Table CG1: Individual species showing major change between transplant treatments from 1988-96

Species	SSSI	Turf	Litter
Key: ++ = larger increase, + = increase, 0 = no consistent change, - = decrease, -+= decline then later increase			
MG5 constants			
Agrostis capillaris	+	++	0
Anthoxanthum odoratum	++	+	0
Centaurea nigra	++	+	0
Cynosurus cristatus	0	++	+
Dactylis glomerata	+	0	0
Festuca rubra	++	+	-
Holcus lanatus	+	++	0
Lotus corniculatus	++	+	0
Plantago lanceolata	+	0	0
MG5a preferentials			
Leucanthemum vulgare	+	0	+
MG5b preferentials			
Carex flacca	++	+	0
MG5c preferentials			
Carex caryophyllea	++	+	0
Danthonia decumbens	+	0	+
Luzula campestris	++	+	-
Prunella vulgaris	+	0	+
Other MG5 associates			
Poa pratensis/humilis	0	0	-
Ranunculus acris	++	+	-
Ranunculus bulbosus	-+	0	-
Ranunculus repens	0	+	0
Rhinanthus minor	0	+	0
Taraxacum officinale agg	0	0	0

Species	SSSI	Turf	Litter
Key: ++ = larger increase, + = increase, 0 = no consistent change, - = decrease, -+= decline then later increase			
Other species			
Anagallis arvensis	0	0	+
Carex hirta	0	+	0
Equisetum arvense	0	+	0
Isolepis setacea	0	0	+
Holcus mollis	0	0	+
Juncus bufonius	0	0	+
Leontodon saxatilis	0	0	+
Oenanthe pimpinelloides	+	++	0
Orchis morio	++	+	++
Stellaria graminea	+	++	0
Ulex europaeus	0	0	+

5. The effects of littering and turf transplant on groups of species

5.1 Introduction

5.1.1 Leach and others (Annex EN9) have examined a large number of different ways of categorising plant species according to their ecology. Only those changes which were judged in Annex EN9 to be large and consistent are referred to here.

5.1.2 There was an overall increase in species richness (the number of species per unit area) over time in all treatments, associated with the reimposition of appropriate management and an associated decline in sward height. This means little by itself: it is the type of species involved which is important.

5.2 The effects of littering

5.2.1 Littering was associated with a rapid increase in ruderal and "competitive-ruderal" species, which later declined again, but have not yet disappeared. These species are by definition short-lived, quick colonisers which are able to take advantage of the bare ground made by the littering treatment. Some are also weeds of agriculture.

5.2.2 More persistent changes have occurred in the representation of species generally associated with species-poor vegetation, which in 1996 were still nearly twice as common in the littered plot as in the SSSI control. Taken together, the eleven species which are constants in MG5 have also remained approximately 20% less common in the littered plot than in the SSSI.

5.2.3 By definition, none of these groups should play a major part in the composition of ancient species-rich grasslands. Although Leach and others showed that many of the groups which are expected to be well represented in MG5 remained common or have recovered (such as stress-tolerators), the littered grassland remains substantially different from an ancient species rich grassland because it bears the "signature" of these groups of species.

5.2.4 Leach and others further noted (Annex EN9, paragraph 3.3.4.2) regarding the littered area that *it is not currently possible to categorise it in NVC terms*. This failure of the littered transplant to settle down is attributed to both the effects of the transplant technique and to environmental differences in wetness and other soil characteristics in the area which received the transplant.

5.3 The effects of turf transplant

5.3.1 Examination of Table CG1 above suggests that the effect of turf transplant might be more subtle than the substantial change in the littered plot. When different categories are examined the picture becomes much clearer and there are substantial differences in categories important to judging the status of MG5 grassland.

5.3.2 The most consistent and largest differences were in categories which are central to the species-rich ancient grassland community. Stress-tolerators in particular declined in the turf transplant relative to the SSSI. In parallel, species associated with species-rich vegetation failed to thrive in the turf transplant but increased in the SSSI.

5.3.3 These differences are reflected in groupings of species derived from the NVC. MG5c preferential species in particular increased in the SSSI control but failed to do so in the turf transplant.

5.4 Conclusion

5.4.1 Changes in both the littered and turf transplant treatments can be categorised according to groupings of plant species with differing ecology. The results suggest that both transplant treatments failed in different ways to preserve the original community structure or to respond to the improvement in management in all treatments.

5.4.2 Interpretation is limited however by the inevitable overlap between groups. For instance, stress-tolerators are often also "species associated with species-rich vegetation" and "declining species" in Britain. Two of the stress-tolerator species showing a differential response (spring sedge *Carex caryophyllea* and heath grass *Danthonia decumbens*) are also MG5c preferentials. To a certain extent, the analysis of different groups of species is rendered difficult because each grouping shows a different side of the same coin.

5.4.3 **The above analysis of plant species groupings is of some help in understanding the sort of species which changed after transplantation. However, an objective assessment of the effects of transplantation also needs tests on changes at the community level, on all the species in the community simultaneously.** This special analysis was the subject of my own report on the Brocks Farm data (Annex EN10). The findings are summarised in the next section of my evidence.

6. The effects of littering and turf transplant on the plant community

6.1 The methods used to analyse change on the community level in Annex EN10 were specially developed by statisticians to examine and test the nature of changes taking into account all the species encountered and treatments applied simultaneously.

6.2 I carried out three analyses, each designed to perform a particular step in analysing change. All the analyses share the feature that they work by dissecting the variability found in species composition in different places into distinct components. These components are extracted from the data in order of their importance and so that each component is unrelated to the others. The components are expressed on "axis" scores which can then be plotted on a graph to show the main variation encountered and the position of each sample or species in relation to it. A problem with a very large number of variables in it (as many as the species and samples) is then reduced to an objective but relatively simple picture of the overall variation.

6.3 Different types of analyses are used depending on the questions being asked. I used the following types. The graphs referred to are from my report (Annex EN10) and are also appended to my evidence.

6.3.1 An analysis (DCA ordination) which simply draws a picture of the variability found in the vegetation. This is shown in Figures 1 and 2 of Annex EN10 and my Appendix. Even though it only draws a picture of the variation, it may show patterns which suggest differences between times and treatment, as this one did.

6.3.2 The second analysis (DCCA ordination) attempts to provide the best explanation of the patterns in terms of what one knows about the vegetation, i.e. when it was sampled, how tall the vegetation was, whether or not it had been transplanted and by what method and so on. The same analysis is used to test whether or not the relationships found are statistically significant. The results of this analysis are shown in Figures 3 and 5 of Annex EN10 and my Appendix.

6.3.3 The third analysis (partial DCCA ordination) was used to test a specific question about the turf transplant treatment. Did the way in which the turf transplant changed differ from the way in which the SSSI changed, and was that change continuing? Here, the overall effect of time was removed by a standard technique so that any differences in the trends between treatments could be examined explicitly. The results of this analysis are shown in Figures 7 to 9 of Annex EN10 and my Appendix.

6.4 I also used the results of the second and third analyses to derive lists of species which were especially characteristic of different treatments (SSSI control, turf transplant and littering), taking into account the overall composition of the plant communities.

6.5 Even a simple picture of the variation in vegetation at Brocks Farm clearly separated effects associated with turf transplant, littering, and the general change over time associated with the reimposition of appropriate management. Remembering that Axis 1 represents the most important variation and axis 2 the second most important, this pictorial analysis suggested the following.

6.5.1 That the three plots in 1988 started out with broadly similar species composition (i.e. before the transplant treatments the vegetation overlapped although some future litter area quadrats differed from the general mass).

6.5.2 That littering was associated with an immediate large shift in composition (movement to the left), which slowly returned towards "normal" (the eventual position of the SSSI). By 1996 it had still only moved just over halfway back towards "normal".

6.5.3 That turf transplant was associated with a slow movement in the opposite direction (right) to that of littering. This change did not appear to diminish over the time of monitoring.

6.5.4 That all treatments changed in the same (towards the bottom of the graph) direction over time.

6.6 The next analysis (Figures 3 and 5) defines the changes associated with littering and turf transplant and also showed that the effects had a chance of less than 1 in 100 of having taken place by random variation alone. The named lines on Figure 3 show the strength and direction of effect of the different variables measured. Axis 1 therefore contrasts the effects of turf transplant (to the left) with littering (to the right). Axis 2 mainly contrasts tall swards found early in the monitoring (top) with shorter swards (bottom) later on (Figure 4), associated with management applied to all areas. It happens that more quadrats were usually taken in littered plots because the strips the plots were divided into were bigger there: this variable (Nquads) is shown for completeness.

6.7 The species associated with littering were relatively few in number and clearly placed towards the right hand side of axis 1. Note that these are largely the same species already identified by Leach and others (Annex EN9) and summarised in Table CG1). The overall difference in the species chosen by the community analysis as "litter species" is however massive. Figure 6 of Annex EN10 and my Appendix shows that they have been virtually "exclusive to litter" species throughout the monitoring. Also, although they peaked early on, they have shown no sign of further decline since 1990.

6.8 The six strongest litter species (HOLCMOL *Holcus mollis* and rightwards in Figure 5) are all "other species" in Table CG1 above. None are species normally frequent in MG5.

6.9 **This demonstrates that littering has caused a statistically significant and substantial shift away from the MG5 species-rich ancient grassland which forms the special interest of the SSSI.**

6.10 The effects of turf transplant, although statistically significant, are more difficult to understand from Figures 3 and 5, mainly because of the very large cluster of species in the left-hand half of Figure 5. The third analysis was directed at a more precise comparison of the turf transplant and SSSI by examining them alone, which allows a more precise definition of the effects of turf transplant.

6.11 This third analysis showed that the most important feature of the turf transplant was the way in which its composition over time became different from the SSSI control (i.e. the longest named line on Figure 7 and the closest to axis 1 is Yea*Turf). Axis 2 expressed vegetation height. Independently of the way in which differences accumulated and the turf height, grazing treatment had little effect. Nevertheless all the variables shown in Figure 7 had statistically significant effects (one chance in a hundred or less of happening by chance).

6.12 I then used the third analysis to examine the magnitude of difference in those species most strongly associated with later years in the turf transplant on the one hand, and with the SSSI control on the other. This was done by dividing Figure 9 parallel to the direction of the way the turf transplant changed over time (Yea*Turf) and examining the abundances (Figure 10) of the resulting groups of species. The points of division were to a certain extent arbitrary but chosen from experience of these analyses to pick out the species most characteristic of the different treatments. Clearly the "indifferent" group of species in the centre of Figure 9 will also contain some which are biased towards occurring in the SSSI or turf transplant respectively, but less so than those shown in Figure 10.

6.13 As with the litter indicators, the difference between turf transplant and control was not only statistically significant, but substantial. Further, the turf transplant indicator species (Figure 10a) were still increasing by 1996. The SSSI increasing species may on the other hand have levelled off but show no sign of beginning to increase in the turf transplant.

6.14 Comparison between my Figure 9 and Table CG1 above shows that the species involved confirm and extend Leach and others impression from the analysis of species groups. In particular, only one of the SSSI increasing species (ORCHMOR - *Orchis morio*) is not at least an associate of MG5. The others are constants in the community or preferentials to a MG5 subcommunity. Conversely the only turf transplant indicators which <u>are</u> associates of MG5 are the two annual species (TRIFDUB - *Trifolium dubium* and RHINMIN - *Rhinanthus minor*) which would be expected to benefit from disturbance, and tufted vetch VICICRA - *Vicia cracca*, which is found in a wide range of coarse grassland as well as in MG5.

6.15 **The conclusion is that changes in the turf transplant are both significant and substantial and represent a shift away from the MG5 species-rich ancient grassland community, i.e. damage.**

6.16 **Further, the changes associated with turf transplant take time to become apparent: without the benefit of the full nine-year monitoring period the exercise might mistakenly have been judged to be a success because the changes were then smaller and less easy to detect.**

6.17 The causes of these changes are more difficult to establish as the different transplant techniques have the potential to change so many factors, including rooting depth, minor differences in soil types at the receiver site and increases in bare ground, to name only the most obvious. The precise causes are not known and cannot be determined from the existing data. Without such knowledge, it is not possible to improve any subsequent translocation exercise. **Whatever the factors involved, they have caused substantial change arising from both transplant techniques.**

7. Conclusion - consequences of transplantation for the special interest of grassland

7.1 Both transplant techniques have caused substantial damage to the vegetation community which forms the special interest of the species-rich grassland. Littering caused an immediate shift in species composition which later reduced but did not disappear. Turf transplant initiated a slow change which has continued to increase throughout the monitoring period.

7.2 Turf transplant has generally been acknowledged from the Brocks Farm experience and in other examples to be the better practice for habitat transplant. From the Brocks Farm data, it is now clear that it takes many years for the damage to be expressed fully - at least nine years as it is still increasing.

7.3 Against this knowledge, any claim that turf transplant can preserve a vegetation community is specious. Likewise, any attempt to improve on past techniques is merely guesswork without knowledge of their effects or the benefits or otherwise that claimed improvements can bring. The transplants at Brocks Farm have produced an exercise in habitat creation which has not preserved the species-rich ancient grassland community of special interest. Any further attempts at transplantation are likely to have similar results.

7.4 This means not only that substantial damage to the special interest of species-rich grassland communities results from transplant attempts but also that it would not be possible to offset this damage by means of planning conditions or obligations, other than an obligation to leave the SSSI grassland with appropriate management *in situ*.

7.5 I have shown that the transplants at Brocks Farm have produced statistically significant and substantial change which represents deviation from the vegetation community, and therefore habitat, of special scientific interest. The significance of this to nature conservation at the local and national level is described in Dr Jefferson's and Dr Wolton's evidence.

7.6 In view of the demonstrated significant harm to the special interest of communities of national importance, I respectively request that this Appeal be dismissed.

Appendix

Figures 1 to 10 of Annex EN10 (see Appendix 5)

Note: In Figure 6, the y-axis, as in Figure 10, shows the average total frequency of all species being considered.

3.3 Proof of evidence of Dr Richard Jefferson, English Nature

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1. Qualifications and experience

1.1 I am the Senior Grassland Ecologist in the Lowlands Team of the Nature Conservancy Council for England (English Nature) based at the National Office in Peterborough. I am responsible for providing scientific and technical advice within English Nature and to external partners to ensure the effective conservation of England's lowland grasslands of wildlife value. I have held this post for five years prior to which I worked for the Nature Conservancy Council as a Conservation Officer in North and East Yorkshire between 1985 and 1991 and as Senior Officer for English Nature's York Office in 1992 where I was responsible for managing a team of thirteen staff.

I hold a B.Sc. First Class Honours degree in Geography from the Council for National Academic Awards (CNAA) for studies undertaken at Middlesex Polytechnic and an M.Sc in Ecology from the University of Durham.

In 1985 I was awarded the degree of Doctor of Philosophy by the University of York for research into the ecology and conservation of the vegetation of disused chalk quarries in the Yorkshire Wolds, England. I also hold an IDQ in vascular plant identification awarded by the Natural History Museum, London in 1996.

I was elected as a Fellow of the Royal Entomological Society (FRES) in 1984 and as a Member of the Institute of Ecology and Environmental Management (MIEEM) in 1991.

I am joint editor and part author of the *Lowland Grassland Management Handbook*, published by English Nature and The Wildlife Trusts in 1994, to provide advice on suitable management practices for semi-natural lowland grassland. I have also published a range of papers and reports on the ecology and conservation of lowland grassland and related habitats.

2. Scope of the evidence

In order to support the evidence of my colleagues, Dr Robert Wolton and Dr Charles Gibson, it is the purpose of my evidence to:

a. describe briefly the general characteristics of lowland semi-natural dry/seasonally damp neutral meadows and pastures of which the grassland found at the appeal site is an example;

b. demonstrate that these grasslands are a nationally rare and threatened habitat of high nature conservation value;

c. Provide an overview of other previous attempts to translocate semi-natural grassland and to demonstrate that this technique has failed to conserve the original plant community composition and which forms a major part of the special interest of these grasslands.

3. The plant community of the appeal site: Brocks Farm Site of Special Scientific Interest

3.1 The grassland of the appeal site (Brocks Farm SSSI) consists of neutral or mesotrophic grassland referrable to the MG5 Common knapweed (*Centaurea nigra*) - crested dog's-tail (*Cynosurus cristatus*) grassland of the National Vegetation Classification (NVC). The grassland most closely conforms to the heath grass sub-community of MG5c as explained by Dr Gibson. The MG5 grassland type is often known as lowland dry old meadow and pasture. It is one of 13 lowland mesotrophic grassland communities described by the National Vegetation Classification (Annex EN11).

3.2 The National Vegetation Classification was commissioned by the former Nature Conservancy Council in 1974 as there was a recognised need for a systematic classification of British vegetation to enable conservation organisations to take decisions relating to the evaluation and conservation of wildlife habitats by possessing a common "language". The classification is being produced as five volumes of which four have been published to date by Cambridge University Press under the series title "British Plant Communities". The classification used approximately 35,000 sample plots of vegetation covering all regions of Great Britain and the full range of vegetation types. These data were analysed by computer using a multivariate statistical method known as two way indicator species analysis (TWINSPAN). The method sorts sample plots of vegetation or quadrats into groups with floristic coherence. The groups are termed **communities** or, if a further division is made, **sub-communities**.

3.3 For each community described by the National Vegetation Classification, there is firstly a description which provides details of its plant species composition and structure, its habitat and distribution in terms of soil type, hydrology, climate, and management and its past and present distribution status. Secondly, a data table (**floristic table**) (Annex EN11) lists the plant species for the community and which also includes information on the frequency and abundance of the species in the samples. The floristic table is split into three blocks of species. At the top of the table the first block of species comprises the community **constants**, that is those species which are likely to be regularly encountered (normally in greater than 60% of quadrat samples) in any area of vegetation said to be of the community type. Below these occur other blocks of species known as **preferential** species which are distinctly more frequent within one or more of the sub-communities than the others i.e they help to characterise the sub-communities. At the bottom of the table are the **associate** or **companion** species which occur with lower frequency and are rarely of value in categorising the community.

4. Habitat and botanical composition of MG5 grassland

4.1 The MG5 grassland community occurs throughout the British lowlands on neutral (neither very acidic or alkaline) relatively free-draining brown earth soils such as loams and clays where there has been a long history of traditional management of hay cutting and/or grazing with occasional applications of farmyard manure but without recourse to the use of inorganic fertilisers or herbicides. In Europe this grassland type is confined to the UK, Republic of Ireland and northern France. It is most commonly encountered in small, relatively level enclosed fields in the lowlands and on the upland fringes where it is used for hay and pasture. It can also occur as part of lowland limestone landscapes particularly on the sides of valleys and dales where soils are deeper often giving way to limestone grassland on thinner more lime-rich soils. In the latter situation it is usually managed as pasture.

4.2 It is rich in a variety of forbs, grasses and sedges with herbaceous plants comprising a substantial proportion of the herbage. A number of plant species with a restricted distribution in Britain can occur in the community including Corky-fruited Water-dropwort (*Oenanthe pimpenelloides*), green-winged orchid (*Orchis morio*), meadow saffron (*Colchicum autumnale*) and sulphur clover (*Trifolium ochroleucon*) but the key aspect of the community is the abundance of a suite of characteristic species none of which in themselves is very rare.

4.3 The National Vegetation Classification shows that a sample area of $4m^2$ of the grassland may on average contain 23 different plant species with a range from 12 - 38 (Annex EN11). The appeal site had a mean of $28.5/4m^2$ (range 24-34) and 28.3 (range 26-31) from seven and six quadrats taken in May 1994 and 1997 respectively (see Annex 2 of Annex EN9 and Annex EN13), thus having greater than average species richness than for the described NVC community.

4.4 The community is divided into three sub-communities, the **yellow meadow vetchling (*Lathyrus pratensis*) sub-community** (MG5a) which occurs on soils which are near neutral, the **lady's bedstraw (*Galium verum*) sub-community** (MG5b) on more alkaline soils and the **heath grass (*Danthonia decumbens*) sub-community** (MG5c) on more acidic soils. The differences in species composition between the sub-communities are thought to be related to differences in soil pH, although management history may also be influential.

4.5 Of the MG5 sub-communities, the heath grass type (MG5c) seems to be especially distinctive of the lowlands and upland fringes of western Britain.

5. Status and threat to lowland semi-natural grassland

5.1 Grassland is the most abundant type of vegetation in England. However, most of this grassland, which is used largely for agriculture and amenity, is very poor in plant species and has been either recently created by ploughing and re-seeding with one or a few grass species and sometimes clovers (*Trifolium* spp.) or is the result of regular applications of inorganic fertiliser and herbicide to older, originally more species-rich grassland.

5.2 Conversely, lowland semi-natural grassland now constitute only approximately 3% of all the permanent grassland in the English lowlands. In area terms it has been estimated that less than 100,000 ha now remain (Annex EN14).

5.3 A project to assess the extent of lowland semi-natural grassland plant communities in Great Britain is currently being undertaken as a joint exercise supported by the Joint Nature Conservation Committee, Scottish Natural Heritage, Countryside Council for Wales and English Nature. The estimates are derived principally from grassland surveys undertaken by the former Nature Conservancy Council and its successor bodies over the last 17 years. The estimates from this project coupled with other unpublished data indicates that semi-natural neutral grasslands which include MG5, now occupy less than

12000 ha in England of which less than 6000 ha is MG5. The project data suggests that the heath grass sub-community (MG5c) is the rarest of the three sub-communities in England.

5.4 Using data from a series of grassland surveys carried out between 1930 and 1984 by agronomists and ecologists it is estimated that by 1984 in lowland England and Wales semi-natural grassland had declined by 97% over the previous 50 years (Annex EN15). This decline is principally attributable to agricultural intensification where sites have been converted to arable or improved by drainage, ploughing and re-seeding with high yielding agricultural grass species such as rye-grass or application of artificial fertilisers. It is well established that application of artificial fertiliser to semi-natural grassland results in changes in their botanical composition including a decline in the number of plant species. Application of fertiliser converts MG5 grassland to species-poor MG6 Perennial rye-grass *(Lolium perenne)*-Crested Dog's-tail *(Cynosurus cristatus)* grassland which is not valued highly for nature conservation. The community is particularly vulnerable to agricultural improvement occurring as it does on dry or damp free-draining soils usually on level terrain which requires little drainage and does not provide difficulties of access or use of modern agricultural equipment for spraying, ploughing and reseeding

5.5 Losses have continued during the 1980s and 1990s and have been recorded at 2-10% per annum from county to county. As far as semi-natural neutral grassland is concerned, data from Dorset have shown that between 1983 and 1988 there was a 60% loss (1000 ha reduced to 396 ha) (Annex EN16) and in Worcestershire loss rates of MG5 grassland between 1980 and 1991 were estimated to be 3% per annum (1350 ha reduced to 500 ha) (Annex EN17).

5.6 Prior to agricultural intensification, MG5 grassland was probably the most frequent grassland type in the lowlands due to the widespread occurrence of suitable free-draining neutral soils. It is now very thinly scattered and fragmented throughout England although a particularly important concentration occurs in Worcestershire. It usually survives as small isolated fields or groups of fields. A study in Dorset estimated that 50% of all semi-natural neutral grassland sites were less than 5 ha in extent (Annex EN16).

5.7 In the forthcoming Red Data Book of British Plant Communities (Rodwell & Cooch, in preparation), MG5 grassland is evaluated as a vulnerable vegetation type, uncommon in its distribution, of small total extent and still declining and dependent on traditional management (Dr John Rodwell personal communication).

5.8 It is clear that MG5 grasslands are now a rare and fragmented resource which remain threatened particularly by agricultural intensification. It is interesting to note that the Nature Conservation Review published in 1977 concluded that "*as a class* [neutral grassland] *this is the most threatened of all British habitats....*" (P 194- Annex EN18).

6. Nature conservation value and status

6.1 Semi-natural neutral grasslands, which include MG5 neutral grasslands, are valued for nature conservation because they are typically ancient, species-rich and composed of native species. Evidence suggests that neutral grasslands have been a feature of the landscape since at least the Iron Age (Annex EN19). The physical and biological characteristics of this grassland have often evolved over considerable time periods. They cannot easily be re-created over short timescales. Thus conservation of the remaining examples *in situ* is a priority.

6.2 Although the importance of MG5 grassland derives principally from the rich assemblage of relatively widespread plant species which together characterise the community, a number of regionally and nationally scarce and rare species do also occur adding to its value.

6.3 The Guidelines for selection of biological SSSIs 1989 (p.26) defines nationally rare habitats as those which occupy less than 10000 ha and hence MG5 falls into this category (Annex EN20). The community, as previously stated, is not known outside of the British Isles and northern France and thus the MG5 is of considerable significance in an international context and the UK has a special responsibility for ensuring its conservation.

6.4 Recognition of their nature conservation value by ecologists came late (early 1970s) compared to other types of semi-natural habitat such as chalk and limestone grassland. This was probably due to their widespread occurrence in the lowland agricultural landscape up until the 1950s, the fact that they had been little studied, and perhaps a lack of realisation of their vulnerability to agricultural intensification which had been accelerating through the post-war years.

6.5 In the 1970s it was realised that they were declining and increasing efforts were made to protect some examples as SSSIs and Nature Reserves, including those managed by both voluntary and statutory organisations. Following the enactment of the 1981 Wildlife & Countryside Act, which gave greater powers for the protection of SSSIs, increased resources for nature conservation resulted in the implementation of a programme of grassland survey through the 1980s and early 1990s. Although surveys of neutral grassland were not completed for all areas due to the difficulties and cost of locating sites, nonetheless many were discovered by such surveys and were notified as SSSIs.

6.6 The current *SSSI guidelines* (Nature Conservancy Council 1989) identifies MG5 as a type which qualifies for SSSI selection on botanical grounds. To qualify, sites must be greater than 0.5 ha. As far as (neutral) meadow sites are concerned the guidelines states "*adequate representation in the SSSI series tends to involve a large number of small sites*" and "*it is imperative to notify as SSSIs as many as possible of good examples that remain*" (Annex EN20).

6.7 As at 31 May 1997, there are 413 SSSIs in England containing MG5 grassland. Although it is not possible to say what proportion of the total area of the community is within SSSIs nationally, a few examples from Areas of Search show wide variation. In Dorset, Suffolk and Worcestershire 78%, 44% and 25% of the resource is within SSSIs respectively. Fourteen of the 187 National Nature Reserves declared under the 1949 National Parks &

Access to the Countryside Act or the 1981 Wildlife & Countryside Act contain MG5 grassland.

6.8 The nature conservation importance of these ancient species-rich grasslands is recognised in the national policy document, the UK Biodiversity Action Plan (The UK Steering Group Report 1995) endorsed by Government in May 1996. The UK Biodiversity Action Plan was developed as the UK's response to the Biodiversity Convention developed at the Earth Summit in Rio in 1992. It aims to take steps to conserve UK biodiversity. It lists 38 key habitats for which costed action plans will be produced over the next three years (Annex EN21).

To be included a habitat had to satisfy one or more of the following criteria:

- habitats for which the UK has international obligations;
- habitats at risk, such as those with a high rate of decline especially over the last 20 years, or which are rare;
- areas, particularly marine areas, which may be functionally critical;
- areas important for key species.

Lowland hay meadow is one of the key habitats and includes the MG5 grassland community.

6.9 A habitat statement for unimproved neutral grassland is published in volume 2 of Biodiversity: the UK Steering Group Report (Annex EN6). This is intended to help inform national and local policy and action prior to the production of detailed costed plans. Under the heading "Conservation Direction" the statement stresses the objective of maintaining the extent and quality of species-rich neutral grassland in the UK through in part protecting it from inappropriate changes in land use. The costed Action Plan will be produced for consultation in 1997.

6.10 The importance of unimproved grassland is recognised by The Ministry of Agriculture, Fisheries & Food's Countryside Stewardship and Environmentally Sensitive Areas Schemes (ESAs), which are co-funded by the EU under Agri-environment Regulation 2078/92. They are voluntary discretionary schemes aimed at protecting and enhancing threatened landscapes and wildlife habitats. The former scheme targets a range of habitats and landscape types including all lowland hay meadows and pastures (Annex EN22) . ESAs are defined geographically and include MG5 grasslands for example in the Upper Thames Tributaries and the Somerset Levels ESAs.

7. A review of grassland translocations

7.1 Deliberate attempts to translocate plant communities of nature conservation value, which would otherwise be destroyed by land use change, particularly urban/industrial development, have taken place over the last 25 years. Translocation has been attempted on many occasions although precise details of community type, methods and results are only available for very few sites. A range of habitats have been subject to translocation although grasslands are the predominant type. The principle is that translocation is put forward as compensation for the loss of the *in situ* community.

7.2 The most common technique used involves the lifting of vegetation at the donor site as turves which are subsequently re-laid at a prepared receptor site. Occasionally, transfer of rotovated soil and vegetation (littering or blading) to a receptor site has been used. It would appear that most translocations consider only the botanical community rather than any other physical and biological attributes of the site. By implication, the aim of many translocations would seem to be to translocate a plant community and, it is to be hoped, some of the other taxa (e.g. invertebrates) such that the translocated plant community resembles the pre-translocated state.

7.3 It is the intention here to provide a brief overview of the results of known grassland translocations to provide an overall context for the more detailed assessment of the existing translocations at Brocks Farm which will be made by Dr Gibson in his proof.

It is acknowledged that it is not possible to extrapolate the results directly from other grassland translocations to the Brocks Farm situation as each case is different. However, this exercise will provide an overview of the general principles and risks involved.

7.4 A number of sources of information are readily available and these include the published reports from selected grassland sites monitored by the former Nature Conservancy Council's England Field Unit and ecological consultants and a review entitled "*A moving story: species and community translocation in the UK: a review of policy, principle, planning and practise*" commissioned by WWF-UK and published in 1997.

7.5 The information contained in the monitoring reports for sites has a number of limitations. Firstly, monitoring data from translocations have not been, as far as I am aware, subject to rigorous statistical analysis similar to that performed by my colleague Dr Gibson on the Brocks Farm data. Secondly, long term monitoring data are seldom available thus limiting the conclusions that can be drawn. Brocks Farm is unusual in this respect with its nine years of data. Thirdly, determination of physical parameters such as soil type and hydrology at both the donor and receptor sites are rarely recorded thus limiting the conclusions that can be drawn in terms of what causes vegetation change. Finally, few translocations state the aims and objectives and without these measurement of success is difficult even where some form of monitoring has occurred.

7.6 A review of the literature indicates that all grassland translocations show changes in plant community composition and pattern following translocation. The magnitude of change ranges from changes in the frequency and abundance of plant species (including extinction of species and the invasion of new species not previously recorded) which would not be expected to be due to natural year to year fluctuations, through to a change in the plant community type, for example from one NVC community to another. The causes of changes in species composition following translocation are often not easy to deduce but the likely factors include:

- The creation of disturbed conditions as a result of lifting, transport and the re-laying of the turves may result in invasion of species more suited to disturbed ground;

- Differences between the physical and chemical environment of the donor and receptor site particularly soils and hydrology;

- Lack of or changes in management. In some cases the treatment/management of the translocated community was different to that of the donor site;

- Root disturbance/pruning. Cutting of turves inevitably results in the severing of the roots of plant species and it is possible that this may result in species extinctions or changes in abundance perhaps as a result of changes in the competitive "balance" between species. Some herbaceous species in grasslands are known to be deep rooted, sometimes in excess of 1 metre. It is known that many cereal crops draw water from up to 1.2 metres depth.

- disruption to mycorrhizal associations which may influence the competitive ability of plant species

7.7 A few examples are given below, in addition to the Brocks Farm example detailed by Dr Gibson in his proof, to show the types of change that have taken place in translocated grassland. An area of translocated Magnesian limestone grassland, conforming to a mixture of NVC communities CG6 Downy Oat-grass *(Helictotrichon pubescens)* grassland and CG8 Blue moor grass (*Sesleria albicans*)-Small scabious (*Scabiosa columbaria*) grassland, at Thrislington Plantation in County Durham is often cited to show that translocation can be successful. However, examination of the botanical monitoring data shows that whilst the transplants are still clearly a type of limestone grassland, there have been a number of important changes in species composition. Blue moor grass, a key component of lowland Magnesian limestone grassland, has undergone substantial declines in the transplants in contrast to the pre-transplant site and the SSSI "control" plot where it has increased . Other limestone grassland species characteristic of the pre-transplanted grassland have also declined post-transplant including Common Bird's-foot-trefoil *(Lotus corniculatus)* and common Rock-rose (*Helianthemum nummularium*). Upright brome (*Bromopsis erecta*) has increased substantially in the transplants in contrast to the SSSI. In addition, the transplants have a few species, such as Smooth sow-thistle (*Sonchus oleraceous*), which are indicative of disturbance and which do not occur in the SSSI plot.

7.8 Part of a site known as Monkspath Meadows, an MG5c neutral grassland in the West Midlands was translocated to two different locations, one site within the existing field which was disturbed by a pipeline and the other a few miles away at Temple Balsall. The latter translocation was recorded by English Nature Local Team staff in 1992 five years after transplantation and it is now a mosaic of two very different NVC communities MG9 Yorkshire fog (*Holcus lanatus*) - Tufted hair grass (*Deschampsia cespitosa*) grassland and M23 Soft-rush (*Juncus effusus*)/Sharp-flowered rush (*J. acutiflorus*)- Common Marsh-bedstraw (*Galium palustre*) rush-pasture. The former is of lesser botanical conservation value and one which the SSSI guidelines indicate should not normally be put forward for notification.

7.9 The translocated part of a MG5 grassland at Brampton Meadow, Cambridgeshire now conforms to NVC MG1 False oat-grass *(Arrhenatherum elatius)* grassland, a species-poor community of lower botanical interest, as defined by the SSSI guidelines. The cause of change may be in part due to lack of management following translocation but it illustrates the practical difficulties in ensuring favourable management following a translocation.

7.10 The changes in plant community composition that have taken place in many translocations are greater and more persistent than the species fluctuations that occur in most untranslocated semi-natural grassland communities which are receiving appropriate management. It thus follows that these changes represent damage to the original wildlife interest of the original *in situ* vegetation.

7.11 As has been mentioned previously, the majority of translocations have concentrated on replicating the plant community at the receptor site. Other taxa (fauna, fungi, micro-organisms etc) have rarely been considered. A few have monitored elements of the terrestrial above-ground invertebrate fauna such as at Thrislington and a neutral grassland at Ashington, Northumberland. These both showed differences in the composition of the invertebrate fauna in the transplant in contrast to a control with translocated grassland at Thrislington experiencing a decline in species characteristic of limestone grassland.

7.12 It is extremely unlikely that translocation, unchanged, of all populations of every taxon from one area to another is feasible due to problems in exactly reproducing the original physical environment including soils, hydrology and microtopography and ecosystem processes. Even if this were possible, this would still not be the same as conserving a site *in situ*. Semi-natural grasslands are a product of the interplay of both local physical and biological processes and past economic and social activities over many hundreds if not thousands of years in a particular locality. Translocation removes or disrupts the historical and cultural context of the site in the landscape. In terms of the nature conservation evaluation criteria outlined in A Nature Conservation Review (Annex EN23) and the SSSI guidelines, a translocated "semi-natural" grassland would not rate highly on the criteria of Naturalness or Typicalness. The former is a measure of the extent of human-induced modification. The latter was included as a criterion to ensure that typical examples (as opposed to unusual or atypical) of a plant community type were represented in any series of protected habitats.

7.13 The above conclusions are not novel or controversial. For example a guidance document on impacts, mitigation and enhancement in relation to road schemes prepared for English Nature by Penny Anderson Associates concludes that habitat transferral does not provide compensation for loss or damage to high value, non-replaceable sites (Annex EN24). It supports the contention that translocation can never be a substitute for *in situ* conservation. The WWF-UK report mentioned earlier states that it is not possible to attribute outright success in any [habitat translocation] case.

8. Policy and precedents

8.1 Translocations are normally carried out in response to a change in land use forming part of an application for planning permission which may or may not have been granted as the result of an appeal to the Secretary of State. Translocation is viewed as a last resort by conservation organisations where *in situ* conservation cannot be achieved through opposition to a development and should not be seen as an alternative.

8.2 As already referred to in Dr Wolton's proof, the inspector's report (September 1992) from a recent appeal case at Maryport, Cumbria is relevant. This was an application for a housing development within a designated SSSI. The developer planned to translocate part of the SSSI which contained a number of rare and local plant and animal species. The report expresses sympathy with the view that translocation should not be considered as a substitute for in-situ conservation and that it would not avoid demonstrable harm to the SSSI. It is essentially a rescue technique to be attempted only where development is already going ahead (Paragraph 14.32 (Annex EN7). In this case the inspector dismissed the appeal.

9. Summary and conclusion

9.1 Lowland neutral meadow and pasture conforming to NVC MG5 is a rare and threatened community in England and has suffered substantial declines over the last 50 years. The Brocks Farm SSSI forms part of this nationally important resource. It is a community which is largely confined to the British Isles and the UK thus has a special responsibility for its conservation.

9.2 Evidence from previous grassland translocations including Brocks Farm shows that this technique results in subsequent changes in plant community species composition and fails to conserve the original nature of the *in situ* vegetation. It also does not fully reproduce the original physical environment including soils, hydrology and microtopography and ecosystem processes. It also removes or disrupts the historical and cultural context of the site in the landscape. Translocated semi-natural grasslands do not score highly on the primary nature conservation evaluation criteria of Naturalness and Typicalness used in site evaluations (Annex EN23).

9.3 If the appeal is allowed then part of this nationally important resource of ancient species-rich neutral grassland of high nature conservation value will be lost as a result of translocation.

On behalf of English Nature, I thus request that this appeal be dismissed.

4. National Vegetation Classification

The National Vegetation Classification (NVC) was used extensively during the course of the Brocks Farm Inquiry to describe the vegetation of the site. It also provided the standard for evaluating the nature conservation significance of Brocks Farm compared to other stands/sites of MG5 in England and Great Britain.

The NVC is widely used for nature conservation purposes as a reference framework. It was originally commissioned by the Nature Conservancy in 1971. To date, four volumes have been published, including grasslands (Rodwell 1992). It has been officially adopted as the standard for vegetation description by EN, Scottish Natural Heritage and the Countryside Council for Wales, the country agencies in Great Britain (GB). It is increasingly used to implement key aspects of national and international site designation legislation. It is the main classification underpinning the selection of terrestrial habitats for SSSI designation (NCC 1989) and has been used to interpret Annex 1 of the EC Habitats Directive, where relevant.

The NVC standard, established by the GB country conservation agencies, has also been accepted and used by many other organisations involved in nature conservation and vegetation description including Non-Governmental Organisations, university and research scientists. The majority of all vegetation data in the UK are stored using NVC codings (D. Jackson & J.J. Hopkins, JNCC pers comm).

5. Monitoring

The detailed, long-term botanical monitoring of the SSSI and translocated grasslands at Brocks Farm (see section 3, sub-section 3.2. and Appendices 4 and 5) was clearly important in underpinning EN's case at the Inquiry.

The monitoring programme provided EN with high quality data amenable to quantitative whole community analysis. The application of a consistent field methodology, the continuity of key personnel, and the long time period over which the monitoring was carried out, were all important factors in enabling EN to take an authoritative stance at the Inquiry.

EN's work at Brocks Farm has produced the longest post-transplant monitoring data set for any translocation in the UK (Bullock 1998) and, importantly, it has shown that floristic changes associated with translocation can take many years to become clearly discernible (see section 3, sub-section 3.2). This should be borne in mind when faced with claims that a translocation has 'succeeded' since, invariably, such claims will be based on analysis of data acquired over a much shorter time period.

Since the Inquiry, EN has continued to monitor the SSSI and translocated grasslands at Brocks Farm (Leach 1997, Leach & Pulteney 1999a) now giving 10 years of post-transplant data. Interestingly, Leach & Pulteney (1999a) conclude that in 1997-1998 the turf transplant at Brocks Farm deteriorated further in comparison with the SSSI. In particular, stress-tolerant species continued to decline and there were increases in several species more indicative of semi-improved grasslands.