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Lowland grassland

Wildlife value and conservation status

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Lowland grassland: wildlife value and conservation status

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Foreword

Lowland semi-natural grassland is a resource of considerable nature conservation value in England. Many grassland types have also been identified as being of European significance and are listed on Annex 1 of the EU Habitats and Species Directive. However, England's semi-natural grasslands are seriously threatened by changes in land use.

This English Nature Research Report is intended to provide a compendium of information on the distribution, extent and conservation status of lowland grassland and associated species in England. The information will assist in the process of conserving and enhancing the remaining areas of this important wildlife resource.

English Nature's Lowland Grassland Strategic Review and Action Plan (ENRR No. 163), which sets out detailed proposals to further grassland conservation, has already utilised the information in this report. The English Nature Action Plan is designed to help deliver the targets and goals for the conservation of lowland grassland formulated in 1995 by the UK Biodiversity Action Plan Steering Group.

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1. Introduction and definition

Lowland grassland in England supports a rich variety of wild plants and animals. Among England's rare and scarce species of plants, birds and butterflies, 25%, 20% and 65% respectively are closely associated with lowland grassland. The high biodiversity of this habitat is the result of England's varied topography, geology, soils, climate and past land use.

Lowland grasslands are here defined as generally enclosed meadow or pasture land normally occurring at altitudes of 350 metres or less in England and are of a type included in the grassland section of the National Vegetation Classification.. Lowland grasslands have been systematically described by the NVC (Rodwell 1992) and Table 1 lists the communities occurring inland in the English lowlands.

Some habitats, which may also be managed by cutting or grazing and which are sometimes described as "meadows" or "grasslands", are actually classified under different habitats in the NVC. Fen meadows and some rush pastures, for example, are technically Mire communities (M22-M28) (Rodwell 1991) and coastal grasslands are described in the draft NVC volume on coastal vegetation as maritime cliff grassland (NVC MC5, MC8-MC12), and dune grassland (SD9-SD14). These communities are thus excluded from the NVC definition of lowland grassland, and from this report.

Lowland grasslands of botanical interest are listed in part A of Table 1 (extracted from NCC SSSI Guidelines 1989). Lowland grassland types which have been the subject of agricultural improvement by ploughing and reseeding or the use of artificial fertilisers or are the result of natural recolonisation following disturbance are usually of lower botanical interest. Damp improved grasslands that have been invaded by rushes and tussocky grasses like *Deschampsia caespitosa* are also generally of low botanical interest but may be important for birds. All these communities are listed in Section B of Table 1.

Table 1 Lowland grassland communities and their distribution in England

Note: Community codes refer to the NVC codes in volume 3 of the NVC (Rodwell 1992).

A.	Grasslands of high botanical interest
1.	**Neutral grasslands**
MG2	*Filipendula ulmaria - Arrhenatherum elatius*: Northern tall herb grassland A sub-montane community restricted to the Carboniferous limestone in Northern England especially in Pennine areas of Derbyshire and North Yorkshire.
MG3	*Anthoxanthum odoratum - Geranium sylvaticum*: Northern hay meadow Valley grasslands and river banks of northern England; often used as hay meadows. Major concentrations in the Pennine Dales of Swaledale, Wharfedale (N Yorks) and Teesdale (Durham).
MG4	*Alopecurus pratensis - Sanguisorba officinalis*: Flood meadow Seasonally flooded land in lowland river flood plains. Widely scattered but concentrations in N Yorkshire/Humberside (along the rivers Derwent, Ouse and Wharfe) and Oxfordshire (Thames Valley and tributaries).
MG5	*Cynosurus cristatus - Centaurea nigra*: Lowland hay meadow and pasture Widely scattered throughout the English lowlands. The community covers a wide range of soil types and the sub-communities reflect this. The *Galium verum* sub-community shows affinities with some CG grasslands and the *Danthonia* sub-community with acid grasslands. Major concentration in Worcestershire.
MG8	*Cynosurus cristatus - Caltha palustris*: Flood pasture Widespread but rather local distribution throughout lowland England. Characteristic of periodically inundated land. Sometimes managed in the past as water meadows.
MG11	*Festuca rubra - Agrostis stolonifera - Potentilla anserina*: Inundation grassland Scattered localities in lowland England characteristic of areas frequently inundated with fresh or brackish water. Only one sub-community (*Lolium perenne* sub-community) is found inland and it has often been improved.
MG13	*Agrostis stolonifera - Alopercurus geniculatus*: Inundation grassland, silver meadows Scattered localities in lowland areas usually in river flood plains. In eastern England it forms mosaics with swamp communities in extensive stands on washlands, but elsewhere it is fragmentary alongside watercourses and on the edges of ponds. This community has special value in providing feeding areas for wildfowl.
2.	**Calcareous grassland**
CG1	*Festuca ovina - Carlina vulgaris*: Warm temperate limestone grassland Distribution limited to scattered sites on harder limestones principally around and near to southern and western coasts of England.
CG2	*Festuca ovina - Avenula pratensis*: Species-rich chalk grassland Species-rich grassland widely distributed over southern lowland calcareous formations, with regional differences showing up as sub-communities.
CG3	*Bromus erectus* Distribution follows that of the species and so this community is especially frequent over the Chalk, Jurassic limestone (Oolite) and Magnesian Limestone (Permian).
CG4	*Brachypodium pinnatum* Frequent on the Cretaceous chalk and Jurassic limestone.

CG5	*Bromus erectus - Brachypodium pinnatum* Distribution is centred on the Jurassic limestone in Central and Eastern England.
CG6	*Avenula pubescens* Occurs in scattered localities over a variety of lowland limestone areas but is nowhere extensive, being a product of little or no grazing of grasslands over moist, mesotrophic calcareous soils on flat or gently-sloping sites. Most of these areas have been converted to arable.
CG7	*Festuca ovina - Hieracium pilosella - Thymus praecox* Scattered localities in Wiltshire, the Yorkshire Wolds, the Carboniferous Limestone of Derbyshire and the Mendips, with its greatest concentration and extent in Breckland.
CG8	*Sesleria albicans - Scabiosa columbaria*: Magnesian limestone grassland Distribution is confined to Magnesian Limestone in County Durham.
CG9	*Sesleria albicans - Galium sterneri*: Carboniferous limestone grassland Distribution is confined to the Carboniferous Limestone of Northern England, with the sub-communities marking regional differences.
3.	**Acid grasslands**
U1	*Festuca ovina - Agrostis capillaris - Rumex acetosella* These very diverse and open swards occur widely on light soils in the drier areas of lowland England.
U2	*Deschampsia flexuosa* These swards are of local distribution on wetter but free-draining, base-poor soils in lowland England.
U3	*Agrostis curtisii* A community based on the abundance of *Agrostis curtisii* and therefore confined to central southern and south west England.
U4	*Festuca ovina - Agrostis capillaris - Galium saxatile* Principally a community of upland (sub-montane) areas of North and Western England associated with a range of acidic soils on lime-poor substrates. Examples do, however, occur in lowland situations (<350m) on the "upland fringes" and in Dorset and Wealden districts.
B.	**Grassland communities of lower botanical interest**
MG1	*Arrhenatherum elatius* An unmanaged coarse grassland occurring throughout the English lowlands on road verges and railway embankments and in neglected agricultural and industrial habitats.
MG6	*Lolium perenne - Cynosurus cristatus*: improved permanent grassland The major permanent pasture type in lowland England, often brought about by the action of fertilisers, herbicides and drainage on many other MG, CG or U types or by agricultural rundown of MG7. May also be used for silage or hay-making.
MG7	*Lolium perenne*: re-seeded grassland The major and ubiquitous sown grassland type in England.
MG9	*Holcus lanatus - Deschampsia cespitosa*: damp pasture This is highly characteristic of permanently moist soils throughout the English lowlands. Often results from invasion of *Deschampsia caespitosa* into MG6 and 7 where drainage has deteriorated.
MG10	*Holcus lanatus - Juncus effusus*: rush pasture This is ubiquitous throughout the English lowlands, commonly developing by invasion of *Juncus* into MG6 and MG7 where drainage becomes impeded.

2. Total extent of lowland grassland in England

Lowland semi-natural grasslands of high botanical interest constitute approximately 3% of all the permanent grassland in the English lowlands. In area terms it is likely that less than 100,000 ha remain in England. 'Lowland wet grassland' which encompasses ornithological interest and aquatic fauna and flora of ditches is estimated to cover approximately 220,000 ha in England (Dargie 1993). This includes coastal grazing marsh and improved, botanically uninteresting grassland. The exact proportion that is of botanical interest is as yet unknown, but is thought unlikely to raise the total for all botanically interesting grasslands over the estimated total of 100,000 ha. José & Self (1994) estimate that 105,000 ha of lowland wet grassland in England and Wales holds breeding waders, including 30,000 ha of grazing marsh. Overall, the botanically interesting grassland and the more improved grassland within the lowland wet grassland resource accounts for less than 8% of all permanent grassland.

3. Types of lowland grasslands: distribution and extent

At present it is not possible to provide a complete and accurate account of the distribution and extent of the lowland grassland communities in England as, firstly, Phase 2 (NVC) surveys of grasslands have not been undertaken for all grassland types in all counties and, secondly, collation of existing data is incomplete. However, the following section and Table 1 attempt to give a rough idea of the distribution and extent of the NVC communities belonging to the three main grassland types (calcareous, neutral and acidic).

It should be emphasised that more detailed information on the distribution and extent of semi-natural grassland at a county or Natural Area level is sometimes available from individual Phase 2 grassland survey reports. Palmer and Blake (1991) provide a reasonably up-to-date inventory of Phase 2 grassland surveys. Over 45 Phase 2 survey data sets are also held on computer in the national grassland database VEGAN (Rowell and Robertson 1994).

In addition, English Nature County Grassland Inventories are now available for most counties. By the end of 1996 inventories should be available for all counties. The inventories provide maps and brief details listing all known grassland sites of interest in each 10 km square in a county.

3.1 Neutral grasslands (NVC communities MG2-MG5, MG8, MG11 and MG13)

The distribution maps of neutral grassland communities and sub-communities in Rodwell (1992) provide a general idea of the spatial distribution of grassland types. However, these should be treated with caution as they represent the location of quadrat samples taken for the NVC which have subsequently been ascribed to community types. They do not thus give a complete picture of the distribution of the resource.

Table 2 provides crude estimates of the extent (in hectares) of the botanically interesting neutral grassland communities. There is probably less than 10,000 ha in total. Neutral grasslands are clearly a scarce, fragmented resource with many extant examples being small in extent (<20 hectares). Some communities appear to be especially rare (eg MG2 and MG8) and their conservation is an utmost priority. The estimate for MG5 includes stands that occur on soils overlying chalk and limestone rocks.

Table 2 **Estimates of the extent in hectares of the neutral grassland resource in England**

NVC community type	Area (ha)
MG2	<100
MG3	<1500
MG4	<1500
MG5	<5000
MG8	<500
MG11	<1000?
MG13	<2000? (800 ha in Ouse Washes, Cambs)

3.2 Calcareous grasslands (CG1-CG9)

Lowland calcareous grasslands (NVC communities CG1-CG9) probably occupy an area less than 40,000 hectares. Calcareous grasslands are undoubtedly a nationally and internationally rare habitat (Willems 1990) but nonetheless their extent in England exceeds that of neutral grassland four- or five-fold.

There is good information available on the extent of calcareous grassland on chalk. In 1995, all the Phase 2 chalk grassland survey information was collated by the authors and a national figure for the amount of chalk grassland was calculated. A total of 32,000 hectares of calcareous grassland on chalk (CG types in the NVC) is made up of 25,000 hectares of calcareous grassland in pure strands plus 6,800 hectares recorded in mixtures with other habitats, such as mesotrophic grassland and heath. Only a proportion of the latter figure is calcareous grassland, thus the total of 32,000 is very much a maximum figure. Table 3 shows the relative properties of calcareous NVC types on the chalk. *Bromus erectus* grassland (CG3) is the most extensive type.

Table 3 **Area of NVC communities on chalk in England**

NVC community type	Area of pure stands	Area associated with other CG types	Areas associated with other habitats
CG1	2	49	1
CG2	5,600	880	1,000
CG3	14,000	670	2,900
CG4	1,800	430	410
CG5	470	95	100
CG6	270	140	270
CG7	1,100	160	1,100
All CG	25,000	NA	6,800

Across all the lowland limestone, including chalk, in England the following are particularly scarce:

- CG1 *Festuca ovina - Carlina vulgaris* grassland, all 5 sub-communities which occur in England. (The *Helianthemum canum* and the *Festuca rubra - Scilla verna* sub-communities appear to be restricted to Wales, according to Rodwell (1992).)

- CG6 *Avenula pubescens* grassland.

- CG7 *Festuca ovina - Hieracium pilosella - Thymus praecox* grassland. Breckland (Norfolk and Suffolk) probably retains the greatest concentration of this grassland type. The *Ditrichum - Diploschistes* sub-community is wholly confined and the *Cladonia* sub-community largely confined to this area.

- CG8 *Sesleria albicans - Scabiosa columbaria* grassland. Restricted to the Magnesian limestone in eastern County Durham and covers only 70 ha (Dalby 1991).

- CG9 *Sesleria albicans - Galium sterneri* grassland. Of the five sub-communities, two are principally lowland types. These are the *Helianthemum canum - Asperula cynanchica* and the typical sub-community. The former is confined to the Carboniferous limestone formation in the Morecambe Bay area whilst the latter also occurs in this area but in addition is known from higher altitudes (>350 metres) on the Carboniferous limestone in Cumbria, Durham and North Yorkshire.

3.3 Acidic grasslands (U1-U4)

The extent of the lowland acid grassland resource in England is poorly known but is probably between 10,000 to 20,000 hectares. Thus acid grassland is a scarce resource in the lowlands.

Acid grasslands have on the whole been neglected by ecologists and conservation biologists who have tended to concentrate on botanically more diverse swards. Nevertheless they have their own communities and species of nature conservation value.

Whilst none of the acid grassland communities are very widespread, the following NVC communities would appear to be particularly restricted in extent in the lowlands:

- U1 *Festuca ovina - Agrostis capillaris - Rumex acetosella* grassland, in particularly the *Cornicularia aculeata - Cladonia arbuscula* sub-community and the *Erodium cicutarium - Teesdalia nudicaulis* sub-community. These two sub-communities are largely restricted to Breckland.

- U3 *Agrostis curtisii* grassland. This community is often associated with lowland heathland and may in some cases be a derivation due to overgrazing and excessive burning. It is restricted to central southern and south west England.

- U4 *Festuca ovina - Agrostis capillaris - Galium saxatile* grassland. This is primarily an upland community typical of Northern and Western England. However, there are examples of acid grassland in the lowlands which are referrable to this community (eg in the Weald and in Dorset) and in enclosed grasslands on the upland fringes below 350 metres.

4. Species conservation

Lowland semi-natural grasslands support a range of plant and animal species, some of which are rare and scarce. This section provides a brief summary of the species conservation interest of lowland grasslands but concentrates on identifying the rare and scarce species.

4.1 Vascular plants

Table 4 lists those nationally rare and nationally scarce species (excluding critical groups such as micro-species) which have a high affinity with lowland semi-natural grassland. The status of the species is according to the recently published scarce plant atlas (Stewart *et al* 1994). The NVC communities in which these species occur is given where information permits. Table 4 emphasises the importance of calcareous grasslands as a habitat for rare and scarce plant species.

Table 4 Nationally rare and nationally scarce vascular plant species occurring in lowland semi-natural grasslands in England

Scientific Name	English Name	NVC Community	Status (see key)
Aceras anthropophorum	Man Orchid	CG2, CG3, CG4, CG5	NS
Allium schoenoprasum	Chives	U1, CG7, MG?	NS
Althaea hirsuta	Rough Marsh-mallow	CG7, MG?	RDB, S8
Alyssum alyssoides	Small Alison	CG7, U1	RDB, S8
Ajuga chamaepitys	Ground-pine	CG2	NS, S8
Alchemilla acutiloba	Lady's-mantle	MG3	RDB
A. monticola	Lady's-mantle	MG3	RDB
A. subcrenata	Lady's-mantle	MG3	RDB
Apium repens	Creeping Marshwort	MG4, MG13	RDB
Arabis scabra	Bristol Rock-cress	CG1	RDB, S8
Armeria maritima ssp. elongata	Tall Thrift	MG?	RDB
Artemisia campestris	Field Wormwood	CG7	RDB, S8
Aster linosyris	Goldilocks Aster	CG1, CG9	RDB
Bartsia alpina	Alpine Bartsia	CG9, MG?	RDB
Bunium bulbocastanum	Great Pignut	CG2, CG3	RDB
Bupleurum baldense	Small Hare's-ear	CG1	RDB, S8
Calamintha nepeta	Lesser Calamint	CG?	NS
Carex ericetorum	Rare Spring-sedge	CG2, CG5, CG7, CG9	NS
C. humilis	Dwarf Sedge	CG1, CG2, CG3	NS

Scientific Name	English Name	NVC Community	Status (see key)
C. montana	Soft-leaved Sedge	CG2	NS
C. ornithopoda	Bird's-foot Sedge	CG2, CG9	RDB
C. filiformis	Downy-fruited Sedge	MG4, MG5?	RDB
Cerastium pumilum	Dwarf Mouse-ear	CG1, CG2, CG7, MG5, CG2	NS
Chamaemelum nobile	Chamomile	MG, U?	NS
Cirsium tuberosum	Tuberous Thistle	MG5, CG2, CG3	RDB
Cotoneaster integerrimus	Wild Cotoneaster	CG1	RDB, S8
Crassula tillaea	Mossy Stonecrop	U1	NS
Crepis mollis	Northern hawk's-beard	MG?	NS
Cypripedium calceolus	Lady's-slipper	CG9	RDB, S8, AII, V
Dianthus armeria	Deptford Pink	U1?	NS
D. deltoides	Maiden Pink	U1	NS
Draba aizoides	Yellow Whitlowgrass	CG1	RDB
Epipactis atrorubens	Dark-red Helleborine	CG8, CG9	NS
Euphorbia portlandica	Portland Spurge	CG1	NS
Euphrasia pseudokerneri	Eyebright	CG2	NS, E1? (France?)
E. virgursii	Eyebright	U3	RDB
Festuca caesia	Blue Fescue	U1?	RDB
Fritillaria meleagris	Fritillary	MG4, MG5	NS
Galium pumilum	Slender Bedstraw	CG2, CG3, CG5	NS
Gastidium ventrocosum	Nit-grass	CG1, CG2? CG7	RDB
Gentianella anglica	Early Gentian	CG1, CG2, CG7	NS, AII, E3
G. ciliata	Fringed Gentian	CG2	RDB, S8
G. germanica	Chiltern Gentian	CG2	NS
Helianthemum apenninum	White Rock-rose	CG1	RDB
H. canum	Hoary Rock-rose	CG1, CG2, CG9	RDB
Herminium monorchis	Musk Orchid	CG2, CG4, CG5	NS
Himantoglossum hircinum	Lizard Orchid	CG3, CG5, CG7	RDB, S8
Hornungia petraea	Hutchinsia	CG7	NS
Hypochaeris glabra	Smooth Cat's ear	U1	NS
H. maculata	Spotted Cat's-ear	CG2, CG3, CG9	RDB
Iberis amara	Wild Candytuft	CG2	NS
Koeleria vallesiana	Somerset Hair-grass	CG1	RDB
Linum perenne ssp. anglicum	Perennial Flax	CG2, CG3, CG8	NS, E2
Lychnis viscaria	Sticky Catchfly	U1	RDB
Medicago falcata	Sickle Medick	CG7, U1	NS
Meum athamanticum	Spignel	MG3	NS
Minuartia hybrida	Fine-leaved Sandwort	CG7	NS
Muscari atlanticum	Grape Hyacinth	U1?	RDB

Scientific Name	English Name	NVC Community	Status (see key)
Oenanthe silaifolia	Narrow-leaved Water-dropwort	MG4	NS
Orchis fuciflora	Late Spider-Orchid	CG2	RDB, S8
O. militaris	Military Orchid	CG2, CG3, CG7	RDB, S8
O. simia	Monkey Orchid	CG2	RDB, S8
O. sphegodes	Early Spider-Orchid	CG2, CG4	RDB, S8
O. ustulata	Burnt Orchid	CG2	NS
Orobanche artemisae-campestris	Oxtongue Broomrape	CG2	NS
O. caryophyllacea	Bedstraw Broomrape	CG?	RDB, S8
O. reticulata	Thistle Broomrape	CG?	RDB, S8
Phleum phleoides	Purple-stem Cat's-tail	CG7	RDB
Phyteuma orbiculare	Spiked Rampion	CG2, CG3, CG4, CG5	NS
Polemonium caeruleum	Jacob's-ladder	MG2	RDB
Polygala amara	Dwarf Milkwort	CG2, CG9	RDB
Potentilla tabernaemontani	Spring Cinquefoil	CG1, CG7, CG9	NS
Primula farinosa	Bird's-eye Primrose	CG8, CG9	NS
Pulsatilla vulgaris	Pasque flower	CG2, CG3, CG5	NS
Rhinanthus serotinus	Greater Yellow-rattle	MG5, CG3	RDB, S8
Salvia pratensis	Meadow Clary	CG2, CG3	RDB, S8
Scilla autumnalis	Autumn Squill	CG1	NS
Scleranthus perennis	Perennial Knawel	U1	RDB, S8
Sedum forsteranum	Rock Stonecrop	CG1	NS
Senecio integrifolium	Field Fleawort	CG2, CG3, CG7	NS
Seseli libanotis	Moon Carrot	CG2, CG3	RDB
Sesleria albicans	Blue Moor-grass	MG2, CG8, CG9	NS
Silene conica	Sand Catchfly	CG7, U1	RDB
S. nutans	Nottingham Catchfly	MG1, CG2	NS
S. otites	Spanish Catchfly	CG7, U1	RDB
Spiranthes spiralis	Autumn Lady's-tresses	CG2	NS
Teucrium botrys	Cut-leaved Germander	CG2	RDB, S8
Thesium humifusum	Bastard-toadflax	CG2, CG3, CG5	NS
Thymus serpyllum	Breckland Thyme	CG7, U1	RDB
Trifolium ochroleucon	Sulphur Clover	MG5	NS
T. suffocatum	Suffocated Clover	U1	NS
Trinia glauca	Honewort	CG1	RDB
Veronica spicata subsp hybrida	Spiked Speedwell	CG1, CG2, CG9	NS, S8
V. spicata ssp. spicata	Spiked Speedwell	CG7, U1	RDB, S8

Scientific Name	English Name	NVC Community	Status (see key)
V. verna	Spring Speedwell	CG7	RDB
Vulpia unilateralis	Mat-grass Fescue	CG7	NS

KEY

S8	-	Listed on Schedule 8 of the 1981 Wildlife & Countryside Act
RDB	-	Listed in Red Data Book (Perring & Farrell 1983) (Nationally rare)
NS	-	National scarce (occur in 16-100 10 x 10 km squares)
AII	-	EC Annexe II
E1	-	Endemic to British Isles
E2	-	Endemic to Great Britain
E3	-	Endemic to England
V	-	Vulnerable

Note: Table excludes introduced and doubtfully native species

4.2 Lower plants

The lower plant interest of grasslands is not well known but some types of grassland have been recognised as important for their lower plants. Palmer (1994) in the UK Plant Conservation Strategy document lists bryophyte and lichen-rich heath (this includes the grass heaths of Breckland covering NVC types CG7 and U1) and metallophyte lichen communities (eg on old mine waste). Gilbert (1993) describes the importance of a range of chalk grassland sites for lichens and Rose *et al* (1991) list some important bryophytes in chalk grassland sites in Sussex.

Table 5 lists the nationally rare lower plants (mosses, liverworts and lichens) associated with grassland. This is a **provisional** list and some of the species may not actually turn out to be closely associated with semi-natural grassland. In addition, many of the listed species also occur in other habitats in addition to grassland. (N Hodgetts, Lower Plant Specialist, JNCC, pers. comm.).

Table 5 Provisional list of nationally rare lower plants associated with lowland grassland

Species	Notes
1. **Mosses**	
Bryum caespiticium var imbricatum	Bare patches in calcareous grassland.
B. turbinatum *B. uliginosum*	Damp soil. Could potentially occur in damp/wet grassland?
Cheilothela chloropus	Bare earth over basic rocks in calcareous grassland.
Ephemerum sessile *E. stellatum*	Damp soil. Could potentially occur in damp/wet grassland?
Funaria pulchella	Thin soil in calcareous grassland.
Leptodontium gemmascens	Base of grass tussocks and on rotting grass material. Grassland species??
Pottia caespitosa	Bare soil in calcareous grassland.
Weissia multicapsularis	Damp clayey acidic soil in grassland.

Species	Notes
W. levieri	Thin soil on limestone, limestone rocks. Calcareous grassland?
W. tortilis	Calcareous soil and rocks. Calcareous grassland?
2. Liverworts	
Cephaloziella baumgartneri	Limestone substrates. Rocks, cliffs, quarries etc on stones and soil. Calcareous grassland?
C. integerrima	Damp sandy or clayey soil.
Lophozia perssonii	Bare calcareous soil in calcareous grassland.
3. Lichens	
Buellia asterella	Thin dry basic soil. Calcareous grassland?
Caloplaca atroflava	On flint pebbles in calcareous grassland.
Cladonia convoluta	On base rich (limestone) coastal slopes.
Collema bachmanianum	On ± basic soil. Calcareous grassland?
Fulgensia fulgens	Thin soil on calcareous grassland.
Peltigera ponojensis	Calcareous grassland, old lead mine spoil tips.

4.3 Birds

The birds of grasslands have been relatively well studied in comparison to some other groups. Brown and Grice (1993) give detailed assessments of the significance of grasslands for birds.

Wet grassland

Wet lowland grasslands are often of great importance as habitat for a range of bird species but especially for breeding and wintering wildfowl and waders (see Fuller 1982). Wet grassland is a composite habitat and most definitions embrace a wide range of grassland, swamp and mire types including both inland and coastal situations. Water table height, substrate type and the duration of extent of inundation at specific times of the year together with the maintenance of low intensity agricultural management and lack of human disturbance are the most important factors in determining the suitability of sites as breeding or wintering localities for birds. Botanical composition is a relatively unimportant factor. Table 6 lists the Red Data and candidate Red Data birds (see Batten *et al* 1990 for definitions) dependent or partly dependent on **inland** lowland wet grassland.

Table 6 Red Data birds[1] and candidate Red Data birds[1] dependent on lowland wet grassland

Scientific Name	English name	Breeding	Wintering/ Passage	Schedule 1. Wildlife & Countryside Act	Annex 1. EC Bird Directive
Cygnus columbianus	Bewick's Swan		✓	✓	✓
C. cygnus	Whooper Swan		✓	✓	✓
Anser fabalis	Bean Goose		✓		
A. anser	Greylag Goose		✓		
Anas penelope	Wigeon		✓		
A. strepera	Gadwall		✓		
A. crecca	Teal		✓		
A. acuta	Pintail		✓		
A. querquedula	Garganey	✓		✓	
A. clypeata	Shoveler	✓	✓		
Aythya ferina	Pochard	✓	✓		
Coturnix coturnix	Quail	✓		✓	
Crex crex	Corncrake	✓		✓	✓
Porzana porzana	Spotted Crake	✓		✓	
Pluvialis apricaria	Golden Plover		✓		✓
Vanellus vanellus	Lapwing	✓			
Tringa totanus	Redshank	✓			
Gallinago gallinago	Snipe	✓			
Philomachus pugnax	Ruff	✓		✓	✓
Limosa limosa	Black-tailed Godwit	✓		✓	
Numenius arquata	Curlew	✓	✓		
N. phaeopus	Whimbrel		✓	✓	
Tyto alba	Barn Owl	✓		✓	
Asio flammeus	Short-eared Owl	✓			

Scientific Name	English name	Breeding	Wintering/ Passage	Schedule 1. Wildlife & Countryside Act	Annex 1. EC Bird Directive
Saxicola rubetra	Whinchat	✓			
Acrocephalus scheonobaenus	Sedge Warbler	✓			
Motacilla flava	Yellow Wagtail	✓			

[1] For definition see Batten *et al* (1990).

Dry grassland

Lowland dry grasslands, which are here defined as broadly NVC communities CG1-CG9 (calcareous grassland), U1-U4 (acid grassland) and MG5 (neutral grassland) where this occurs over limestone on sloping terrain, generally support few breeding and wintering species. The presence of scrub on dry grassland can swell the list of species but these tend to be widespread passerines such as yellowhammer, willow warbler, dunnock and blackbird (Fuller 1982). However, there are a limited number of rarer species which are dependent or partly dependent on dry grassland and these are listed in Table 7. Further information on the dry grassland avifauna and its conservation can be found in Dolman (1992) and Porter *et al* (1991).

Table 7 **Red Data birds[1] and candidate Red Data birds[1] associated with lowland dry grassland**

Scientific Name	English Name	Breeding	Wintering/ Passage	Schedule 1. Wildlife & Countryside Act	Annex 1. EC Bird Directive
Circus cyaneus	Hen Harrier		✓	(✓)	✓
Buteo buteo	Buzzard	✓	✓		
Falco columbarius	Merlin		✓	(✓)	✓
Burhinus oedicnemus	Stone Curlew	✓		✓	✓
Vanellus vanellus	Lapwing	✓			
Asio flammeus	Short-eared Owl	✓	✓		✓
Lulla arborea	Woodlark	✓	✓	✓	✓
Saxicola rubetra	Whinchat	✓			
Oenanthe oenanthe	Wheatear	✓	✓		
Turdus torquatus	Ring Ouzel		✓		

[1]For definition, see Batten *et al* (1990).

Other Red Data birds and candidate Red Data birds which can occur on lowland dry grassland include Grey Partridge, Quail, Barn Owl and Corn Bunting

4.4 Invertebrates

Lowland semi-natural grasslands of all types are of considerable interest for invertebrates. Different types of grassland vary widely in the richness of the invertebrate fauna they support and in the number of rare, scarce and declining species they contain.

As a broad generalisation, the invertebrate species-richness and nature conservation interest of calcareous grassland is greater than that of neutral grassland or acidic grassland. Such differences relate to variation in factors such as plant species-richness, microclimate, type of management and structural and topographical diversity. For further information on the grassland invertebrate fauna see Duffey *et al* (1974), Ratcliffe (1977), BUTT (1986) and Kirby (1992).

There are a number of rare and scarce invertebrate species associated with lowland grasslands. Kirby (1994) gives a total of 153 for numbers of Red Data Book invertebrate species found in grassland habitats (ie occurring, as far as is known, in less than 15 10 km squares in Britain) and 350 notable species (ie occurring in fewer than 100 10 km squares). Space does not permit the listing of species and further information on Red Data Book species and their habitat preferences can be found in Kirby (1994), Shirt (1987) and Bratton (1991).

However, two obvious and well known insect groups are the butterflies and grasshoppers and crickets, and Tables 8 and 9 list the nationally rare and scarce species associated with lowland grassland. Apart from some of these species, the black-veined moth *Siona lineata* is the only other invertebrate associated with grassland that is fully protected under Schedule 5 of the Wildlife and Countryside Act 1981.

Table 8 Rare and scarce butterflies associated with lowland semi-natural grassland

Scientific Name	English Name	Red Data Book Category (see key)	Wildlife & Countryside Act 1981: Schedule 5	Nationally Rare (1-15 10 x 10 km squares)	National Scarce (16-100 10 x 10 km squares)
Aricia artaxerxes	Northern Brown Argus	-	✓ Section 9 (5) only	-	✓
Cupido minimus	Small Blue	-	✓ "	-	-
Eurodryas aurinia	Marsh Fritillary	-	✓ "	-	✓
Hamearis lucina	Duke of Burgundy Fritillary	-	✓ "	-	✓
Hesperia comma	Silver Spotted Skipper	3	✓ "	-	✓
Lysandra bellargus	Adonis Blue	-	✓ "	-	✓
L. coridon	Chalkhill Blue	-	✓ "	-	-
*Maculinea arion**	Large Blue	1	✓	✓	-
Plebejus argus	Silver Studded Blue	-	✓ Section 9 (5) only	-	✓
Thymelicus acteon	Lulworth Skipper	-	✓ "	✓	-

Key:

* Became extinct 1979; Swedish sub-species subsequently re-introduced

RDB CATEGORIES

1. Endangered
2. Vulnerable
3. Rare
4. Out of danger

Table 9 Rare and scarce Orthoptera (grasshoppers & crickets) associated with lowland semi-natural grassland

Scientific Name	English Name	Red Data Book Category (see key)	Wildlife & Countryside Act 1981: Schedule 5	Nationally Rare (1-15 10 x 10 km squares)	National Scarce (16-100 10 x 10 km squares)
Decticus verrucivorus	Wart-biter	2	✓	✓	
Metrioptera roeselii	Roseel's Bush-cricket	-	-	-	✓
Omocestus rufipes	Woodland Grasshopper	-	-	-	✓
Gomphocerippus rufus	Rufous Grasshopper	-	-	-	✓
Tetrix subulata	Slender Ground-hopper	-	-	-	✓
Conocephalus dorsalis	Long-winged Cone-head	-	-	-	✓
Gryllus campestris	Field cricket	1	✓	✓	-
Gryllotalpa gryllotalpa	Mole cricket	1	✓	✓	-

Key:

RDB CATEGORIES

1. Endangered
2. Vulnerable
3. Rare
4. Out of danger

4.5 Reptiles

Four species of reptile are sometimes found in grassland habitats in England. These are adder *Vipera berus*, grass snake *Natrix natrix*, slow worm *Anguis frgilis* and common lizard *Lacerta vivapara*. These are generally 'woodland edge' species and where they occur in managed grassland it is normally in association with tall herb vegetation, scrub or woodland. The adder uses a variety of habitats including calcareous grassland in southern England. While remaining relatively widespread in Britain, it is thought to be declining as a result of habitat loss. The grass snake occurs in a variety of habitats including semi-natural grasslands but is normally found close to water. While still relatively widespread in England and Wales, numbers appear to be declining.

4.6 Mammals

The majority of native species of mammals are primarily adapted to woodland. Only a few have very specialised habitat requirements and many use a variety of habitats within their range. Some species of bat, including greater horseshoe bat, search for prey over permanent pasture (including improved grassland) and this can be an important component of suitable habitat mosaics for bats.

5. Losses of lowland grassland

Lowland unimproved grasslands have been a particular focus for the processes of agricultural intensification over the last 50 years and thus many have lost their nature conservation interest.

Agricultural improvement has in fact been the main cause of loss of unimproved grassland. Grasslands have been improved by a combination of ploughing and reseeding with high yielding strains of rye grasses, under-drainage and/or the use of herbicides and artificial fertilisers (NCC 1984, 1989). Damage and eventual loss through lack of grazing or mowing, leading to scrub invasion, are other important problems, often because in areas that are now predominantly under arable land use, livestock farming has become uneconomic. Other less significant factors that have contributed to the losses include afforestation and industrial and residential development.

Fuller (1987) estimated that in 1984 unimproved grassland occupied 3% of the area it occupied in 1930 in England and Wales. Detailed information on recent losses is not available for the whole of England but several examples (see below) show that loss and damage are continuing apace and are widespread rather than confined to limited geographical areas. It is interesting to note that almost all the loss figures exceed the average yearly loss of tropical rainforest (0.6% p.a.) (Berkmüller 1992).

- Worcestershire (1980 to 1991/2). 37% complete loss of neutral grasslands (MG4 and MG5) (c.3% loss per annum). 28% of resource damaged (c.2.5% damage per annum). This equates to a c.6% loss or damage rate per annum (Stephen 1993).

- Dorset neutral grasslands (1982/3 to 1988). 60% loss equating to a 10% loss rate per annum (Porley and Ulf-Hansen 1991).

- Hereford and Radnor. Unimproved grassland and wetland sites (1982/3 to 1990). 14% loss, 21% partial damage/loss. Total 35% damage/loss which equates to a *c.*5% rate per annum (unpublished information from the Hereford and Radnor Naturalists' Trust).

- Devon Culm grasslands (Torridge district). Although a mix of mire, heath and grassland communities the same pressures of change apply. 62% loss of sites between 1984 and 1989/90, *c.*10% loss of total area outside SSSIs per annum (Devon Wildlife Trust 1990).

- Norfolk and Suffolk neutral, calcareous, acid grasslands. 2% loss of sites over a three year period in both counties (1987-1989/90 in Suffolk, 1985-1988 in Norfolk) (Roberts *et al* 1990, Roberts and Smyth 1990).

- Berkshire neutral grassland. Re-survey of sites in 1995 of sites surveyed either in 1984 or 1987 showed that 50% had been damaged or destroyed (60% by area) (Redgrave 1995).

- Kent calcareous grassland. Phase I habitat survey of Kent in the early 1990s revealed that over 25% of calcareous grassland in Kent was unmanaged and nearly 20% had significant scrub invasion (Kent County Council *et al* 1995).

6. Fragmentation

Severe losses in unimproved lowland grasslands have resulted in the habitat becoming a rare and fragmented resource and large sites are scarce.

6.1 Neutral grassland

These normally occur as very small sites, generally less than 10 hectares in size . A sample of eight counties produced a mean site size of 7.1 ha for MG5 grassland SSSIs (Hopkins 1991). Porley and Ulf-Hansen (1991) estimated that *c.*50% of all neutral grassland in Dorset occurred as fragments of less than 5 ha in extent and 71% of sites were less than 10 ha in extent.

6.2 Calcareous grassland

Site size is normally greater than that for neutral grasslands but most sites probably do not exceed 40 hectares. For example, a Phase 2 survey of Dorset chalk grasslands (NCC 1987) showed that 87% of sites were less than 40 ha in extent. In Berkshire, a survey of 29 chalk grassland sites (Wiggington 1985) revealed that no sites exceeded 40 ha and 79% were less than 10 ha. These figures show that there is variation in site size across the country. Perhaps the extreme case is Lincolnshire where a Phase 2 survey (Blake 1990) showed that 97% of chalk grassland sites were less than 5 ha. There are exceptions to the pattern, most notably Salisbury Plain which has over 11,000 hectares of calcareous grassland distributed in three large blocks.

6.3 Acid grassland

There are very few Phase 2 surveys of acid grassland in England from which to assess their degree of fragmentation. However a random sample of 47 grassland SSSIs on COREDATA, which had habitat information indicating that they

included areas of acid grassland, showed that 66% of the sites had less than 10 ha of acid grassland and 83% of them had less than 20 ha.

7. Conservation status

7.1 International Designations

Semi-natural grassland of all types were probably widespread in Europe at the turn of the century (Dijk 1991). However, much of this resource has been lost in the last 50 years and all types of semi-natural lowland grassland are probably now scarce at a European scale.

Some British grassland types, notably NVC type MG5, do not appear to occur elsewhere in North West Europe whilst other types have varying affinities with types described from continental Europe.

7.1.1 Habitats and Species Directive

The Directive lists habitats and species for which Special Areas for Conservation (SACs) are required across Europe.

The lowland grassland types and grassland species listed on Annex 1 and II of the EC Habitats and Species Directive (92/43 EEC) are as follows:

a. **Priority habitats**

- *Festuco-Brometalia* (includes NVC types CG1-CG9). Semi-natural dry grasslands on calcareous substrates with important orchid populations.

b. **Habitat types of European Community interest**

- *Festuco-Brometalia* (CG1-CG9). Semi-natural dry grasslands on calcareous substrates.
- Lowland hay meadows. MG4 *Alopecurus pratensis-Sanguisorba officinalis* flood meadows on neutral substrates.
- Mountain hay meadows (British types with *Geranium sylvaticum*) MG3 *Geranium sylvaticum-Anthoxanthum odoratum* grassland.
- Calaminarian grasslands. (OV37 in the draft NVC volume on open vegetation). Grasslands on substrates containing high concentrations of heavy metals.

c. **Species**

Lowland grassland plant species listed on Annex II:

- *Cypripedium calceolus* (lady's slipper orchid). Found in Carboniferous limestone grassland.

- *Gentianella anglica* (early gentian). Occurs in chalk and limestone grassland.

- *Apium repens* (creeping marshwort). A plant of wet grassland.

Lowland grassland invertebrate species listed on Annex II:

- *Euphydryas aurina* (marsh fritillary). A butterfly found in fen meadows, wet grassland and calcareous grassland.

- *Maculinea arion* (large blue). A butterfly of calcareous grassland.

7.1.2 Special Protection Areas for Birds and Ramsar Wetland Sites

Grassland sites identified under international legislation relating to these two types of protected area are listed in Table 10. Sixteen inland sites have been designated or are proposed (p) for international recognition, either as Wetlands of International Importance under the Ramsar Convention or as SPAs under the EC Directive on the Conservation of Wild Birds. As would be expected from the discussion of ornithological interest of grasslands (Section 4.3) wetter types of grassland predominate in this listing and reflect the relative importance of wet grassland for bird conservation. Some of these sites (for example the Ouse Washes and Nene Washes) have a high proportion of improved or semi-improved grassland of low botanical interest. The importance of these sites is principally based on their concentrations of wintering and breeding waders and wildfowl.

Among the dry grasslands, Salisbury Plain and Porton Down qualify for SPA status on the basis of their populations of breeding stone curlew. This is listed as an Annex 1 species under the EC Directive on the Conservation of Wild Birds as deserving special conservation measures concerning its habitat.

Table 10 SPAs/pSPAs and Ramsar/pRamsar sites likely to have a significant lowland grassland component (excluding coastal grazing marsh).

SPA/Ramsar Site Name	County	Status	Grassland Type
Amberley	West Sussex	pSPA/Ramsar	Wet Neutral
Avon Valley	Hampshire/Dorset	pSPA/Ramsar	Wet Neutral
Breckland Heaths	Norfolk/Suffolk	pSPA	Calcareous, Acid
Broadland	Norfolk/Suffolk	SPA/Ramsar	Wet Neutral
Wealden Heaths	Surrey/Hants/ W Sussex	SPA/pSPA	Acid
Derwent Ings/Lower Derwent Valley	N Yorkshire/ Humberside	SPA/Ramsar	Wet Neutral
Dorset Heathlands	Dorset	pSPA	Acid
Minsmere-Walberswick	Suffolk	SPA/Ramsar	Wet Neutral, Acid
Nene Washes	Cambridgeshire	SPA/Ramsar	Wet Neutral

SPA/Ramsar Site Name	County	Status	Grassland Type
North Pennine Moors (Upper Teesdale)	Durham/Cumbria/ Northumberland	SPA/Ramsar	Neutral Meadow (MG3)
Ouse Washes	Cambridgeshire	SPA/Ramsar	Wet Neutral
Porton Down	Wiltshire/Hampshire	SPA	Calcareous
Salisbury Plain	Wiltshire	SPA	Calcareous
Somerset Levels & Moors	Somerset	pSPA/Ramsar	Wet Neutral
The New Forest	Hampshire	SPA/Ramsar	Acid, Neutral
Walmore Common	Gloucestershire	SPA/Ramsar	Wet Neutral

7.2 National Designations

7.2.1. National Nature Reserves

Reserves with a significant component of unimproved lowland grassland (as far as the authors are aware) are listed in Table 11. The distribution of the NNRs (71% in the area south of a line between the Wash and the Severn Estuary) reflects the high number of grassland NNRs on chalk outcrops.

Table 11 National Nature Reserves in England with a significant unimproved lowland grassland component

NNR Name[1]	Local Team	Grassland Type[2]	Other Comments
Ashford Hill	Hants & IoW	Neutral (MG5, MG6)	
Aston Rowant	Thames & Chiltern	Calcareous (Chalk)	
Barnack Hills and Holes	Beds, Cambs & Northants	Calcareous (Jurassic limestone)	
Barrington Hill Meadows	Somerset & Avon	Neutral	
Barton Hills	Beds, Cambs & Northants	Calcareous (Chalk)	
Beacon Hill	Hants & IoW	Calcareous (Chalk)	
Bredon Hill	Three Counties	Calcareous (Jurassic limestone)	
Brettenham Heath	Norfolk	Acid	Forms part of the Breckland Heaths pSPA site
Castle Hill	Sussex & Surrey	Calcareous (Chalk)	
Castor Hanglands	Beds, Cambs & Northants	Calcareous (Jurassic limestone)	
Cavenham Heath	Suffolk	Acid	Forms part of the Breckland Heaths pSPA site
Chaddlesley Woods	Three Counties	Neutral (MG5)	Small but significant areas of neutral grassland occur within this woodland site
Chimney Meadows	Thames & Chilterns	Neutral (MG5)	
Cotswolds Commons and Beechwoods	Three Counties	Calcareous (Jurassic limestone)	
Derbyshire Dales	Peak District and Derbyshire	Calcareous (Carboniferous limestone)	
Foster's Green Meadows	Three Counties	Neutral (MG5)	
Gowk Bank	Cumbria	Neutral (MG3)	
Hambledon Hill	Dorset	Calcareous (Chalk)	
Hardington Moors	Somerset & Avon	Neutral (MG5)	
High Leys	Cumbria	Neutral and wet neutral	
Hog Cliff	Dorset	Calcareous (Chalk)	
Kingley Vale	Sussex & Surrey	Calcareous (Chalk)	
Knocking Hoe	Beds, Cambs & Northants	Calcareous (Chalk)	
Lewes Downs	Sussex & Surrey	Calcareous (Chalk)	
Lower Derwent Valley	North & East Yorks	Neutral + Wet Neutral	SPA/Ramsar site. Breeding and wintering waders and wildfowl

NNR Name[1]	Local Team	Grassland Type[2]	Other Comments
Lullington Heath	Sussex & Surrey	Calcareous (Chalk)	Includes areas of "chalk heath"
Martin Down	Hants & IoW	Calcareous (Chalk)	Includes areas of "chalk heath"
Mottey Meadows	West Midlands	Neutral and wet neutral (MG4/MG5)	
Muston Meadows	East Midlands	Neutral (MG5)	
North Meadow, Cricklade	Wiltshire	Wet neutral (MG4)	
Old Winchester Hill	Hants & IoW	Calcareous (Chalk)	
Parsonage Down	Wiltshire	Calcareous (Chalk)	
Pewsey Down	Wiltshire	Calcareous (Chalk)	
Prescombe Down	Wiltshire	Calcareous (Chalk)	
Rodney Stoke	Somerset & Avon	Calcareous (Carboniferous limestone)	
Sandy Beck Meadow	Cumbria	Neutral (MG3)	
Skoska Wood	North & East Yorks	Calcareous (Carboniferous limestone)	
Somerset Levels, including Shapwick Heath	Somerset & Avon	Neutral + Wet neutral grassland	pSPA/Ramsar site. Breeding and wintering wildfowl and waders
The Flits	Three Counties	Neutral/Wet Neutral	
Thetford Heath	Suffolk	Calcareous (CG7), Acid	Forms part of the Breckland Heaths pSPA site
Thrislington Plantation	Northumbria	Calcareous (Magnesian limestone) (CG8)	
Upper Teesdale (part)	Northumbria	Neutral (MG3)	Forms part of North Pennine Moors pSPA/Ramsar site
Upwood Meadows	Beds, Cambs & Northants	Neutral (MG5)	
Walberswick	Suffolk	Acid (U1)	
Weeting Heath	Norfolk	Acid (U1), Calcareous (Chalk)	Forms part of Breckland Heaths pSPA site
Westleton Heath	Suffolk	Acid (U1)	
Wye & Crundale Downs	Kent	Calcareous (Chalk)	
Wylye Down	Wiltshire	Calcareous (Chalk)	
Wyre Forest	Three Counties	Neutral (MG5)	
TOTAL NO OF SITES = 49			

[1]Only those NNRs which have been formally declared are listed. Sites listed where a principal interest is unimproved grassland.
[2]Other habitats which form important components on some sites (eg fen meadows, woodland etc) are not detailed.

7.2.2 Nature Conservation Review Sites

From the most recent list of NCR sites (September 1994), inspection of NCR descriptions or SSSI citations was used by the authors to establish the number of NCR sites that appeared to have a significant component of unimproved lowland grassland. A total of 131 were found and a breakdown by grassland type is given in Table 12. The full list is given in Appendix 1. It includes fen meadows which are not included in the SSSI and NNR lists and comparative counts.

Table 12 Grassland types represented on Nature Conservation Review sites

Calcareous	Chalk	62
	Jurassic Limestone	13
	Carboniferous Limestone	15
	Magnesian Limestone	2
	Devonian Limestone	1
	TOTAL	93
Neutral		25
Wet Neutral		15
Acidic		14
Calaminarian (Metallophyte grassland)		3
Note: There are 131 sites in total, some sites have more than one grassland type		

7.2.3 Sites of Special Scientific Interest

Types of grassland

In November and December 1992, the authors carried out an exercise to estimate the number and distribution of grassland SSSIs in England from the national set of SSSI citations held at Peterborough. The citations provide the only comprehensive, readily available information as COREDATA habitat information is incomplete. A site was included on the list of grassland SSSIs if (a) grassland habitat was a principal reason for notification as SSSI, and (b) 'lowland' grassland was present (ie the site was usually less than 350 m altitude, the site was not unenclosed hill grazing land or the grassland could be ascribed to a 'lowland' NVC type (see Table 1)). Sites were classified according to broad grassland type present; a summary of and the results is given in Table 13.

When using the results it should be noted that:

i. The exercise was intended to give a rapid estimate of the number and distribution of grassland SSSIs rather than a definitive categorisation of individual sites. The list can no doubt be refined as more information becomes available.

ii. The categorisation of wet grassland was problematic and the figures should be used with caution.

Table 13 Grassland types represented in the SSSI series in England as at December 1992

Total number of biological SSSIs: 2909
Total number of sites with grassland interest: 1322 (45%)

Type	Number of Sites	% of total[1] number of grassland sites	% of sites occurring with other grassland types	% of sites occurring with other habitats
Acid grassland	235	18	62	80
Calcareous grassland	593	45	28	54
Neutral grassland	550	42	58	52
Wet neutral grassland	374	28	72	62
Wet neutral grassland/fen	123	9	87	86

[1]Note: Sites can contain more than one type of grassland

Definitions:

Acid: Dry acid grassland (NVC types U1-U3 and lowland U4, where identifiable).

Calcareous: Dry calcareous grassland (NVC types CG1-CG8 and lowland CG9, where identifiable).

Neutral: Dry neutral grassland (NVC types MG2, 3, 5, where identifiable).

Wet neutral: Wet neutral grassland (NVC types MG4, 8, 11, 13 where identifiable). Interpretation of citation sometimes difficult.

Wet neutral/fen: Sites where type not clear, could be neutral wet grassland or mire/swamp types or transition between neutral wet grassland and mire/swamp.

Note:

1. Maritime sites: Where grassland occurred in a site that had one edge along a sea cliff, judgements where based on whether the description of the grassland habitats made any mention of maritime species. If these were present or if the NVC community described was clearly MC (maritime cliff) then the site was excluded from the list.

2. Grass heath was treated as acid grassland, unless clearly calcareous in type, eg in some Breckland sites.

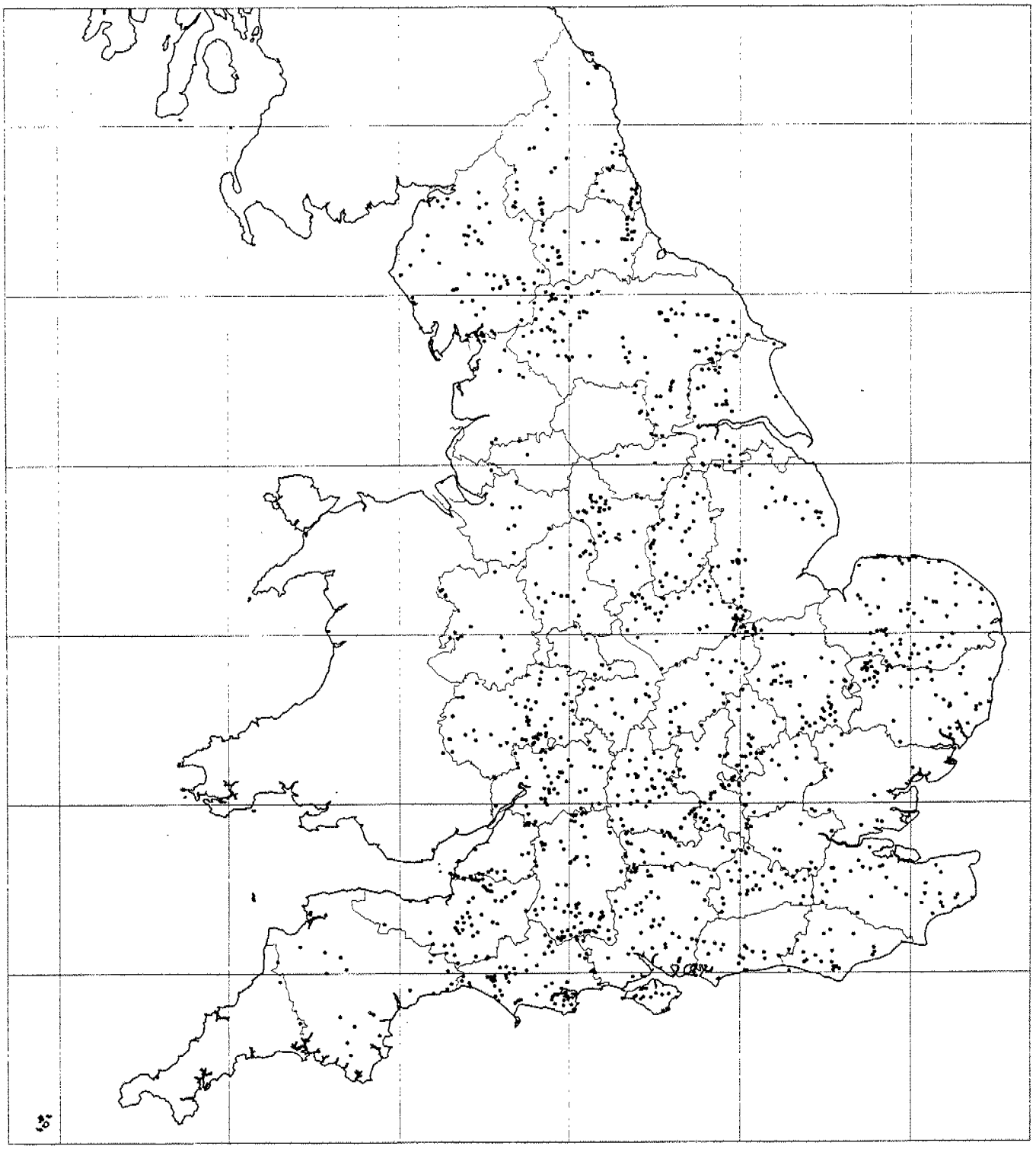
3. Damp acid grasslands were treated as "acid" unless they were clearly mire types, eg *Molinia* dominated grasslands which were excluded. These were almost always obvious from the description and very few 'damp acid' grasslands were recorded under acid grassland

4. Grasslands on igneous intrusions (primarily Whin Sill) were identified as acid and/or calcareous using Phase 2 survey information where available.

5. Grassland described as "additional habitat" was generally ignored, eg most woodland rides unless the citation indicated that it was a principal reason for the site's status as an SSSI.

Distribution of grassland SSSIs

The distributions of these grassland SSSIs are shown in Figures 1 to 5. Broad patterns are obvious, especially in Figure 3 where most calcareous grassland sites clearly relate to calcareous rock outcrops. Acid grasslands are also clustered, particularly in the heathland areas of the Breck, Surrey and Dorset. As might be expected, neutral grasslands are more widely scattered, as suitable soils exist over much of England. However, there are still some concentrations, for instance in the Pennine Dales, Hereford and Worcester and river valleys in Oxfordshire and Wiltshire.

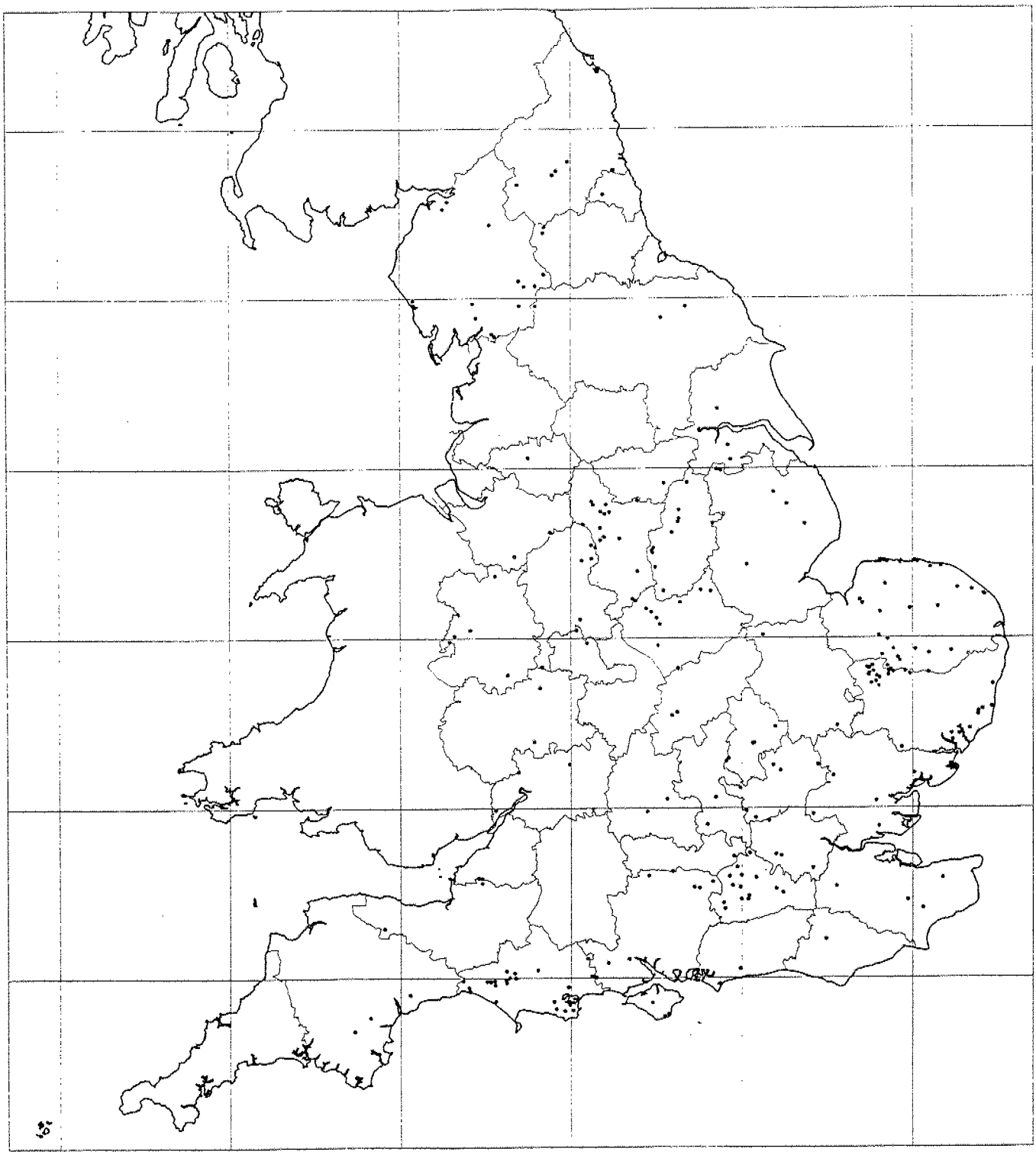


Key

— County boundary

• SSSI

Figure 1. Distribution of grassland SSSIs (all types) in England

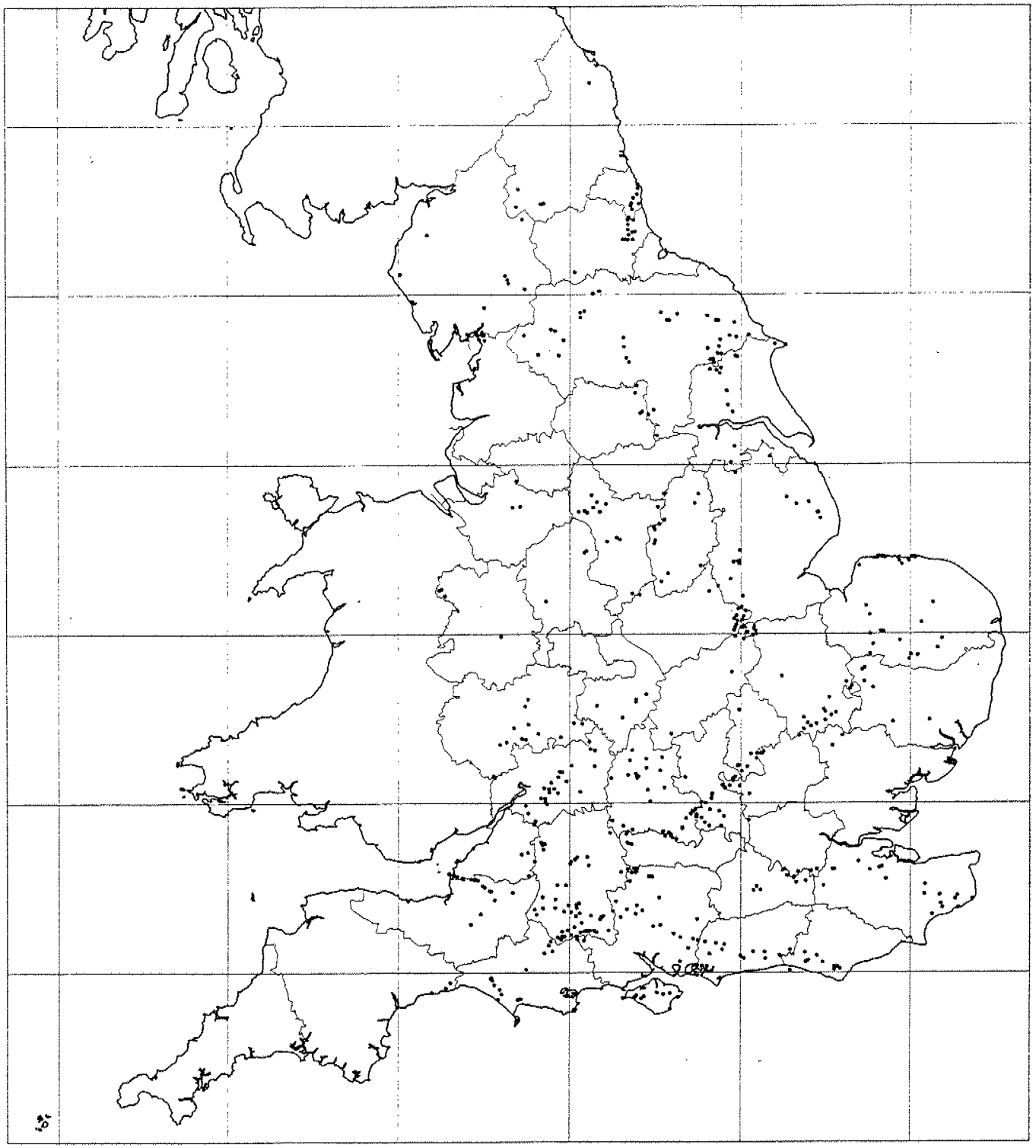


Key

— County boundary

• SSSI

Figure 2 Distribution of acid grassland SSSIs in England

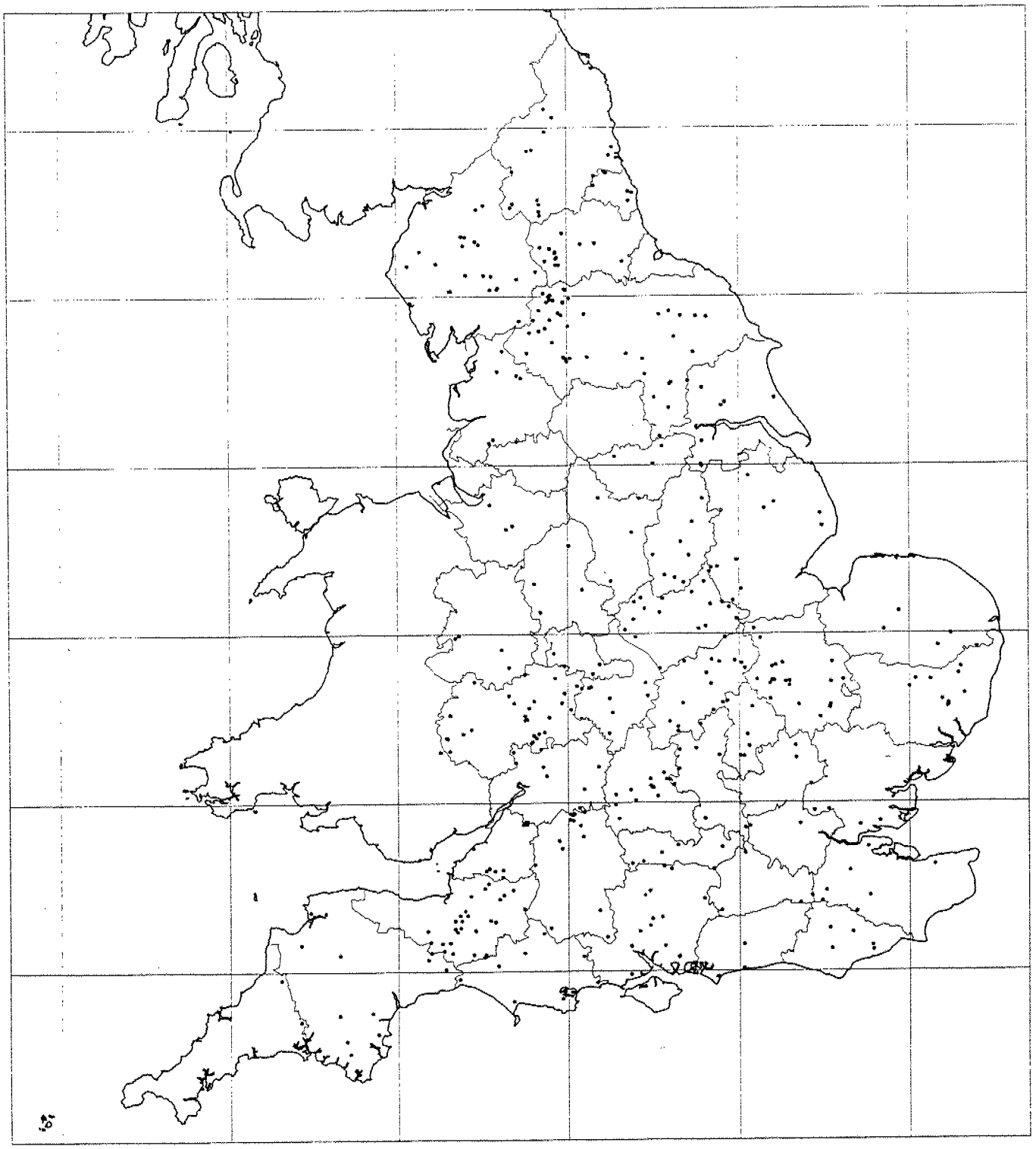


Key

— County boundary

• SSSI

Figure 3 Distribution of calcareous grassland SSSIs in England

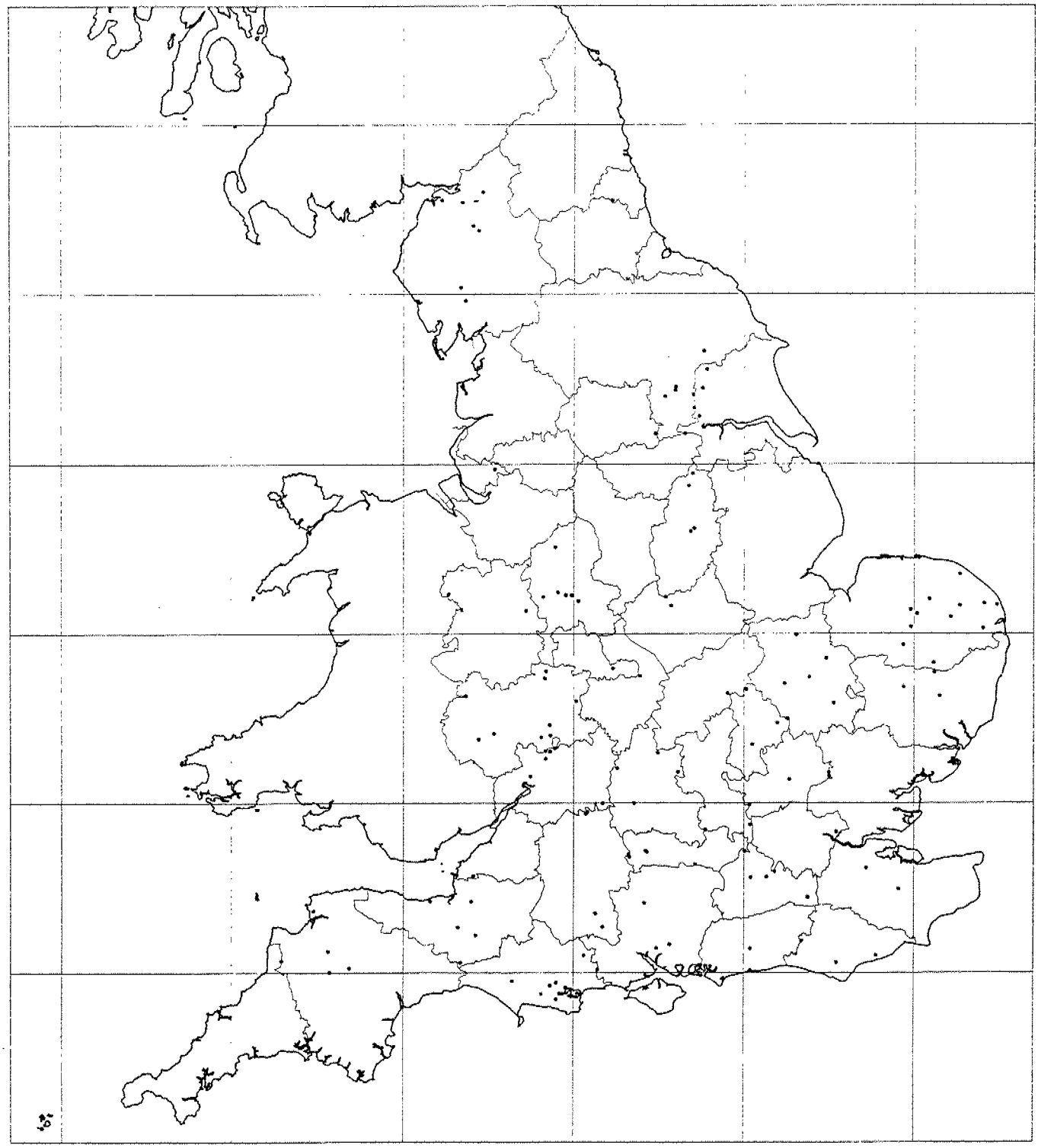


Key

— County boundary

• SSSI

Figure 4 Distribution of neutral grassland SSSIs in England



Key

— County boundary

• SSSI

Figure 5 Distribution of wet neutral grassland SSSIs in England