# Monitoring at Middle Fen, Thelnetham, Suffolk 1992

1. Background

Thelnetham Middle Fen (TM 014788) is part of the Thelnetham and Blo'norton Fens SSSI. It is a seepage fed rich-fen with some areas of "Schwingmoor" or floating fen remaining (Ausden and Harding 1991). The fen is of very great conservation interest (an NCR Grade I site) being the last example in Suffolk of floating fen and having a range of plant species of high botanical value.

Because of the long drought and the increasing threat such fens have faced from abstraction and land drainage, the NRA, EN and the County Trust began a programme of valley fen monitoring in East Anglia. The programme included water level monitoring with dip-wells, base line NVC surveys and the recording of vegetation monitoring plots. Thelnetham is one site in the programme.

Old Fen has been monitored with three plots, first in 1960 (Bellamy and Rose 1960) and subsequently in 1991 (Fojt and Harding 1992). Middle Fen had no previous plots.

2. Aims

Aims were twofold:

1. To establish a baseline data set for comparison of future change as part of the East Anglian wetland monitoring programme.
2. To examine effect of number of quadrats on the frequency of species recorded.

2. Methodolgy

In the base line NVC survey (Ausden and Harding 1991) an area of M13 Shoenus nigricans-Juncus subnodulosus seepage mire was identified on Middle Fen (Map 1). This was chosen as the monitoring plot for the following reasons:

1. It was an area under active management and had been identified in the management plan as the highest priority. It was therefore the most likely area to have continuity of management.
2. It was sufficiently large to take a reasonable monitoring plot.
3. With the exception of the floating part of the fen, it is the area most sensitive to hydrological change and would therefore indicate problems the soonest. The floating raft is too small to accommodate a plot.

**Map 1: Location of Monitoring Plot at Thelnetham Middle Fen**
**TM014788**

Hatched area shows location of 20x20m plot, marked on the ground with posts

SCALE: 1:1250

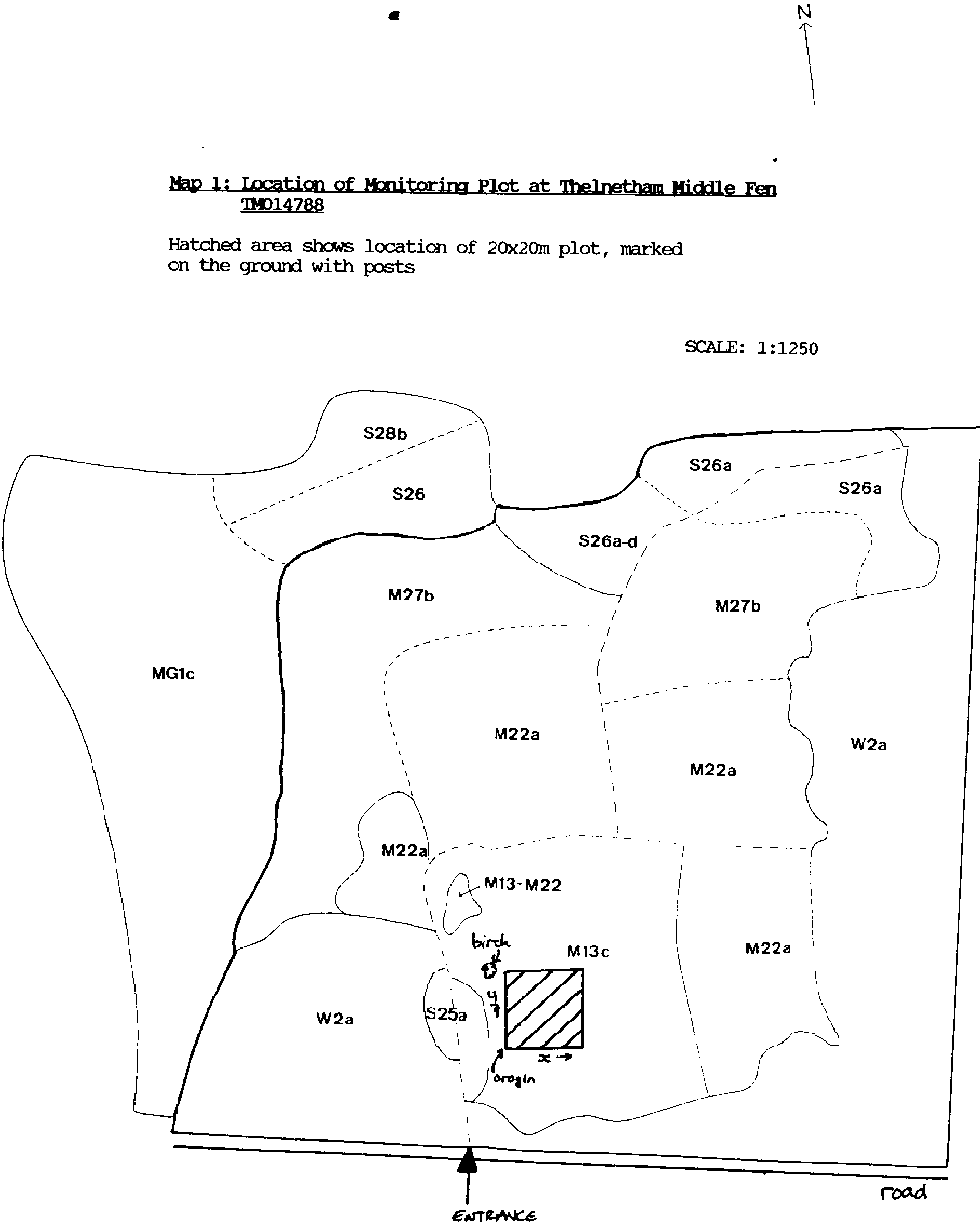


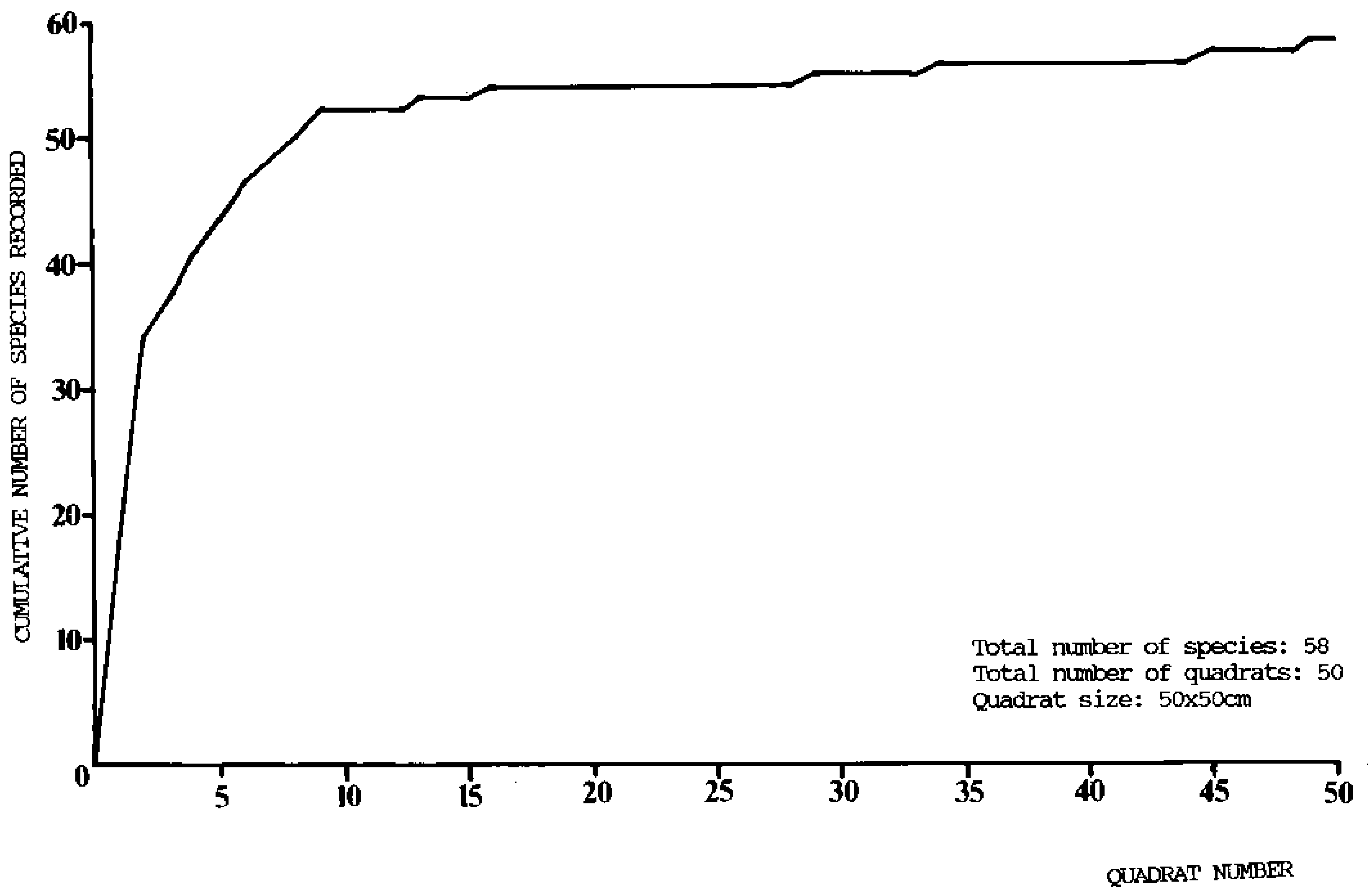
Table 1: Coordinates for Samples at Thelnetham Middle Fen

The orogin is the south-west corner of the plot. Figures in metres

| Sample | X | Y | Sample | X | Y |
|---|---|---|---|---|---|
| 1 | 1.8 | 4.4 | 26 | 15.4 | 18.3 |
| 2 | 8.0 | 13.0 | 27 | 11.2 | 1.4 |
| 3 | 12.6 | 15.0 | 28 | 1.7 | 0.4 |
| 4 | 19.0 | 15.3 | 29 | 17.3 | 12.2 |
| 5 | 17.6 | 12.2 | 30 | 14.8 | 4.8 |
| 6 | 18.5 | 16.4 | 31 | 3.7 | 7.2 |
| 7 | 11.8 | 11.9 | 32 | 6.9 | 20.0 |
| 8 | 15.7 | 4.1 | 33 | 15.5 | 10.1 |
| 9 | 12.0 | 16.3 | 34 | 1.6 | 2.8 |
| 10 | 17.8 | 18.2 | 35 | 17.2 | 16.7 |
| 11 | 8.5 | 14.6 | 36 | 17.9 | 23.1 |
| 12 | 18.5 | 3.7 | 37 | 23.0 | 23.4 |
| 13 | 17.0 | 9.0 | 38 | 5.4 | 17.0 |
| 14 | 6.5 | 2.9 | 39 | 2.9 | 23.5 |
| 15 | 1.4 | 13.2 | 40 | 5.8 | 0.8 |
| 16 | 4.1 | 1.6 | 41 | 7.4 | 5.5 |
| 17 | 1.9 | 12.6 | 42 | 20.8 | 24.8 |
| 18 | 18.5 | 0.1 | 43 | 10.5 | 1.4 |
| 19 | 17.3 | 0.2 | 44 | 12.8 | 15.0 |
| 20 | 9.4 | 15.1 | 45 | 0.7 | 13.9 |
| 21 | 8.1 | 17.0 | 46 | 7.6 | 4.3 |
| 22 | 13.7 | 3.1 | 47 | 8.8 | 18.7 |
| 23 | 14.9 | 6.7 | 48 | 18.9 | 0.2 |
| 24 | 18.9 | 15.0 | 49 | 7.0 | 18.4 |
| 25 | 14.3 | 10.4 | 50 | 18.6 | 13.5 |

Coordinates were generated through random numbers from an electronic calculator.

**Figure 1: Relationship Between Number of Samples and Number of Species Recorded.** Thelnetham Middle Fen, M13 Scheono-juncetum, 1992



The methodology followed that recommended by English Nature for fens of this sort (Fojt, by letter and Wheeler and Shaw 1991) and involves random sampling within the chosen community. A plot of 20x20m was laid out with measuring tapes, a size that fittted the most homogeneous area within the community. The two tapes formed the x and y axis of a plot with the origin in the south-west corner (see Map 1). Coordinates to locate the quadrats were obtained using random numbers generated by a calculator, and are recorded in Table 1. Wheeler and Shaw (1991) identified a 50x50cm quadrat as the most appropriate for this type of work and this size has been adopted for the monitoring programme. Presence of each species rooting in the quadrat was recorded, but abundance was not. All taxa were recorded to species level, including bryophytes. Vegetation height, % cover of herbs, bryophytes and litter were all recorded. No samples recorded water on the surface and the water table was below the surface in all cases. Fifty quadrats were recorded in total.

## 3. Results

Results are presented in Table 2. Species are in frequency order, with the most frequent first, and split into blocks of 20% frequency.

### 1. Baseline Plot Data

The data (Table 2) confirms the community as M13 (c) Schoenus nigricans-Juncus subnodulosus mire, Caltha palustris-Galium uliginosum sub-community. There is a rich assemblage of associated herbs and rich fen bryophytes. Many (eg Drepanocladus revolvens, Riccardia chaemydrifolia) indicate high water levels and calcareous seepage. Overall, the plot was dominated by a mixture of Schoenus, Molinia and Juncus subnodulosus, with an abundance of Cladium mariscus, Carex panicea, valeriana dioica and Succisa pratensis. Because of regular mowing the sward was comparatively even in structure without large tussock stumps. Other species were patchy in occurrence although some (eg Sanguisorba, Filipendula, and Festuca rubra) could be abundant where they did occur. Bryophytes were also abundant, and locally formed the classic brown moss carpet. Their abundance in any particular location seemed to depend upon above ground biomass and quantity of litter.

There appeared to be a distinct gradient within the plot, with the area just west of the origin forming the locus for most of the bryophytes indicating calcareous seepage (Calliergon giganteum, Riccardia chaemydrifolia, Drepanocladus revolvens, etc). Moving north west from here, to the opposite corner of the plot, the vegetation becomes increasingly tall and rank with a greater representation of species of more eutrophic conditions (eg Filipendula ulmaria). Thus there is a muted type of the concentric zonation which was noted for the whole fen by Ausden and Harding (1991).

### 2. The Effect of Quadrat Number

In their study, Wheeler and Shaw (1991) examined the effects of quadrat number on the recording of species richness, in order to determine the number of random samples that would be required to ensure the monitoring included most of the species present on the fen. They recommended that 10 samples be the absolute minimum, but because of the continued increase in species represented in the data set with increased sample number, that it would be undesirable to record less than 30 quadrats. The graph of number of species recorded against number of quadrats for Middle Fen (figure 1) in fact shows 10 samples will record most (90%) of the species, with only small increases with additional samples. In fact 59% of species were recorded in the first two quadrats! This may be because Thelnetham is much richer than any of Wheeler and Shaws plots, with the richest ( a type of M24 Molinia-Cirsium dissectum fen meadow) recording 13-14 species per quadrat compared to 20.4 at Thelnetham.

However, Wheeler and Shaw did not recommend the number of quadrats required to produce a reliable estimate of the frequency of a species, of critical importance in the monitoring exercise. Inaccurate estimates of a species frequency could give misleading results when comparing data from two time periods, with apparent changes in species frequency being a consequence of sample number rather than ecological change.

When Bellamy's plots at Redgrave from 1960 were resurveyed and examined by consultants (EAWC 1990) they found that Bellamy had recorded too few quadrats (15-25 depending on plots) to identify changes which were statistically significant, either in frequency or abundance scores, for all except a handful of species. This is despite the gross changes that had taken place. If monitoring is to be at all useful, it must pick up changes a long time before they had become so obvious as at Redgrave and therefore it seems that to produce reliable estimates which will identify significant but small changes, much larger data sets than the 30 identified by Wheeler and Shaw (1991) must be used.

Intuitively, and statistically, the more quadrats that are taken, the more reliable the estimate will be, and therefore at Thelnetham 50 quadrats were recorded. It was hoped to see how quickly the frequency estimates stabilised as sample number increased. Cumulative frequency scores were therefore calculated for all species in blocks of 10 samples (see Table 2). Some species appear to have stable frequency very quickly, while some frequencies vary wildly. It was considered that an acceptable and stable estimate of frequency was established when the cumulative frequency varied at less than 5% between successive blocks of ten samples, and was also within 5% of the final frequency.

Table 3 groups the species according to how many quadrats were required to stabilise their frequency. It can be seen that in general, the more frequent the species, the fewer the quadrats that are required, although there are exceptions. The very frequent species could be estimated accurately with 10 or 20 samples. However, these are less important in the monitoring - previous experience (Fojt and Harding 1992) shows that the dominants do not change without the grossest of environmental change. It is the less frequent associates which tend to react to change the quickest. Wheeler and Shaw (1991) also identified the species of middling frequency to be the greatest use in monitoring. It can be seen from Table 3 therefore that to gain accurate frequency estimates of the majority of these species, at least 40 samples are required. However, several important plants had not stabilised by then, and it is likely that for the community as a whole 50 samples are required.

Estimates made by the England Field Unit for grasslands (NCC 1990) suggested 200 quadrats of 10x10cm produced reliable frequencies.

Table 2: Numbers of Quadrats required for species frequency to stabilise. Figure in parenthesis are final frequency. Species with final frequency of less than 10% omitted. See text for method of compilation.

**Species where frequency stable after 10 samples:**

Carex panicea (100) Campylium stellatum (94) Riccardia chaemydrifolia (12) Juncus subnodulosus (100) Valeriana dioica (90) Drepanocladus revolvens (10) Molinia caerulea (94) Oenanthe lachenalii (58) Schoenus nigricans (94) Festuca rubra (30)

Mean final frequency: 68.2

**Species where frequency stable after 20 samples:**

Calliergon cuspidatum (98) Succisa pratensis (94) Angelica sylvestris (62) Cirsium palustre (86) Cladium mariscus (88) Holcus lanatus (18) Ctenidium molluscum (16) Carex flacca (10)

Mean final frequency: 59.0

**Species where frequency stable after 30 samples:**

Galium uliginosum (66) Lophocolea cuspidata (54) Aneura pinguis (14) Pseudoscleropodium purum (48) Eurynchium speciosum (10)

Mean final frequency: 38.4

**Species where frequency stable after 40 samples:**

Mentha aquatica (82) Fissidens adianthoides (62) Hydrocotyle vulgaris (58) Lythrum salicaria (46) Chiloscyphus polyanthus (38) Agrostis stolonifera (34) Eupatorium cannabinum (50) Valeriana officinalis (24) Plagiomnium affine (22) Sanguisorba officinalis (14) Brachythecium rutabulum (12) Festuca arundinacea (12) Carex elata (12) Taraxacum officinale (10) Bryum pseudotriquetrum (10)

Mean final frequency: 32.4

**Species where frequency stable after 50 samples:**

Phragmites australis (64) Filipendula ulmaria (42) Vicia cracca (27)

Mean final frequency: 44.3

## 4. Further Work

The analysis of frequency here has been extremely crude and is not statistical. However this is an important aspect which needs more detailed investigation. Other questions of concern are:

1. How is monitoring data best analysed? Comparing two years information may be easy, but how do you analyse a data set with ten time series? Should it be statistical or should it be based on an ordination technique?
2. Who is to undertake such analyses? We do not have access to computing power sufficient to analyse such data, nor the time, nor the expertise.
3. Who is coordinating the monitoring? Someone needs to, and English Nature are the obvious ones.
4. How is data storage to be handled?
5. What is the recommended periodicity for recording the plots?

These are critical questions outside of Wheeler and Shaws study. If we are to avoid wasting much effort they need to be answered swiftly.

## 5. References


Bellamy, D and Rose, F (1960) The Waveney-Ouse Valley Fens of the Suffolk-Norfolk Border. Trans. Suff. Nats. V.2 346-385.

FAWC (1990) Water Resources Study Stage 2. Redgrave Sub-Study, Progress Report 2.2. Suffolk Water Company, Lowestoft.

EFU (1990) Monitoring Techniques in Grasslands. English Nature, Peterborough.

Fojt, F. and Harding, M (1992) Changes in 3 Suffolk Fens Over 30 Years. In Press.

Wheeler, B and Shaw, S (1991) Vegetation Changes at Chippenham Fen. Monitoring Procedures and Baseline Data for 1991. Report to English Nature, Peterborough.


## 6. Circulation

In order to prevent loss of this data (a common event!) it has been widely circulated to those who collate data on this:

| | |
|---|---|
| SWT Reserve File | SWT Redgrave and Lopham Office |
| SWT Warden, Thelnetham Fen | English Nature Bury St Edmunds |
| English Nature East Region Science | Suffolk Biological Records Centre |

M. Harding 21 October 1992
Reserves Manager

# Table 2: Monitoring Plot Data

| SAMPLE NUMBER | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | CF | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | CF | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | CF | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | CF | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | CF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carex panicea | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | P | P | P | 100 |
| Juncus subnodulosus | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | P | P | P | 100 |
| Calliergon cuspidatum | P | P | P | P | . | P | P | P | P | P | 90 | P | P | P | P | P | P | P | P | P | P | 95 | P | P | P | P | P | P | P | P | P | P | 97 | P | P | P | P | P | P | P | P | P | P | 98 | P | P | P | P | P | P | P | P | P | P | 98 |
| Molinia caerulea | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | P | P | P | 100 | P | P | P | P | P | P | P | . | P | P | 97 | P | P | P | P | P | P | P | . | P | P | 95 | P | P | P | P | P | P | P | P | P | . | 94 |
| Schoenus nigricans | P | P | P | P | . | P | P | P | P | P | 90 | P | P | P | P | P | P | P | P | P | P | 95 | P | P | P | P | P | P | P | P | P | P | 97 | P | P | P | P | P | P | P | . | . | P | 93 | P | P | P | P | P | P | P | P | P | P | 94 |
| Succisa pratensis | . | P | P | P | . | P | P | P | P | P | 80 | P | P | P | P | P | P | P | . | P | P | 90 | P | P | P | P | P | P | P | P | P | P | 90 | P | P | P | P | P | P | P | P | P | P | 93 | P | P | P | P | P | P | P | P | P | P | 94 |
| Campylium stellatum | P | P | P | P | P | P | P | . | P | P | 90 | P | P | P | P | P | P | P | P | P | P | 95 | P | P | P | P | P | P | P | P | . | . | 90 | P | P | P | P | P | P | P | P | P | P | 93 | P | P | P | P | P | P | P | P | P | P | 94 |
| Valeriana dioica | P | P | P | P | . | P | P | P | P | P | 90 | P | P | P | P | P | P | P | P | P | P | 95 | P | P | . | P | P | P | P | P | P | P | 93 | . | P | P | P | . | P | . | P | P | P | 88 | P | P | P | P | P | P | P | P | P | P | 90 |
| Cladium mariscus | P | P | P | . | . | P | P | P | P | P | 80 | P | P | . | P | P | P | P | P | P | P | 85 | P | P | P | P | . | P | P | P | . | P | 83 | P | P | P | P | P | P | P | P | P | P | 88 | P | P | P | P | P | P | P | P | P | P | 88 |
| Cirsium palustre | P | P | P | P | P | P | P | P | P | P | 100 | . | P | P | P | . | . | P | . | P | P | 80 | . | P | P | . | P | P | P | P | P | P | 80 | P | P | P | P | P | P | P | P | P | P | 85 | P | P | P | P | P | P | P | P | . | P | 86 |
| Mentha aquatica | . | P | P | P | P | P | P | . | P | P | 80 | P | . | P | . | P | P | . | . | . | P | 65 | P | P | P | P | P | P | P | P | P | P | 77 | P | P | P | P | P | P | P | P | P | P | 83 | P | P | . | P | P | . | P | P | P | P | 82 |
| Galium uliginosum | P | P | P | P | . | P | P | P | P | P | 90 | . | . | P | P | P | P | . | . | P | P | 75 | . | . | P | P | P | P | . | . | P | P | 70 | . | P | . | P | P | P | P | P | P | P | 73 | P | P | . | . | . | P | P | . | . | . | 66 |
| Phragmites australis | . | P | P | . | . | . | P | . | P | . | 40 | P | P | P | P | P | P | P | . | P | P | 65 | P | P | . | P | P | P | P | . | P | . | 67 | . | P | P | P | P | . | P | P | P | P | 70 | . | P | . | P | P | . | P | . | . | . | 64 |
| Fissidens adianthoides | P | P | . | P | . | P | P | . | P | P | 70 | . | P | P | P | . | P | . | P | P | . | 65 | . | P | P | P | P | . | P | P | . | P | 67 | . | P | P | P | . | . | . | . | . | P | 60 | P | P | P | P | P | . | P | . | . | P | 62 |
| Angelica sylvestris | P | P | P | . | . | . | P | P | P | P | 70 | P | P | P | . | . | P | . | P | . | . | 60 | P | . | . | . | P | P | P | . | P | P | 60 | P | P | P | . | . | . | . | P | P | P | 60 | P | . | . | P | P | P | P | . | P | P | 62 |
| Oenanthe lachenalii | P | P | P | P | . | P | P | . | . | . | 60 | . | . | P | . | . | P | P | P | . | P | 55 | P | P | . | P | P | . | P | P | P | . | 60 | P | . | . | P | P | . | . | P | . | . | 55 | P | . | P | . | P | P | . | P | P | P | 58 |
| Hydrocotyle vulgaris | . | P | P | P | . | . | P | P | P | . | 60 | P | . | . | . | P | P | P | . | . | P | 55 | P | . | . | P | . | . | . | P | P | . | 50 | P | P | P | P | P | . | . | P | P | P | 58 | . | P | P | P | . | . | P | . | P | P | 58 |
| Lophocolea bidentata | . | P | . | P | P | . | P | . | . | P | 50 | . | . | . | P | P | . | . | . | . | P | 40 | . | . | P | P | P | P | P | P | P | . | 50 | P | P | P | P | . | P | . | . | . | P | 53 | P | P | P | P | P | . | P | . | . | . | 54 |
| Eupatorium cannabinum | P | P | . | P | . | . | P | . | P | . | 50 | . | P | P | . | . | P | . | P | . | P | 50 | . | P | . | P | P | P | P | . | P | P | 57 | P | . | . | . | . | . | . | P | . | P | 50 | . | . | . | P | P | P | P | . | P | . | 50 |
| Pseudoscleropodium purum | . | P | . | . | . | P | P | P | P | . | 50 | P | P | . | P | P | . | . | . | P | P | 55 | P | P | P | . | . | . | . | . | . | . | 47 | P | P | . | . | . | . | P | . | P | . | 45 | . | . | P | . | P | P | P | P | P | . | 48 |
| Lythrum salicaria | P | P | P | P | . | P | P | . | P | P | 80 | P | . | P | . | . | . | . | . | . | P | 55 | . | . | . | P | . | P | P | P | . | P | 53 | P | P | . | P | . | . | . | . | . | . | 48 | P | P | . | . | P | . | P | . | . | . | 46 |
| Filipendula ulmaria | P | P | . | . | P | P | . | . | . | P | 50 | . | . | . | P | P | . | P | . | . | P | 45 | . | P | P | P | . | . | P | P | . | . | 47 | P | P | . | P | P | P | P | . | P | . | 53 | P | . | P | . | P | P | P | P | P | . | 42 |
| Chiloscyphus polyanthus | . | . | . | . | . | P | . | . | P | . | 20 | P | P | . | P | . | . | . | . | P | P | 35 | . | . | P | P | P | P | P | . | . | P | 43 | . | . | . | P | P | P | . | . | . | . | 35 | P | P | . | . | . | . | . | . | P | . | 38 |
| Agrostis stolonifera | . | . | P | P | . | . | . | . | P | . | 30 | P | . | . | P | P | . | P | . | . | . | 35 | P | . | . | P | P | P | P | P | . | . | 43 | . | . | . | . | . | . | . | . | P | P | 30 | P | . | . | . | . | . | . | . | P | . | 34 |
| Festuca rubra | . | . | . | . | P | . | . | P | . | P | 30 | . | P | . | . | . | . | . | P | P | . | 30 | . | P | P | . | . | . | . | . | . | P | 30 | . | . | . | P | P | P | . | . | . | . | 30 | . | . | P | P | . | . | . | P | . | . | 30 |
| Valeriana officinalis | . | P | . | . | . | . | P | . | P | . | 30 | . | . | . | . | . | . | . | . | . | . | 15 | P | . | P | . | . | . | . | . | . | . | 15 | . | . | . | P | . | P | P | . | . | . | 20 | . | . | . | . | P | P | P | . | P | . | 24 |
| Vicia cracca | . | . | . | P | P | . | . | P | . | . | 30 | . | . | . | . | . | . | . | P | . | . | 20 | . | . | P | P | . | P | . | . | P | . | 27 | . | . | . | P | P | P | . | . | . | . | 28 | . | . | . | . | . | . | . | . | . | . | 22 |
| Plagiomnium affine | . | . | P | . | . | . | P | . | . | . | 20 | . | . | P | P | P | . | . | . | . | . | 25 | . | P | . | . | P | . | P | . | . | P | 30 | . | . | P | . | . | . | . | . | . | . | 25 | . | . | . | P | . | . | . | . | . | . | 22 |
| Holcus lanatus | . | P | . | . | . | . | . | . | . | . | 10 | P | . | . | P | . | . | . | . | . | P | 20 | P | . | . | . | . | . | . | . | . | . | 17 | . | P | . | . | . | . | . | P | P | . | 20 | . | . | . | . | . | . | . | . | P | . | 18 |
| Ctenidium molluscum | . | . | . | . | . | . | . | P | P | . | 20 | . | . | . | P | . | . | . | . | . | . | 15 | . | . | P | . | . | . | P | . | . | P | 20 | . | . | . | . | . | . | . | . | . | . | 15 | . | P | . | . | P | . | . | . | . | . | 16 |
| Sanguisorba officinalis | . | . | . | . | . | . | . | P | . | . | 10 | . | P | . | . | . | . | . | P | P | . | 20 | . | P | P | . | . | . | . | . | . | . | 20 | . | . | . | . | . | . | . | . | . | . | 15 | . | . | P | . | . | . | . | . | . | . | 14 |
| Aneura pinguis | P | . | . | P | . | . | P | . | . | . | 30 | . | P | . | . | . | . | . | . | . | . | 20 | . | . | . | . | . | . | . | . | P | . | 17 | . | . | . | . | . | . | . | . | . | . | 13 | P | P | . | . | . | . | . | . | . | . | 14 |
| Riccardia chaemydrifolia | . | P | . | . | . | . | . | . | . | . | 10 | . | P | . | . | . | . | . | . | . | . | 10 | . | P | P | . | . | . | . | . | . | . | 13 | P | P | . | . | . | . | . | . | . | . | 15 | . | . | . | . | . | . | . | . | . | . | 12 |
| Brachythecium rutabulum | . | . | . | . | P | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 5 | . | . | . | . | . | . | . | . | . | . | 3 | . | P | . | P | P | . | . | . | . | . | 10 | . | . | . | P | . | P | . | . | . | . | 12 |
| Festuca arundinacea | . | . | . | P | P | . | P | . | . | P | 40 | . | . | . | . | . | . | . | . | . | . | 20 | . | . | . | P | . | . | . | . | P | . | 20 | . | . | . | . | . | . | . | . | . | . | 15 | . | . | . | . | . | . | . | . | . | . | 12 |
| Carex elata | . | . | . | . | . | . | . | P | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 5 | . | P | . | . | . | . | . | . | . | . | 7 | . | . | . | . | . | . | P | P | . | P | 13 | . | . | . | . | . | . | . | P | . | . | 12 |
| Taraxacum officinalis | . | . | . | . | . | P | . | . | . | . | 10 | . | . | . | . | . | . | . | . | P | P | 15 | . | P | . | . | . | . | P | . | . | . | 17 | . | . | . | . | . | . | . | . | . | . | 13 | . | . | . | . | . | . | . | . | . | . | 10 |
| Bryum pseudotriquetrum | . | P | . | . | . | . | P | . | . | . | 20 | . | . | . | . | . | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 6 | . | . | . | P | P | . | . | . | . | P | 13 | . | . | . | . | . | . | . | . | . | . | 10 |
| Drepanocladus revolvens | . | . | P | . | . | . | . | . | . | . | 10 | . | . | . | . | . | P | . | . | . | . | 10 | . | . | . | . | . | . | . | P | . | . | 10 | . | . | P | . | . | . | . | . | . | P | 13 | . | . | . | . | . | . | . | . | . | . | 10 |
| Eurynchium speciosum | . | . | . | . | . | . | . | . | P | . | 10 | . | . | P | . | P | . | . | . | P | . | 20 | . | . | . | . | . | . | . | . | . | . | 13 | . | . | . | . | . | P | . | . | . | . | 13 | . | . | . | . | . | . | . | . | . | . | 10 |
| Carex flacca | . | P | . | . | . | P | . | . | . | . | 20 | . | . | . | . | . | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 7 | . | . | . | . | . | . | . | P | P | . | 10 | . | . | . | . | . | . | . | P | . | . | 10 |
| Quercus robor sapling | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | P | . | 10 | . | . | . | . | . | . | P | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 8 |
| Betula pendula seedling | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | P | . | . | . | . | 5 | . | . | . | . | . | . | . | P | . | . | 7 | . | . | . | P | . | . | . | . | . | . | 8 | . | P | . | . | . | . | . | . | . | . | 8 |
| Calliergon giganteum | . | . | P | . | . | . | . | . | . | . | 10 | . | . | . | . | . | P | . | . | . | . | 10 | . | . | . | . | . | . | . | P | . | . | 10 | . | . | . | . | . | . | . | . | . | P | 10 | . | . | . | . | . | . | . | . | . | . | 8 |
| Salix spp. | . | . | . | . | . | . | . | . | . | . | 0 | . | . | P | . | . | . | P | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 7 | . | . | . | . | . | . | . | P | . | . | 8 | . | . | . | . | . | . | . | . | . | . | 6 |
| Eurynchium praelongum | . | . | . | P | P | . | . | . | . | . | 20 | . | . | . | . | . | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 7 | . | . | . | . | . | . | . | . | . | . | 5 | P | . | . | . | . | . | . | . | . | . | 6 |
| Arrhenatherum elatius | . | . | . | . | . | . | . | . | P | . | 10 | . | . | . | . | . | . | . | . | . | . | 5 | . | . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | P | P | . | . | . | 8 | . | . | . | . | . | . | . | . | . | . | 6 |
| Carex lepidocarpa | . | . | . | P | . | . | . | . | . | P | 20 | . | . | . | . | . | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 7 | P | . | . | . | . | . | . | . | . | . | 8 | . | . | . | . | . | . | . | . | . | . | 6 |
| Iris pseudacorus | . | . | . | . | P | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 5 | . | . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | . | P | . | . | . | 5 | . | . | . | . | . | . | . | . | . | . | 4 |
| Lotus uliginosus | . | P | . | . | . | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 5 | . | . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | 2 |
| Cardamine pratensis | . | P | . | . | . | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 5 | . | . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | 2 |
| Hypericum tetrapterum | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | P | . | 2 |
| Ranunculus flammula | . | . | . | . | . | P | . | . | . | . | 10 | P | . | . | . | . | . | . | . | . | . | 10 | . | . | . | . | . | . | P | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | 2 |
| Viburnum opulus seedling | . | P | . | . | . | . | . | . | . | . | 10 | . | . | . | . | . | . | . | . | . | . | 5 | . | . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | 2 |
| Rhizomnium punctatum | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | P | . | . | . | . | . | . | 3 | . | . | . | . | . | . | . | . | . | . | 2 |
| Equisetum palustre | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | . | . | . | . | . | . | 0 | . | . | . | . | P | . | . | . | . | . | 2 |
| Vegetation height (cm) | 50 | 50 | 50 | 50 | 75 | 50 | 40 | 50 | 50 | 50 | | 30 | 50 | 50 | 60 | 40 | 30 | 30 | 70 | 75 | 30 | | 40 | 50 | 40 | 60 | 60 | 80 | 40 | 40 | 60 | 50 | | 60 | 40 | 25 | 50 | 65 | 70 | 70 | 30 | 40 | 30 | | 60 | 40 | 50 | 50 | 70 | 50 | 40 | 50 | 40 | 25 | 49.1 |
| % Cover herbs | 60 | 60 | 60 | 90 | 100 | 90 | 70 | 80 | 70 | 90 | | 70 | 90 | 80 | 90 | 80 | 60 | 90 | 90 | 100 | 80 | | 80 | 65 | 90 | 90 | 80 | 90 | 80 | 60 | 90 | 90 | | 80 | 95 | 80 | 90 | 100 | 100 | 100 | 40 | 80 | 50 | | 40 | 90 | 80 | 90 | 80 | 90 | 90 | 80 | 90 | 60 | 80.4 |
| % Cover bryophytes | 60 | 60 | 70 | 30 | 5 | 30 | 45 | 30 | 30 | 30 | | 20 | 50 | 70 | 50 | 60 | 75 | 30 | 40 | 50 | 40 | | 30 | 40 | 60 | 30 | 50 | 40 | 70 | 70 | 50 | 60 | | 30 | 30 | 60 | 40 | 50 | 20 | 20 | 85 | 40 | 80 | | 60 | 30 | 70 | 50 | 60 | 40 | 60 | 60 | 20 | 40 | 46.4 |
| % Cover litter | 14 | 40 | 20 | 40 | 80 | 40 | 30 | 30 | 20 | 50 | | 70 | 35 | 40 | 60 | 40 | 20 | 40 | 50 | 50 | 30 | | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 50 | 50 | 40 | | 70 | 50 | 40 | 40 | 50 | 90 | 100 | 40 | 80 | 40 | | 40 | 60 | 50 | 30 | 30 | 70 | 30 | 50 | 80 | 90 | 49.0 |
| Total number species | 17 | 30 | 21 | 23 | 14 | 20 | 26 | 17 | 23 | 21 | | 19 | 20 | 21 | 21 | 19 | 19 | 17 | 15 | 19 | 21 | | 16 | 26 | 22 | 23 | 20 | 20 | 25 | 19 | 23 | 20 | | 20 | 23 | 18 | 24 | 21 | 19 | 21 | 20 | 19 | 23 | | 22 | 21 | 18 | 21 | 22 | 18 | 23 | 17 | 21 | 14 | 20.4 |

**Site: Middle Fen, Thelnetham, Suffolk, NGR TM 014788**

P = Present . = Absent CF = Cumulative Frequency

Quadrat size: 50x50cm, Plot size 20x20m. See attached map for location