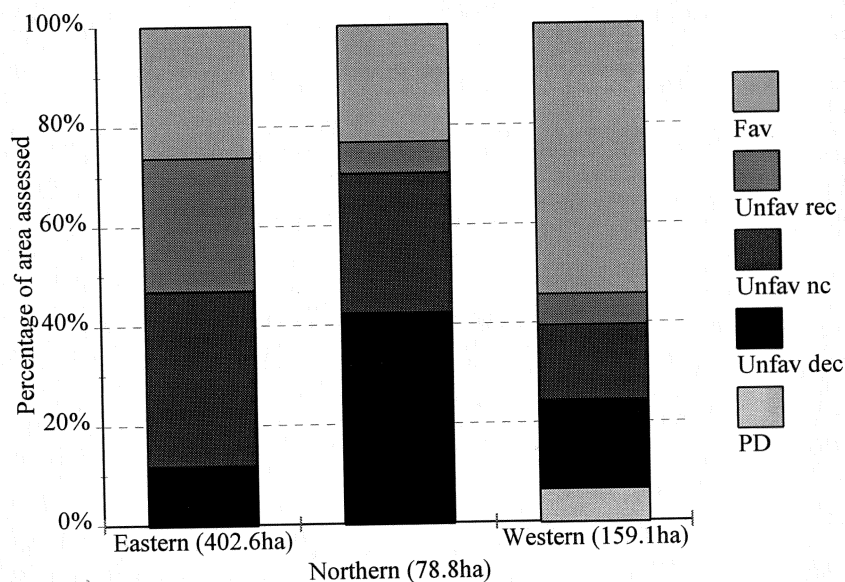


Figure 10. Percentage of fen area assessed in eastern, northern and western England within each condition assessment category. Figures in brackets are the area of fen habitat assessed within each region.



4.4. Problems in securing appropriate management

Problems in securing appropriate management were identified by the owners / occupiers of 89 (74%) of the 120 units surveyed. The number of units affected by each management issue is shown in Table 6. Up to eight of these factors were identified for some units. Identification of a problem did not necessarily mean that the management was inappropriate, or that the nature conservation objectives would not be achieved. Nevertheless, site managers thought that the nature conservation objectives would be more readily achieved if these issues were addressed.

Table 6. Problems or constraints identified in relation to achieving the nature conservation objectives for the units surveyed (n = 120 units). Up to eight of these factors were identified for some units.

Problem / constraint	Number of units	% of units	% of area†
Practical difficulties, e.g. poor access, lack of appropriate livestock	52	43.3	63.2
Financial disincentives	30	25.0	46.6
Lack of time or labour needed to undertake management	30	25.0	43.4
Externally generated problems (e.g. activities of third parties)	28	23.3	27.1
Dependence on land use in the surrounding area	27	22.5	26.5
Need for cooperation with other landowners	20	16.7	16.4
Lack of knowledge	17	14.2	14.7
Lack of interest	17	14.2	17.1
Conflict with other land uses or objectives	15	12.5	9.8
Other obstacles	10	8.3	25.1

† Based on 102 units for which the area of fen habitat was estimated.

4.5. Management prognosis

Conservation Officers were asked whether the existing management regimes would lead to the achievement of the nature conservation objectives for each site. A management prognosis was recorded for 119 of the 120 sites surveyed. These are summarised in Table 7. Overall, current management was thought to be appropriate - i.e. it would deliver the nature conservation objectives - on 55% of sites, and inappropriate on 31% of sites. The management prognosis was “unknown” (i.e. uncertain) for the remaining sites.

In terms of area, however, only 48.5% of the fens assessed had a favourable management prognosis, whilst 42.9% of the area assessed was judged to have inappropriate management.

Table 7. Assessment of whether existing management regimes would achieve the nature conservation objectives for the fen habitats within each unit ($n = 119$).

Current condition	Number of units where current management will		Unknown
	Achieve objectives	Not achieve objectives	
Favourable	51	3	3
Unfavourable, recovering	10	1	5
Unfavourable, no change	4	11	6
Unfavourable, declining	1	21	2
Part destroyed	0	1	0
Totals	66	37	16

5. Key factors affecting site condition and management prognosis: results of multi-variate analyses

“Best subsets” regression analysis was used to identify the factors most closely associated with each condition category and with a positive management prognosis (see Section 2.3). The factors which had the largest effect on condition and management prognosis, identified through this analysis, were:

- Problems in securing appropriate management, in particular practical constraints, time or labour constraints, financial constraints and lack of interest
- Grazing
- Mowing
- Scrub control
- Management agreements and incentive schemes.

Each of these factors is considered in more detail below. It should be remembered that whilst the best subsets analysis indicates that each of these factors is important in its own right, they still may be correlated with each other.

5.1. Problems in securing appropriate management

Problems in securing appropriate management were identified by the owners / occupiers of the sites selected for the survey; they were thus independent of the condition assessments made by Conservation Officers. Identification of a problem did not necessarily mean that owners / occupiers were unable to manage the site appropriately, but indicated that they thought that the nature conservation objectives would be more readily achieved if the issue were addressed (see Section 4.5, above).

Figure 11 illustrates the relationship between management problems and the condition of the fen habitats surveyed. Fewer than 35% of units with one or more of these management problems were in favourable condition; in contrast, more than 85% of units without any of these constraints were judged to be in a favourable state. Likewise, only 44% of units with one or more management problems had a favourable management prognosis, whereas management was thought likely to achieve the nature conservation objectives on 90% of units without problems (Figure 12).

Considering those units for which fen area was estimated, only 22% by area was in favourable condition when there were management problems, compared with 96% by area in favourable condition without such constraints. Similarly, it was thought that the nature conservation objectives would be achieved on only 40% of fens, by area, when there were management constraints, whilst without these constraints 98% of fens (by area) had a favourable management prognosis.

Figure 11. Condition in relation to problems in securing appropriate management. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; PD: Part destroyed. Figures in brackets are the number of units in each category.

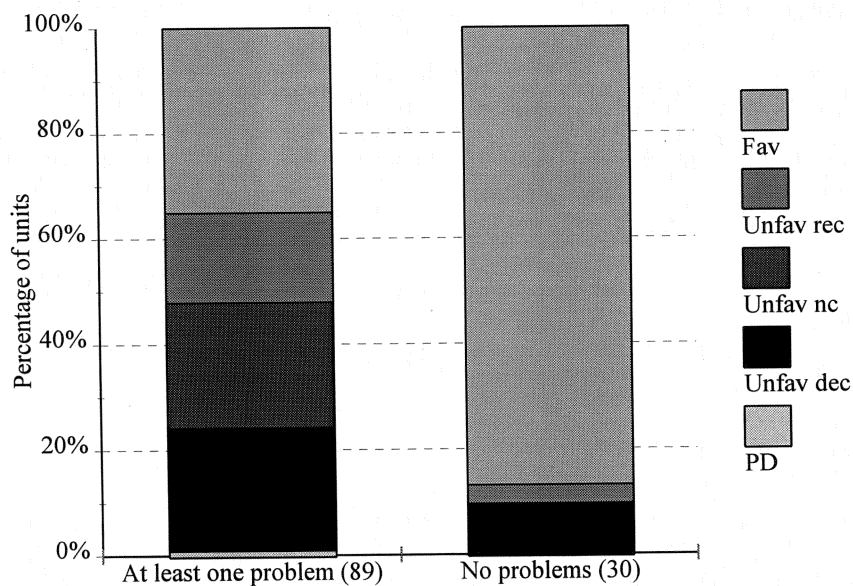
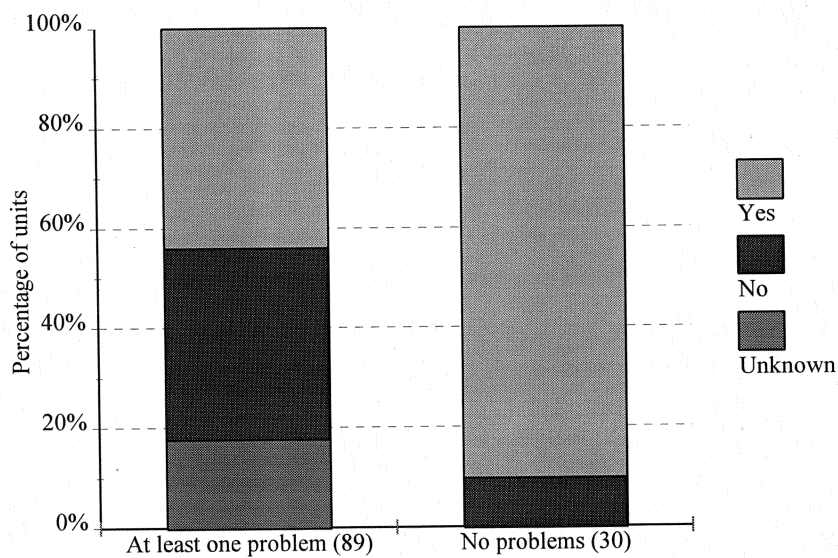


Figure 12. Management prognosis in relation to management problems. Yes: current management will achieve nature conservation objectives; No: current management will not achieve nature conservation objectives. Figures in brackets are the number of units in each category.



5.1.1. Practical constraints

Practical constraints affected 44% of those units for which condition assessments were made. The problems most commonly identified within this category were:

- lack of appropriate livestock (17 units);
- difficult access, e.g. sites too wet or remote (11 units);
- ownership by several owners / occupiers (4 units);
- inability to manage scrub (3 units);
- lack of appropriate machinery (2 units); and
- problems with fencing or stock control (2 units).

The condition of units with and without practical management constraints is shown in Figure 13a, whilst Figure 13b illustrates the proportion of the area of fen within each condition category, where this was estimated.

5.1.2. Time or labour constraints

The condition of units where management was constrained by lack of time and/or labour is shown in Figure 14a, below. Some 60% of these units were in an unfavourable condition and either not improving or declining; in contrast, where time or labour constraints were not an issue, fewer than 30% of units fell within these condition categories.

For those sites where management was not constrained by lack of time or labour there was little difference between assessments based on unit numbers and those based on area (Figure 14b). Where time/labour constraints were identified, however, less than 10% of the area assessed was in favourable condition, although the proportion where condition was unfavourable and declining was also lower than that suggested by the analysis based on the number of units. Nearly 50%, by area, was judged to be in an unfavourable, but stable, condition.

Figure 13a. Unit condition where practical constraints were identified as a management problem. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; Unfav: PD: Part destroyed. Figures in brackets are the number of units in each category.

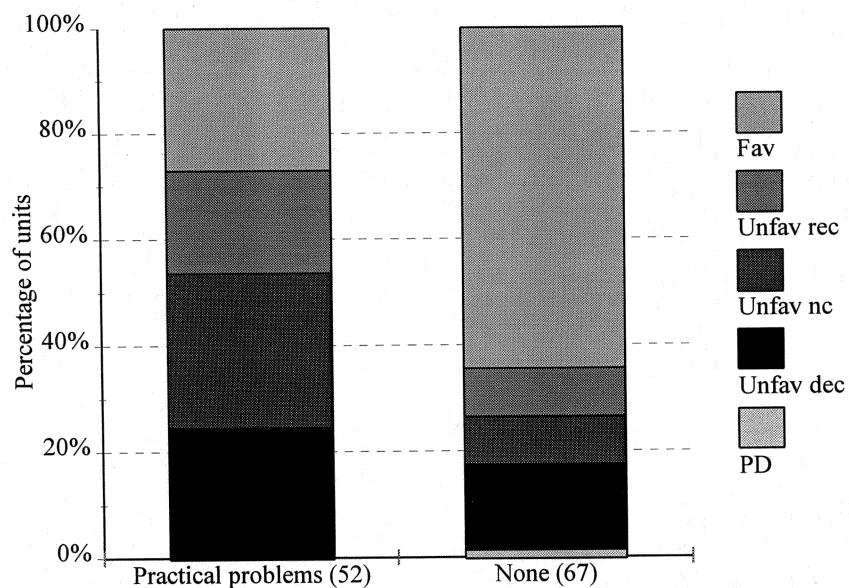


Figure 13b. Condition where practical constraints were identified as a management problem, by area. Figures in brackets are the area of fen habitat in each category.

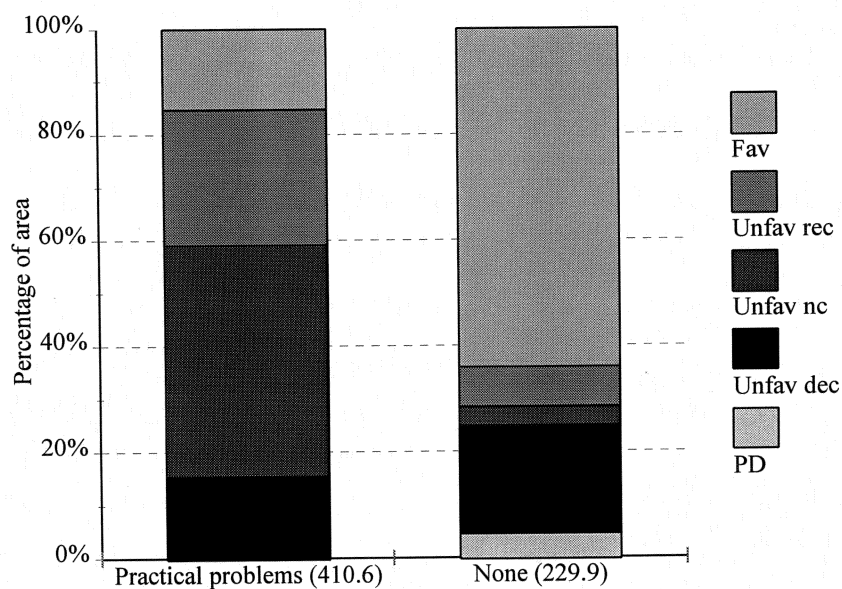


Figure 14a. Unit condition where time or labour constraints were identified as a management problem. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; Unfav: PD: Part destroyed. Figures in brackets are the number of units in each category.

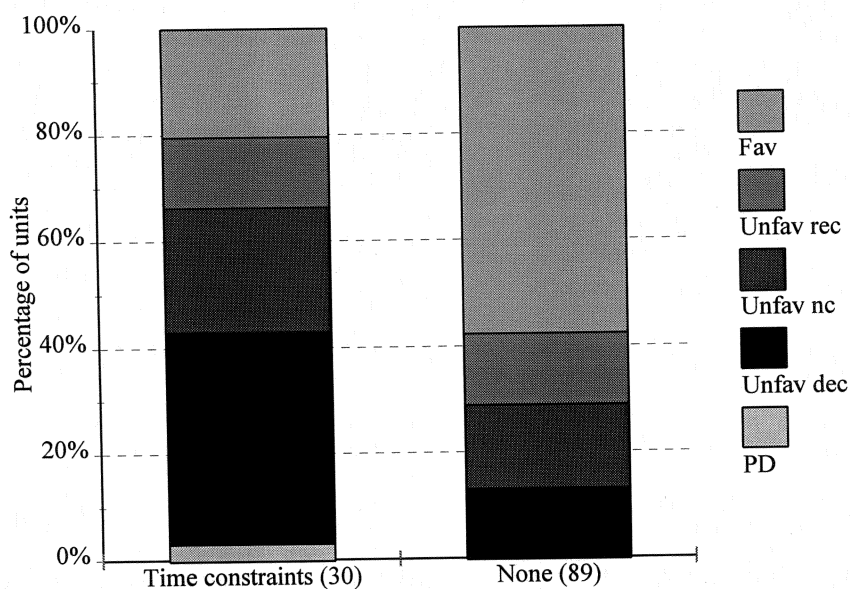
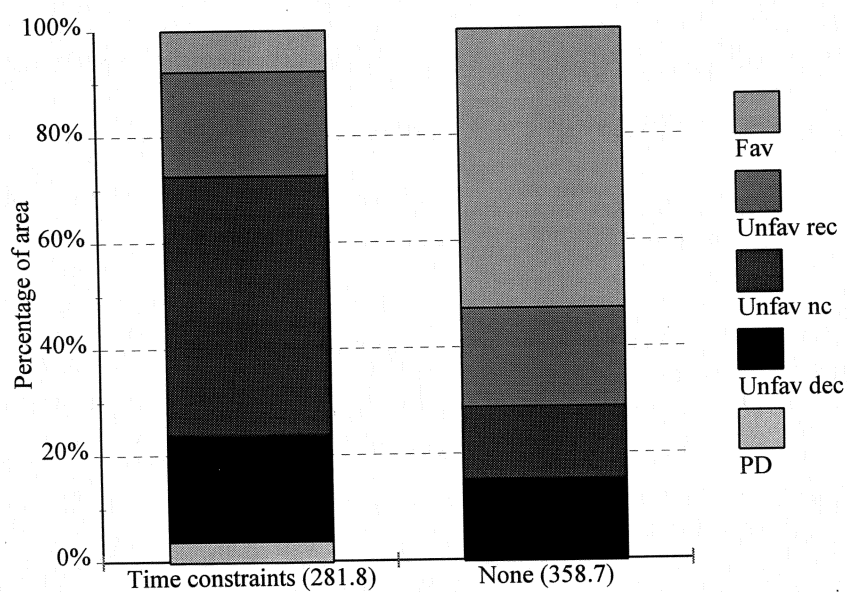


Figure 14b. Condition where time or labour constraints were identified as a management problem, by area. Figures in brackets are the area of fen habitat in each category.

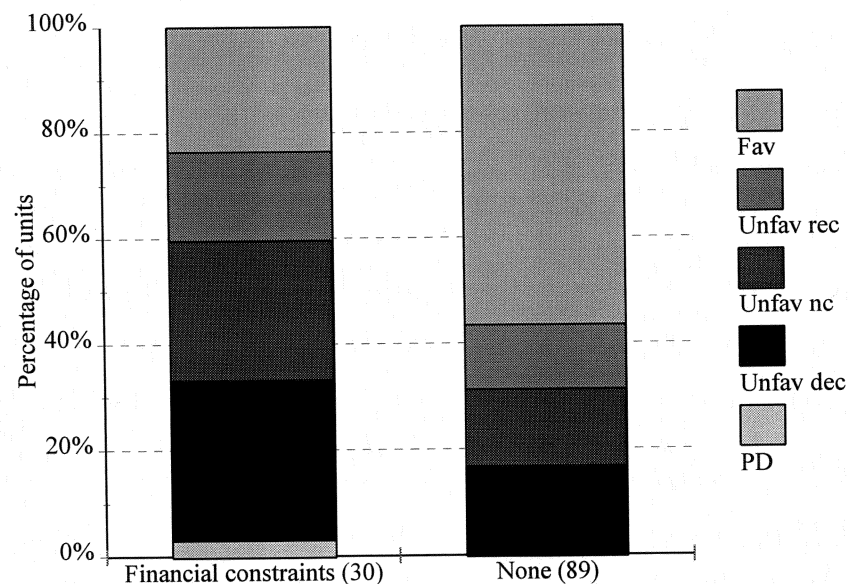


5.1.3. Financial constraints

The influence of financial constraints on habitat condition is illustrated in Figure 15. Fewer than one in four of the units with this management constraint was in favourable condition, whilst 30% were judged to be unfavourable and declining. Where financial constraints were not an issue, more than half the units were in favourable condition, and fewer than 20% were classified as unfavourable declining.

The condition of fens with or without financial management constraints did not differ substantially, on an area basis, from the assessment based on the number of units.

Figure 15. Condition where financial constraints were identified as a management problem. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; PD: Part destroyed. Figures in brackets are the number of units in each category.



5.1.4. Lack of interest

Lack of interest was identified as a management problem on 17 units, some 14% of those for which condition assessments were made. Lack of interest varied from indifference to the nature conservation value of the fen habitats, to refusal by the occupier to co-operate with English Nature. The condition of units where management was constrained by lack of interest is shown in Figure 16a. Unsurprisingly, fewer than 20% of units within this category were in favourable condition, whilst more than 50% were assessed to be in an unfavourable condition and declining.

By area, the proportion of fens in favourable condition was even lower when the owner / occupier lacked interest in managing the site (Figure 16b). The proportion which was unfavourable and declining was relatively unchanged, however.

5.2. Grazing

Grazing is the traditional form of management for many fen types and was the most common management activity, occurring on 57.5% of the units surveyed (Section 3.5). Figure 17a illustrates that more than 60% of grazed units were in favourable condition, compared with fewer 30% of ungrazed units. Furthermore, only 10% of grazed units were judged to be in unfavourable state and declining, whilst a third of all ungrazed units were in this category.

The condition of ungrazed fens is relatively unchanged when considered on an area basis (Figure 17b). However, only 38% of grazed fens, by area, were considered to be in favourable condition, whilst a greater proportion were in an unfavourable but stable state than indicated by the number of units.

Figure 16a. Unit condition where lack of interest was identified as a management problem. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; PD: Part destroyed. Figures in brackets are the number of units in each category.

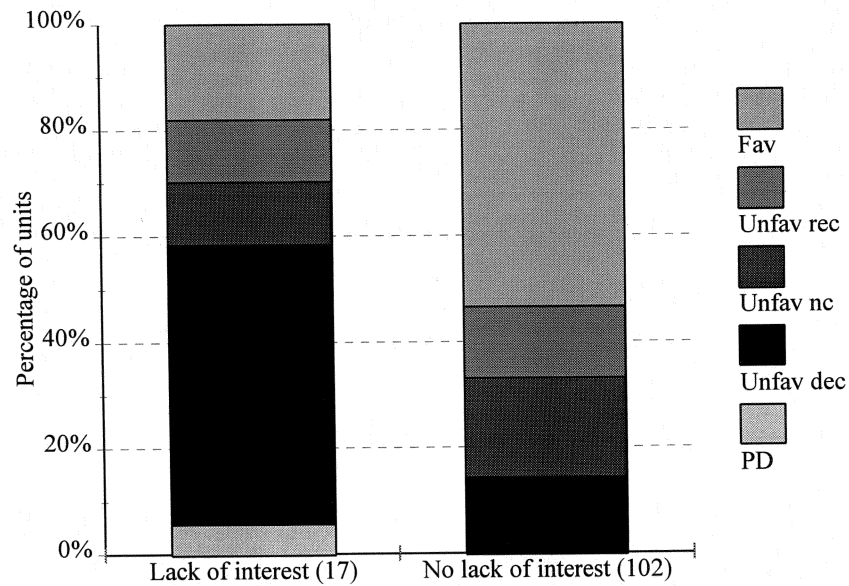


Figure 16b. Condition where lack of interest was identified as a management problem, by area. Figures in brackets are the area of fen habitat in each category.

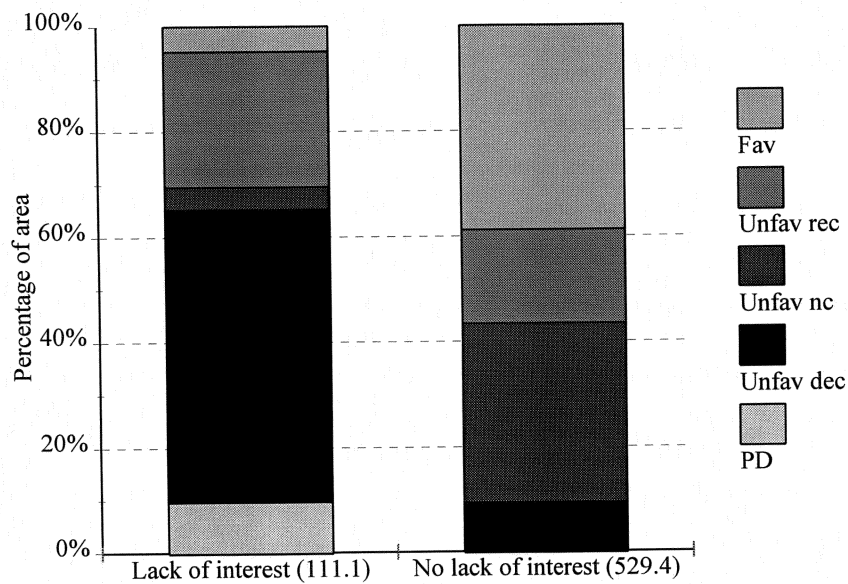


Figure 17a. Unit condition in relation to grazing. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; PD: Part destroyed. Figures in brackets are the number of units in each category.

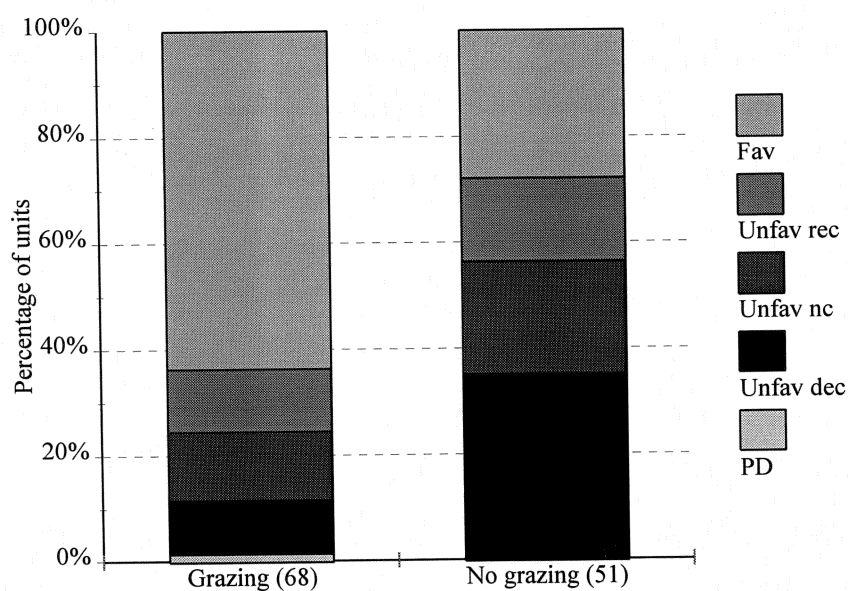
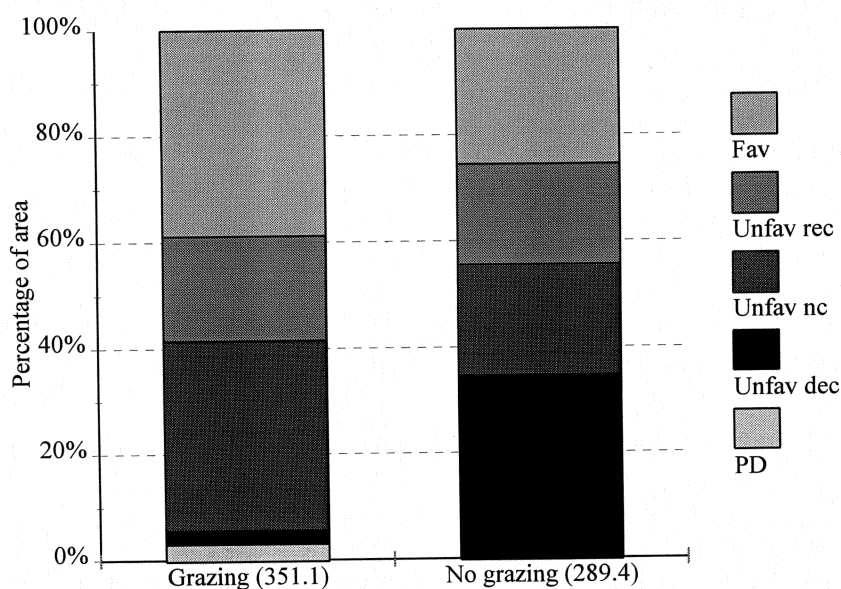


Figure 17b. Condition in relation to grazing, by area. Figures in brackets are the area of fen habitat in each category.



5.3. Mowing

Many reedbeds and tall fen communities have traditionally been managed by mowing or cutting; mowing may also be used as a surrogate for grazing of short fen communities in situations where grazing is impractical. Surprisingly, mowing did not affect the percentage of units in favourable condition (Figure 18a); however, the proportion of sites assessed as “unfavourable recovering” was significantly greater when sites were mown.

On an area basis (Figure 18b), the proportion of mown fens in favourable condition was lower, and the proportion in an unfavourable but stable state was higher, than that indicated by the number of units.

5.4. Scrub control

Fewer than 40% of units on which scrub control was undertaken were in favourable condition (Figure 19a); in contrast, more than 55% of those units without scrub control were in this condition category. Obviously, scrub control is only required on those sites where scrub encroachment is a problem. Typically, these sites are ones which have previously been neglected, or under-managed, and which are thus in an unfavourable condition. Scrub clearance is often the first stage in restoring a regular management regime, creating conditions appropriate for subsequent grazing or mowing. Unsurprisingly, therefore, the percentage of units which were unfavourable but recovering was more than five times greater with scrub control than without it.

The combined percentage of units within the favourable and unfavourable recovering condition categories was the same with and without scrub control, but fewer sites were judged to be unfavourable and declining where scrub control was undertaken. This latter difference was even more pronounced when considered on an the basis of area (Figure 19b).

Figure 18a. Unit condition in relation to mowing. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; PD: Part destroyed. Figures in brackets are the number of units in each category.

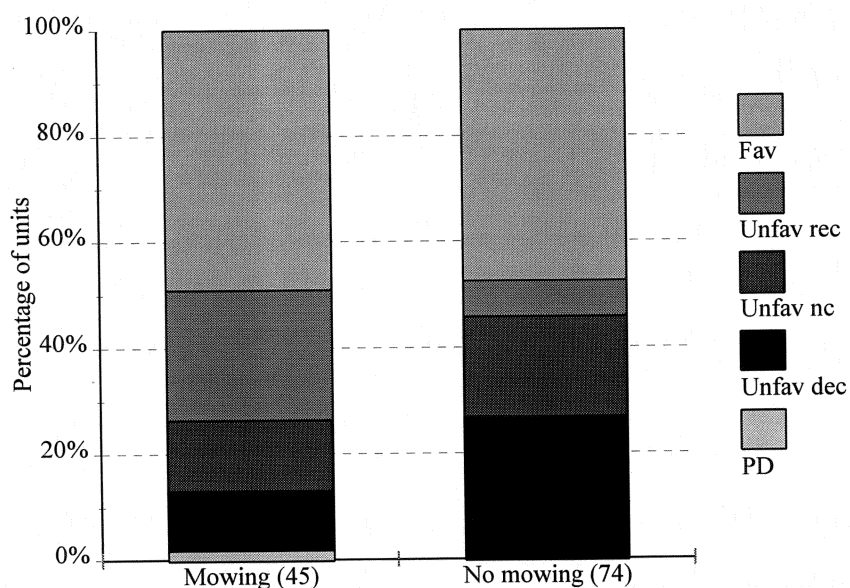


Figure 18b. Condition in relation to mowing, by area. Figures in brackets are the area of fen habitat in each category.

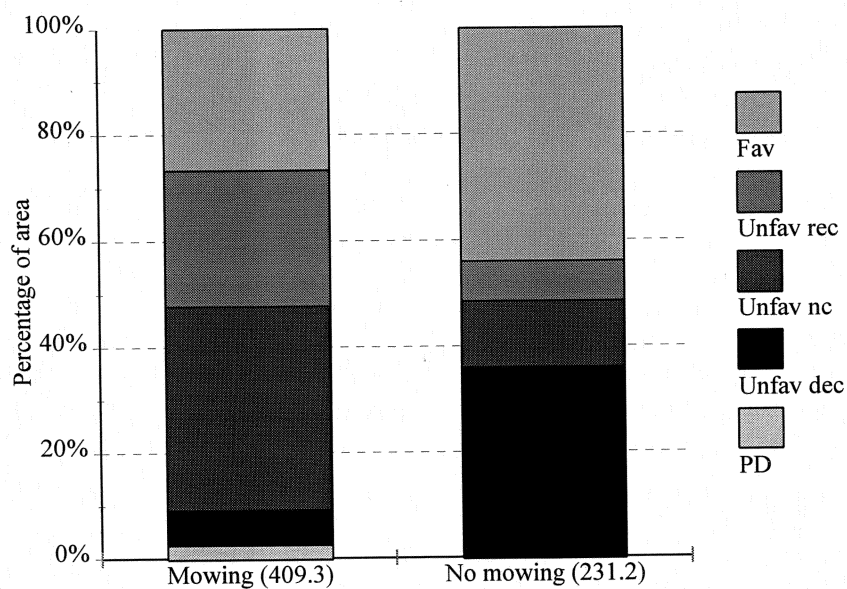


Figure 19a. Unit condition in relation to scrub control. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; PD: Part destroyed. Figures in brackets are the number of units in each category.

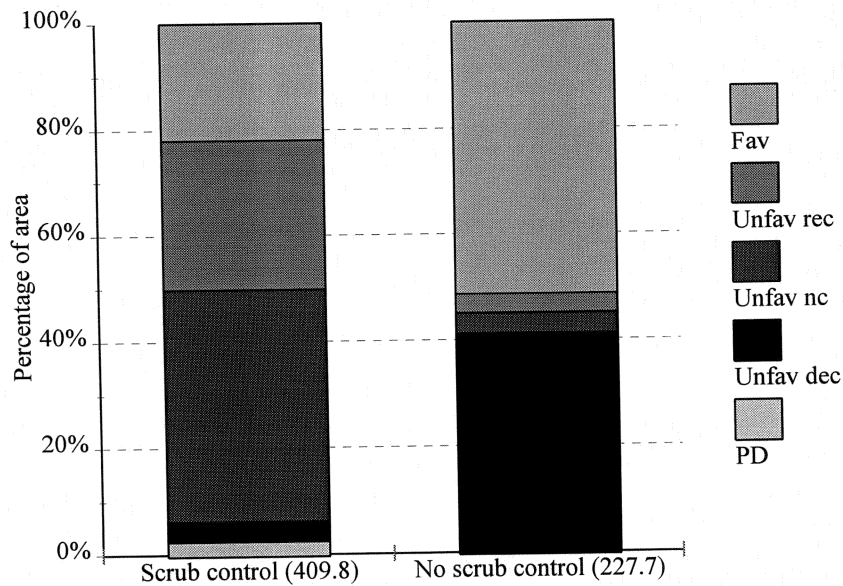
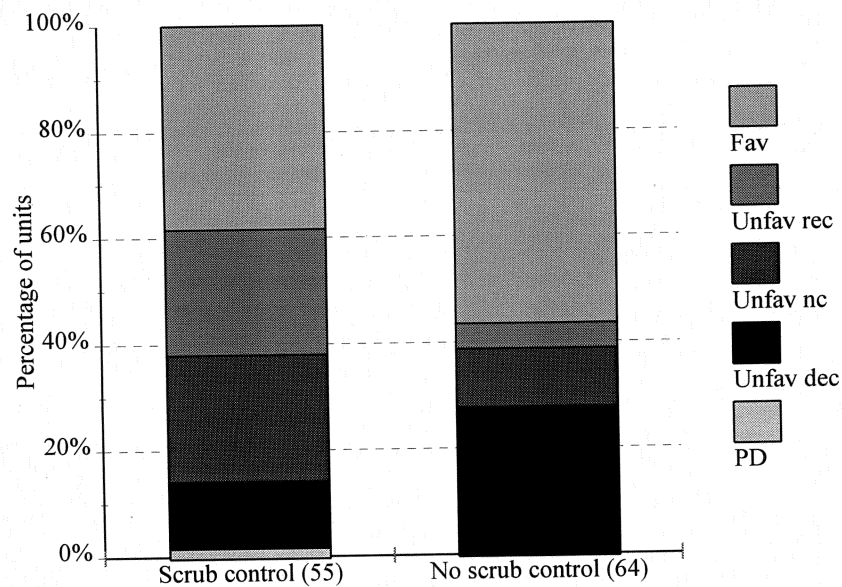


Figure 19b. Condition in relation to scrub control, by area. Figures in brackets are the area of fen habitat in each category.



5.5. Management agreements and incentive schemes

The condition of units with and without management agreements or grant schemes is shown in Figure 20a. English Nature agreements were the most common type of agreement and therefore the “all incentives” category reflects that for “all EN incentives”. The percentage of units in favourable condition was not affected by management agreements or incentives. However, improvement in condition, indicated by an assessment of “unfavourable recovering”, was strongly associated with agreements and grant schemes, and there was a corresponding decrease in the percentage of units where the condition was declining.

Management agreements and grant schemes notwithstanding, a smaller proportion of fens were in favourable condition, and a greater proportion were unfavourable but stable, when considered on an area basis (Figure 20b).

The association between management agreements/grant schemes and management prognosis is depicted in Figure 21a. More than 40% of units without management agreements or grant schemes were judged to have management that would not meet the nature conservation objectives. In contrast, fewer than 25% of units with agreements or grant schemes fell into this category, whilst more than 60% were thought to have appropriate management. However, some 35% of units with management agreements/grant schemes had management which either would not meet the nature conservation objectives or which would have an uncertain outcome.

By area, a greater proportion of fens, both with and without management agreements, had an unfavourable management prognosis (Figure 21b).

Figure 20a. Unit condition in relation to management agreements and incentives. All EN incentives: All English Nature management agreements and grant schemes; All incentives: All management agreements and incentives, including EN schemes. Fav: Favourable; Unfav rec: Unfavourable, recovering; Unfav nc: Unfavourable, no change; Unfav dec: Unfavourable, declining; PD: Part destroyed. Figures in brackets are the number of units in each category.

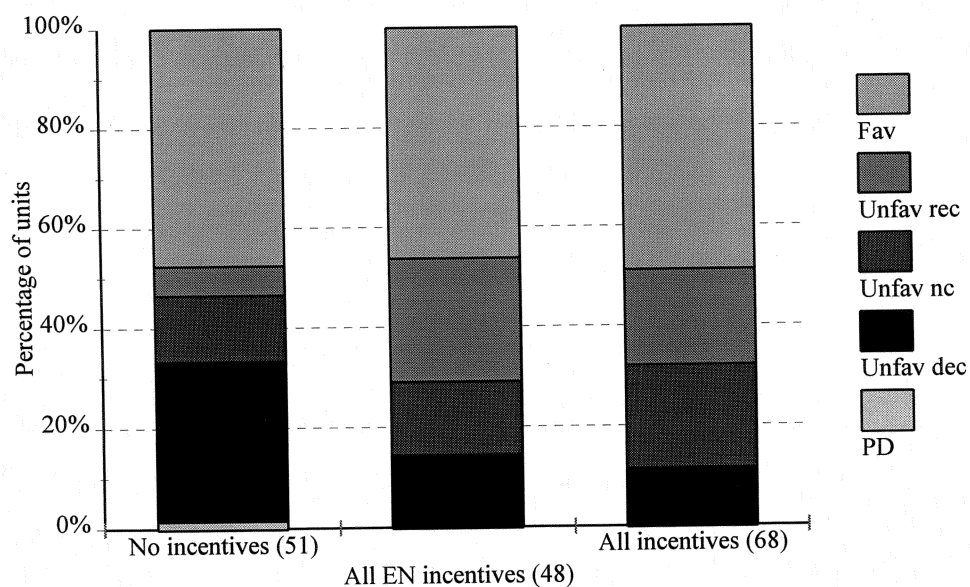


Figure 20b. Condition in relation to management agreements and incentives, by area. Figures in brackets are the area of fen habitat in each category.

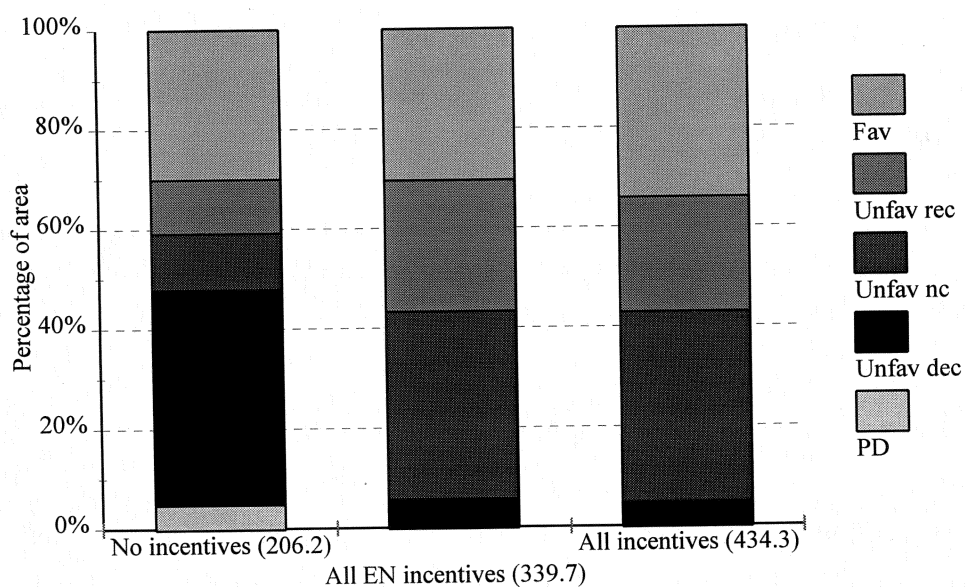


Figure 21a. Management prognosis in relation to management agreements and incentives. All EN incentives: All English Nature management agreements and grant schemes; All incentives: All management agreements and incentives, including EN schemes. Yes: management will achieve nature conservation objectives; No: management will not achieve nature conservation objectives. Figures in brackets are the number of units in each category.

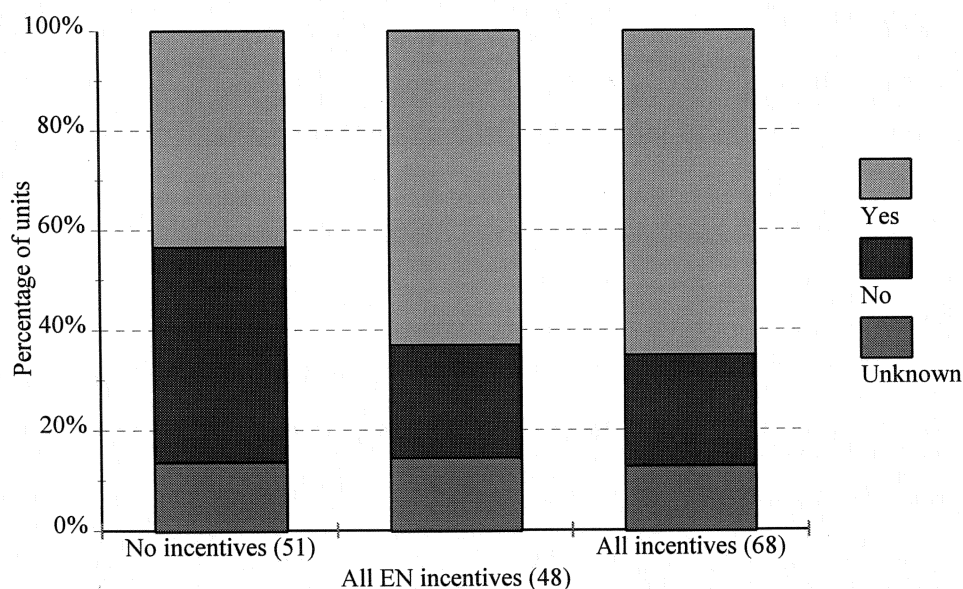
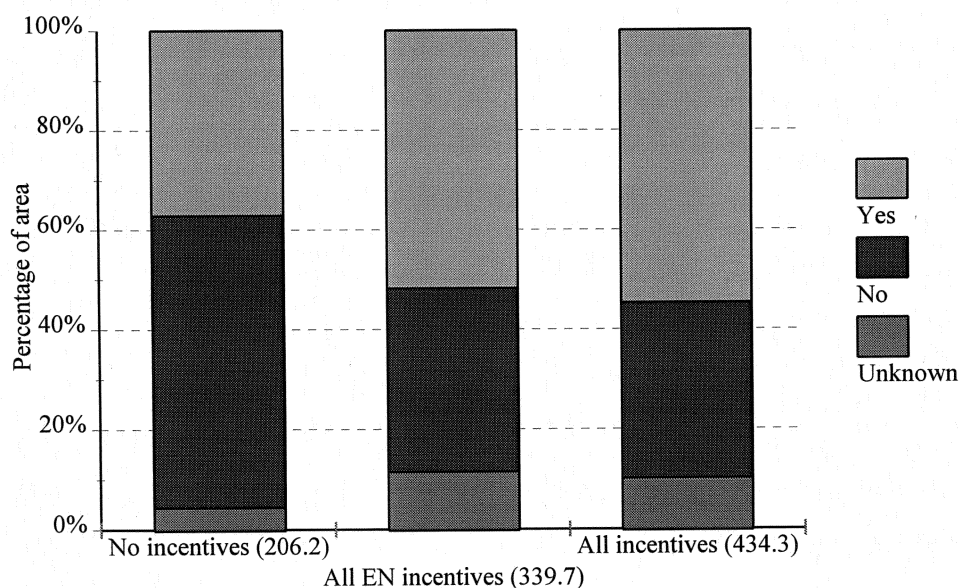


Figure 21b. Management prognosis in relation to management agreements and incentives, by area. Figures in brackets are the area of fen habitat in each category.



6. Discussion and conclusions

In this section the main management issues affecting fen condition are discussed, and actions required to deliver appropriate and sustainable management of these habitats are suggested.

6.1. Issues affecting fen habitats and their management

The Habitat Action Plan for Fens (UK Biodiversity Steering Group 1995) listed the main factors affecting the habitat as:

- Part loss of area by drainage and conversion to intensive agriculture
- Excessive water abstraction
- Small total area of habitat and small population sizes of several key species dependent on the habitat
- Lack of or inappropriate management of existing fens, leading to drying, scrub encroachment and succession to woodland
- Vulnerability to agricultural run-off and afforestation within valley fen catchments
- Enrichment of hypertrophication resulting in changing plant communities.

This survey, by concentrating on those fens within SSSIs, did not explicitly address the wider issue of habitat loss. However, the partial destruction of one site illustrates that, even within designated sites, these habitats are still vulnerable to deliberate damage and conversion to other forms of agricultural use.

Issues such as water abstraction and changes in water quality, more commonly arising from actions outside SSSIs, affected relatively few of the fens surveyed for this report. Whilst such problems undoubtedly exist, the greatest issue affecting the condition of the fens assessed for this report was that of lack of, or inappropriate, management. The ability, or willingness, of managers to adopt appropriate forms of management was often limited by practical constraints, lack of time or resources or lack of interest.

6.1.1. *Grazing*

Fens are dynamic semi-natural systems and without appropriate management natural succession will generally lead to the development of scrub and, eventually, woodland. Grazing has traditionally been the most widespread form of management for fen habitats (other than reedbeds and swamp communities), and the results of this survey show that this remains the case. Grazing is clearly appropriate for maintaining the nature conservation interest of many fen communities: by number, more than 70% of the fens sampled for this report, or nearly 60% by area, were in favourable condition or recovering when grazed (Section 5.2). Equally important, less than 10% of grazed fens (by number and area) were in an unfavourable and declining state, compared with more than 30% of ungrazed fens.

The occurrence of grazing has been severely affected by changes in agricultural practice, most particularly in recent years by the decline in the beef industry. Traditional low-intensity grazing by beef cattle has been much reduced due to the post-BSE collapse of the beef market. The regulations introduced following the BSE crisis have further limited the options for securing suitable grazing regimes on many sites. Older cattle are better suited to grazing coarse vegetation and controlling scrub invasion, but the requirement to slaughter cattle at 30 months has reduced the availability of suitable livestock. Lack of appropriate livestock was an issue on nearly 15% of the sites surveyed for this study, and clearly had a negative impact on site condition (Section 5.1.1).

The decline in the beef industry has implications not just for the management of fens, but also for other valuable wildlife habitats where extensive grazing is required (see Winter *et al.* 1998). English Nature has therefore developed proposals for an Environmental Beef Scheme which could be funded under the beef national envelope and which would support extensive beef production, achieve an acceptable level of environmental management and countryside care on a whole farm basis and help deliver UK BAP objectives.⁴ Under an Environmental Beef Scheme, farmers would undertake to manage appropriate land (i.e. SSSI and other land managed for conservation purposes) in an extensive and environmentally sustainable manner using beef cattle in return for a standard annual area payment. Promotion of such a scheme would clearly have benefits in terms of delivering the sustainable management and conservation of many fen communities.

The majority of fens sampled in this survey were small (<5ha in extent) and were often isolated from other areas of similar habitat. The small, fragmented nature of these fens creates additional problems in securing their management. Appropriate management regimes are more readily established if the fen can be included as part of a larger area with similar management requirements, e.g. where it is associated with areas of grassland or heathland which can be managed as a single grazing block. In such cases, however, it can be difficult to ensure that the grazing pressure is appropriate for each of the habitats concerned.

Management as part of a larger block may not be possible, since surrounding land uses are frequently not amenable to this (e.g. where the fen lies within an area of intensively managed agricultural land). Many sites must therefore be managed in isolation from the surrounding land. Often, sites are too small for this to be viable, whilst others would require fencing before the introduction of livestock. Where small areas of fen are to be grazed for limited periods, arrangements must also be made to transport livestock from other, often distant, locations.

6.1.2. Mowing

Mowing or cutting maintains or promotes species diversity, by controlling the dominance of the more vigorous species. Provided that the cut material is removed from the site, mowing also reduces the rate of litter accumulation

⁴ These proposals were outlined in *A New Direction for Agriculture: Response to MAFF Consultation by English Nature* (October 1999).

and reduces nutrient input into the fen. For some community types, such as reedbeds, cutting is the preferred form of management. For other communities, however, grazing would be preferable since this generates greater structural diversity than that created by mowing. These communities may be mown where grazing is constrained, e.g. where livestock are not available (see above) or where sites are small and isolated. In these situations mowing in itself can prevent deterioration, but will not necessarily create the range of conditions required for the site to be judged “favourable”. This is reflected in the results of the survey, where mowing did not increase the proportion of sites in favourable condition, but did reduce the proportion (by number and area) which were unfavourable and declining.

6.1.3. Scrub control

Scrub control is only necessary as a separate activity on sites where scrub encroachment has become a problem; these sites are likely to be assessed as in unfavourable condition. Where grazing or mowing regimes are appropriate the need for scrub control *per se* will be reduced.

Scrub clearance is often regarded as the first stage in restoring a regular management regime to formerly neglected or under-managed fens. In other cases it may be the only management, which is only undertaken periodically. Whilst this will prevent dominance by woody species, it does not prevent the accumulation of litter; gradual drying, and dominance by coarse grasses will still occur. Other management practices will almost certainly need to be undertaken if the essential nature conservation interest of the fen is to be maintained (Fojt 1994). This suggestion would appear to be supported by the results reported above (Section 5.4); scrub control was not generally associated with sites in favourable condition, but substantially reduced the proportion of fens (by number, and particularly by area) where the condition was unfavourable and declining.

6.1.4. Management agreements and grant schemes

Management agreements and grant schemes provide financial support for favoured management activities. They are thus correlated with activities such as scrub control, mowing and grazing.

English Nature is working to agree the management of all SSSIs with managers on these sites; this may be through a formal Management Agreement under Section 15 of the Wildlife and Countryside Act 1981, or through less formal site management statements. Grant schemes such as Countryside Stewardship, which are co-ordinated and funded by other agencies, may also contribute to the delivery of appropriate management on SSSIs.

English Nature’s Wildlife Enhancement and Reserves Enhancement Schemes have mainly been focussed on sites in unfavourable condition and where a modest input of funds can help to secure the desired management. It is therefore encouraging that a greater proportion of sites with these management agreements were “recovering”, and a smaller proportion were “declining”, than those without such agreements (Section 5.5). Similarly, fewer sites had an unfavourable management prognosis when subject to one of these agreements.

However, even with some form of management agreement, some 20% of fens by number, or 40% by area, still had management which would not deliver the nature conservation objectives. Such problems can arise for a number of reasons:

- agreements have only recently been entered into and the desired management changes have not yet taken place;
- knowledge of management requirements has advanced, or conservation objectives have been changed, since the management agreement was prepared;
- the agreement does not address the particular issues causing an unfavourable management prognosis;
- where a site unit is managed by several owners / occupiers, an agreement with one manager would not guarantee appropriate management of the entire unit;
- compensatory agreements under S15 of the Wildlife and Countryside Act do not necessarily ensure positive management of the wildlife features.

There are undoubtedly some sites where the management which has been agreed is inappropriate or inadequate to maintain the nature conservation interest of the features concerned. In such cases the agreement should be reviewed to determine whether it can be amended or renegotiated to secure the desired outcome.

6.2. Action to promote appropriate and sustainable management of fen communities

The Habitat Action Plan for Fens included targets to agree a list of fens requiring remedial treatment by 1998; and to ensure that favourable management is in place, through SSSI management agreements or equivalent, for priority fen sites by 2005. However, it is clear from this report that many of these habitats are still subject to inappropriate and unsustainable management. Of those fens assessed in this survey, some 31% by number, or 43% by area, had management that would not deliver the nature conservation objectives which had been set for them.

In light of the discussion above, the following measures are considered necessary to ensure the delivery of the Habitat Action Plan targets and to secure the sustainable management of fens and their associated wildlife.

1. Changes to agricultural policy and funding, particularly the adoption of an Environmental Beef Scheme would deliver the greatest benefits for the sustainable management of fens and the conservation of their wildlife.
2. Additional protection for SSSIs, including measures to prevent sites deteriorating from neglect or inappropriate management and to deter owners or third parties from deliberately damaging SSSIs, would likewise be expected to have a substantial benefit for the conservation of these habitats. The Government has announced that a Bill on wildlife protection will be considered by Parliament during 2000. Whilst the exact content of the Bill is not yet known, among the changes to existing legislation that English Nature

has recommended⁵ are a number of proposals which would benefit fen conservation:

- consent for damaging activities on SSSIs should be refused automatically without leading to compensation (but with the right of appeal);
- neglect of SSSIs should be addressed by requiring owners and managers to carry out positive conservation management with positive payments and advice from English Nature;
- third parties and the few owners who deliberately damage SSSIs should be dealt with robustly by the courts, through increased fines and a requirement to restore the damaged sites.

The effectiveness of many of these measures would be dependent on the resources available to implement them.

3. A much greater allocation of resources to agri-environment schemes would help deliver conservation targets both within and outside SSSIs. In its submission to MAFF's consultation on *A New Direction for Agriculture*, English Nature called for a further £50m p.a. to be added to these schemes through releasing resources by modulation and match funding. English Nature's priorities for agri-environment schemes include the following:

- Positive management incentives for sites designated under the EU Habitats and Species Directive, SSSI and local sites of nature conservation importance for which agricultural management is essential;
- Expansion of Countryside Stewardship to meet UK BAP targets for priority habitats;
- Schemes to reduce diffuse pollution of internationally important wetland wildlife sites resulting from agricultural management;
- Extensive beef farming where it is an essential management tool for pastures;
- Higher enhancement tiers to be more widely adopted within ESAs, especially for the management of wet grasslands.

All of these measures would benefit those habitats included within the broad classification of fens. The Government's announcement in December 1999 of a £1.6 billion package of measures over seven years, including £580m for the Countryside Stewardship Scheme, is therefore particularly welcome; efforts must now concentrate on ensuring that this money delivers the intended environmental outcomes.

4. Previously neglected or under-managed sites will often need a period of rehabilitation prior to the commencement of long-term, sustainable management. Clearance of scrub and/or the erection of fencing may be a prerequisite to the restoration of grazing, for example. Where possible, agri-environment schemes should facilitate these activities.

⁵ These recommendations were summarised in *Sites of Special Scientific Interest: What action is required? A brief for Parliament prepared by English Nature*, November 1999. Details were also given in Press Release EN/99/44, October 1999.

5. Grants offered by English Nature should be complementary to those offered through agri-environment schemes. The greatest benefits are likely to arise through targeting positive payments (under the Wildlife Enhancement and Reserves Enhancement Schemes) on activities such as scrub clearance and fencing, and on encouraging grazing (or mowing) on those fens for which agri-environment schemes are not available.
6. Where grazing remains impractical, whether due to the unavailability of suitable livestock, or because sites are too small and isolated to be grazed economically, other forms of management should be encouraged. Mowing is likely to be the preferred option in such cases. Grants offered by English Nature may facilitate this; alternatively English Nature may arrange for this management to be undertaken (see below).
7. English Nature can also provide assistance to those managers who are ill-equipped to manage sites appropriately, by promoting networking among managers, graziers and contractors offering specialist services such as scrub clearance. Considerable progress has already been made with initiatives such as *Eco-Ads*, the *Machinery Rings Information Pack* and the Grazing Animals Project, being promoted through the Forum for the Application of Conservation Techniques (FACT) and English Nature's newsletter for SSSI owners / occupiers, *Sitelines*.
8. Efforts should be made to raise awareness of the wildlife value and management needs of fen habitats, through increased and better-targeted communication with land managers and others involved in land use and planning. These efforts should highlight the importance of land use in the wider countryside and its effects on hydrology and water quality, as well as addressing the management of specific fen habitats. Cooperation between English Nature, the Environment Agency, MAFF, FRCA, the Countryside Agency and others with an interest in land management will help to ensure the effective delivery of these messages. Examples of such cooperative ventures include the *Habitat Action Plan for Fens* (UK Biodiversity Steering Group 1995) and *Wet Fens for the Future* (RSPB 1996).

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**Appendix 1. Fen and swamp communities considered in the national sample survey of SSSI
fens (from Rodwell 1991b, 1995)**

M4	<i>Carex rostrata</i> - <i>Sphagnum recurvum</i> mire
M5	<i>Carex rostrata</i> - <i>Sphagnum squarrosum</i> mire
M6	<i>Carex echinata</i> - <i>Sphagnum recurvum</i> / <i>auriculatum</i> mire
M9	<i>Carex rostrata</i> - <i>Calliergon cuspidatum</i> mire
M10	<i>Carex dioica</i> - <i>Pinguicula vulgaris</i> mire
M11	<i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire
M13	<i>Schoenus nigricans</i> - <i>Juncus subnodulosus</i> mire
M14	<i>Schoenus nigricans</i> - <i>Narthecium ossifragum</i> mire
M21	<i>Narthecium ossifragum</i> - <i>Sphagnum papillosum</i> valley mire
M22	<i>Juncus subnodulosus</i> - <i>Cirsium palustre</i> fen-meadow
M23	<i>Juncus effusus</i> / <i>acutiflorus</i> - <i>Galium palustre</i> rush-pasture
M24	<i>Molinia caerulea</i> - <i>Cirsium dissectum</i> fen-meadow
M29	<i>Hypericum elodes</i> - <i>Potamogeton polygonifolius</i> soakway
S1	<i>Carex elata</i> swamp
S2	<i>Cladium mariscus</i> swamp
S3	<i>Carex paniculata</i> swamp
S4	<i>Phragmites australis</i> swamp and reedbeds
S24	<i>Phragmites australis</i> - <i>Peucedanum palustre</i> fen
S25	<i>Phragmites australis</i> - <i>Eupatorium cannabinum</i> fen
S26	<i>Phragmites australis</i> - <i>Urtica dioica</i> fen
S27	<i>Carex rostrata</i> - <i>Potentilla palustris</i> fen
S28	<i>Phalaris arundinacea</i> fen

Appendix 2

NATIONAL SSSI SAMPLE SURVEY 1998-99: FENS QUESTIONNAIRE

SSSI Name: FIELD(Sitnam)

Local Team: FIELD(Tmnam)

Grid ref.: FIELD(Gridref)

SSSI Area: FIELD(Sitarea)

Natural Area: FIELD(Natcode), FIELD(Natarea)

Site Unit Number: FIELD(Unitno)

Site Unit Area:

Area of fen within Site Unit:

Site Unit owner(s):

Occupier's name:

Address:

Visit by:

Date:

SECTION 2: OWNER/OCCUPIER DETAILS

2.1 What is the occupier's status as regards the specified site unit? (Circle one)

Private Enterprise	Private individual or estate; private enterprise; charity; public trust office; other trust or society
Commercial Enterprise	Agro-forestry group; British Coal; British Gas; Railtrack; British Telecom; education/research establishment; electricity company; water company; national commercial concern; other commercial enterprise; investment/insurance/pension fund; local hunt/shoot/fishing interest; recreation group (golf etc.)
Government Agency or Department	British Waterways; Crown Estate Commission; English Nature; Environment Agency; Forest Enterprise; Ministry of Defence; other Government agency or department
Local Authority	County Council; Borough/City/District Council; Town Council; Parish Council; National Parks/Broads Authority; Internal Drainage Board; Port/Harbour/Haven Authority; other local authority
Voluntary Conservation Body	County Wildlife Trust; RSPB; National Trust; Woodland Trust; other conservation trust or society

2.2 Is the specified site unit part of a larger block of fen and/or bog?

(Yes / No)

If yes, please give approximate area:

2.3 Please indicate the composition of the property (which includes the specified site unit) managed by the owner / occupier (give approximate areas, if possible, or tick appropriate boxes):

Arable		Heath	
Temporary grassland		Fen / bog	
Permanent grassland		Open water	
Woodland			
Other (please specify)			

SECTION 3: USE AND MANAGEMENT OF THE SAMPLE UNIT

3.1 Is the specified site unit subject to any form of management agreement, incentive scheme or regulation? (Tick appropriate boxes)

Reserve Enhancement Scheme		Countryside Stewardship	
Wildlife Enhancement Scheme		Environmentally Sensitive Area	
Other English Nature Management Agreement†		Nitrate Sensitive Area	
Local Authority Management Agreement‡		Other (please specify)	

† E.g. S16 (National Parks & Access to the Countryside Act 1949) or S35 (Wildlife and Countryside Act 1981) agreements (please specify).

‡ Under S39 of the Wildlife and Countryside Act 1981.

3.2 Which of the following land uses occur within the specified site unit? (Tick appropriate boxes):

Arable		Recreation	
Grazing		Shooting	
Forestry / woodland		Nature conservation	
Other (please specify)			

3.3 Details of grazing on specified site unit (if any):

Controlled grazing	Type of livestock	
	Approximate number / stocking density	
	Approximate grazing dates	
Uncontrolled grazing e.g. rabbits, deer etc.	Type of herbivore (if known)	
	Level of grazing	

3.4 Details of cutting or mowing on specified site unit (if any):

Type of operation	Details (e.g. area affected, time of year and frequency)

3.5 Other management (tick appropriate boxes and give details of areas affected, frequency etc.):

Controlled burning		
Scrub control		
Tree planting		
Drain or ditch management		
Seasonal flooding		
Management of open waters		
Peat extraction		
Other management likely to alter water levels (please specify)		
Management for particular species		
Other (please specify)		
None		

SECTION 4: MANAGEMENT FOR CONSERVATION

- 4.1 What are the main obstacles to managing the fen in a way which maintains or restores its nature conservation interest? Tick appropriate boxes and give further details below:

Lack of knowledge	
Lack of interest	
Lack of time / labour	
Practical difficulties - e.g difficult access, lack of appropriate equipment or livestock	
Financial disincentives	
Conflict with other management objectives	
Dependence on land use over larger area (within or outside owners' control)	
Need for cooperation with neighbours or other interests	
Externally generated problems - e.g. pollution, invasive species, public pressure	
Other	

Appendix 3.

Site unit recording form

Site Unit Recording Form

File ref: _____

Site name _____

Date visited _____ Visited by _____ Status (Please tick)

Assessed by _____

Owner ☐
Occupier ☐
Agent ☐
Manager ☐

Name of person contacted (unit1) _____ (unit2) _____ (unit 3) _____

Potentially
damaging
activities

Interest feature within unit

Condition assessment

Unit Number & Name	Level 1 - Nearest Phase 1 code	Favourable	Unfavourable	Destroyed
		F maintained F recovered	U recovering U maintained U declining	Part destroyed Not assessed
1				
2				
3				

PDO nos.	Neglect	Pollution
1		
2		
3		

Great prognosis

What is the likely consequence? (tick one)

	Spontaneous recovery		Managed recovery		No recovery part feature	No recovery whole feature	Unknown
	Short-term	Long-term	Short-term	Long-term			
1							
2							
3							

Natural catastrophe (describe)

Unit 1
Unit 2
Unit 3

Management

Management prognosis Will objectives be met as a result of management?

Management regime(s) Current management for each unit	Yes	No	Unknown
1			
2			
3			

Comments

JNIT1

T 2

JNIT 3

Action

which unit?)

Loss and damage assessment

Unit No ☐ 1 ☐ 2 ☐ 3 (tick boxes)

Approx date of damage _____ Area of feature destroyed or damaged _____ (ha) or % of feature _____
(Must be given for habitats)

Brief description _____

Agent thought responsible _____

Purpose of damaging
activity (tick one)

Agriculture ☐
Forestry ☐
Development ☐
Recreation ☐
Unknown ☐
Other ☐

Causal agent (tick one)

Owner/occupier ☐
Statutory body ☐
Third party ☐
Unknown ☐
Other ☐

Legality (tick one)

PDO consented ☐
PDO not consented ☐
Notified but after 4 months ☐
General development order ☐
Emergency operation ☐
Planning permission obtained ☐
Planning permission not obtained ☐
Other ☐

Temporal aspects (tick one)

Short-term damaging ☐
Repeated damaging ☐
Continuing damaging ☐

Source (tick one)

On SSSI ☐
Off SSSI ☐

Pollution form filled in? ☐ (tick box)

Signed: _____

Appendix 4.

Notes on the character of fen communities considered in the national sample survey of SSSI fens

Description of fen communities (from Fojt 1989: *Quick reference to Fen Vegetation Communities*)

Community	Description
M4 <i>Carex rostrata</i> - <i>Sphagnum recurvum</i> mire	There is usually a cover of sedges (mainly <i>C. rostrata</i>) over a carpet of semi-aquatic <i>Sphagna</i> with few other associates. Rather species-poor.
M5 <i>Carex rostrata</i> - <i>Sphagnum squarrosum</i> mire	Sedges and scattered poor-fen herbs over a carpet of base-tolerant <i>Sphagna</i> . Of medium species-richness.
M6 <i>Carex echinata</i> - <i>Sphagnum recurvum</i> / <i>auriculatum</i> mire	Small sedges or rushes dominate over a carpet of more oligotrophic <i>Sphagna</i> with a variable contribution from higher plants. Of medium species-richness.
M9 <i>Carex rostrata</i> - <i>Calliargon cuspidatum</i> mire	Medium to tall fen vegetation, often species-rich, typically dominated by such species as <i>Carex rostrata</i> , <i>C. diandra</i> , <i>C. lasiocarpa</i> and <i>Eriophorum angustifolium</i> . Sometimes there is patchy <i>Cladium</i> and/or <i>Phragmites</i> . Bryophytes, especially <i>Calliargon</i> species, are conspicuous.
M10 <i>Carex dioica</i> - <i>Pinguicula vulgaris</i> mire	In general this is a low-growing small-sedge community. <i>Schoenus</i> and <i>Molinia</i> may be present. Moderate to high species-richness. May be associated with a wide variety of peripheral communities.
M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire	This open community containing a rich mixture of small sedges and herbs with many bryophytes occurs among water-scoured runnels. Usually no single vascular plant is dominant. Generally species-rich.
M13 <i>Schoenus nigricans</i> - <i>Juncus subnodulosus</i> mire	This vegetation is usually distinguished by both <i>S. nigricans</i> and <i>J. subnodulosus</i> and a wide range of low-growing associates. <i>Phragmites</i> , <i>Molinia</i> and sometimes <i>Cladium</i> may be important. The community has a high species-richness. When occurring as a hydrosereal stage in turf-cuttings it grades into S24 and S25.
M14 <i>Schoenus nigricans</i> - <i>Narthecium ossifragum</i> mire	<i>S. nigricans</i> is usually dominant, with <i>Molinia</i> generally abundant and bryophytes variable in cover.
M21 <i>Narthecium ossifragum</i> - <i>Sphagnum papillosum</i> valley mire	Carpets of <i>Sphagna</i> are characteristic, with scattered herbs and sub-shrubs. Of medium species-richness. Associated with M29 water-tracks and M14 flushed zones and often grades into M16 wet heath.

M22 <i>Juncus subnodulosus</i> - <i>Cirsium palustre</i> fen-meadow	Variable, but usually dominated by a range of grasses, rushes (especially <i>Juncus subnodulosus</i>) and sedges (e.g. <i>Carex acutiformis</i> and <i>C. disticha</i>). Species-richness variable.
M23 <i>Juncus effusus</i> / <i>acutiflorus</i> - <i>Galium palustre</i> rush-pasture	Characterised by both or just one of the rushes with a range of herbs.
M24 <i>Molinia caerulea</i> - <i>Cirsium dissectum</i> fen-meadow	Almost always dominated by <i>Molinia</i> , typically with <i>Potentilla erecta</i> , <i>Succisa pratensis</i> , <i>Cirsium dissectum</i> , and smaller <i>Carex</i> species and sometimes with <i>Gymnadenia conopsea</i> . Species-richness fairly high.
M29 <i>Hypericum elodes</i> - <i>Potamogeton polygonifolius</i> soakway	<i>H. elodes</i> and <i>P. polygonifolius</i> (singly or jointly) may form floating mats on water in runnels or pools. Other higher plants and bryophytes have variable presence.
S1 <i>Carex elata</i> swamp	Vegetation dominated by <i>C. elata</i> tussocks with some taller herbaceous dicotyledons. Generally species-poor.
S2 <i>Cladium mariscus</i> swamp	<i>Cladium</i> -dominated vegetation. Pure stands common and no other species frequent. Species-poor.
S3 <i>Carex paniculata</i> swamp	Dominated by <i>C. paniculata</i> tussocks. Species-poor.
S4 <i>Phragmites australis</i> swamp and reedbeds	<i>P. australis</i> is the dominant. Generally species-poor, though variable, e.g. <i>Galium palustre</i> sub-community is richer.
S24 <i>Phragmites australis</i> - <i>Peucedanum palustre</i> fen	Composed of tall monocotyledons (e.g. <i>Phragmites</i> and <i>Cladium</i>) and herbaceous dicotyledons with a lower layer of sedges and rushes and a patchy bryophyte layer. Generally species-rich.
S25 <i>Phragmites australis</i> - <i>Eupatorium cannabinum</i> fen	Characterised by tall monocots and dicots with variable amounts of small herbs and sedges. Less species-rich than S24.
S26 <i>Phragmites australis</i> - <i>Urtica dioica</i> fen	Generally dominated by <i>P. australis</i> and <i>U. dioica</i> but associates are variable. Generally species-poor.
S27 <i>Carex rostrata</i> - <i>Potentilla palustris</i> fen	<i>C. rostrata</i> may or may not be dominant, but <i>P. palustris</i> and <i>Menyanthes trifoliata</i> are constant. Species-poor.
S28 <i>Phalaris arundinacea</i> fen	<i>P. arundinacea</i> is usually dominant, though associates are variable. Species-poor.

Management and potential threats to fen communities (from Fojt 1989: *Quick reference to Fen Vegetation Communities*)

Community	Management and threats
M4 <i>Carex rostrata</i> - <i>Sphagnum recurvum</i> mire	This poor-fen community is probably quite stable if high water tables and some water movement are maintained. Partial drainage is recognised as a threat, leading to a decrease or even loss of the aquatic <i>Sphagna</i> and transition to M6. Grazing may encourage the spread of <i>Juncus</i> .
M5 <i>Carex rostrata</i> - <i>Sphagnum squarrosum</i> mire	<p>This community is generally characterised by a high water table, though its tendency to form a floating raft may prevent inundation by surface water. Raft formation allows a degree of compensation against lower water levels caused by partial drainage, but there will be a limit to such tolerance.</p> <p>Grazing may occur at the periphery of the community where it abuts onto firmer peat, and here <i>Juncus effusus</i> may dominate. The <i>Sphagnum</i> carpet is sensitive to trampling and burning.</p>
M6 <i>Carex echinata</i> - <i>Sphagnum recurvum</i> / <i>auriculatum</i> mire	<p>Long-continued grazing is believed to encourage the trend from sedge to rush dominance, but wetter stands are unlikely to be grazed. Complete exclusion of grazing will allow scrub invasion.</p> <p>Drainage and application of fertiliser or lime can damage the community, but the blocking of drains may allow some recovery.</p>

M9 <i>Carex rostrata</i> - <i>Calliergon cuspidatum</i> mire	<p>Examples of this community may be lightly grazed and even mown, but generally it is unmanaged. The richest and best examples of this community are of very low fertility, and this is almost certainly essential to the maintenance of their character. Mild eutrophication may lead to a slight shift in species composition or to a slightly depauperate version. High eutrophication leads to an increase of species such as <i>Agrostis stolonifera</i> and <i>Phragmites</i> and, though the essential characteristics of the community may persist for a while, it is highly likely that it will be replaced by a more eutrophic type (e.g. S27) or even a <i>Phragmites</i>-dominated community.</p> <p>Even partial drainage of this community is an obvious threat. Terrestrialisation may result in the replacement of M9 by a type of <i>Salix</i> - <i>Carex</i> woodland. In other cases <i>Sphagnum</i> carpets may develop and then coalesce to form an ombrotrophic surface, which may be prone to birch invasion.</p>
M10 <i>Carex dioica</i> - <i>Pinguicula vulgaris</i> mire	<p>Grazing is probably necessary in a light form for the maintenance of this community. Heavy grazing may damage both the vegetation and the substrate. In the least fertile sites this may be serious, as the capacity for regrowth will be limited. Higher-altitude sites are probably stable, but lower-altitude examples may suffer a degree of scrub invasion.</p> <p>Enhancement of fertility tends to lead to a tall-herb element within the stand (e.g. <i>Filipendula ulmaria</i>).</p> <p>Comments for M13 are applicable to this community.</p>
M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire	<p>This essentially high-altitude community is probably quite stable in exposed positions. Constant erosion by running water helps to prevent the development of a woody cover, but in some places birch and juniper can invade in the absence of grazing.</p>

M13 <i>Schoenus nigricans</i> - <i>Juncus subnodulosus</i> mire	<p>This community is generally associated with low-productivity, very base-rich, spring-fed sites. Inherent infertility allows the community to have a degree of resistance to invasion by more aggressive species after drainage, cessation of management and eutrophication. However, whilst some examples of the community appear to have a low water level without suffering in the short term, even partial drainage will lead to a decrease in characteristic species.</p> <p>Light grazing may occur without harm to the community, but heavy grazing may damage both the vegetation and the substrate. Occasional burning has been known to occur in some sites without any obvious damaging effects. In general, overgrowth due to lack of management is regarded as one of the most serious threats to this community.</p>
M14 <i>Schoenus nigricans</i> - <i>Narthecium ossifragum</i> mire	<p>Grazing influences many stands and probably prevents invasion by scrub. Heavy grazing may cause damage. Burning is also part of the management regime of some examples and, if light, is probably not deleterious; heavy burns will damage <i>Sphagna</i>.</p> <p>Drainage is damaging to the community and partial drainage may be deleterious to the <i>Sphagna</i> growing between the tussocks. In some sites major drainage appears to have encouraged <i>Molinia</i>, leading to dense litter-filled spaces between the tussocks.</p>
M21 <i>Narthecium ossifragum</i> - <i>Sphagnum papillosum</i> valley mire	<p>The wetness of this community is believed to give it a natural resistance to burning, which would otherwise be damaging. Light grazing may prevent excessive scrub invasion.</p> <p>Drainage is deleterious and even partial drainage will make stands more susceptible to scrub invasion. Peat-cutting has affected many sites, but, where the hydrological regime of sites has remained undisturbed, regeneration has occurred.</p>

M22 <i>Juncus subnodulosus</i> - <i>Cirsium palustre</i> fen-meadow	<p>Many rich-fen meadows are or have been traditionally managed by grazing and/or mowing. Such treatments applied to tall-herb fen vegetation have given rise to this community and now help to maintain it. Abandonment may lead to reversion and/or scrub invasion. Neglect is one of the most serious threats to this community.</p> <p>Water levels may be low but this does not appear to be deleterious to species-richness. Some examples may be able to tolerate a degree of eutrophication without change to their basic floristic composition provided that active management continues.</p> <p>Grazing is generally more important than mowing for maintaining fen-meadow, but trampling encourages pasture-associated species and eliminates sensitive species which would otherwise remain if management was by mowing.</p>
M23 <i>Juncus effusus</i> / <i>acutiflorus</i> - <i>Galium palustre</i> rush-pasture	<p>This is a grazed community, but the poaching of wetter soils encourages dominance by rushes. Scrub may rapidly invade in ungrazed stands. Mowing is now a rare practice.</p> <p>Drainage and enrichment by fertilisers are deleterious, leading to an increase in grasses.</p>
M24 <i>Molinia caerulea</i> - <i>Cirsium dissectum</i> fen-meadow	<p>Many examples of this community have been derived from other fen types by grazing and/or mowing. Both forms of treatment prevent succession to scrub and disadvantage taller herb species. Different frequencies of treatment can result in different floristic and structural characteristics. Neglect may lead to overgrowth and decrease species-richness.</p> <p>Water table levels are usually low, except where the community is found on seepage slopes, but associated characteristic species may be lost if water table levels are very low.</p>
M29 <i>Hypericum elodes</i> - <i>Potamogeton polygonifolius</i> soakway	<p>This community is associated with flowing water, usually concentrated into a distinct channel. For substantial periods there will be surface flowing water. Drainage is expected to be harmful, though blocked drains, if still a focus of some flow, may be colonised by this community.</p> <p>Grazing will prevent excessive scrub development but, if heavy, may lead to poaching.</p>

S1 <i>Carex elata</i> swamp	<p>This is regarded as a natural development in some open water transitions and also in old turf-cuttings. Examples may be lost through hydrosereal succession but might be restored by re-excavation in the latter case.</p> <p>The community may be grazed, where accessible, and this will hinder colonisation by willows.</p>
S2 <i>Cladium mariscus</i> swamp	<p>Stands in East Anglia have traditionally been cut for sedge. If left uncut, the dense litter of <i>Cladium</i> discourages invasion by woody plants, but initial patchy invasion will gradually expand. <i>Cladium</i> may survive for some time beneath a tree canopy, but will gradually be eliminated.</p>
S3 <i>Carex paniculata</i> swamp	<p>Grazing may occur where examples of this community abut onto firmer ground and are accessible to stock. This often leads to bad poaching between tussocks.</p> <p>The tussock-tops provide footholds for <i>Salix</i> and <i>Alnus</i> seedlings.</p>
S4 <i>Phragmites australis</i> swamp and reedbeds	<p>Winter-cutting is one of the main treatments of this community. Summer-cutting may be used to weaken reed.</p> <p>Light grazing is not deleterious, but heavy grazing, particularly of newly emerged shoots, and associated trampling will damage stands. Grazing by geese can be quite hard and may cause damage.</p> <p><i>Phragmites</i> can tolerate lower water tables, but large fluctuations will allow an acceleration of hydrosereal succession; such fluctuations may be brought about by drainage. Eutrophication is also suspected of causing a decline in reed in East Anglia.</p>

S24 <i>Phragmites australis</i> - <i>Peucedanum palustre</i> fen	<p>In general, most examples of the community are prone to invasion by woody plants and therefore require management in order to retain species-richness. Many of the characteristic species (e.g. <i>Carex elata</i> and <i>Thelypteris palustris</i>) can tolerate shade and would survive in carr, but open fen allows other small species to survive. The main method of management is by mowing, for either <i>Cladium</i> (3-4 years rotation) or litter (annually). <i>Cladium</i> beds which are regularly mown are more species-rich than unmown stands. <i>Phragmites</i> is winter-cut and <i>Cladium</i> summer-cut. <i>Glyceria maxima</i> is summer-cut before panicle emergence in June, to provide green fodder or hay, and sometimes again between June and July. Stands are usually too mixed to be harvested for reed. Grazing of this community was probably never extensive on undrained fens, but it may be encountered in marginal situations.</p>
S25 <i>Phragmites australis</i> - <i>Eupatorium cannabinum</i> fen	<p>Many examples of this community were probably grazed in the past.</p> <p>The S25a sub-community has in some cases been derived from derelict fen-meadow. Resumption of management may increase vegetation diversity. Excessive eutrophication may be expected to lead to impoverishment of the community, especially if there is little management.</p>
S26 <i>Phragmites australis</i> - <i>Urtica dioica</i> fen	<p>The vegetation is largely unmanaged and may occupy naturally fertile sites (e.g. riverside areas) or those where high fertility is maintained by nutrient run-off from agricultural land. In some cases it is likely that more species-rich vegetation could be reinstated by grazing or mowing, but this cannot be guaranteed.</p>
S27 <i>Carex rostrata</i> - <i>Potentilla palustris</i> fen	<p>Light grazing may affect this community and this generally has a beneficial effect in preventing scrub encroachment. Excessive grazing may encourage <i>Juncus effusus</i>; degraded stands with <i>Juncus</i> may also be eutrophic in comparison to stands without <i>Juncus</i>. High eutrophication leads to impoverishment, with increased frequency of <i>Agrostis stolonifera</i>, <i>Juncus</i> and <i>Phragmites</i>.</p>
S28 <i>Phalaris arundinacea</i> fen	<p>Drainage will result in great changes in the nature of the vegetation and, combined with grazing, may lead to the development of fen-meadow.</p> <p>May be grazed by stock in the summer and wildfowl in the winter.</p>