Table 12. Possible indicator species for assessing dehydration in East Anglian valley fens

Ebq: Ellenberg 'moisture value'
Ind: - species associated with fluctuating water conditions (Ellenberg)
= species found in sites that are periodically inundated (Ellenberg)

Water table values are expressed as cm relative to the soil surface.

Entries in bold type refer to relatively common species (in East Anglian valley fens)

Species suggestive of high water-table conditions in fens

NVC	Name	Ebq	Ind	Wtab EE	Wtab UK	Fert	%man
132	Beru erec	10	-	3.3	2.2	18.41	0
179	Calt palu	8	=	-6.09	-4.47	16.69	33.3
213	Care dian	9	=	-3.33	4.34	9.04	100
215	Care dioi	9		-4.85	-0.86	6.09	50
229	Care lepi	8		-3.5	-2.27	7.6	50
240	Care pani	9	=	-5.6	-3.63	19.85	0
371	Dact trau	9	=	-3.8	-1.03	7.9	50
392	Dros angl	9	=	-0.67	1.93	6.79	25
410	Eleo quin	9		-2.67	-1.51	6.5	33.3
425	Epil palu	9		-6.67	-1.91	9.52	100
433	Equi fluv	10		-4.1	-2.27	15.58	63.6
435	Equi palu	X		-3.95	-3.67	12.24	42.9
447	Erio lati	9		-4.35	-3.52	6.02	100
509	Gali palu	9	=	-2.64	-2.18	15.53	55.6
665	Lemn mino	11		0.1	0.45	19.39	50
755	Ment aqua	9	=	-7.88	-4.84	12.8	51.2
762	Meny trif	9	=	-6.67	-0.17	9.59	42.9
786	Myos laxa	8	-	-3.4	-3.57	23.67	100
810	Oena fist	9	=	-2.4	-2.4	13.16	0
811	Oena lach			-6.8	-7.39	5.66	50
846	Pedi palu	9	=	-4.24	-0.76	9.15	41.7
870	Ping vulg	8		-5.94	-2.83	6.84	77.8
937	Pota poly	12		-4.2	1.81	6.92	66.7
989	Ranu flam	9	-	-2.1	0.68	9.5	71.4
1254	Trig palu	9	=	-5.2	-2.43	6.84	50
1294	Vero becc	10		-3.4	-3.13	23.67	100
1496	Crat comm			-1.2	-2.22	11.56	50
1558	Drep revo			-2.29	-1.86	7.81	50
1691	Plag affi			-7.65	-3.78	8.89	50
1700	Rhiz pseu			-5.1	-1.16	13.95	100
1701	Rhiz punc			-5	-0.49	6	100
1704	Plag elat			-5.4	-4	5.05	100
1745	Phil calc			-2.65	-1.05	7.27	50
1873	Spha subn			-6.3	-1.6	8.96	37.5
2122	Pell endi			-0.2	-3.17	12.49	50
2154	Ricc mult			-8.2	-2.14	10.74	100
2157	Ricc cham			-0.3	-0.02	7.2	50

Species frequently associated with low-water conditions in fens

169	Cala cane	9	~	-18.9	-18.9	11.63	75
421	Epil hirs	8	=	-5.54	-13.14	19.96	0
483	Fili ulma	8		-11.4	-8.54	15.3	50
709	Luzu mult	6	~	-19.09	-8.53	11.42	66.7
776	Moli caer	7	~	-10.98	-2.49	9.27	47.9
946	Pote erec	X		-17.12	-5.38	9.45	56.7
1205	Succ prat	7	~	-15.02	-4.69	9.12	61.5

APPENDIX A

ACQUISITION OF INFORMATION ON THE PAST AND PRESENT CONDITION OF EAST ANGLIAN VALLEY FENS AND OF THEIR FLORISTIC AND VEGETATIONAL RESOURCE

SOURCES OF INFORMATION

The major sources of information used in this study are identified. Some of the limitations of each of them are discussed below.

Floras and Plant lists

The major floras and plant lists for each of the vice-counties has been consulted. These include (arranged by date):

SUFFOLK (v/c 25/26)

Turner, D & Dillwyn, L.W. (1805). *The Botanist's Guide through England and Wales. Vol II.* Phillips & Fardon, London

Suckling, R.A. (1846). *The History & Antiquities of the County of Suffolk, Vol 1 Part 1.* J. Veale, London

Henslow, J.S. & Skepper, E. (1860). *Flora of Suffolk.* Simpkin & Marshal, London.

Hind, W.M. (1889). *The Flora of Suffolk.* Gurney & Jackson, London.

Bloomfield, E.N. (1911). Botany. In: *The Victoria History of the Counties of England & Wales. A History of Suffolk. Vol 1.* (ed. by W Page), pp. 47-84. University of London, London.

Mayfield, A. (1935). The hepatics, mosses and lichens of Suffolk. *Ipwich & District Natural History Society*, 1, 89-140.

Trist, P.J.O. (1979). *An Ecological Flora of Breckland.* EP Publishing, Wakefield.

Simpson, F.W. (1982). *Simpson's Flora of Suffolk.* Suffolk Naturalists' Society, Ipswich.

NORFOLK (v/c 27/28)

Linnaeus, C. (1775). *Elements of Botany*, Cadell, London. *[A translations of the* Philosophia Botanica *and other Treatises of the Celebrated Linnaeus to which is added an appendix, wherein are described some plants lately found in Norfolk and Suffolk, by Hugh Rose, Apothecary]*

Turner, D & Dillwyn, L.W. (1805). *The Botanist's Guide through England and Wales. Vol II.* Phillips & Fardon, London

Paget, C.J. & Paget, J. (1834). *Sketch of the Natural History of Yarmouth and its Neighbourhood.* Longman, Rees, London

Mundford, G. (1841). *A list of Flowering Plants found growing wild in West Norfolk.* [*Annals & Magazine of Natural History*].

Trimmer, K. (1866). *Flora of Norfolk.*

Trimmer, K. (1885). *Supplement.*

Galpin, F.W. (1888). *The Flowering Plants and Birds of Harleston in Norfolk.* Bartlett, London.

Geldart, H.D. (ed)(1901). *Botany.* In: *The Victoria History of the Counties of England. Norfolk. Vol 1.* (ed by H.A. Doubleday), Constable, London.

Nicholson, W.A. (1914). *Flora of Norfolk.*

Petch, C.P. & Swann, E.L. (1962). *West Norfolk Plants Today.* BSBI.

Petch, C.P. & Swann, E.L. (1968). *Flora of Norfolk.* Jarrold, Norwich.

Petch, C.P. & Swann, E.L. (1975). *Supplement to the Flora of Norfolk.* Crowe, Norwich.

Trist, P.J.O. (1979). *An Ecological Flora of Breckland.* EP Publishing, Wakefield.

Swann, E.L. (1982). Norfolk bryophytes today. *Journal of Bryology*, **12**, 77-112.

CAMBRIDGE (V/C 29)

Ewer, A.H. & Prime, C.T. (transl. 1975) *Ray's Flora of Cambridgeshire (1660).* Wheldon & Wesley, Hitchin.

Turner, D & Dillwyn, L.W. (1805). *The Botanist's Guide through England and Wales. Vol I* (pp 41-71). Phillips & Fardon, London

Babington, C.C. (1860). *Flora of Cambridgeshire.* van Voorst, London.

Marshal, W. (1878). Chapter 10 *Botany of the Fenland.* In: Miller, S.H. & Skertchley, S.B.J., *The Fenland Past & Present.* Longmans, London.

Godwin, H. (1938). Botany. In: *Victoria History of the Counties of England. A History of the County of Cambridge and the Isles of Ely. Vol 1.* (ed. by L.F. Salzman) pp. 35-76. Oxford University Press, Oxford.

Evans, A.H.. (1939). *A Flora of Cambridgeshire.* Gurney & Jackson, London.

Proctor, M.C.F. (1956). A bryophyte flora of Cambridgeshire. *Transactions of the British Bryological Society*, **3**, 1-49.

Perring, F.H., Sell, P.D., Walters, S.M. & Whitehouse, H.L.K. (1964). *A Flora of Cambridgeshire.* Cambridge University Press, Cambridge.

Walters, S.M. (1965). Natural History. In: *The Cambridge Region 1965* (ed bt J.A. Steers), pp. 51-67.

Crompton, G. & Whitehouse, H.L.K. (1983). *A Checklist of the Flora of Cambridgeshire.* University Printing Services, Cambridge.

Although *Flora* records are sometimes invaluable, their use is often limited, mainly because (a) it is not always clear to exactly which site they refer; and (b) the date and status of the record is not always evident. In consequence, *Flora* records are used only in the absence of other, more satisfactory information. In sites where species remain extant, their past listing in *Floras* is not of great importance to this study, and in these cases, or where the data from the *Floras* are subsumed by more recent information, the information from the *Floras* may not be presented.

Other published records of species

Plant records published in the following journals have been examined:

Journal of Botany
Nature in Cambridgeshire.
Proceedings of the Botanical Society of the British Isles
Proceedings of the Suffolk Naturalists' Society
Reports of the Botanical Society and Exchange Club
Transactions of the British Bryological Society
Transactions of the Norfolk & Norwich Naturalists' Society
Watsonia

Published accounts of sites

Published accounts of East Anglian fen sites have been examined in:
Journal of Ecology
Transactions of the Norfolk & Norwich Naturalists' Society
Proceedings of the Suffolk Naturalists' Society
Nature in Cambridgeshire.
Proceedings of the Linnaean Society

Site information is also available in various other publications, such as:
Manning, M. (ed) (1988). *Commons in Norfolk*. Norfolk Research Committee, Norfolk.

Details are given for individual sites.

Where available, the information provided by these sources is often of exceptional value. Unfortunately, rather few sites are thus encompassed.

Accounts of sites in reports and theses

A range of site information is available in 'semi-published' form, as reports and theses. Sources that refer to several sites include:

Ph.D. theses.

Haslam, S.M. (1960). *The Vegetation of the Breck Fen Margin.* Ph.D. thesis, University of Cambridge.

Bellamy, D.J. (1967). *Ecological Studies on some European Mires.* Ph.D. thesis, University of London.

Wheeler, B.D. (1975). *Phytosociological Studies on Rich-fen Systems in England & Wales.* Ph.D. thesis, University of Durham.

Reports

England Field Unit (1982). *Norfolk and Suffolk Commons: Botanical Survey of Selected Sites.* Project No 16, July 1982. Nature Conservancy Council, Peterborough.

Wheeler, B.D. & Shaw, S.C. (1987). *Comparative Survey of Habitat Conditions and Management Characteristics of Herbaceous Rich-fen Vegetation Types.* Contract Survey No. 6, Nature Conservancy Council, Peterborough.

Fojt, W. (1990). *Comparative Survey of Selected Norfolk Valley Head Fens.* Contract Survey No. 87, Nature Conservancy Council, Peterborough.

Roberts, N. & Smyth, W. (1990). *Norfolk Grassland Survey 1987-1988.* Nature Conservancy Council, East Anglia Region.

Shaw, S.C. & Wheeler, B.D. (1990). *Comparative Survey of Habitat Conditions and Management Characteristics of Herbaceous Poor-fen Vegetation Types.* Contract Survey No. 129, Nature Conservancy Council, Peterborough.

Shaw, S.C. & Wheeler, B.D. (1991). *A Review of The Habitat Conditions and Management Characteristics of Herbaceous Fen Vegetation Types in Lowland Britain.* Report to Nature Conservancy Council, Peterborough.

Reports relating to individual sites are not itemised here. (See individual site accounts).

Unpublished information

Unpublished notes, species lists, surveys, management plans etc. have been examined at the following sources:

English Nature [Bury St Edmunds, Norwich, Peterborough offices]:
- Scientific files
- SSSI renotification files
- Archive files

Norfolk Naturalists' Trust [Norwich office]
- Site files

Cambridge & Isle of Ely Naturalists' Trust [Fulbourn office]
- Site files

Suffolk Wildlife Trust [Saxmundham office]
- Site files

Castle Museum [Norwich]
- Site files
- Herbarium (selected species only)

In general, the greatest amount of site information available was in site files of the English Nature offices, where reports, notes and letter from various individuals, not necessarily EN staff, were held.

Unpublished notes, lists etc. provide a valuable, if sometimes exasperating, source of information. Much of the information they contain is unobtainable elsewhere, but the quality is variable: many site lists are incomplete, either because they were not intended to be comprehensive, or because of taxonomic difficulties; textual information has sometimes become divorced from maps to which it ostensibly refers; and a few documents are undated (it is sometimes possible to guess an approximate date)

Field records

The following field notebooks and records have been examined:

F. Rose (1945 - 1991) (Norfolk and Suffolk)
B.D. Wheeler (1972-1991) (mainly Norfolk and Cambridge)

Comments on field sites have been made by:

P.W. Lambley

Historical maps

The following sources have been examined:

Faden, W. (1797). *A New Topographical Map of the County of Norfolk.* (Surveyed 1790-94 by T. Donald and T. Milne). 1" to 1 mile.

Faden, W. (1783). *The County of Suffolk.* (Surveyed by J. Hodskinson). 1" to 1 mile.

1st edition Ordnance Surveys (6" to 1 mile; 25" to 1 mile). Surveyed 1880s-1890s.

The Faden maps are astonishingly useful documents for showing the state of the landscape at around the time of Inclosure, as they are (for the time) both surprisingly detailed and accurate. Their main value here is in showing whether the sites are marked as "marsh", "rough pasture"[1] or as "normal", i.e., cultivated, land, and for helping to locate some "lost" fen sites. The 1st edition OS 6" and 25" surveys have been used in much the same way, but are relevant to the late nineteenth century. (The earlier 1st edition 1" series (1830s-40s) is generally of little value as they tend not to distinguish the fen sites.

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1 The Faden Suffolk map does not clearly discriminate between marsh and other forms of uncultivated land.

Inclosure and Tithe documents.

For each county the following published documents were consulted:

Reports of the Commissioners appointed in Pursuance of Acts of Parliament to Inquire Concerning Charities and *Education of the Poor in England and Wales.*
The Charities in the County of Norfolk (Vol 23)(1815-1839)
The Charities in the County of Cambridge (1839)
The Charities in the County of Suffolk (1839).

These reports were essentially made to ascertain, restrospectively, how effectively provision was being made for the Poor, consequent upon land inclosure. In particular, they are concerned with provision of fuel, and make frequent references to the 'Poors Allotments' and 'Fuel Allotments', that were established at Inclosure, and comment on their state. This is particularly useful as many of the Poors Allotments were fens (and include many of the remaining fen sites) and provide details for such activities as turf extraction. Unfortunately, coverage is variable. Entries for some parishes, particularly for the towns, to do not record anything concerning the 'Poor's land', even though the parish is known to have had such areas. [I have yet to establish the full reason for this, though in some cases it is because some areas of 'Poor's land' were designated after 1839]

No attempt has been made to examine Inclosure and Tithe documents for individual parishes. This is because it would have been a *very* time consuming exercise to do this, for rather limited return. [In the present context its main value would be to help locate the sites of some disappeared fens.]

A quite comprehensive survey of the Norfolk "Commons", which provides useful details relating both to their use and biological interest has been provided by:

Clarke, W.G. (1910). The Commons of Norfolk. *Transactions of the Norfolk & Norwich Naturalists Society*, **9**, 52-70.

Clarke, W.G. (1918). The natural history of Norfolk Commons. *Transactions of the Norfolk & Norwich Naturalists Society*, **10**, 294-318.

LIMITATIONS TO AVAILABLE DATA

In most cases, species records and surveys of East Anglian fens have not been made with a view to providing comprehensive data that could be used as a basis for assessing subsequent vegetation change. Many records were made casually, often as part of an amateur interest in plants. The problems that such data present are discussed below. The comments made are not intended as criticisms of the workers concerned.

Accuracy and scope of plant records

Many of the records have been made by individuals who were not specialists in the taxonomy of wetland plants. In consequence there has been a frequent tendency to ignore unfamiliar taxonomic groups, especially in casual notes made on site visits. Unfortunately, the groups that have been ignored most frequently - sedges and bryophytes - are of particular relevance to assessing vegetation change in wetland ecosystems. However, failure to record groups is preferable to inaccurate records.

Misidentifications are often difficult to recognise, though there are exceptions (e.g. a record for *Carex microglochin* at Holt Lowes (in what is otherwise an apparently credible list[2])). Records confirmed by experts (such as certified *Flora* records, or site species lists by workers such as F Rose) are likely to be correct, though even "experts" can make mistakes, not least because individuals who correctly identify species are well capable of inadvertently recording the incorrect name. And it is salutary to note a confession concerning a field survey of bryophytes that "the most serious omissions fall in the Sphagna, where the lack of anybody really competent was most evident .. It is difficult therefore to see whether the lack of *Sphagnum* represents a deterioration in habitat, or a lack of expertise[3]" - and this referring not to a meeting of a local naturalist's group but to a field meeting of the British Bryological Society! Records by less experienced workers have to be treated with some caution. Apart from bryophytes and the genus *Carex*, particular confusion tends to surround *Dactylorhiza* sp. and the separation of *Juncus acutiflorus/articulatus/subnodulosus* and *Pedicularis palustris/sylvatica*.

Location of plant records

Site specificity of records

Records made at named sites, and particularly specific surveys, obviously relate to the sites concerned, although many of the more casual records may also include a variable extent of hinterland. Likewise with records in *Floras* and other regional lists: even for those records that do refer specifically to fen sites, it is often not clear if they refer to plants on the fen site or somewhere in its vicinity. Moreover many *Flora* records, particularly in the older *Floras*, refer just to a parish and it is not known (though can sometimes be guessed) exactly to which fen site they refer. The more recent trend, just to give 2km^2 "tetrad" records, is, of course, even less site specific. In consequence, little use has been made of *Flora* records in this study unless (a) they give site specific references, or (b) there are no other sources of information.

Even where records do refer to specific sites, there are occasional problems of synonymy which call for attention. Thus, with reference to some sites in Norfolk: 'Caldecot Fen' is also 'Oxborough Fuel Allotment'; 'Swangey Fen' is also 'Attleborough Poor's Fen'. Records referring to 'Wolferton Fen' are subsumed by some workers into 'Dersingham Bog'; some of those from 'Gooderstone Fen' into 'Foulden Common'. In most cases such 'synonymy' is known, or could be guessed. However, it might be less widely appreciated that a site referred to by E A Ellis as 'Stow

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2 List of Plants found growing at HOLT LOWES (including woods and hedgerows). [GAH McClelland, undated] [Almost certainly refers to Carex pulicaris][Holt Lowes File, NCC, Bracondale]

3 In lit. R Stevenson 1986 [Holt Lowes File, NCC, Bracondale]

Bedon Fen' is the same site as the 'Rockland All Saint's Fen' from which F Rose made important records in 1960. This problem is probably greatest with regard to sites that have been lost, or thought to have been lost, and whilst in most cases it is probably not of great moment, at best it causes uncertainty, at worst, genuine confusion. Thus, as an example of the former, it is unfortunate that we cannot be certain whether the site near Felthorpe (Norfolk), from which various records of *Sphagnum* species have been made quite recently, is the same site as the "Felthorpe Bogs" from which numerous important records were made in the last century. As a salutary example of confusion, we can cite the case of 'Barnham Broom Fen', again in Norfolk. Here, the original SSSI, which was designated in 1953 to include part of Runhall Common as well as Barnham Broom Fen *sensu stricto*, was subsequently contracted to the area in Barnham Broom parish, following a regrettable reclamation of part of Runhall Common (which was apparently the "best" area of the SSSI). However, recent surveys have shown that much of the area of Runhall Common has not been as drastically reclaimed as this revision implies; and moreover, a site has recently been "found", with most of the floristic attributes of the former "best" bit of Runhall Common in the guise of Coston Fen pSSSI (a site within the original area of both Runhall Common and, apparently, the SSSI!). This thus raises the (possibly unanswerable) question: was Coston Fen the area referred to as part of the original SSSI, which was not, in fact, reclaimed, the location of which has since been forgotten or come to be known under some other name ? Or was there originally more than one 'good' area in Runhall Common so that 'Coston Fen' is a 'new' site that was perhaps not known to the surveyors of the 1950s ? Such considerations may be of little consequence to the conservation of the present-day resource, but they make it extremely difficult to assess the extent to which the sites have been damaged by past land-use events.

Location of records within sites

The above comments lead naturally into the related 'problem' of the location of records within named sites. Many records are composite lists for entire sites. Whilst these are extremely valuable, they are inevitably limited in situations where there are strongly contrasting habitats, or in particularly large sites. For example, in some sites certain fen species may have been restricted to the margins of ditches rather than occurring in the main fen. This status would not be obvious in a composite species lists.

Some records do differentiate sites into "zones" or "communities". These are especially useful when accompanied by an appropriate map, though in an irritatingly large number of cases, particularly with some of the older documents, the records have become divorced from the maps. In some cases repeat visits have been made, but the subsequent surveyors have not always subdivided the site into the same zones and communities as did their predecessors. This may be: (a) because the zonation has changed; (b) because of different perceptions by the surveyors; or (c) because different parts of the site were being examined. There is often no way of knowing which of these options is most likely, and this makes it particularly difficult to make time-series comparisons of sites.

Various workers have made detailed quadrat records from parts of sites, but the location of these is not always precisely specified, either because the worker concerned had no need to do so, or because of the difficulties of specifying locations in the absence of clear landmarks and adequate vegetation maps. Sometimes the location of former quadrats is sufficiently well specified (e.g. some of the Bellamy (1967) records) for comparisons to be made with more recent studies. However, in general there is a remarkable lack of *detailed* older data which can be located with a great deal of

precision. But neither are there many appropriate recent studies which can be used for comparative purposes. And when there are, they do not necessarily refer to exactly the same locations.

Completeness of site records

In addition to the problem of the taxonomic range that has been recorded by workers is that of the thoroughness with which they examined the site. There are relatively few thorough site lists available, either because only part of the sites were examined or because no attempt was made to produce comprehensive lists either for the site or particular parts of it. It is, of course, rather difficult to make truly comprehensive sites surveys, except perhaps in the smaller sites. Comprehensive records tend to be made only by individuals who know sites well or who have sufficient time to examine them, preferably on several occasions. This is because many important species, especially some of the less common ones, are sometimes far from easy to locate. Hence: "Another problem is, I am sure, knowing the exact spot to look for. Dr Petch turned up to Roydon Common and told us exactly where to look for the *Homalothecium nitens* - but no trace of it could be found. I suspect that Eric Swann is one of the few folk alive who know where many of the other species hang out, if they are still in existence"[4].

The completeness of site records is largely determined on the purpose for which they were made:

1. *Casual records*: Most past records have been made casually and with constraints of time and do not pretend to be comprehensive. This includes such valuable lists as those provided by F Rose. Such lists frequently omit species which were almost certainly present, presumably because they were of no interest to the author, or because of time constraints. Fortunately, the more notable species were often the ones that were recorded, but it cannot be assumed that the absence of a species from such lists reflects an absence from the site.

2. *Site surveys*: There are very few *detailed* site surveys available, but there is a rather greater number of relatively comprehensive species lists (e.g. Petch, 1947). More recently, there have been site surveys of SSSI sites (associated with renotification), but although these give broad descriptive information and distinguish vegetation-types (not NVC) they usually do not provide comprehensive species lists. And whilst there is doubtless a tendency to record the more notable species (especially "target" species) such surveys undoubtedly overlook a number of species. Some other surveys, such the England Field 'Unit Commons survey, give what appears to be quite comprehensive site information, but such surveys do not include all of the fen sites and may well be out-of-date for some sites. Similarly, quite detailed records have been made for some "fenny" sites by Grassland Surveys. Again, these encompass some, but not all, of the main fen sites. Moreover, many of the sites they include have few, if any, old records.

3. *Quadrat records*: There are a number of quadrat records available for several fen sites (e.g. Bellamy 1967; Wheeler, 1975). Whilst these are (hopefully) comprehensive for the quadrat concerned they do not provide information relevant to the entire site. Rather, most quadrat records

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4 In lit. R Stevenson 1986 [Holt Lowes File, NCC, Bracondale]

attempt to define the character of particular vegetation-types. [And the extent to which they reliably do this is dependent upon their area, number and disposition].

Abundance of species

Vegetation is defined not just by the identity of its component species, but by their relative abundance. Indeed, it is grossform changes in the character of vegetation that help display the effects of a changing environment. However, data on the abundance of species at fen sites are often sparse. Some site lists are annotated with DAFOR-type abundance ratings and these are sometimes of considerable value, particularly when it is clear (it often isn't) to what they refer - in some cases they seem to be abundance estimates for the entire site, in others, just to a particular area. Quadrat records have a similar limitation. Whilst they may contain good quantitative information for the vegetation to which they refer, they give little indications on conditions elsewhere in the site.

Inertia of records

It is often difficult to ascertain *if* species have been lost from sites; even more to establish the dates *when* they were lost. There are several complicating factors which contribute to this situation:

(a) certain types of records do not indicate the presumed status of species. This is especially the case with certain *Floras* which frequently repeat old records. In some of these cases it *is* clear that certain records are relatively contemporary with the *Flora,* but often this is not so. Thus, whilst Evans, (1932) clearly identifies *some* recent records, he also appears to just repeat records from Babington (1860), the status of which is, by 1932, very doubtful (and in some cases was even in Babington's time). Records that have been certified by the authors of *Floras* are, of course, of considerable use. However, even these may sometimes date back many years. A good example of this is provided by Swann's entry for *Homalothecium nitens* in his bryophyte flora of Norfolk (Swann, 1982). Amongst other records, he cites the 1962 record of F Rose from Swangey Fen, together with the comment "This glacial relic[5] has become extinct in many counties but still persists in Norfolk where, as at Swangey Fen, it is locally frequent." Yet a detailed survey of Swangey Fen had failed to find *any Homalothecium nitens* in 1981 and there have been no further records. Indeed, we have been unable to locate any records that confirm that *Homalothecium nitens* was present in *any* East Anglian valley fens in the 1980s!

There is also a need to be careful with negative information - it cannot be concluded that the failure of the authors to authenticate a record means that it was absent from a site. Together, these problems imposes a strong limit to the value of *Flora* records, except where it is clear that they consistently refer to up-to-date surveys. Note also that this problem is not confined to *Floras*. Various composite lists are kept by Conservation Organisations of the species on particular reserves: some of these also fail to distinguish recent from old records.

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5 Although the term "glacial relict" is sometimes used to describe such bryophyte species as Cinclidium stygium, Homalothecium nitens and Leiocolea rutheana in East Anglia, it is unclear exactly what is meant by this.

(b) the lack of comprehensive surveys (above) means that the status of species at particular times is often hard to establish, especially if the exact locality is not known.

(c) even when sites are well known, much less attention is generally given to the loss of particular old species (unless they are especially notable) than to the discovery of new ones.

(d) it is often difficult to be completely sure if a species has been lost. Some species may be extremely difficult to find, if they are in small quantity and not flowering. Others may be able to re-establish from seed.

Age range of material

Except for *Flora* records, early data (pre-1940) are generally sparse, though there is detailed information for a few individual sites. In Norfolk F. Rose made detailed lists from some sites in the 1940s, continuing through the 1950s up to the present. The establishment of SSSI sites in the 1950s led to the collection of a good range of valuable data and from the late 1950s onwards there has been an accumulating wealth of information, of variable informative value, in NCC Scientific Files. A growing interest in wetland vegetation led to a growth of miscellaneous documentation from this period, including some valuable quadrat data from DJ Bellamy dating from 1958. However, the vegetation, or even location, of various fen sites was not at all well known at the time BD Wheeler made detailed quadrat records in a number of East Anglian fens in the early 1970s. The site surveys associated with SSSI renotification in the 1980s also provide useful (though not always detailed or comprehensive) species information, and various other surveys, of varying relevance to fens, have also been made. However, one of the most notable features of this study is the recognition that there is remarkably little *recent* and *comprehensive* information on the species composition of a wide range of fen sites.

Limitations on assessment of vegetation change in East Anglian fens

The above considerations make it clear that there are considerable problems in reconstructing vegetation change in East Anglian fens. These may be summarised:

(a) the absence of *comprehensive* records of past species composition and abundance at the majority of sites

(b) the absence, particularly in older records, of any clear indication of the location of particular species or vegetation types in the majority of sites

(c) the absence of repeated studies: thus, even where detailed records have been made, there have rarely been subsequent studies; and where successive studies have been made at the same site, they have sometimes been in different (or, at least, uncertain) locations

(d) the absence of an up-to-date comprehensive survey or species list from the majority of sites.

All of the problems (a - c) of using past species and vegetation records are, of course, to be expected with an *ad hoc* data set, the components of which were not collected with a mind to their subsequent use to reconstructing species change in the fens concerned. Despite their limitations, they do provide a useful data set, but the utility of this is severely constrained by (d) - i.e. there is, in many cases, a marked lack of reliable information on the *present* composition of the sites. This means that it extremely difficult, except for a few instances, to demonstrate any conclusive change in species composition, though in rather more cases is can, perhaps, be guessed.

Approach used to assess vegetation change

Although these various considerations constrain an assessment of vegetation-change, they do not prevent some evaluation being made. Three sets of information seem particularly important:

(i) identification of the nature of available information

(ii) collation of records (usually incomplete) for entire site

(iii) Collation of records for specific, located areas within each site where (a) the location is known with reasonable confidence; and (b) more than one study has been made (not possible in most cases)

(iv) collation of anecdotal comments on the vegetation (given the deficiencies of the species information, these are particularly useful in conveying the character of the vegetation, despite their subjective character)

(v) identification of changes in specific parts of sites, where known.

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APPENDIX B

Main community-types referred to in the text, their synonymy and equivalents (Wheeler, 1984; National Vegetation Classification)

Wheeler, 1984	*NVC*	
Phragmites Swamp	S4a	Phragmites Swamp, Phragmites sc
Juncus subnodulosus - Carex paniculata springhead		
Carex lasiocarpa - Menyanthes swamp		
Scirpo-Phragmitetum		
Scirpo-Phragmitetum typicum	S4a	Phragmites sedge swamp, Phragmites sc
Scirpo-Phragmitetum caricetosum pseudocyperi		
Cicuto-Phragmitetum	S4b	(includes Cic-Phrag)) Phragmites swamp, Galium pal. sc
Cicuto-Phragmitetum typicum		
Cicuto-Phragmitetum juncetosum		
Cladietum marisci		
Cladietum marisci typicum		
Cladietum marisci utricularetosum	S2b	Cladium sedge swamp, Menyanthes sc
Cladietum marisci caricetosum lasiocarpae	S2b	Cladium sedge swamp, Menyanthes sc
Caricetum elatae		
Caricetum paniculatae		
Caricetum paniculatae typicum	S3	**Carex paniculata sedge-swamp**
Caricetum paniculatae peucedanetosum	S24a	Phrag-Peuc fen, Carex paniculata sub-community
Potentillo-Caricetum rostratae		
Potentillo-Caricetum rostratae typicum	S27a	C. rost - Pot pal fen, Cx. rost. Equis fluv sc
Potentillo-Caricetum rostratae lysimachetosum	S27b	C. rost - Pot pal fen, Lysimachia vulgaris sc
Potentillo-Caricetum rostratae juncetosum		
Potentillo-Caricetum rostratae caricetosum		
Peucedano-Phragmitetum	S24	**Phragmites-Peucedanum fen**
Peucedano-Phragmitetum typicum	S24d	Phrag - Peucedanum fen, Typical sub-community
Peucedano-Phragmitetum typicum, Phalaris var	S26d	Phrag - Urtica fen, Epil hirsutum sub-community
Peucedano-Phragmitetum myricetosum	S24g	Phragmites - Peucedanum fen, Myrica sc
Peucedano-Phragmitetum arrhenatheretosum	S26b	Phragmites - Urtica fen, Arrhenatherum sc
Peucedano-Phragmitetum symphytetosum	S24c	Phragmites - Peucedanum fen,.Symphytum sc
Peucedano-Phragmitetum glycerietosum	S24b	Phrag - Peuc fen, Glyceria max. sub-community
Peucedano-Phragmitetum cicutetosum	S24e	Phrag - Peuc fen, Cicuta sub-community
Peuc-Phrag cicut, typical var	S24ei	Phrag - Peucedanum fen, Typical sc, Typical var
Peuc-Phrag cicut, Carex lasio var	S24eii	Phrag - Peuc fen, Typical sc, Carex lasio var
Peucedano-Phragmitetum schoenetosum	S24f	Phrag - Peuced fen, Schoenus sub-community
Peucedano-Phragmitetum caricetosum	M9b	Cx rost - Call cusp, Cx. diandra - Call gigant sc
Peucedano-Phragmitetum caricetosum typicum var		
Peucedano-Phrag car, Ranunculus lingua sub var		
Peucedano-Phrag caricetosum Molinia sub var		
Angelico-Phragmitetum	S25	**Phragmites - Eupatorium fen**
Angelico-Phragmitetum typicum	S25a	Phrag - Eupatorium fen, Phragmites sc
Angelico-Phragmitetum caricetosum paniculatae	S25b	Phrag - Eupatorium fen, Cx paniculata sc
Angelico-Phragmitetum juncetosum subnodulosi	S25a	Phrag - Eupatorium fen, Phragmites sc
Angelico-Phragmitetum lysimachetosum		
Cladio-Molinietum		
Cladio-Molinietum typicum		
Cladio-Molinietum ericetosum		
Phragmites consociation		
Phragmites-Sium latifolium community		
Phragmites-Agrostis stolonifera community	S4dii	Phragmites swamp, Atriplex sc, Agr. stol var.
Phragmites-Thelypteris palustris community		
Phragmites sociation		
Phragmites-Solanum community		

Cladium consociation	S2a	Cladium sedge swamp, Cladium sub-comm
Cladium-Carex elata community		
Cladium-Thelypteris community		
Glyceria maxima consociation		
Glyceria maxima sociation	S5	**Glyceria maxima swamp**
Schoeno-Juncetum subnodulosi	M13	**Schoenus - Juncus subnodulosus mire**
Schoeno-Juncetum subnodulosi typicum	M13a	Schoenus - J subnod, Festuca rubra - J. acutifl sub-community
Schoeno-Juncetum subnodulosi caricetosum rostratae	M13c	Schoenus - J. subnod, Caltha - Galium ulig sc
Schoeno-Juncetum subnodulosi leontodetosum	M13b	Schoenus - J. subnod, Briza - Ping. vulg sub-community
Schoeno-Juncetum subnodulosi cladietosum	M13c	Schoenus - J. subnod, Caltha - Galium ulig sc
Schoeno-Juncetum subnodulosi ericetosum	**M14**	**Schoenus - Narthecium mire**
Schoeno-Juncetum subnodulosi serratuletosum	M13b	Schoenus - J. subnod, Briza - Ping. vulg sub-community
Pinguiculo-Caricetum dioicae	M10	Carex dioica Pinguicula vulgaris mire (M10b)
Pinguiculo-Caricetum dioicae molinietosum	M10bii	C. dioica - Ping vulg, Briza - Prim far sc, Molinia - E. latif var
ditto	M10biii	C. dioica - Ping vulg, Briza - Prim far sc, Thymus-Racomitrium lanug var
Pinguiculo-Caricetum dioicae filipenduletosum	M10bi	C. dioica - Ping vulg, Briza - Prim far sc, Cirs pal var
Pinguiculo-Caricetum dioicae poor fen var		
Acrocladio-Caricetum diandrae	(M9	Carex rostrata - Calliergon cuspidatum mire)
Acrocladio-Caricetum diandrae typicum	M9b	C. rost - Call cusp, C. diandra - Call. gigant sc
Acrocladio-Caricetum diandrae cicutetosum	M9b	C. rost - Call cusp, C. diandra - Call. gigant sc
Acrocladio-Caricetum diandrae schoenetosum	M9a	C. rost - Call cusp, Campylium - Scorpidium sc
Acrocladio-Caricetum diandrae sphagnetosum	M9a	C. rost - Call cusp, Campylium - Scorpidium sc
Acrocladio-Caricetum diandrae juncetosum (1975)	M9a	C. rost - Call cusp, Campylium - Scorpidium sc
(juncetosum subnodulosi (1980))	M9b	C. rost - Call cusp, C. diandra - Call. gigant sc
Acrocladio-Caricetum diandrae crepetosum	M9b	C. rost - Call cusp, C. diandra - Call. gigant sc
Molinia caerulea-Myrica gale association	M25a	Molinia - Pot erecta mire, Erica tetralix sc
Molinia caerulea-Myrica gale association typicum		
Molinia -Myrica association Juncus subassociation		
Molinia -Myrica association Narthecium subassociation		
Rich Fen Meadows	**M22**	**Junc subnod - Cirsium palustre fen-meadow**
Juncus-Carex lepidocarpa nodum		
Juncus-Centaurea nigra nodum	M22a	J. subnod - Cirs pal, typical sc
ditto	M22b	J. subnod - Cirs pal, Briza - Trifolium spp sc
Juncus-Carex hirta-Deschampsia cespitosa nodum	M22a	J. subnod - Cirs pal, typical sc
ditto	M22b	J. subnod - Cirs pal, Briza - Trifolium spp sc
Juncus subnodulosus nodum	M22a	J. subnod - Cirs pal, typical sc
ditto	M22b	J. subnod - Cirs pal, Briza - Trifolium spp sc
Juncus-Carex disticha nodum	M22b	J. subnod - Cirs pal, Briza - Trifolium spp sc
Juncus subnodulosus-Iris pseudacorus nodum	M22d	J. subnod - Cirs pal, Iris sub-community
Juncus subnodulosus-Carex elata nodum	M22c	J. subnod - Cirs pal, Carex elata sub-community
Carex acutiformis sociation		
Juncus subnodulosus - Epilobium hirsutum nodum		
Fen Meadow		
Juncus acutiflorus-Acrocladium cuspidatum nodum		
Cirsio-Molinietum	**M24**	**Mol. caerulea - Cirs. dissectum fen meadow**
Cirsio-Molinietum typicum	M24a	Molinia - Cirs diss, Typical sc
Cirsio-Molinietum eupatoretosum	M24b	Molinia - Cirs diss, Eupatorium sc
Cirsio-Molinietum nardetosum		
Carex nigra-Sanguisorba officinalis community	M26(a)	Molinia - Crepis paludosa mire, (Sanguisorba offic sc)
Molinia caerulea consociation		
Tall Herb Fen		
Epilobium hirsutum-Filipendula ulmaria communities	S26d	Phragmites - Urtica fen, Epilobium hirsutum sc
ditto	M27b	Filipendula - Angelica mire, Urtica - Vicia cracca sub-community
Epilobium hirsutum sociation		
Phragmites-Epilobium-Filipendula community		
Phragmites-Urtica dioica community	S26a	Phragmites - Urtica fen, Filipendula sc

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