

### *Survival of Fen Sites from the Nineteenth Century*

The combined efforts of the various contributors identified above (and others) provide an (incomplete) basis for assessing the nature of change in East Anglian valley fens.

Perhaps one of the most surprising conclusions from this survey is that, if rich-fen sites alone are considered, remarkably few examples of the high quality valley fen sites<sup>4</sup> known to the nineteenth century botanists have disappeared completely. Some of them may have substantially lost their former character (and interest) but many are nonetheless still identifiable, in some fenny shape or form, today. Moreover, a good number of these sites still retain some of the species for which they were formerly noted, or at least did until the last couple of decades or so. These conclusions are important, not so much because they indicate that the total destruction of base-rich valley fen vegetation over the last 100 years has perhaps been rather less than might have been feared, but because they suggest that even in the nineteenth century high quality soligenous fen vegetation was confined to a small number of well-known sites and was not dramatically more widespread than it has been in more recent times.

This suggestion may, to some extent, run counter to expectations, so it is important to try to assess both its accuracy, and some of its implications.

As with most sweeping generalisations, there are various caveats that need to be made. The first is that the generalisation refers specifically to *base-rich* valley fens that once supported high quality *Schoeno-Junceta* or *Acrocladio-Cariceta* (or at least their nineteenth century analogues): there has been a much more precipitous loss of *base-poor* valley fens (see below). The second caveat is, of course, that there may have been many more good East Anglian valley fen sites in the nineteenth century than we are currently aware of but that they were simply no more known to contemporary botanists than they are to us today. Indeed, there is some evidence that even in the hey-day of Victorian collecting and of the *Botanical Exchange Club*, not all the good sites were known. For example, there is a marked lack of early records from the important *Schoeno-Juncetum* site of Badley Moor (Norfolk), even though Clarke (1918) seems to have visited it.

Whilst there may have been some such unknown sites, it is clear that the nineteenth century botanists were undoubtedly well, and perhaps selectively, familiar with many of the species-rich spring-fed fens that exist today. Inspection of *Floras* frequently indicates a greater proportion of records from soligenous sites than from other wetland areas (at least, outside of the flood-plain fens of Broadland and Wicken Fen). It is not difficult to find possible reasons for this. One is simply that the soligenous sites were of particular botanical interest (i.e. had more and rarer species - a possibility which itself tends to support the suggestion that such vegetation was even then not very widespread). By comparison, many of the badly-drained valley bottom wetlands may have had a tendency (as they do now) to be comparatively species-poor and to have relatively few uncommon species.

It may also be suspected that some soligenous sites survived the drainage initiatives of the early nineteenth century rather better than did some of their topogenous counterparts. From the

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<sup>4</sup> These are regarded here, and recognised from *Flora* records, as sites that supported a range of characteristic species of the *Schoeno-Juncetum* and *Acrocladio-Caricetum* community-types.

perspective of present-day concerns for dehydration, it is easy to forget that the drainage of many East Anglian fens occurred at around the time of the Inclosure movement at the turn of the eighteenth century, and in some cases, well before then. If the maps of Faden can be taken as a reliable guide, many of the bottoms of most of the river valleys in Norfolk and Suffolk were badly-drained areas of marsh and rough pasture towards the end of the eighteenth century. By the mid-nineteenth century many of these once-waterlogged flood-plains had been drained and improved and may have scarcely merited botanical visitations. It may be presumed that various soligenous sites also succumbed to the initiatives of the Commissioners for Drainage, but it seems most probable that in many cases it was the flood-plain wetlands that were the prime targets for post-Inclosure drainage and reclamation. This is because they were extensive, relatively fertile and comparatively easy to drain (for summer-dry conditions, at least). That contemporary agriculturalists certainly appreciated the potential value of such areas is well illustrated by a comment of Young (1804), an noted "improver", referring to an unreclaimed portion of the Wensum flood-plain in the vicinity of Sculthorpe Mill (and Fen): "Of all the nuisances that a country can be plagued with, certainly water mills are very high in the black catalogue; for the sake of this beggarly mill [Sculthorpe Mill], which apparently cannot be worth more than from 20 *l.* to 30 *l.* a year, here is a noble tract, from a furlong to a mile wide, of what ought to be rich meadow, poisoned with water and producing rushes, flags, sedge and all sorts of aquatic rubbish."

By contrast quite the opposite was true of many of the soligenous sites. They were frequently rather small, often not "good" land and, where there were strong springs, usually not at all easy to drain. Burrell and Clarke (1913) certainly recognised the difference in agricultural potential between the two different wetland types: "Artificial drainage and grazing improve these swamps [ i.e. marshes along valley bottoms] into alluvial pasture; but where spring heads occur, and especially where both soil and water are deficient in food salts, the natural balance of species is retained." Thus there was a tendency for spring fed areas not to be reclaimed, even though there were doubtless some farmers who were prepared to follow Young's (1804) commendations and instructions to attempt this quite difficult task.

### *The Importance of Poor's Land*

A large number of the best quality (as well as some not-so-good quality) extant valley fens are in land parcels that were set apart at Enclosure as Poor's Allotments, or have some other form of "Common Land" status. This observation is by no means novel. Haslam (1960) also recognised that most of the "wet fens" she examined on the Breck - Fen margin were Poor's Allotments. It is therefore of some interest to try to establish the basis of this relationship.

One explanation of the importance of Poor's Allotments for fen plant species is that they have been "protected" from more intensive exploitation by their status. However, whilst this suggestion undoubtedly has some truth, it is by no means axiomatic. For example, in some cases, even at Inclosure the allotment of Poor's Land may have led to some improvement or change in use. Again Burrell & Clarke (1914) provide a useful insight: "On Horsford Heath, St Faith's Common and Newton Common, natural regeneration of pine is taking place. Horsford Heath was formerly manorial waste subject to common rights; the trees were suppressed as a matter of policy by the

common-right holders and villagers now living remember it as open heath. Since its allotment to the poor at enclosure, the trustees have protected the seedling trees, and it is now open canopy forest, the small annual produce being divided amongst the poor."

In other situations "Poor's Land" has sometimes been rented or sold for use for more productive agriculture and the income derived from this has, when done legally, been used to benefit the "poor". In some instances this has led to improved drainage and even cultivation of the fen sites. Moreover, even when Poor's Fens themselves have not been directly improved, they have not been immune to the effects of drainage schemes in adjoining land parcels. These are no respecters of status, whether Poor's Allotments, SSSIs or nature reserves, as is nowhere better illustrated than in the indirect dehydration of Caldecote Fen (Oxborough Fuel Allotment) in a tributary of the R Wissey. Thus the "protection" against improvement offered to valley fens by parish land status is less than watertight.

A second, perhaps more cynical, explanation of the relationship between Poor's Land and botanically-rich valley fens rests upon the intrinsic character of many of the allotments given to "benefit" the land-deprived poor. These very often comprised some of the worst land in the parish. Hence the *Charities Commissioners Report* for Hevingham parish (Norfolk) observed in 1838 that "This allotment [known today as Buxton Heath] consists of very bad land; it is not let but given up to the poor for the purposes of cutting fuel thereon." Likewise the Tithe File suggests that "The western part is heathy interspersed with belts of Scotch fir and it is a poor black gravel fit for nothing." - except, presumably, the Poor. In many parishes much, or all, of the land allocated to the Poor was that which was regarded as being particularly difficult of improvement - for example, land which was particularly impoverished and which had strong, difficult-to-drain springs: conditions which had little agricultural merit, but which were ideal for soligenous mire vegetation! And, of course, such land did, very often, provide a good supply of turf, which gave a practical basis to its designation as a "Fuel Allotment" - though sometimes it did not even sustain this. Thus the *Commissioners* report for Helhoughton Fuel Allotment: "Upon the Helhoughton Inclosure an allotment of about 20 acres was set out for the poor. This is very bad, wet land, not worth cutting for fuel and nearly unproductive. A poor man is allowed to turn his cows upon it". But whatever its inadequacies for the poor of the parish, this parcel of Poor's land doubtless supported fen vegetation! Seen from this perspective, "good" valley-fen sites have not so much survived because they were Poor's Land but they were Poor's Land because they were "good" valley-fen sites.

### *Turf Cutting and Valley fens*

#### *Turf Cutting in the Valley Fens*

The peat resource of valley fens had undoubtedly been important as a source of domestic fuel long before Fuel Allotments were allocated during the Inclosures. Where appropriate documentation exists, it is clear that some sites, such as Dernford Moor, have long-standing rights of turbarry (in the Dernford example, extending back to Medieval times). Equally, even after the Inclosures, turf extraction was not confined to the Poor's Allotments. Other areas are also known to have been cut, (sometimes as a "swap" with designated Poor's Land). However, emphasis is placed on

Poor's land in this account, purely because the cutting is relatively recent and because it has some relatively accessible documentation. Much of the (rather scanty) information available about turf cutting derives from the Poor's Fens, as in these examples information on rates of extraction was (sometimes) recorded by the Overseers and Trustees of the Poor's Charities and has (in rather fewer instances) survived. There would be much interest in an historical analysis of turf cutting in East Anglia, by collation of such documentary evidence as exists. For present purposes, the *Reports of the Charities Commissioners* made during the 1830s provide a useful, if brief and incomplete, synopsis of turf extraction in Poor's Fens.

### *Rates of extraction*

Perhaps the most remarkable feature of turf extraction is the high rate at which it appears to have been carried out. Permissible maxima of 4000 - 5000 per household per year are commonplace, and in a few sites, there were consents for eligible cottagers to remove up to 8000 turves per year. Yet even these high rates probably did not provide a basis for extravagant fuel consumption! Whilst right-holders may not always have cut their full entitlement to turf, extraction on this sort of scale undoubtedly had a major impact on the peat resource of the sites and in some cases led to its virtual depletion. Right-holders of East Ruston parish (Norfolk) were particularly fortunate in being endowed with a rich supply of turf within some 11 allotments. Equally propitious has been the record of their activities collated by Bird (1909). Bird indicates that, in these Allotments, turf extraction was carefully regulated, in terms of date of extraction and number of turves cut. Yet even in this well-supplied and well-ordered parish there seem to have been concerns about the finitude of the resource. In 1845 the sale of turf outside of the Poor of the parish was prohibited; in 1853 the maximum number of turves per household was reduced from 5000 to 3500; both dictates suggest a concern over the rate at which the resource was being exhausted.

In other parishes, there was apparently rather less regulation. The Charity Commissioners for Norfolk several times report a free-for-all of use of the Poor's Land and consequent exhaustion of turf. For example, at Wendling Fuel Allotment "Turf has been cut without restriction and is now almost exhausted". At present Wendling Poor's Fen (Holly Farm Meadows SSSI) has an almost skeletal substratum in places, with only some 30cm of peat even in the deeper depressions (Wheeler & Shaw, 1987), to the extent that it is difficult to imagine a much deeper peat resource.

### *Impact on the peat resource*

It is extremely difficult even to hazard a guess at the total amount of peat that has been stripped from valley fen sites. This is because the extent of pre-Inclosures turf removal is generally unknown, and because even when permissible rates of post-Inclosures extraction are specified it is not always clear how closely they were followed, nor how many cottagers cut turf, nor even the size of the turves (which probably varied between parishes). It is therefore difficult to assess the actual impact of turf extraction upon the fens. However, if some reasonable assumptions are made, at the very least it is hard to avoid the conclusion that substantial quantities of peat may have been removed. If, for example, it is assumed that the typical size of turves were comparable with those cut

using a turf-becket of, say, about 4" x 4" x 12" depth<sup>5</sup>, then extraction of 1000 turves would equate to removal of a volume of some 3.0 m<sup>3</sup> of peat. Given that at some sites a cottager was permitted to dig as many as 8000 turves annually, and that in some others the process was effectively unregulated, it is clear that substantial inroads could have been made into the peat resource. Even at the relative modest rate of 3000 turves extracted per year, if 20 right-holders were cutting, it would take only some 50 years for 1 m depth of peat to be stripped from 1 ha of fen. Thus perhaps it is not surprising that Wendling Poor's Land and Dernford Fen currently have next-to-no peat cover; or that in most East Anglian valley fens the peat depth is consistently shallow (< 50 cm (Wheeler & Shaw, 1987; H.J.B. Birks, *pers. comm.*). And even though there are still some relatively deep (→ 2m) peat reserves in a few sites (mainly in the Waveney-Ouse valley), these may also have once been much deeper. It would be intriguing to know the original depth of peat in these sites, or indeed in others where a favourable valley topography could once have contained a substantial peat infill. Is it possible that present-day valley-head sites, such as Buxton Heath or Scarning Fen, were once filled flat-across with peat ?

### ***Turf cutting and vegetation***

It is equally interesting to speculate upon the effects of turf cutting on vegetation composition. In some cases, of course, there is no need to speculate: evidence is (or at least was) readily available. In some of the more topogenous sites with deeper peats, i.e. the 'riverside valley fens' peat was cut (at least in the last phases) as a series of (sometimes quite large) pits which appear to be more-or-less analogous with the turf-ponds of Broadland (Wheeler, 1983). In consequence of their situation, these have often become flooded to form sometimes quite deep water-filled hollows which have often terrestrialised by the formation of a semi-floating hover to form swamp and wet fen. This process was not universally welcomed. Vancouver (1794), writing about the rather different situation of Burwell Fen in Cambridgeshire, remarks that a considerable part of this site (of some 2000 acres) "has been greatly injured by digging turf ... constantly inundated ... a most deplorable situation ... water encourages the growth of reed and sedge, ... cut by the poor.." But whatever the agricultural viewpoint, the botanical one must be that turf cutting helped to produce pools and swamps in sites from which these had perhaps been long absent. In various instances these ultimately came to sustain a topogenous vegetation analogous to the *Acrocladio-Caricetum diandrae* which supported a range of unusual species, including in some cases *Liparis loeselii*. Such water-filled pits were probably quite widespread, but are best known from sites such as East Ruston Common and some of the Waveney-Ouse fens, partly through the graphic description of Clarke (1918): "Many of them, notably Blo' Norton, and parts of East Ruston and Burgh St Margaret, consist of a mass of vegetation floating on an unknown depth of water and mud. The floating carpet yields at every step; the surface for yards round becomes tremulous....Unpleasant, though not dangerous, is the effect of

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<sup>5</sup> Beckets of some 18" x 4" x 4" were used in the latter-day "commercial" peat cutting of The Fenland peats around Mildenhall (Trist, 1971) and Wicken (Day, 1985), though there was considerable variation in dimensions from place-to-place. Skertchly (1877) suggests average dimensions of 9½" x 6¼" x 4". Little information has been located relevant to the Poor's Fens, though the Inclosure documents for Tuddenham suggest extraction of 4" x 4" turves. It is likely that the size of turves removed may have varied between parishes (cf. Skertchly, 1877), and perhaps within them for, as Day (1985) comments "Digging for themselves on the common turbaries men were apt to use larger than the commercial beckets to dig out all that they could while they were about it"! The size of becket used in this present calculation is therefore fairly modest. Note also that calculation of the volume extracted is also hampered by the possibility that the number of turves making up "one thousand" may have depended upon their dimensions (Day, 1985).

new and old peat workings, which occur over most of the fens. Walking carefully in nine inches of water, the depth of which is hidden by the vegetation, a sudden drop of two feet or more into an older peat working is apt to interrupt botanical investigations for a time. Further troubles are caused by the sharp edges of the sedge and the saw-like teeth of *Cladium*, the stumps of reed cut below the water, the slipperiness of the putrid mud, and the fall from the narrow ridges that intersect peat workings. Happily, however, these drawbacks preserve *Liparis* and other Norfolk rarities from the ravages of the collector."

The "sudden drop of two feet or more" is rather small compared with claims of 10-12 feet-deep pits in the Lopham Fens, but still deep enough. But whilst such hollows provided an ideal situation for terrestrialization, this process has now been continuing for what must, in many cases, be close to, or more than, one hundred years. Even in the deepest examples, the pools have grown over, the fen mats stabilized, and, with few exceptions, such remnants as there are, are generally just found as small hollows. One exception is provided by Great Cressingham Fen where there was, at least until recently, an excellent (if largely un-noticed) example of *Acrocladio-Caricetum* in the main basin of this fen, though unfortunately, as far as is known, without *Liparis loeselii*.

In the rather different topographical circumstances of 'valley-side valley fens' peat extraction has less often produced deep pits full of standing water, but has more typically generated a series of shallow trenches and hollows. These have frequently served more to create a wet or swampy environment within the fen, rather than a deep pool over which hover could develop. In some sites they seem to have helped focus and funnel the discharge of spring water across the peat surface, though in others, the moving water has itself helped to erode and coalesce some of the irregularities produced by peat-winning.

Such considerations suggest a further possible effect of peat removal, and one that has received rather little consideration, namely that it may have had a substantial effect upon the spring-flow of the sites: by exposing the point of discharge of seepage and spring inputs; and by creating a skeletal substratum with numerous surface runnels. Such conditions appear to be particularly favourable to the development of one of the most valued soligenous fen communities, the *Schoeno-Juncetum* (Wheeler & Shaw, 1987). It is certainly possible, though speculative, that before the turf was removed the deeper peats had a more disseminated spring flow which disfavoured this vegetation in preference for communities such as fen meadow which are generally less clearly associated with the immediacy of spring discharge. It is notable that in the Waveney-Ouse fens, even before the sites were badly damaged, the "best" examples of *Schoeno-Juncetum* were located near the edge of the mires, either on seepage slopes or in their immediate vicinity, rather than on the deeper peats (Bellamy & Rose, 1961). Is it therefore possible that, particularly in valley-side situations, the present occurrence of high quality *Schoeno-Junceta* is a direct product of stripping a deeper peat overburden?

These above comments are clearly speculative, but they undoubtedly point to the intriguing possibility that turf cutting may have substantially *caused* the present conservational interest of at least some valley fen sites. It has certainly been instrumental in creating topogenous pools in some of the flatter valley-fen sites; has it also been critical in helping to expose strongly soligenous conditions in some of the sloping valley-side sites?

### *Past vegetation composition*

The major difficulty of assessing the impact of post-1800 human activities on the vegetation of valley fens is the poor evidence available on its former composition. Most botanical records relate just to the last two centuries, by which time the valley fens were considerably exploited (and probably had been for several centuries). Little information can be gleaned from peat stratigraphical data, not least because there is very little peat. Peat depth in most sites is less than 50 cm, possibly largely in consequence of turf digging. Even in the Waveney-Ouse fens, where deeper deposits do occur, the character of the peat is not very well known. The deposits in Lopham Little Fen have received some examination (Tallantire, 1953; Heathcote, 1975) are reported as having more than a metre depth of sedge peat, but as this site has also been extensively used for turf cutting, the age of the residual deposit is not known. Much of it could well be, say, an early post-glacial deposit that has been exposed by removal of the overlying peat. Nonetheless, the Waveney-Ouse fens may provide some of the best opportunities for future macrofossil studies in East Anglian valley fens, possibly for example in some of the deeper peats of Hinderclay Fen.

In the absence of more direct evidence, other considerations become relevant. Rose (1957) has drawn attention to the occurrence in some of the fens of some bryophyte species (*Cinclidium stygium*, *Homalothecium nitens* and *Leiocolea rutheana*<sup>6</sup>) that have an arctic-alpine distribution and which are typically associated with open conditions. He suggests that these may have some relict status. However, it is not entirely clear just what is implied by "relict" in this context. It clearly cannot mean "having undisturbed continuity" as, in at least some examples, the exact spots where these species occur (or occurred) have undoubtedly been cut for peat! At the very most, these species must have surely survived such events in a proximate locality - which may or may not have been on the same site. If the possibility of re-establishment from a nearby site is accepted, the occurrence of these species today, or in the recent past, does not of necessity provide any indication of the former character of their present locality. Thus whilst these species may well be late-glacial "relicts", their occurrence at a site may not provide unambiguous evidence of continuity of open vegetation throughout the post-glacial, though it may point to the possibility of this, or at least to the existence of such conditions in the vicinity.

It thus seems that, at present, there is rather little evidence of the former vegetation of the valley fen sites prior to substantial human interference. Given the present proclivity of the sites to spontaneously revert to fen woodland it seems likely that formerly many examples may also have been wooded, except possibly for areas that for topographical reasons were especially wet. There may also have been natural glades around the sites of strong springs, though this is far from certain, partly because present-day evidence suggests that even the wettest spring sites are readily susceptible to scrub invasion; and partly because, as has already been suggested, it is possible that at one stage the "strong springs" were buried more deeply beneath a peat mantle than they are today.

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<sup>6</sup> The only one of these species currently known to occur in Norfolk valley fens is *Leiocolea rutheana* which grows in at least one [possibly two] valley-fen site. [R Stevenson, in litt., 1992]

### *Loss and Deterioration of Valley Fens*

Whilst a considerable number of the valley fens known to Victorian botanists still exist today, especially some of the strongly spring-fed rich-fen sites, others have been lost, in some cases even to the extent that the exact site of their former location is not known. In a greater number of cases, the sites are (more-or-less) extant, but have lost considerable floristic interest.

Of the sites that have largely disappeared completely, in some cases the loss is long-standing, dating from the early to mid nineteenth century. Thus, whilst it has already been suggested that the survival of some sites is in some way related to the Parliamentary Enclosures and their designation as Poor's Land, equally the Inclosure movement and its associated land improvement has apparently led to the destruction, or at least damage, of other sites. For example, the regrettable loss of Gamlingay Bogs (Cambridge) seems to have been a direct consequence of changes induced by the Inclosures. It is not known, and would be fascinating to know, just how many good sites also disappeared at about this time, or even before it, as obviously information is available only for sites with which contemporary (and subsequent) botanists were familiar.

It is usually not too difficult to recognise those instances where sites, for which there are nineteenth century records of fen species, have been entirely or largely destroyed. It is often more difficult to establish evidence for floristic changes within a site, unless they have been particularly gross (such as the replacement of herbaceous fen by woodland). This is because in many such cases neither the recent past nor the present composition of the vegetation is known with much confidence. There is little that can be done about the lack of past information, other than to collate such data as exist (which has been the object of the present survey) whilst recognising that the value of these is sometimes considerably constrained. However, the lack of rigorous up-to-date survey information on the remaining fen sites, can and should be remedied as a matter of urgency - as the absence of this information is perhaps the primary obstacle to evaluating the changes that have occurred in the vegetation or to assessing the vulnerability of the sites.

However, even with thorough and up-to-date surveys of sites, it may sometimes still be difficult to assess the magnitude of change. This is because, for the most part even when past species records are comprehensive they are rarely quantitative. And whilst presence / absence data are important, they may give limited comparative information on vegetation changes, which are quantitative as well as qualitative. The fact that a few individuals of, say, *Pinguicula vulgaris*, are found, by rigorous survey, to persist in a derelict fen (e.g. Thelnetham Old Fen (Suffolk)(Ausden & Harding, 1991)) may obscure the fact that they are now much less widespread than they once were; or even that the current conditions are no longer compatible with their long-term survival. Biological inertia is little understood, but probably of great importance.

In the following analysis of habitat loss and deterioration, an informal (and overlapping) subdivision of East Anglia is made into regions and mire types.



### *Poor Fen Sites throughout East Anglia*

Poor fen vegetation (not to be confused with Poors Fens) is found in situations which are irrigated by water that is less base-rich (pH <5.5) than is the case with rich fens. It is generally localised and rare in this region although it is widely scattered, mainly in association with either acidic drift deposits (glacial sands, river gravels or decalcified tills) or with the Lower Greensand outcrop along the west edge of the region. In some sites (e.g. Roydon Common) it flanks richer fen vegetation along the valley axis, where irrigation is with more base-rich water.

The poor-fen sites are considered together here as, in general, they appear to have been much more prone to destruction or substantial damage than have their rich-fen counterparts. There are some notable exceptions to this generalisation (Beeston Bog, Buxton Heath, Dersingham Bog and Roydon Common) but inspection of the *Floras* identifies a number of (largely) poor-fen sites that have been substantially lost (e.g. Belton Bog and Common, Felthorpe Bogs, Gamlingay Bogs, Horsford Heath, Lound Bogs, Ormesby Common, St Faiths Bogs). This is a much greater proportion of the known poor-fen sites than is the case for loss of rich fens. Moreover there are various other sites which still exist as rich fens but which formerly had what appears to have been poor-fen along the margins; in this situation the marginal poor-fens seem to have been particularly susceptible to loss or damage (e.g. the disappearance of *Hammarbya paludosa* from Roydon Fen and Redgrave Fen).

In some areas loss of poor-fen has been particularly complete. Thus the once-important poor-fens of Lothingland have almost entirely disappeared, to the extent that today it seems remarkable that Paget & Paget (1834) were able to describe *Hypericum elodes* as "common" in the neighbourhood of Great Yarmouth (though doubtless this partly refers to records in dykes).

Another area which was particularly subject to considerable loss of (mainly) poor fens (and wet heath) was the block of acid sands and gravels to the north and northwest of Norwich. There are various records from Trimmer (1866, 1885) and Nicholson (1914) of wet heath and fen species from Felthorpe, Horsford, Hainford and Newton St Faiths, and these were clearly important localities (Clarke, 1921). The loss of the wetland habitat here was almost certainly due to reclamation, in greatest measure for forestry. Interestingly, the status of Poor's Allotments and "Commons" in this area is rather obscure. Clarke (1910) included Felthorpe Common in his original list of "Commons", but subsequently (1918) removed it as being an area "privately owned or inaccessible to the public". It is also notable that some sites over which there was some common access may have been susceptible to spontaneous encroachment by pines, which may have been encouraged by the beneficiaries (Burrell & Clarke, 1914)

The apparently greater susceptibility of poor-fen sites were to destruction (compared with rich fens) may be largely a reflection of their hydrogeological status. Many examples were probably irrigated by a local and possibly perched aquifer in superficial sands and gravels, and this was quite easily drained, or even just intercepted and lowered by drainage operations in adjoining land parcels. Moreover, in some cases the object of drainage appears to have been afforestation, which would not demand perfect drainage and which would, once established, further reduce soil water levels.

### ***Valley fens of Central Norfolk***

The rich-fen valley fens of "Central Norfolk" include some of the most important East Anglian fen sites, several of which are nature reserves (Booton Common, Scarning Fen, Swangey Fen). There are only a few known examples of good-quality sites in this area that are known to have been largely or completely lost (Saham Fen and Carbrooke Fen may be cited) and indeed the fairly recent "discovery" of Badley Moor was a welcome addition to this series of sites.

Some of the sites in this region may have lost little if anything of their former interest. "Scarning Fen, for example, is now as quite good as it was when I first saw it in 1956" [F Rose, *in litt*, 1992]. In others there have been small losses, insofar as several species have not been recorded in recent years. Nonetheless some other sites have shown substantial change and loss, such as Swangey Fen, where areas bordering the R Thet have become coarse and impoverished, though some interest remains on the seepage slopes; or Whitwell Common, where there has been substantial species loss, though the vegetation is still primarily herbaceous; or Rockland All Saints Fen, which is apparently now entirely carr.

In some of these sites (e.g. Swangey Fen) deterioration is apparently related to deepening of adjoining water courses. Others (e.g. Whitwell Common) seem still to be wet, and deterioration appears primarily a consequence of dereliction. The groundwater irrigation of these sites is not really known, but it is likely that many of them are fed directly or indirectly by a partially confined Chalk or Crag/Chalk aquifer, which may go some considerable way to explaining why these sites have hitherto not been readily amenable to drainage and improvement.

### ***The Waveney-Ouse valley fens***

Although, because of their proximity, the sites in the upper reaches of the Waveney and Ouse rivers tend to be considered together, such an approach can obscure some important differences. In particular, Weston Fen is somewhat set apart, both spatially (by occupying a side valley) and hydrologically (by being a "valley-side" fen, developed on well-flushed seepage slopes. Thus in some respects it is more comparable with of the "Central Norfolk Valley Fens" than it is to its more immediate neighbours, which, as "riverside valley fens" are more intimately associated with the rivers that drain them. This distinction is reflected in the present condition of the sites: Weston Fen remains in a fairly well-watered state whilst the other Waveney-Ouse valley fens mostly show some evidence of dehydration, which has been particularly severe in the cases of Hinderclay and Redgrave & Lopham Fens.

Reports of dehydration in the Redgrave & Lopham Fens have a quite distinguished pedigree. Even in 1901 Geldart was prompted to comment that "Marshes near the source of the Waveney are the best known habitat of *Malaxis paludosa* and still yield *Liparis loeselii* - these marshes have become distinctly drier and the number of individuals of the rarer plants, although not perhaps the number of species to be found in them, has diminished within the writer's experience." (Geldart, 1901). Similarly, in an unpublished report, no lesser notables than A.G. Tansley and A.S. Watt comment that in 1949 "Little Fen and Redgrave Fens are good mowing fens, but the surface was very dry (possibly due to the weather)". The onset of real damage to these fens, however, appears to stem

from the early 1960s, in consequence of the twin effects of deepening the adjoining R. Waveney and of a major reduction of soligenous inputs, associated with water abstraction from the chalk by a nearby water supply borehole. In consequence these fens have shown a very substantial reduction in floristic quality. Groundwater abstraction may well have influenced rates of soligenous water supply to some of the other Waveney-Ouse fens too, but these do not have the same proximity to major water abstraction boreholes. [It is not even *known* with certainty, that some of these sites (e.g. the Thelnetham Fens) are spring fed, though it seems likely that they are.]

At one time probably all of the Waveney-Ouse riverside valley fens were of very great floristic interest, though not too much is known about either the vegetation or land-use history of some of them. Some, such as Bressingham Fen, have effectively been reclaimed, whilst others (e.g. Roydon Fen) have become much drier. In the late 1950s the three riverside sites examined by Bellamy & Rose (1961) were undoubtedly of high floristic quality. Today Hinderclay Fen is today scarcely recognisable as a fen and, whilst the other riverside sites remain as ostensible fens, all except for Thelnetham West Fen they have shown a substantial loss of floristic quality. This must be regarded as one of the most serious recent losses of fen vegetation in England. The Waveney-Ouse fens can be regarded as a soligenous parallel to the flood-plain fens of the Norfolk Broadland, and were once probably of similar importance, as was reflected in early proposals to incorporate them within a large National Nature Reserve. The recognised national importance of these sites is still evidenced by such designations as Grade 1 NCR sites, though it is a moot point whether they still deserve this, other than in terms of their potential for rehabilitation. There can be few better examples of a general failure, over the last 30 years, to protect one of the most important fen systems in Britain. It is, however, by no means certain that the damage is completely irreversible.

### *South Cambridgeshire*

Whilst Norfolk today ranks as the richest region for rich-fen vegetation in lowland England, Cambridgeshire is surely amongst the poorest. Yet the area around Cambridge must have once been of outstanding fen interest, on account of both the flood-plain fens of the southern Fenland basin and of the nearby, and in some cases contiguous, valley fens along the valleys of the streams and rivers draining from the Chalk uplands. The area to the east of Cambridge once supported some fen sites which were clearly extremely rich in plants (e.g. Bottisham Fen, Hinton Moor, Teversham Moor), though even by the time of Babington (1860) much, and in some cases almost all, of their wetland interest had been lost. The hydrotopographical status of these "lost" sites is not entirely clear. They mostly seem to have been part of the flood-plain fens of the Fenland basin but, being located at its southern edge, and with an adjoining Chalk upland further south, they were quite probably partly irrigated by groundwater, perhaps as much by a wide zone of upwelling as from discrete springs. And certainly where fingers of fen extended up the feeder valleys, soligenous valley fens occurred, as they still do in the R. Snail valley further to the east, where Chippenham Fen and Snailwell Meadows remain as important fen sites.

The magnitude of loss of fen vegetation and plant species from this once-interesting area is evident even on a cursory inspection of recent comital records (Crompton & Whitehouse, 1983). For example, *Epilobium palustre*, which is tolerably widespread in Norfolk, is apparently extinct in v/c 29.

It is therefore scarcely surprising that conservation organisations generally cherish such fen relicts as remain, even though some would scarcely get a consideration in better fen-endowed regions.

At the present time there are some (dry) remnants of the fens immediately east of Cambridge, most notably at Fulbourn Fen, Little Wilbraham Fen and Quy Fen. Even if these sites once had a substantial input of groundwater, it is far from obvious that they do today (Gilvear *et al.*, 1989) and, like Lakenheath Turf Fen in Suffolk, they generally possess floristic attributes of flood-plain fens.

Apart from the fens along the R. Snail, most of the residual valley-fen interest in vice-county 29 is situated in a small area southwest of Cambridge, in the catchments of the Rivers Rhee and Granta. Several sites still occur, designated as SSSIs. These localities were mostly well known to the Victorian botanists, though it is sometimes difficult to know the exact fen sites to which old records refer, partly because of changing names. For example, uncertainty surrounded the location of old records from "Triplow Peat Holes" until it was clarified by Crompton (1959), but other sites (e.g. Sawston Moor) have not been the beneficiaries of such detailed attention.

The "Peat Holes" area turns out to be a spring-fed valley-bottom location that once supported a notable range of fen plants. It was not directly destroyed at Inclosure, but was instead largely planted with trees. The area survives as wet woodland today. The higher adjoining land of Thriplow Heath also seems to have supported areas of wetland vegetation, which apparently included a "plentiful" population of *Eriophorum vaginatum*. This presumably represented a form of poor-fen vegetation developed perhaps under the influence of water derived from the shallow, superficial drifts upon the Chalk. Unfortunately it did not survive the Inclosures, as the Heath was ploughed and reclaimed. Today the main fen interest at Thriplow attaches to a couple of wet meadows (Thriplow Meadows), a site not specifically referenced by the nineteenth century recorders - probably because parts of it were cultivated and because there were (then) more interesting localities elsewhere in the vicinity.

Foulmire Common is quite close to Thriplow and may have provided a similar habitat for some wetland calcifuge species to that of Thriplow Heath (there are records for *Drosera rotundifolia*), but this site was similarly reclaimed. The spring-fed fen below the Common (Foulmire Moor) does still survive, though in a much modified form, as it was converted into an extensive watercress bed complex in the late nineteenth century. It is now an RSPB reserve. A short way downstream is the CAMBIENT fen meadow reserve of Shepreth-L-Moor.

The nearby valley of the Granta also supports two fen remnants, in Dernford Fen and Sawston Hall Meadows, on either side of Sawston village. These retain a quite wide range of plants, including, in the Meadows, *Selinum carvifolia*. This species is more a plant of MOLINION fen meadows than of true fen vegetation and it indicates faithfully the character of these two sites, which is generally more that of wet grassland than of wet fen. Yet the Sawston area once supported a goodly number of fen plants. Babington (1860) lists a wide range of these, including *Liparis loeselii*, from "Sawston" and "Sawston Moor", though the exact locations of these sites does not seem to be known. There was formerly also some other notable fen sites in the Granta valley, such as Shelford Common, and there can be no doubt that the two rather scruffy fen sites of the present day are but a very impoverished remnant of what must once have been an important area of fen.

With the exception of Thriplow Peat Holes, species loss from specific examples of valley fens south west of Cambridge is generally rather difficult to evaluate. This is because in some cases, as with the records from "Sawston", it is clear that a large number of fen species have been lost, but it is not known from exactly where (it is possible that Dernford Fen and Sawston Hall Meadows may once have sustained some of these "lost" species, but supporting evidence is currently unavailable). In other cases, where the location of old sites can be more specifically defined (or at least guessed!), it is because there are rather few old records. Thus the nineteenth century botanists noted only a handful of species from Foulmire and Shepreth and this has meant that the number of *apparent* losses from these sites is correspondingly small. It would be of considerable interest to know if these sites were formerly more rich than the small number of published records suggest or if, even in the nineteenth century, they were not sites of great fen species richness.

Whatever the changes at specific identifiable sites, if this area is considered as a whole, it is clear that there has been a very substantial reduction of fen interest, much of it probably quite long-standing. Moreover, the fen fragments that remain are currently subject to dehydration and, in some cases, lack of management and possibly nitrate-enrichment.

### ***Southwest Breckland***

Under this heading is included the fen sites developed along the lower reaches of the Rivers Lark and Little Ouse, at the Breck margin near their confluence with the flood-plain fens of the Fenland basin. This was once an area of enormous wetland interest, which has now largely disappeared. For example, Mildenhall parish once contained huge areas of peatland, but now has scarcely any fen vegetation. Of course, most of this loss has been through the reclamation of flood-plain fens of the Fenland basin, rather than of spring-fed sites. However, here at the Breck-Fen margins, improved drainage of the Fens has undoubtedly had a knock-on effect upon some of the marginal, soligenous mires.

This can be readily seen with reference to the area of Wangford Fen, a flood-plain fen complex occupying a side arm of the main Fenland basin which had (and still just has) some spring-fed fen along the margin with the adjoining Breck. Inspection of the 1st edition 6" OS maps (Suffolk sheets 12 NW and NE) for the Wangford Fen area is instructive. By this stage much of Wangford Fen had been ditched and reclaimed, but there were still considerable areas of rough pasture marked, particularly, but not exclusively, adjoining the margins. These areas may perhaps still have corresponded to the description of the whole Fen given on the 1836 1st ed 1" OS, Geological Survey (51.NE): "Peat with Many Heath Plants". Along the SW margin of the Fen, the Ordnance Surveyors distinguished the area of Pashford Poor's Fen, with groups of marsh symbols (especially towards the east end). Marsh symbols are also shown along the west and central north margin of the fen, along the lower slopes of Palmer's Heath. And also, and of particular interest, also shown are thin strips of marsh occupying the sites of old fishponds<sup>7</sup> on the drier land beyond the east end of the fen, east of what is now the A1065 road. The existence of these quite extensive marshy areas at and beyond the margin of Wangford Fen, presumably points to a very high (just subsurface) water table in the surrounding Breck. In one of them *Phragmites* and *Lythrum salicaria* once grew, prior to the early

<sup>7</sup> It is not clear if all of the marshy areas were occupying former fish ponds.

1980s, when the area dried up. Up till about this time there was also evidence of a sort of fen vegetation in Wangford Glebe (with *Carex paniculata*, *Juncus effusus*, *Glyceria maxima*, *Phragmites* etc) and of *Molinia caerulea* spp. *arundinacea* along the lower part of Palmer's Heath<sup>8</sup>. Today, not only are these areas of Breck dry, but so also is Wangford Fen to the extent that the one remaining marginal spring-fed site (Pashford Poor's Fen) is subject to major dehydration. The hydrological changes in this area reflect improved drainage in the Fens themselves coupled with a lowering, or interception, of groundwater sources.

Some areas close to the Fen margins were perhaps less directly affected by the earlier drainage events, but have nonetheless since suffered considerable damage. Eriswell Lode Fen was clearly once well irrigated by springs, particularly on the east side. There appears to have been considerable loss of some the wetter areas around the turn of the century, but the Poor's Fens near the head of the Eriswell Lode seem to have been little affected and, until recently (1960), provided one of the most valuable spring-fed sites on the Breck-Fen margin. They suffered an unusually premature demise because of the construction of a flood-relief channel (the New Cut) close to the course of the Lode. This has not only helped to drain the site but has possibly also intercepted seepage inputs. The site persists scarcely as a fen (Hurst Fen & Howlett Hills SWT reserve), though it seems likely that even without the New Cut it would still have suffered dehydration.

Further up the Lark valley, between Barton Mills and Icklingham, is a series of generally rather low-grade fens which provide yet another reminder of the possible difficulties of distinguishing valley fens from flood-plain fens, and indeed epitomise some of the problems of assessing past habitat change. Haslam (1960, 1965) regarded these mires as "valley fens" (i.e. flood-plain fens) that were generally silted and nutrient-rich, though some (e.g. Icklingham Poor's Fen) had marginal springs. Tuddenham Turf Fen, on the opposite side of the river, was also regarded as a flood-plain fen and, in the late 1950s clearly supported impoverished, fairly characteristic, flood-plain fen vegetation, with much scrub and *Phragmites*, *Glyceria maxima*, *Carex paniculata* etc. If this site has long been a nutrient-enriched flood-plain fen, then it may be suspected that it has long been floristically rather poor. However, there are former records from Tuddenham for a diverse range of low-productivity soligenous fen species, apparently representing what must have once been an excellent seepage fen in the Lark valley. Unfortunately, it is not at all obvious to just which site these records referred. Haslam (1960, 1965) regarded them as "headwater fen" species records and suggested that they belonged to a site which she called Tuddenham Mill Stream fen, which she considered to have been located somewhere near the headwaters of the Mill Stream, in the vicinity of Tuddenham village (i.e. quite separate from Tuddenham Turf Fen in the main Lark valley). By contrast F. Rose (*pers. comm.*) considers that at least some of these species may have occupied a soligenous margin in the Turf Fen of the main Lark valley. At present these conflicting viewpoints cannot be resolved, not least because neither Haslam (Haslam, 1966) nor Rose saw the lost species at either of their putative sites! At present, however, the balance of evidence tends to favour Rose's viewpoint.

### *Northwest Norfolk fens*

The Northwest Norfolk fens have some similarities with those of SW Breckland in that some of them also represent formerly extensive tracts of flood-plain fen situated at, or close to, the edge of the Fenland basin and that much of this has long been reclaimed. However, they differ in that more of the soligenous vegetation in some of the side valleys remains. Thus, the very large complex of fens on the Wissey flood-plain west of Stoke Ferry have long been reclaimed, but the spring-fed Foulden and Gooderstone Commons, irrigating a small tributary stream, remain in good condition. Similarly in the lower Nar valley the large areas of Wormegay Fen and Narborough Fen have long since been reclaimed, but East Walton Common, and to a lesser extent Lamb's Common and East Winch Common remain as quite good sites in fairly close proximity.

However, as in SW Breckland, some of the edges of the flood-plain complexes of NW Norfolk were undoubtedly spring fed and were able to persist as soligenous remnants following reclamation of the wetlands in the main valley expanse. For example, this was the case with the Marham Fens that flanked the south margin of the flood-plain fens of the R Nar valley (Norfolk). However such remnants have in most cases eventually succumbed to drainage activities elsewhere in the flood-plain, even when direct reclamation has not been attempted (sometimes because of their status as Poor's Fen sites). The Marham Fens have both been thus indirectly damaged, and one has since been largely cultivated.

Likewise the fens of the Caldecote valley (a tributary of the R. Wissey) have been progressively reclaimed. Even before the Second World War some of the larger areas of (probably largely flood-plain) fen had been badly damaged, but some proximate areas of spring-fed fen persisted in reasonable condition at least until the 1950s: "In the Wissey valley, improvement in drainage has lowered the water level and in the small patches of sedge that represent the former Beechamwell and Eastmoor Fens and will, if maintained, complete their extinction. Caldecote and Oxborough Fens, on the other hand, are not affected and retain their characteristic covering of *Cladium mariscus*." (Petch, 1948). However, there was little cause for optimism about these latter sites. Further drainage schemes in the valley led to dehydration and Oxborough Fen has since been reclaimed, whilst Caldecote Fen (Oxborough Poor's Fen) is now largely just rather dry woodland.

The three small fens near the headwaters of the Gaywood River valley (Derby Fen, Leziate Fen and Sugar Fen) were also damaged by drainage operations on the river in the late 1950s and early 1960s and by a direct attack upon Derby Fen, even though this was parish land. Although all three sites retain some conservational interest, much has been lost, and as areas of scrub or rough grazing they provide good examples of sites where conservation interest has been lost, for little agricultural gain. In this case the loss is particularly irksome because, being situated on Greensand, but alongside a river arising from the Chalk, they once supported a vegetation complex not found elsewhere in Norfolk, different even from the nearby Roydon Common.