4. Extent of lowland acid grassland and component NVC communities in England

4.1 Introduction

The information on the extent and distribution of acid grassland derived from the various lines of enquiry described in Chapter 3 is summarized below. More detailed information on a county basis is given in **Volume II**. As well as estimates for the extent of acid grassland in different parts of England, the typical locations of acid grassland in the landscape of the lowlands is described in the following chapter. Actual examples are given in **Appendix 1**. The estimates of extent of acid grassland in each county were made by using area classes. These area classes have been converted into overall low, medium and high estimates for different types of grassland as follows:

Estimates (ha)					
Area class	**Range (ha)**	**No. of counties**	**Low**	**Medium**	**High**
A	1-50	j	10 X j	25 X j	50 X j
B	50-100	k	50 X k	75 X k	100 X k
C	100-500	l	100 X l	250 X l	500 X l
D	500-1000	m	500 X m	750 X m	1000 X m
E	1000-5000	n	1000 X n	1500 X n	2000 X n

The upper, lower and mid-points of area classes are used for all except class E. Here local estimates were usually qualified as being 'near 1000' so it was felt that using figures lower than 2500 and 5000 for the mid and upper limits of the class would provide a more realistic estimate. The county by county estimates are summarized in **Table 5**. Very rough estimates for sub-communities are also made in **Table 5**.

4.2 Total area of lowland acid grassland

Estimates (ha)				
Area class	**No. counties**	**Low**	**Medium**	**High**
A	11	110	275	550
B	6	300	450	600
C	14	1400	3500	7000
D	8	4000	6000	9000
E	3	3000	4500	6000
Totals	**42**	**8810**	**14725**	**22150**

The estimates range between 9,000 to 22,000ha, with the true total more likely to be between 15,000 and 22,000ha. This matches well with the previous estimates made by Jefferson & Robertson (1996) of between 10,000 to 20,000ha for the total area of lowland acid grassland in England.

The geographical distribution of estimates for the total area of acid grassland by county is shown on **Map 16**. Hampshire, Suffolk and Norfolk are the only counties where more than 1,000ha of acid grassland has been recorded, with between 500-1,000ha estimated for Cumbria, Dorset, Greater London, Hereford and Worcester, Kent, Somerset, Surrey and Sussex (East and West). Between 100-500ha were estimated from Berkshire, Cornwall, Devon, Essex, Gloucestershire, Hertfordshire,

Humberside, Isle of Wight, Leicestershire, Lincolnshire, North East England, Nottinghamshire, Shropshire and Staffordshire. Other counties were estimated as having less than 100ha of lowland acid grassland.

The consultation exercise suggested that significant areas of upland fringe acid grassland occurred in the following areas: Cheshire, Cornwall, Cumbria, Derbyshire, Devon, Greater Manchester, Hereford and Worcester, Lancashire, North East England, North Yorkshire, Shropshire, Staffordshire, Somerset and West Yorkshire.

4.3 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland (U1)

4.3.1 Community estimates

The area estimates and distribution pattern for parched acid grassland (U1) by county are given in **Table 5** and **Map 17**. Overall estimates are:

Estimates (ha)				
Area class	**No. counties**	**Low**	**Medium**	**High**
A	18	180	450	900
B	7	350	525	700
C	8	800	2000	4000
D	3	1500	2250	3000
E	2	2000	3000	4000
Totals	**38**	**4830**	**8225**	**12600**

The estimates range between 5,000-12,500ha, with the true total more likely to be between 8,000-12,500ha. Hampshire and Norfolk are the only counties where more than 1,000ha of parched acid grassland has been recorded.

The coincidence maps of characteristic lowland acid grassland plant species (**Maps 2-4**) reflect, to a large extent, the distribution of U1. **Map 2** shows all records from all dates and thus indicates the probable maximum distribution of the community. This extends beyond the samples of U1 in the published NVC. In fact, U1 has now been recognised in these unsampled areas, eg in Scotland (Cooper and Mackintosh 1996). **Maps 3** and **4** indicate that there has been a great loss of habitat area and quality in recent years.

Soils

There is a strong association between the distribution of parched acid grassland species and U1 and the occurrence of soil associations dominated by brown sands or lowland podzolic soils over most of lowland England (**Map 1**). To the north, towards the borders of Wales and in the south-west, the strength of this association is much reduced. The county consultations indicate that in the first two areas, parched acid grassland floras are associated with small areas of shallow, rocky, soils (rankers) over hard igneous rocks, while in the south west they are best developed in cliff top grassland, also on rankers.

Some stands of U1 have replaced heath on sites where podzols have been disturbed. This disturbance is often recent but can include situations where ancient disturbance has occurred, eg by wind blown erosion as in Breckland, or by constant low level disturbance near settlements, as in the New Forest.

Climate

Map 2 shows that the diversity of parched acid grassland species per 10 km square declines to the north and west of England and higher diversity areas become increasingly coastal in distribution. Comparison of **Map 2** with a measure of soil moisture deficit (Bendelow and Hartnup 1980) indicates a striking correlation. The measure of moisture deficit is calculated by subtracting potential transpiration from actual rainfall on a monthly basis, and summing the monthly deficits to find the maximum potential deficit for the year. The averae of these maxima for a period of years is then calculated (Bendelow and Hartrup 1980). Areas with rich parched acid grassland floras are largely restricted to parks of England with a deficit of greater than 100mm (**Map 18**).

The equivalent map for Scotland (Birse & Dry, 1970) shows areas supporting diverse lowland acid grassland concentrated in areas with a potential moisture deficit of greater than 75mm (**Map 18**). The measure used by Birse and Dry for Scotland is slightly different, though correlated to, the measure used by Bendelow and Hartrup (1980). Potential moisture deficit is calculated by subtracting potential transpiration from rainfall data for the six summer months only (Birse and Dry 1970, Green 1964).

Rich areas such as Breckland and the New Forest both have similar deficits of just under 180mm. Although Breckland is drier than the New Forest, the latter is warmer, hence the two areas have similar moisture deficits. The floristically rich Shropshire Hills are notable as the only upland area with a deficit of more than 100mm. Dartmoor and parts of the south west, and the small area in the Eden Valley north of Penrith in Cumbria are the only places where concentrations of acid grassland species occur in England where the moisture deficit is lower than 100mm.

Landscape

The majority of significant stands of parched acid grassland are either within extensive heathland landscapes or are the relics of the enclosure of such extensive pastoral systems (eg New Forest examples, Humberside Coversands, **Appendix 1**). The enclosure relics include mown areas of golf courses and military air fields. In heathlands, the acid grasslands are often associated with areas of former (usually 20th century) disturbance or cultivation (eg New Forest examples, **Appendix 1**).

Other landscape types from which parched grasslands have been recorded include:

- Parklands on acidic soils, with some significant sites, especially in Kent, Sussex and London (eg Hatch Park SSSI, **Appendix 1**).
- Areas of sandy alluvium in the raised parts of flood plains or on terrace edges as in the River Waveney valley and the Broads in East Anglia and by the Hampshire Avon (eg Bistern Warren, New Forest, **Appendix 1**).
- Freely draining sands and shingles along the coast on shingle structures, the rear of dune systems and in grazing marshes (eg Dungeness SSSI, **Appendix 1**).
- Cliff top grassland in the south-west of England (see **Appendix 1**).
- Old gravel workings and mine waste tips, as in the Forest of Dean

Ancient, enclosed landscapes generally have very little parched acid grassland, but it sometimes occurs here with neutral and wet grassland (eg Hurcott Pasture SSSI, May Hill SSSI, **Appendix 1**)

4.3.2 *Cornicularia aculeata-Cladonia arbuscula* sub-community grassland (U1a)

This lichen-rich sub-community of U1 is described in Rodwell (1992) as being of very restricted distribution. There is almost certainly less than 1,000ha of the sub-community in England but probably more than 500ha. The largest single stand is 221 ha on the coastal shingle structure of Dungeness, Kent (See **Appendix 1**) (Ferry *et al* 1990), and the only other area where large stands have been found is in Breckland. Smaller stands have been definitely recorded in Cambridgeshire, Hampshire, Humberside, Lincolnshire, Worcestershire and Sussex, on habitats ranging from shingle beaches to inland heathlands. It may also occur as small stands in other counties.

4.3.3 Typical sub-community (U1b)

The Typical sub-community (U1b) of parched acid grassland is the most widespread sub-community in the east of England and is relatively frequent in the north and west including in Shropshire and Northumberland. It is rare to the south-west and is confined to the most freely draining sands in the New Forest (see **Appendix 1**) and in the Poole basin of Dorset. The area covered is difficult to estimate but is likely to be around 4,000ha.

4.3.4 *Erodium cicutarium-Teesdalia nudicaulis* sub community (U1c)

This is a very localised sub-community and easily the rarest sub-community of U1. It seems very unlikely that there is more than 100 ha of this species-rich sub-community in England and this is a matter for considerable concern. It is associated with severe disturbance, including temporary cultivation and heavy grazing pressure. It has been recorded from the Stanford army training area in the Norfolk Breckland, the Greensand heathlands in Hampshire and the edge of the river terraces of the Hampshire Avon. In North Lincolnshire (once south Humberside) it is expanding in area on SSSIs in response to WES scheme management, combined with very high rabbit numbers (see Coversand SSSIs, **Appendix 1**). It is also developing on arable fields that are reverting to grassland under the Countryside Stewardship Scheme (eg the Manton Warren area, **Appendix 1**). Related stands have been recorded from Northumberland and it may occur as fragments in Dorset, Gloucestershire and Staffordshire. These stands may occur on mine waste and on shallow soils over rock in the west.

4.3.5 *Anthoxanthum odoratum-Lotus corniculatus* sub-community (U1d)

On less acidic soils the Anthoxanthum-Lotus sub-community (U1d) of parched acid grassland develops. The largest areas are recorded in Breckland, where it is transitional to calcicolous grass heath (CG7), and the New Forest, where it has developed on heathland formerly cultivated in the 1940s and 1950s (see **Appendix 1** for examples). Beyond these areas it is probably widespread in small stands from Dorset and Kent, and north to Shropshire, Cheshire and Humberside. The sub-community is probably also widespread on coastal shingle. The area covered is very difficult to estimate but is likely to be at least 2,000ha.

4.3.6 *Galium saxatile-Potentilla erecta* sub-community (U1e)

This sub-community is closely related to Deschampsia flexuosa grassland (U2) and Festuca ovina-Agrostis capillaris-Galium saxatile grassland (U4) and probably spreads further north and west than the other sub-communities of U1 (see May Hill SSSI, **Appendix 1**). It is also frequent in the south and east were it will replace Deschampsia flexuosa grassland (U2) if this is heavily grazed. Large areas have been recorded from Breckland and parkland in Kent and Sussex (see Hatch Park SSSI, **Appendix 1**). The total area covered is very difficult to estimate but there could be 3,000 ha.

4.3.7 *Hypochaeris radicata* sub-community (U1f)

Well developed stands of the Hypochaeris radicata sub-community (U1f) are confined to the area south of Shropshire and west of Kent. The sub-community is most extensive in Hampshire where it is part of the habitat mosaic of the New Forest heathlands (see **Appendix 1**). Over 500 ha may occur in the county. Beyond Hampshire the areas are probably quite small and scattered. The sub-community can occur in enclosed pastures along with neutral grassland (eg Hurcott Pasture SSSI, **Appendix 1**). Species-rich examples are found on coastal cliff tops in the south-west (see **Appendix 1**). There is possibly a total of 2,000 ha of the sub-community in England.

4.4 *Deschampsia flexuosa* grassland (U2)

The overall area estimates for Deschampsia flexuosa grassland (U2) are given below, and the county by county estimates are shown **Table 5** and on **Map 19**.

Estimates (ha)				
Area class	**No. counties**	**Low**	**Medium**	**High**
A	21	210	525	1050
B	4	200	300	400
C	6	600	1500	3000
D	1	500	750	1000
E	0	0	0	0
Totals	**32**	**1510**	**3075**	**5450**

The overall estimates range between 1,500-5,500ha, with the true total more likely to be between 3,000-5,500ha of U2 in the lowlands of England.

Only Surrey was estimated as having more than 500ha. Between 100 and 500ha were estimated for Cumbria, Leicestershire, Norfolk, Nottinghamshire, Staffordshire, and Suffolk. Beyond these counties U2 grassland is found in the lowlands only in small amounts.

U2 is mainly found in association with heath (H communities). *Deschampsia flexuosa* has a reputation for being an aggressive invader of heath. To gain an indication of the extent of this problem, EN Local Teams were asked whether this invasion was a serious problem in their area. The problem was considered serious in only a few heathland areas, with Surrey and Nottinghamshire standing out. In many other areas *Deschampsia flexuosa* is not regarded as a problem. *Deschampsia flexuosa* has been found to be very sensitive to cattle and pony grazing in Hampshire. The grass is not especially aggressive here, even on ungrazed heaths. In Breckland, sheep grazing has been found to adequately control *Deschampsia flexuosa*.

The divergence of opinion on the status of this grass reflects genuine differences. There is marked difference between the relatively low amounts of *Deschampsia flexuosa* on the Hampshire and Sussex heathlands, and the more extensive areas on the Surrey heathlands. Nitrogen pollution may be exacerbating the effects of the cessation of grazing on heathland, but the underlying cause of the increase in *Deschampsia flexuosa* is presumably the lack of grazing. The sensitivity of the grass to cattle, pony and rabbit grazing implies that many U2 grasslands in the lowlands may be recent and that they were not an ancient component of the heathlands and grass heaths (see Lakenheath Warren SSSI, **Appendix 1**).

The lowland sub-community, Festuca ovina-Agrostis capillaris sub-community (U2a) appears to predominate throughout the lowlands, with the Vaccinium myrtillus sub-community (U2b) increasingly replacing it in the upland fringes.

4.5 *Agrostis curtisii* grassland (U3)

The overall area estimates for Agrostis curtisii grassland (U3) are given below, and the county by county estimates are shown in **Table 5** and on **Map 20**.

Estimates (ha)				
Area class	No. counties	Low	Medium	High
A	3	30	75	150
B	2	100	150	200
C	1	100	250	500
D	0	0	0	0
E	1	1000	1500	2000
Totals	**7**	**1230**	**1975**	**2850**

The estimates range between 1,000-3,000ha with the true total more likely to be between 2,000-3,000ha. Only Hampshire was estimated as having over 1,000ha of this community, whilst Cornwall is considered as supporting between 100-500ha. Between 50 to 100ha were estimated for Dorset and Somerset and less than 50ha from Devon, the Isle of Wight and Surrey. It is probably extinct in Wiltshire due to the destruction of heathland in the 1980s.

The south-western distribution of this grassland is to be expected, given the distribution of *Agrostis curtisii* (**Map 12**). In the south-west, U3 grassland is extensive but is largely confined to upland moors. It is probably quite distinct from the lowland type found in Hampshire. *Agrostis curtisii* is very much a grass of unenclosed rough grazings and is rarely recorded within enclosed landscapes. Only 1.7ha of U3 was recorded out of 340.2ha of acid grassland recorded from enclosed land in Exmoor (Butcher & Stewart, 1990). In the New Forest, U3 probably occurs in situations where either Festuca-Agrostis-Galium grassland (U4) or Festuca-Agrostis-Rumex grassland Galium-Potentilla sub-community (U1e) would occur elsewhere in the country (see New Forest example, **Appendix 1**).

Difficulties were reported by Local Teams in distinguishing Agrostis curtisii grassland from regenerating, recently burned, heath (Ulex gallii-Agrostis curtisii heath, H4) in the uplands of the south west. The Ulex gallii-Agrostis curtisii heath, Festuca ovina sub-community (H4b) includes many grassland species and there is little floristic difference between this and U3, other than in the proportion of dwarf shrubs.

The problem is much less marked in the New Forest where Ulex minor-Agrostis curtisii heath, H3, and U3 occur. Here U3 is quite distinct due to in the presence of species such as *Agrostis capillaris* and *Danthonia decumbens*. The undescribed herb-rich heath that occurs in the New Forest is related to Calluna vulgaris-Ulex minor heath (H2) and Festuca-Agrostis-Rumex grassland, Anthoxanthum-Lotus sub-community (U1d) and usually lacks *Agrostis curtisii*.

4.6 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland (U4)

The overall area estimates for Festuca-Agrostis-Galium grassland (U4) are given below, and the county by county estimates are shown in **Table 5** and on **Map 21**.

Estimates (ha)				
Area class	**No. counties**	**Low**	**Medium**	**High**
A	20	200	500	1000
B	3	150	225	300
C	6	600	1500	3000
D	1	500	750	1000
E	0	0	0	0
Totals	**30**	**1450**	**2975**	**5300**

The estimates range between 1,500-5,000ha with the true total more likely to be between 3,000 and 5,000ha. Only Cumbria was estimated as having over 500ha of this community in the lowlands, whilst between 100 and 500ha were estimated for Cornwall, Devon, Dorset, North East England, Shropshire and Somerset. Smaller areas are estimated from the rest of England with amounts declining in counties to the south and east. None has been recorded from several counties, particularly in the extreme east and south, eg Suffolk and the Isle of Wight. This distribution relates to the moisture deficit factor (**Map 18**). In contrast to U1, U4 is commonest where the moisture defecit is less than 100mm. U4 is extensive in the uplands and is frequent in the upland fringes and lowland areas close to the uplands. *Viola lutea* is an upland plant that is generally faithful to U4 grassland. **Map 13** shows its distribution, and by association the distribuion of upland U4.

The exact distribution of moist acid grassland (U4) in the lowlands is not clear as it appears to have been much over-recorded. Many stands recorded as U4 in fact contain characteristic U1 species such as *Rumex acetosella* and *Aira praecox*, and would fit better into NVC community Festuca-Agrostis-Rumex grassland, Galium-Potentilla sub-community (U1e). Mis-classification may be the result of an ambiguous dichotomy in the key to calcifugous grassland and montane communities in Rodwell (1992). In dichotomy 5 *Galium saxatile* and *Potentilla erecta* are described as being of restricted occurrence in U1 and frequent in U4, but the two species are actually preferentials in U1e,with constancies exceeding 40%. Stands resembling U4 also develop directly from U1 on the cessation of grazing as the dense sward of grasses that results smothers the distinctive herbs, mosses and lichens of U1.

In west Dorset U4 has replaced heathland complexes of Ulex gallii-Agrostis curtisii heath (H4), Agrostis curtisii grassland (U3) and Festuca-Agrostis-Rumex grassland (U1) after attempts at cultivation of the heathland. In the New Forest heathlands, Agrostis curtisii grassland (U3) dominate the damper acid brown earths on which U4 would be expected elsewhere. U4 does occur occasionally in enclosed grasslands in the lowlands (eg North Poorton, **Appendix 1**).

In drier lowland areas good examples of U4 do occur. These are usually restricted to acid, water-retentive, clayey soils, which are not so poorly drained that wet acid grassland can develop. Examples have been recorded from Buckinghamshire and in the ancient parkland of Windsor Forest (see **Appendix 1**). U4 also occurs in glades within the pasture woodlands of the New Forest, where shade protects the sward from parching. Pasture woodland glades may be a characteristic lowland habitat of the community. It can also be found on Clay-with-Flints and other acidic, fine textured, superficials over chalk and limestone (see Burnthouse Down, **Appendix 1**), but mis-identification of U1 as U4 has sometimes occurred in these situations.

4.6 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland (U4)

The overall area estimates for Festuca-Agrostis-Galium grassland (U4) are given below, and the county by county estimates are shown in **Table 5** and on **Map 21**.

Estimates (ha)				
Area class	**No. counties**	**Low**	**Medium**	**High**
A	20	200	500	1000
B	3	150	225	300
C	6	600	1500	3000
D	1	500	750	1000
E	0	0	0	0
Totals	**30**	**1450**	**2975**	**5300**

The estimates range between 1,500-5,000ha with the true total more likely to be between 3,000 and 5,000ha. Only Cumbria was estimated as having over 500ha of this community in the lowlands, whilst between 100 and 500ha were estimated for Cornwall, Devon, Dorset, North East England, Shropshire and Somerset. Smaller areas are estimated from the rest of England with amounts declining in counties to the south and east. None has been recorded from several counties, particularly in the extreme east and south, eg Suffolk and the Isle of Wight. This distribution relates to the moisture deficit factor (**Map 18**). In contrast to U1, U4 is commonest where the moisture defecit is less than 100mm. U4 is extensive in the uplands and is frequent in the upland fringes and lowland areas close to the uplands. *Viola lutea* is an upland plant that is generally faithful to U4 grassland. **Map 13** shows its distribution, and by association the distribuion of upland U4.

The exact distribution of moist acid grassland (U4) in the lowlands is not clear as it appears to have been much over-recorded. Many stands recorded as U4 in fact contain characteristic U1 species such as *Rumex acetosella* and *Aira praecox*, and would fit better into NVC community Festuca-Agrostis-Rumex grassland, Galium-Potentilla sub-community (U1e). Mis-classification may be the result of an ambiguous dichotomy in the key to calcifugous grassland and montane communities in Rodwell (1992). In dichotomy 5 *Galium saxatile* and *Potentilla erecta* are described as being of restricted occurrence in U1 and frequent in U4, but the two species are actually preferentials in U1e,with constancies exceeding 40%. Stands resembling U4 also develop directly from U1 on the cessation of grazing as the dense sward of grasses that results smothers the distinctive herbs, mosses and lichens of U1.

In west Dorset U4 has replaced heathland complexes of Ulex gallii-Agrostis curtisii heath (H4), Agrostis curtisii grassland (U3) and Festuca-Agrostis-Rumex grassland (U1) after attempts at cultivation of the heathland. In the New Forest heathlands, Agrostis curtisii grassland (U3) dominate the damper acid brown earths on which U4 would be expected elsewhere. U4 does occur occasionally in enclosed grasslands in the lowlands (eg North Poorton, **Appendix 1**).

In drier lowland areas good examples of U4 do occur. These are usually restricted to acid, water-retentive, clayey soils, which are not so poorly drained that wet acid grassland can develop. Examples have been recorded from Buckinghamshire and in the ancient parkland of Windsor Forest (see **Appendix 1**). U4 also occurs in glades within the pasture woodlands of the New Forest, where shade protects the sward from parching. Pasture woodland glades may be a characteristic lowland habitat of the community. It can also be found on Clay-with-Flints and other acidic, fine textured, superficials over chalk and limestone (see Burnthouse Down, **Appendix 1**), but mis-identification of U1 as U4 has sometimes occurred in these situations.

In the lowlands the two main sub-communities of Festuca-Agrostis-Galium grassland (U4) are the Typical sub-community (U4a) and the Holcus lanatus-Trifolium repens sub-community (U4b). The latter tends to be found in semi-improved grassland. There are probably less than 500ha and 1000ha respectively of these sub-communities in the lowlands. The extent of the Lathyrus montanus-Stachys betonica sub-community (U4c) is unclear. The vegetation described by the NVC is a distinctive transition between calcicolous grassland and acid grassland, found in the White Peak in Derbyshire and Staffordshire. There is, however, a similar transition between Cynosurus-Centaurea grassland, Danthonia sub-community (MG5c) and more typical U4, which is particularly found on the Coal Measures across England and has been noted in Dorset (Porley, 1992) and Gloucestershire (Doe 1995). U4c has also been recorded from Scotland (Cooper and MacKintosh 1996). It is not clear how to treat such stands, as they do not seem to be really comparable with U4c as described by Rodwell (1992). The Vaccinium-Deschampsia sub-community (U4e) and to a lesser extent, the Luzula-Rhytidiadelphus sub-community (U4f) are recorded occasionally as the upland fringe is approached. Probably there is less than 50ha of either sub-community in the lowlands.

4.7 *Nardus stricta-Galium saxatile* grassland (U5)

The overall area estimates for Nardus-Galium grassland (U5) are given below, and county by county estimates are shown in **Table 5**:

Estimates (ha)				
Area class	**No. counties**	**Low**	**Medium**	**High**
A	11	110	275	550
B	0	0	0	0
C	0	0	0	0
D	0	0	0	0
E	0	0	0	0
Totals	**11**	**110**	**275**	**550**

No extensive areas of lowland Nardus-Galium grassland (U5) were identified. It was most frequently recorded from Gloucestershire, West Midlands and Nottinghamshire northwards. South of this, *Nardus* is more commonly found in other communities. It is a frequent component of wet heath (M16) and wet acid grassland (M24c and M25b) and occurs in neutral grassland (MG5c). In the south, it can even be found in parched acid grassland (U1). However, U5 grassland can occur in the south, as it has been observed in Norfolk by the author. It has been recorded in heathland and enclosed landscapes. It is likely to be much more common in the upland fringe than in the lowlands.

4.8 *Juncus squarrosus-Festuca ovina* grassland (U6)

This is a strongly upland community of wet soils. In the lowlands *Juncus squarrosus* is largely a species of wet heath and few stands have been recorded as U6. Small areas of U6 were noted in the Humberside Coversands (Wigginton 1990) and at the back of a dune system in Cumbria (Radley, 1994) but neither was typical, and were related to wet heath rather than acid grassland. The areas recorded cover about 25ha in total.

4.9 *Carex arenaria* communities

The occurrence of *Carex arenaria* in acid grassland in inland parts of England is a feature of considerable interest. It is found in heathland landscapes on loose, well-drained, sands in Breckland, the Greensand heaths of Norfolk and the western Weald, the Coversand of Lincolnshire, Humberside,

Nottinghamshsire and South Yorkshire, sandy parts of the Dorset heaths and on river terraces by the Hampshire Avon. In Breckland it is associated with areas of wind blown sand, but in other areas it simply marks out areas of sharply draining sand, although it occurs on what appears to be ancient blow- outs and dunes by the Hampshire Avon. **Map 11** shows the distribution of *Carex arenaria* and the potential distribution of *Carex arenaria* communities.

Carex arenaria can occur in U1, for instance in Breckland. When grazing levels decline *Carex arenaria* can increase in height and dominate in a rank, species-poor, community which has been classified as Carex arenaria dune (SD10) (see Lakenheath Warren SSSI **Appendix 1**). A very approximate overall estimation of the area of SD10 is given below and county by county estimates are shown in **Table 5.**

***Carex arenaria* community SD10**

Estimates (ha)				
Area class	**No. counties**	**Low**	**Medium**	**High**
A	5	50	125	250
B	2	100	150	200
C	0	0	0	0
D	0	0	0	0
E	0	0	0	0
Totals	**7**	**150**	**275**	**450**

As far as can be determined, there is probably less than 500ha and more than 100ha of rank *Carex arenaria* vegetation on inland heathlands. Most of this is found in Breckland, with small stands in Hampshire, Humberside, Lincolnshire, Nottinghamshire and Surrey. The area of this community is likely to have increased as grazing has declined, and like *Deschampsia flexuosa* grassland, SD10 may not have existed when Breckland was heavily grazed. The area of SD10 is likely to decline if grazing is restored, to be replaced by more diverse U1 and SD11 communities.

Inland mobile dunes observed by the author at Risby Warren in the North Lincolnshire Coversands Natural Area have a very distinctive pioneer community of open *Carex arenaria,* combined with *Poa annua* and tall grassland species such as *Cirsium arvense* and *Senecio jacobaea* growing through from the buried sward below. This pioneer vegetation contrasts with stands of short, open, lichen-dominated vegetation with much *Carex arenaria* which are classified as SD11, Carex arenaria-Cornicularia aculeata community. Both are very rare communities in inland areas. Estimates for SD11 are given below:

***Carex arenaria-Coelocaulon aculeatum* community (SD11)**

Estimates (ha)				
Area class	**No. counties**	**Low**	**Medium**	**High**
A	6	60	150	300
B	0	0	0	0
C	0	0	0	0
D	0	0	0	0
E	0	0	0	0
Totals	**6**	**60**	**150**	**300**

Most of the inland stands of SD11 are in Breckland but small stands have been noted in Hampshire, Humberside, Lincolnshire and Surrey. The community may have a much closer association with inland sand dunes or recently disturbed sand than either SD10 or U1 which contains *Carex arenaria*. The Hampshire stand of SD11 was recorded from a bank of bulldozed sand forming an artificial dune on a heathland firing range (Sanderson & Stanbury, 1996). About 250ha of SD11 has been recorded from coastal dunes mainly in East Anglia and Cumbria (Radley, 1994)

4.10 *Pteridium aquilinum* communities

Bracken is often found in association with acid grassland, but during the consultation, enquiries were made as to the presence of herb-rich Bracken or Bracken harbouring rare butterflies. These stands have been categorised as 'U20r' in **Table 5**. This habitat was noted in Cornwall, Cumbria, Devon, Dorset, Hampshire, Hereford and Worcester, the Isle of Wight and Somerset. The richest examples for rare and local plant species appears to be those of the New Forest (See **Appendix 1**) but those of the west are richer in butterflies. It is difficult to estimate the extent of the habitat, there may be between 100 to 500ha.

5. Nature conservation interest of lowland acid grassland: flora

5.1 Introduction

Acid grasslands have a reputation as species-poor grasslands but in fact many are species-rich, especially in uncommon species. A survey of an acid grassland complex in the heathlands of Woolmer Forest, Hampshire (Sanderson & Stanbury, 1996) recorded 135 species including 101 vascular plants, 15 bryophytes and 19 lichens from 7.6ha of grassland composed of U1a, U1b, U1c, U1d, SD10 and SD11. Four nationally scarce vascular plant species were recorded and the richest quadrat (U1c) included 32 species in 4m^2. Other examples given in **Appendix 1** include 38 species in a 4m^2 quadrat placed in U1c in Risby Warren, North Lincolnshire and 35 species in a 4m^2 quadrat placed in U1d/f in the New Forest. Surprisingly, the grasslands with the highest number of species per quadrat sample in the NVC are not lowland calcicolous or neutral grasslands, but U20a (Pteridium aquilinum-Galium saxatile: Anthoxanthum oderatum sub-community) and U4a (Typical sub-community) (Rodwell 1992). Clearly there can be very species-poor examples of these sub-communities (5 and 7 species respectively in the poorest quadrats in the NVC tables), as there can be of calcicolous and neutral grasslands, eg seven species in the poorest quadrats of CG2a Festuca ovina-Avenula pratensis grassland, Cirsium acaule-Asperula cynanchica sub-community).

The flora of acid grasslands has undergone very severe declines in Britain. **Maps 3** and **4** illustrate the dramatic losses among a group of 25 species, of which 20 are nationally rare or scarce. **Maps 5** to **10** show great declines in species of two associated habitats in acid grassland landscapes, namely ephemeral ponds and disturbed sandy soils in ungrazed situations, such as low-intensity arable land and waysides. The general assumption that acid grasslands are species-poor appears to be associated with the impoverished condition of many acid grasslands in the lowlands, due to the widespread collapse of grazing and other management associated with extensive pastoral systems.

A case study in Dorset (Byfield & Pearman 1996), shows that acid grassland species in heathland landscapes have suffered exceptionally serious declines which are far more severe than the loss of heathland habitat. It was found that 35% of heathland samples surveyed in the 1930's by Professor Good and re-surveyed over the period 1990 to 1993 had been destroyed. However, 11 species included by this review in the list of faithful lowland acid grassland (**Table 1**) had been lost from 88% of the samples in which they had been found in the 1930's. This contrasts with losses of 41% and 50% for wet heath and mire species found in the 1930's set of samples. The cessation of grazing was thought to be the primary reason for these declines. No similar decline has occurred in the nearby New Forest where traditional extensive grazing has survived. Declines in the flora of Breckland have also been attributed to the decline in grazing pressure (Lambley 1994c).

As well as evaluating the importance of the flora of acid grasslands, the following section also describes the national and regional distribution of the vascular plants identified as faithful to acid grassland (**Table 1**) and proposes a potential way to use an indicator list of characteristic acid grassland species for floristic assessments of acid grasslands.

5.2 Vascular plants

5.2.1 Rare and scarce plants

Lowland acid grasslands, especially parched acid grasslands (U1), are rich in rare and declining vascular plants. **Tables 1** and **2** list 17 nationally rare and 22 nationally scarce vascular plant species which can occur in acid grasslands. Most of the species in **Table 1**, which includes 8 nationally rare and 13 nationally scarce species, have their main habitat in acid grasslands. These totals indicate that

lowland acid grassland is second only to calcicolous grassland as a grassland habitat for rare and declining species in the English lowlands, and is certainly much richer than either neutral grasslands or base-rich and acid fen meadows. This richness has often been overlooked in the past, perhaps because many acid grassland species have been 'annexed' to other habitats in which they are also found and acid grasslands then defined as species-poor by default. For example many lowland acid grassland species have been described as coastal, although they have concentrations away from coastal habitats. For instance, the sand dune species coincidence map in Stewart *et al* (1994) shows the New Forest as more significant than the Merseyside coastal dunes for 'sand dune species'.

The literature search, especially of local floras, emphasised the local richness of parched acid grassland (Festuca-Agrostis-Rumex grassland) in declining and restricted species of vascular plants, especially U1a, U1b, U1c, U1d and U1f. The Potentilla-Galium sub-community (U1e), appears generally to be much less rich. All the species recorded as either faithful lowland acid grassland species (**Table 1**) or locally characteristic species (**Table 2**) have been recorded at some time in U1 communities.

In contrast the vascular plant diversity of Deschampsia flexuosa grassland (U2) appears to be low, with few references to rare or scarce species. The exception is Sherwood Forest, where outlying colonies of the southern *Ulex minor* are confined to *Deschampsia flexuosa* grass heath.

Agrostis curtisii grassland (U3) stands vary in floristic diversity. Many stands are quite species-poor but dry stands in Dorset and Hampshire share many species with species-rich parched acid grasslands (U1) and the community supports some species which are more typical of U3 grassland than U1, such as *Carex montana*, *Viola lactea* (both nationally scarce)and *Euphrasia vigursii* (nationally rare).

Festuca-Agrostis-Galium grassland, U4, generally has a limited vascular plant flora. During the consultations and literature search special effort was made to discover any special vascular plant interest for this type of grassland. Little was found and the few species mentioned were essentially upland species such as *Viola lutea* (**Map 13**) in Shropshire (Sinker *et al*, 1985) and *Pseudorchis albida* in the Lake District (Ian Slater, EN, pers. comm.).

Significant associated habitats in acid grassland landscapes include ephemeral ponds in heavily grazed acid grassland. These ponds are still frequent in the New Forest area but have been lost in most other areas. They are found within mosaics of acid grasslands (U1f and U3) and neutral grassland (MG6b) and their flora includes the nationally rare species *Galium constrictum*, *Ludwigia palustris*, *Pulicaria vulgaris* and the nationally scarce species *Cicendia filiformis*, *Pilularia globulifera*, *Limosella aquatica* and *Illecebrum verticillatum* (Chatters, 1996).

The meres of Breckland with their varying water levels are found within grass heaths (Trist, 1979), and also support species of interest including the local *Alopecurus aequalis* and *Rumex maritimus* and the nationally rare *Alisma gramineum*. One of the ephemeral pond plant communities that contain these rare and scarce plants may equate to OV35, Lythrum portula-Ranunculus flammula community (Rodwell, in prep). These ephemeral pond habitats increase the totals of nationally rare species associated with acid grassland to 20 species and nationally scarce species to 22 species.

Very heavily disturbed or cultivated sandy soils in ungrazed situations also support a number of declining species. These were once typical of cultivated and wayside situations within heathland and grass heath landscapes, but were rarely found in grazed areas. Characteristic species include the nationally rare Breckland Speedwells *Veronica triphyllos* and *Veronica praecox*, as well as the nationally scarce species *Arabis glabra*, *Apera spica-venti*, *Medicago sativa falcata* and *Silene gallica*. Recent surveys indicate that *Filago lutescens* (Rich 1995 and 1996 and Rich & Davis 1996), another nationally rare species of disturbed ground, is more typical of early succession and U1 grassland than arable land and is tolerant of grazing. Species of disturbed sandy soils were once found widely in the east of England within light acid soil areas but are now largely confined to Breckland.

Unlike ephemeral ponds such arable or wayside habitats are now much less of an integral part of acid grasslands due to the disappearance of the low-intensity arable farming associated with extensive grazing of heathland and grass heath.

5.2.2 National and regional distribution of lowland acid grassland species

As part of the review, a list of vascular plants generally faithful to acid grassland was developed (**Table 1**). As well as indicating the possible distribution of acid grassland (see Section 3.3), the numbers of these species on a county and Natural Area basis were worked out to give an idea of the relative significance of different parts of England for these species. First, the broad national pattern is described and then a summary of county information. Further detail is available in **Volume II**. The species listed in **Table 1** can be divided into four groups in terms of their national distributions:

- A small group of generally distributed species: *Filago minima*, *Moenchia erecta*, *Ornithopus perpusillus*, *Stellaria pallida*, *Teesdalia nudicaulis*, *Trifolium scabrum* and *T. striatum*.

- Species with an eastern tendency in their distribution: *Apera interrupta*, *Corynephorus canescens*, *Festuca longifolia*, *Vulpia ciliata ambigua*, *Crassula tillaea*, *Dianthus deltoides*, *Herniaria glabra*, *Hypochaeris glabra*, *Medicago minima*, *Potentilla argentea*, *Seleranthus perennis*, *Silene conica*, *Thymus serpyllum*, *Trifolium subterraneum*, *Veronica verna* and *Vicia lathyroides*. The rarest tend to be confined to East Anglia but the more widespread species are found with increasing rarity into the south west. They can also reach far into the north but spread further into the north east than the north west. At the north of their range many species are purely coastal.

- Species with a southern or south western tendency: *Chamaemelum nobile*, *Gladiolus illyricus*, *Lotus angustissimus*, *Lotus subbiflorus*, *Trifolium glomeratum*, *T. ornithopodioides*, *T. suffocatum* and *Viola lactea*. These species are largely restricted to the south of the country; the rarer species are only recorded south of the Thames to Bristol line whereas the more widespread species extend towards the East Anglian coast and, rarely, into the Midlands.

Two species have somewhat disjunct distributions. *Sagina subulata* has an largely south western distribution in England but it is widespread in Scotland and survives in Northumberland in spite of it absence from much of eastern and northern England. *Erodium maritimum* is found mainly in western coastal areas in England and Wales but once had some inland records from the Welsh borders.

The county and Natural Area distribution of these 33 species are shown in **Table 6** and **7** and on **Map 22**. The data shown were derived primarily from local floras. The level of sub-division of areas depended on the detail available. In some cases information is presented only at county level, while it was possible to derive Natural Area species totals in other cases. The areas selected for display cover all the areas of England that are of significance for the 33 species.

Table 7 ranks the areas by floristic diversity. The adjacent areas of the western Wealden Greensand heaths in Surrey, Hampshire and Sussex (NA70) have been combined in this table, as have the London Basin heaths south west of London (NA66) and the parts of Dungeness in Kent and Sussex (NA71). **Map 22** shows the areas in **Table 7** that can be defined as part of, or all of, individual Natural Areas.

The richest three areas, with over 20 extant acid grassland species, are Breckland, the Dorset Heaths and the New Forest. Not unexpectedly, given the national distribution of the species (described above), the richest areas are found south of the Wash to Bristol line, and all areas with 15 or more characteristic species are concentrated here. North of this line, only three areas have between 10-14 characteristic species; the heaths around Kidderminster in the West Midlands, the Northumbian Whin

Sill and the Coversand area of Lincolnshire, Nottinghamshire and Humberside. Some areas, such as west Dorset, have very few of the species, despite having relatively large areas of acid grassland. Here, acid grassland is often U3 or U4 and thus has a poor representation of the 33 species, which are primarily found in U1.

Table 6 also gives the ratio between extant species and the total number recorded. The general trend of these ratios is for the proportion of remaining species to be lowest in areas which were initially poorer. Most of these have small areas of grassland and the pattern of extinction probably reflects greater vulnerability of smaller areas to habitat loss and abandonment of management. Areas that originally had rich floras but have lost a high proportion are likely to be areas where habitat loss has been especially severe. These include the Devon Redlands, Cambridgeshire, North Norfolk, north-east Essex and the Midvale Ridge in Oxfordshire.

5.3 Bryophytes

Acid grasslands, especially heavily grazed, parched, U1 and moist acid (U4) grasslands, can have a very high cover of mosses, but these are nearly all widespread species. The composition of these moss mats varies between U1 and U4 grasslands, *Rhytidiadelphus squarrosus* and *Pseudoscleropodium purum* are much more typical of moist acid grassland (U4) and are also found in low productivity neutral grasslands. Species partial to parched acid grasslands (U1) include *Brachythecium albicans*, *Polytrichum juniperinum* and *Polytrichum piliferum* on the more acid soils and *Hypnum lacunosum tectorum* on more base-enriched substrates. Shared species include *Hypnum jutlandicum* and *Dicranum scoparium.*

As well as these species there are a few specialist species, but these are few in number when compared to vascular plants. Some are species which are common in the uplands but are local or scarce in the lowlands and here are confined to parched acid grassland. Examples are *Racomitrium canescens* agg (usually *R. elongatum* Frisvoll) and the liverwort *Ptilidium ciliare*. Another local species, which is largely confined to parched acid grassland where it occurs away from the coast, is the sand dune moss *Tortula ruralis ruraliformis*. A few local southern species are shared between acid and calcicolous grassland, such as *Sceleopdium touretii* in the New Forest and *Rhynchostegium megapolitanum* in the Sussex Greensand heathlands (Rose, *et al* 1991). *Campylopus polytrichoides* is a very localised moss of open parched rocky grasslands on cliff tops in the south west. The list of associated species in Blockeel (1992) suggests that U1f is probably its main habitat.

One nationally rare species, *Leptodontium gemmascens*, has been recorded from lowland acid grasslands. Originally this species was only known from old roof thatch in southern England but has recently been found in acid grasslands in southern England. Presumably grassland is the original habitat. The species has been found on the bases of grass tussocks and on rabbit droppings (Blockeel, 1992). It is likely to be under- recorded, and may be more widespread in lowland heathland habitats. In Wales the nationally rare *Bartramia stricta* grows in stands akin to U1 on dolerite outcrops.

Ephemeral ponds in acid grasslands and grass heaths can also harbour rare and local bryophytes. The meres of Breckland support the nationally rare moss *Physcomitrium eurystomum*, while the nationally scarce liverwort *Fossombronia foveolata* occurs in ephemeral ponds in the New Forest. Ephemeral ponds on Gorley Common in the New Forest have been recorded as supporting large populations of the mainly upland *Bryum alpinum* (Sanderson, 1997b).

5.4 Lichens

Lichens are generally poorly represented in moist acid grassland (U4) but some are usually present in the drier types of *Deschampsia flexuosa* (U2) and *Agrostis curtisii* (U3) grasslands. A notable record for U2 is the northern lichen *Icmadophila ericetorum*, found in Sherwood Forest (Soden 1991) and Charnwood Forest (N. Sanderson, pers. obs.).

Parched acid grassland (U1) is the richest type for lichens. The most typical species are lichens of mildly acidic situations, such as *Cladonia furcata* and *Cladonia rangiformis* and occasionally the local species *Peltigera canina*, *Cladonia cariosa*, *Cladonia foliacea*, and *Diploschistes muscorum*. The first two of these local species are listed as nationally scarce by Hodgetts (1992).

The richest sub-community is U1a (Cornicularia aculeata-Cladonia arbuscula sub-community). The lichen flora of this sub-community is similar to that of dry heath but tends to have a higher cover of *Cladonia furcata* than is typical of dry heaths and *Cladonia foliacea* is especially characteristic. *Cladonia arbuscula* is commoner in grassland communities than heath in the lowlands because it appears to prefer short, open, communities. It is still common where dry heath has this structure, for instance heavily grazed H2a in the New Forest (1997b), but has died out in the unmanaged dry heaths of Sussex (Rose, 1992).

Lichen-rich acid grassland and heath lack very rare species, unlike open calcicolous grasslands (CG7c and CG1), but the lichen flora of dry heath and U1 is a distinctive feature of considerable importance for biodiversity. The following examples give an indication of the range in species richness. Some stands have a high cover of lichens but a low diversity of species, often with the bulky *Cladonia portentosa* totally dominating. Other stands have both a high cover of lichens and a high diversity of species. In areas acknowledged as being important for their lichen flora, EPR recorded the totals given below, which are compared with data from Breckland surveys (Smith & James 1995 and Smith 1996).

Site	Habitat	No. of lichens in stand	Mean no. lichens per quadrat of U1a
New Forest (Sanderson 1997b)			
Hyde Common	H2a, H3c, U1f, U1b	25	NA
Gorley Common	H2a, H3c, U1f, U1b	25	NA
Woolmer Forest (Sanderson & Colebourn 1993 and Sanderson & Stanbury 1996)			
Kingsley Common	H1b, U1b	30	NA
Woolmer Road	U1a	17	0.6
Woolmer Pond	U1a	21	9.8
North Lincolnshire Coversand (this review)			
Manton Warren, South	H11a, U1a, U1b, U1c, SD11	22	7.5
Suffolk Breckland (Smith & James 1995 and Smith 1996)			
8 separate sites	U1a	1-3 (mean 1.9)	1.6

Lichen-rich stands in heath and acid grassland can have between 15 and 30 species of lichen recorded, with high average numbers of species recorded per $4m^2$ quadrats. Similar species rich stands are recorded from Dungeness in Kent (Ferry *et al*, 1990) but U1a stands surveyed recently from Breckland are remarkably species-poor. This paucity may be part of the general decline in the quality of Breckland habitats, mainly due to the decline of grazing and disturbance (Lambley 1994d). Pollution has been suggested as a factor contributing to the decline but the richness of the lichen flora seen on Manton Warren by EPR during this review do not support this idea, as North Lincolnshire apparently suffers from high levels of air pollution. The site is, however, much more heavily grazed by rabbits than the sites surveyed in Breckland, to judge by the pictures in Smith & James (1995) and Smith (1996), and it may be that the open ground and lack of competition from vascular plants are more significant in favouring a rich lichen flora.

5.5 Fungi

Little has been published on the conservation value of the fungi of lowland acid grassland but there are indications from recent work that moist, low productivity acid grasslands (U4) and some neutral grasslands (MG6b) can be especially rich in declining fungi. These grasslands are usually rather poor in vascular plant species but are typically old, short grasslands in habitats such as lawns of old country houses, parklands, glades in pasture woodlands and upland fringe pastures (Rotheroe 1995, Marren 1998). Marren (1998) reports the extreme sensitivity of the scarcer *Hygrocybe* species to nutrient addition, eg chemical fertilizers. An area of grassland in the Forest of Dean, which appears to be a surviving, ancient forest, lawn, consisting of a mosaic of U1, U4 and U5, is currently the richest known site for *Hygrocybe* (waxcaps) species in Britain, with 32 species recorded. It is also rich in *Entoloma* species with 17 species recorded (Rotheroe, 1995 and EN files). Rotheroe *et al* (1996) also mentions 3 ha of acid grassland on a farm near Clitheroe, Lancashire with at least 29 *Hygrocybe* species and 21 *Entoloma* species. Short acidic grassland associated with ancient trees in parklands and pasture woodlands can also be rich in local or rare mycorrhizal fungi that are associated with trees, eg in Windsor Great Park (T. Green, EN, pers. comm.). Overall, the diverse *Hygrocybe* communities, which include rare and scarce species, that are found in acid grassland habitats, may be of national and even European importance (I. Taylor, EN, pers. comm.). Clearly further work is required to assess acid grassland fungi floras. An important contribution is the on-going waxcap survey by the British Mycological Society (Rotheroe *et al* 1996, Marren 1998).

5.6 A provisional indicator species list for floristic assessment

Although U1 grasslands can be very rich, sometimes they can contain only a few species. Floristic richness is an important factor in assessing the conservation value of these grasslands. The following section describes a provisional indicator list that could potentially assist with these floristic assessments. The lists of generally faithful lowland acid grassland species (**Table 1**) and locally characteristic acid grassland species (**Table 2**) have been used to produce a provisional indicator list for lowland acid grassland (**Table 8**). This could provide a measure of the floristic diversity of stands of acid grassland and be used as an aid to assessing the conservation interest of a given stand.

The England Field Unit of the former Nature Conservancy Council have produced separate indicator lists for calcicolous grassland, mesotrophic and acid grassland (Rowell and Robertson 1994). While the calcicolous and mesotrophic grassland indicator lists are reasonable for assessing quality, the acid grassland list has not been used. It covers rather a wide range of acid grassland communities including wet grassland. A more focussed indicator list for dry acid grassland types is suggested here, and would be of use primarily for U1 grasslands.

A good indicator list of ephemeral pond species is given by Chatters (1996). These species could be regarded as bonus species and added to the acid grassland indictor list.

A few species lists from existing data on acid grasslands were examined to gain an idea of the sorts of totals that could be expected from acid grassland sites. Representative lists were not easy to find as several vegetation surveys had been undertaken in late summer (eg Smith & James 1995, Smith 1996 and Wigginton 1990) and hence could not include full species lists. Full site surveys in Dorset, Hampshire and Surrey, and selected quadrat data from Kent and Shropshire illustrate the range of numbers of indicator species compared to country totals.

County: Site **Landscape (main NVC type)**	**Table 1 Spp**	**Table 2 Spp**	**Table 8 Spp**	**Source**
Dorset : Sandford (SZ99) Heathland enclosure relic (U1f, U1d)	14	16	32	(Sanderson 1995c & unpublished data)
Hampshire: Keyhaven (SU39) Coastal grazing marsh (U1f)	5	7	12	(Sanderson, 1996a)
Hampshire: Test Marshes (SU31) Coastal grazing marsh (U1f)	4	4	8	(Sanderson, 1996b)
Hampshire: Titchfield (SU50) Coastal grazing marsh (U1f/d)	8	7	15	(Norton, 1996)
Hampshire: Woolmer (SU73) Disturbed patches in heathland (U1a, U1b, U1c, SD11)	11	16	28	(Sanderson & Stanbury, 1996)
Hampshire: Bransbury (SU44) Flint gravel in base rich alluvial common (U1d)	0	4	4	(Sanderson, 1996c)
Surrey: Reigate Heath Mown recreation grassland on heathland (U1b, U1d/f)	6	10	16	(Sanderson, 1997c)
Kent: Dungeness (quadrats) Shingle beach (U1a, U1d, U1f)	6	14	20	(Ferry *et al* , 1990)
Shropshire: Earls Hill (SJ40) (quadrats) Dolerite outcrop (U1b)	2	5	7	EN files
Shropshire: The Lump (SO29) (quadrats) Dolerite outcrop (U1f)	4	4	7	EN files
County: Natural Areas				
Hampshire: New Forest	21	39	60	(Brewis *et al*, 1996)
Norfolk & Suffolk: Breckland	24	40	64	(Trist, 1979 & dot maps for lower plants)

In 1997 the author obtained community lists for the following sites as part of the acid grassland review

County: Site Landscape	Table 1 Spp	Table 2 Spp	Table 8 spp
N. Lincolnshire: Risby Warren Blown sand grass heath (U1c, SD11)	6	20	26
N. Lincolnshire: Manton Warren Blown sand grass heath (U1a, U1b, U1c, SD11)	4	20	24
Hampshire: Boltons Bench New Forest heathland, ancient settlement green (U1f)	6	11	17
Hampshire: Yew tree Heath New Forest heathland, site of WWII structures (U1 d/f)	6	18	24
Hampshire: Culverley New Forest heathland, site of arable cultivation 1940's (U1 d/f)	3	9	12
Hampshire: Dibden Inclosure New Forest heathland, site of liming & reseeding 1960's (U1 d/f)	3	13	16
Hampshire: Culverly New Forest heathland, ancient acid grassland (U3)	0	1	1
Kent: Hatch Park Deer park (U1d/e, small area U1b, U1a)	3	5	8
Worcestershire: Hurcott Pasture Enclosed grassland (U1f)	2	4	6

In addition a brief examination of the important site of Hartlebury Common in Hereford and Worcestershire produced a count of 13 indicators and more would be likely to be present.

The limited data available suggest that the best U1a, U1b, U1c, U1d and U1f sites, south of Lincolnshire and the Midlands, can be expected to have between 20-30 indicator species, with sites with 10 or more being of high interest. North of this, a lower total would probably be more likely, and sites with more than 5 indicators would probably be regarded as having relatively high interest. Other grassland types, ie U1c, U2, U3 and U4 have a much lower floristic diversity, particularly of vascular plants, and are not easily assessed using this indicator list.