CG5
Bromus erectus-Brachypodium pinnatum grassland

Synonymy
Inferior Oolite grassland Tansley 1939; Unaltered Oolitic Limestone grassland Hepburn 1942; *Cirsio-Brometum typicum* and *astragaletosum* Shimwell 1968*a*; Cotswold Limestone grassland Wells & Morris 1970; *Pulsatilla vulgaris* stands Wells & Barling 1971 *p.p.*; Jurassic Limestone grassland Ratcliffe 1977 *p.p.*

Constant species
Brachypodium pinnatum, *Briza media*, *Bromus erectus*, *Carex flacca*, *Cirsium acaule*, *Festuca ovina*, *Helianthemum nummularium*, *Hieracium pilosella*, *Leontodon hispidus*, *Lotus corniculatus*, *Sanguisorba minor*, *Thymus praecox*.

Rare species
Aceras anthropophorum, *Astragalus danicus*, *Carex ericetorum*, *Galium pumilum*, *Herminium monorchis*, *Phyteuma tenerum*, *Polygala calcarea*, *Pulsatilla vulgaris*, *Thesium humifusum*, *Thymus pulegioides*.

Physiognomy
This community comprises open or closed, sometimes rank and tussocky, swards in which complementary proportions of *Bromus erectus* and *Brachypodium pinnatum* are dominant. In some cases, small tussocks of both species occur together in quite intimate mixtures; in others, more extensive patches of each make up more coarse-grained mosaics, as at Barnack in Northamptonshire, where *Bromus* tends to be more prominent over the 'hills' of spoil and *Brachypodium* in the 'holes' between (e.g. Hepburn 1942). *Carex flacca* and the finer grasses *Festuca ovina* and *Briza media* are constant and each can be locally abundant. Together, and frequently with some smaller amounts of *Avenula pratensis* and *Koeleria macrantha*, they often make up the bulk of the remainder of the sward, giving a generally grassy feel to the vegetation.

Some dicotyledons are, however, a constant feature of the community and may be locally abundant. The chamaephytes *Hieracium pilosella*, *Thymus praecox* and *Helianthemum nummularium* may all be patchily prominent, together with sprawls of *Lotus corniculatus* and, less commonly, *Anthyllis vulneraria*, *Hippocrepis comosa* and *Asperula cynanchica*. *Sanguisorba minor*, *Cirsium acaule* and *Leontodon hispidus* are constant and their rosettes occasionally abundant; other frequent hemicryptophytes are *Scabiosa columbaria*, *Pimpinella saxifraga* and *Campanula rotundifolia*.

Although the distribution of the community is very much towards the limit of the ranges of many of the characteristic Continental rarities of British calcicolous grasslands, certain of these species do occur here. The most frequent is *Pulsatilla vulgaris* which now survives in this country mostly in these ranker swards and in similar vegetation dominated by *B. erectus* (Wells 1968, Wells & Barling 1971). The largest British colony of this species, comprising some 30,000 individuals, occurs in a stand of this community at Barnsley Warren in Gloucestershire (Wells & Morris 1970, Ratcliffe 1977). Other rarities recorded here include the robust orchids *Aceras anthropophorum* and *Herminium monorchis*, *Galium pumilum*, *Polygala calcarea*, *Phyteuma tenerum* and the Oceanic West European *Thesium humifusum*.

Towards the north-eastern edge of the range of the community, two Continental Northern species also occur in this vegetation: *Carex ericetorum*, on the Magnesian Limestone of Derbyshire and Yorkshire and *Astragalus danicus*, largely on the Oolite of Lincolnshire and Northamptonshire. From stands where the distribution of the latter species overlapped with occurrences of *Pulsatilla vulgaris* and *Aceras anthropophorum* (and of the more widespread *Genista tinctoria* and *Serratula tinctoria*), Shimwell (1968*a*, 1971*b*) characterised a distinct type of *Bromus-Brachypodium* grassland, his *Cirsio-Brometum astragaletosum*. Although it is certainly the case that this combination of species is very much associated with *Bromus-Brachypodium* swards over Oolite rather than *Bromus* grasslands over Chalk (Wells & Barling 1971), their coincidental occurrence within

this community is less well marked in these data than in Shimwell's.

The swards here are sometimes quite short or open, at least in patches, and bryophytes are frequent and sometimes abundant. The most common species are *Pseudoscleropodium purum*, *Ctenidium molluscum*, *Fissidens cristatus*, *Campylium chrysophyllum*, *Weissia* cf. *microstoma* and *Homalothecium lutescens*.

Sub-communities

Typical sub-community. The generally closed swards here preserve the floristic features of the community as a whole with no differential or preferential species.

***Hieracium* spp. sub-community.** The vegetation of this sub-community is somewhat more open than in the above and the most obvious distinguishing feature is the high frequency of pauciennials on patches of bare ground: *Linum catharticum*, *Blackstonia perfoliata*, *Euphrasia officinalis* agg., *Centaurium erythraea* and *Carlina vulgaris*. Frequently conspicuous, too, are various Hieracia, mostly of the section Vulgata. These were not identified to individual taxa but, in a study of more open vegetation in the abandoned quarries of which this sub-community is particularly characteristic, Davis (1977) recorded most frequently the introduced *H. strumosum* and *H. maculatum* and the native *H. vulgatum*. Dandelions occur occasionally, sometimes in abundance, and the presence of saplings of *Fraxinus excelsior*, *Quercus robur* (and, at Barnack, *Q. cerris*: Ratcliffe 1977) and *Salix caprea* adds to the scruffy appearance of the vegetation. Individual stands often have a distinctive character which is sometimes enhanced by an abundance of orchids, most notably *Anacamptis pyramidalis* and, less frequently, *Ophrys apifera* and *Coeloglossum viride*.

Habitat

The community typically occurs in those areas where climatic and edaphic conditions suitable for the vigorous growth of both *Bromus erectus* and *Brachypodium pinnatum* coincide with an absence or reduction of grazing pressure. It is thus most characteristic of calcareous, base-rich soils along the north-western fringe of the southern lowland limestones where there is sufficient amelioration of more extreme Continental conditions to favour *B. pinnatum*, yet not such a cool, damp climate as to exclude *Bromus*.

For the most part, therefore, this vegetation occurs over the Oolite (with a narrow extension northwards on to Magnesian Limestone), but it is hard to tell whether this is more than a geological coincidence. Certainly, the scarp soils in this region tend to be somewhat different to those on limestone slopes further south, being generally of the brown rendzina or brown calcareous earth type with some horizon differentiation and sometimes a loss of calcium carbonate above. Though usually free of contamination with superficials, they are also of more loamy texture and, over the Oolite at least, distinctly brashy below (e.g. Avery 1955, Holliday & Townsend 1959, Shimwell 1968*a*, 1971*b*, Findlay 1976, *Soil Survey* 1983). The disturbed soils which develop over Oolite spoil in abandoned dip-slope quarries preserve the same essential features (e.g. Hepburn 1942, 1955, Shimwell 1968*a*, 1971*b*). Such soils are clearly sufficiently calcareous to support the essentially calcicolous flora of the southern limestone grasslands but there may be particular characteristics of their nutrient and water regimes which favour the vigorous growth of both the tussock grasses and the development of this kind of vegetation.

There is little doubt, however, that it is the lack of intensive grazing that is in part responsible for the prominence of *Bromus* and *Brachypodium* in these swards. Though the Oolite grasslands were the mainstay of the thriving medieval wool economy of the Cotswolds, pastoral agriculture has suffered a general decline there as over so many lowland limestone areas. Moreover, many of the stands of the community occur on commons where those with grazing rights now have little interest in exercising them and where such stock as there are, are exposed to dangers from traffic along unfenced roads and to increasing recreation pressures (e.g. Hoskins & Stamp 1963, Denman *et al.* 1967). Where these swards are still grazed, it is more often cattle than sheep that are pastured now.

Burning, too, seems to have had an important influence on the floristics and physiognomy of this vegetation. Though practised sporadically on ranker swards all over the southern limestones, this kind of treatment has, over parts of the Oolite, become an ingrained tradition (e.g. Wells & Morris 1970, Duffey *et al.* 1974). The origins of the annual February burn or 'swale' are obscure but it is very likely that a balanced combination of burning, with its destruction of litter and opening up of the sward, and some grazing, has helped to both renew the vigour of the tussock grasses and yet keep them sufficiently in check to maintain a moderately rich associated flora. It is perhaps the care and regularity with which this treatment has been applied which accounts for the apparant paradox that these swards with both *Bromus* and *Brachypodium* are often much richer than grasslands in other areas where just one or the other of these species dominates. Even outside the Cotswold commons, these Oolite grasslands have sometimes been subject to burning, though this may have been more sporadic (as at Barnack at the time of Hepburn's (1942) survey when there was an occasional autumn burn) or the accidental result of recreational activity. Such studies as have been made of the

effects of fire on swards dominated by these tussock grasses make it abundantly clear that judicious control is necessary if the desired results are to be obtained.

The occurrence of much of this vegetation on commons and other open spaces close to centres which have become important for tourism and retirement means that it is often subject to heavy trampling pressure, especially around those spots, as along the Cotswold scarp, which offer attractive views. Moderate trampling may help prevent the spread of the tussock grasses and, to *Pulsatilla vulgaris*, may even be beneficial (Wells 1968, Wells & Barling 1971).

The floristic differences between the two sub-communities can probably be understood in terms of the age of the swards and the extent of any continuing substrate instability and disturbance. The Typical sub-community is characteristically a vegetation type of natural slopes which, though they may be occasionally disrupted by trampling and poaching, have a generally graded, stable profile. The *Hieracium* sub-community, by contrast, is very much associated with disturbed sites such as road verges and quarries which, though often long-abandoned, have irregular heaps of spoil and rock faces that are still subject to natural erosion or prone to gross movement when interfered with.

Zonation and succession

As with other lowland calcicolous grasslands, stands of the community are now very much restricted to slopes or abandoned quarries isolated within landscapes devoted largely to arable farming. On such sites, zonations are usually a reflection of seral progressions related to the intensity of grazing and/or burning. Over scarp slopes, the community occurs in patchworks with *Festuca-Avenula* grassland (usually of restricted occurrence over the Oolite), other rank swards dominated by *B. erectus* or *B. pinnatum* alone, scrub and woodland. In old quarries, zonations may involve more open weed vegetation on young or recently-disturbed spoil and rock faces.

The details of seral changes involving this vegetation type have never been studied. It seems likely that, in quarries, the *Hieracium* sub-community could progress to the Typical sub-community with colonisation of exposed surfaces and that either sub-community, perhaps especially the more open *Hieracium* vegetation, is prone to invasion by shrubs and trees. Continued burning and grazing can, however, maintain the community as a plagioclimax and some of the more extensive stands occur on commons where public demands and/or ownership by conservation agencies provide incentives to their continued maintenance as open spaces.

Distribution

The *Bromus-Brachypodium* grassland is very much centred on the Oolite of the Cotswold scarp and Northamptonshire/Lincolnshire with more isolated occurrences on the southern Chalk and the Magnesian Limestone of Derbyshire and West Yorkshire.

Affinities

The calcicolous grassland of the Oolite has long been recognised as distinct in some way (Tansley 1939) but, though its essential character has been described in Hepburn's account of quarry vegetation (1942, 1955), in part of Shimwell's *Cirsio-Brometum* (1968*a*, 1971*b*) and in accounts of some of the *Pulsatilla vulgaris* vegetation (Wells 1968, Wells & Barling 1971), its diversity and relationships to other communities have remained unclear. In this scheme, it is characterised as a particular kind of Mesobromion community in which certain coarser grasses have attained prominence in response to a rather distinct combination of environmental conditions. The presence of both *Bromus* and *Brachypodium* and a fairly wide range of calcicolous associates mean that this vegetation, despite its restricted occurrence in Britain, is closer to some Continental Mesobromion swards than either the *Festuca-Avenula* grassland or those communities in which either *Bromus* or *Brachypodium* are present alone (e.g. the *Gentiano-Koelerietum* Knapp 1942 *ex* Bornkamm 1960: Westhoff & den Held 1969, Oberdorfer 1978, Ellenberg 1978).

Floristic table CG5

	a	b	5
Bromus erectus	V (2–9)	V (2–8)	V (2–9)
Brachypodium pinnatum	V (2–8)	V (2–9)	V (2–9)
Carex flacca	V (1–4)	V (2–6)	V (1–6)
Sanguisorba minor	V (2–7)	IV (1–5)	IV (1–7)
Lotus corniculatus	IV (1–5)	V (1–6)	IV (1–6)
Cirsium acaule	IV (1–5)	V (1–8)	IV (1–8)
Briza media	IV (1–5)	V (1–8)	IV (1–8)

Hieracium pilosella	IV (1–4)	IV (1–5)	IV (1–5)
Festuca ovina	IV (1–8)	IV (1–7)	IV (1–8)
Helianthemum nummularium	V (1–5)	III (1–5)	IV (1–5)
Leontodon hispidus	III (1–5)	IV (1–7)	IV (1–7)
Thymus praecox	III (1–5)	IV (1–4)	IV (1–5)
Linum catharticum	II (1–3)	IV (1–4)	III (1–4)
Hieracium sect. *Vulgata*	I (1–3)	IV (1–3)	III (1–3)
Anacamptis pyramidalis	I (1–3)	IV (1–3)	III (1–3)
Blackstonia perfoliata	I (1–3)	III (1–3)	II (1–3)
Euphrasia officinalis agg.	I (1–3)	II (1–3)	II (1–3)
Taraxacum officinale agg.	I (1–2)	II (1–3)	II (1–3)
Centaurium erythraea	I (1–3)	II (1–3)	II (1–3)
Carlina vulgaris	I (1–2)	II (1–2)	I (1–2)
Fraxinus excelsior sapling	I (1)	II (1–3)	I (1–3)
Cerastium fontanum	I (1–3)	II (1–3)	I (1–3)
Quercus robur sapling		I (1–2)	I (1–2)
Salix caprea sapling		I (1–4)	I (1–4)
Plantago major		I (1–3)	I (1–3)
Avenula pratensis	III (1–4)	III (1–4)	III (1–4)
Pseudoscleropodium purum	III (1–8)	II (1–4)	III (1–8)
Pimpinella saxifraga	II (1–3)	III (1–3)	III (1–3)
Scabiosa columbaria	II (1–4)	III (1–5)	III (1–5)
Viola hirta	II (1–3)	III (1–5)	III (1–5)
Carex caryophyllea	II (1–4)	III (1–4)	III (1–4)
Campanula rotundifolia	II (1–4)	III (1–3)	III (1–4)
Ctenidium molluscum	II (1–5)	III (1–4)	III (1–4)
Koeleria macrantha	III (1–3)	II (1–3)	II (1–3)
Anthyllis vulneraria	II (1–6)	III (1–4)	II (1–6)
Plantago lanceolata	II (1–4)	II (1–3)	II (1–4)
Fissidens cristatus	II (1–4)	II (1–6)	II (1–6)
Campylium chrysophyllum	II (1–5)	II (1–5)	II (1–5)
Prunella vulgaris	II (1–4)	II (1–3)	II (1–4)
Pulsatilla vulgaris	II (1–4)	II (1–2)	II (1–4)
Asperula cynanchica	II (1–3)	II (1–4)	II (1–4)
Galium verum	II (1–4)	I (1–3)	I (1–4)
Centaurea nigra	II (1–3)	I (1–4)	I (1–4)
Filipendula vulgaris	II (1–3)	I (1–3)	I (1–3)
Weissia cf. *microstoma*	I (1–3)	II (1–3)	I (1–3)
Hippocrepis comosa	I (1–4)	II (1–4)	I (1–4)
Plantago media	I (1–4)	II (1–3)	I (1–4)
Ranunculus bulbosus	I (1–2)	I (1–4)	I (1–4)
Homalothecium lutescens	I (1–2)	I (1–4)	I (1–4)
Polygala calcarea	I (1–4)	I (1–3)	I (1–4)
Knautia arvensis	I (1–3)	I (1–3)	I (1–3)
Poa pratensis	I (1–3)	I (1–4)	I (1–4)
Festuca rubra	I (2–7)	I (2–5)	I (2–7)
Trifolium pratense	I (1–5)	I (1–3)	I (1–5)
Tragopogon pratensis	I (1)	I (1–3)	I (1–3)
Centaurea scabiosa	I (1–3)	I (1–2)	I (1–3)
Leucanthemum vulgare	I (1–3)	I (1–6)	I (1–6)

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Floristic table CG5 (*cont.*)

	a	b	5
Gentianella amarella	I (1–3)	I (1–2)	I (1–3)
Medicago lupulina	I (1–5)	I (1–4)	I (1–5)
Ulex europaeus	I (1–3)	I (1–3)	I (1–3)
Dicranum scoparium	I (1–3)	I (1–4)	I (1–4)
Bellis perennis	I (1–4)	I (1–3)	I (1–4)
Inula conyza	I (1–3)	I (1–3)	I (1–3)
Anthoxanthum odoratum	I (1–3)	I (1–3)	I (1–3)
Dactylis glomerata	I (1–4)	I (2–5)	I (1–5)
Polygala vulgaris	I (3–4)	I (1–2)	I (1–4)
Rhinanthus minor	I (3–6)	I (3–7)	I (3–7)
Sorbus aria sapling	I (1–3)	I (1–2)	I (1–3)
Crataegus monogyna sapling	I (1–3)	I (1–2)	I (1–3)
Galium mollugo	I (2–4)	I (1–3)	I (1–4)
Succisa pratensis	I (1–3)	I (1–3)	I (1–3)
Astragalus danicus	I (1–3)	I (1–3)	I (1–3)
Ononis repens	I (1–4)	I (1–2)	I (1–4)
Thesium humifusum	I (1–3)	I (2–4)	I (1–4)
Picris hieracioides	I (2)	I (1–3)	I (1–3)
Genista tinctoria	I (1)	I (1–3)	I (1–3)
Acer pseudoplatanus sapling	I (1)	I (1–3)	I (1–3)
Cirsium eriophorum	I (1)	I (1–3)	I (1–3)
Avenula pubescens	I (2–3)	I (1–4)	I (1–4)
Primula veris	I (1–4)	I (1–2)	I (1–4)
Sambucus nigra sapling	I (1)	I (1–4)	I (1–4)
Trisetum flavescens	I (1–4)	I (3–5)	I (1–5)
Serratula tinctoria	I (1)	I (1–3)	I (1–3)
Campanula glomerata	I (1–3)	I (1–3)	I (1–3)
Clematis vitalba	I (1)	I (1–4)	I (1–4)
Fagus sylvatica sapling	I (1)	I (1–4)	I (1–4)
Senecio jacobaea	I (1–3)	I (1)	I (1–3)
Vicia cracca	I (1)	I (1–3)	I (1–3)
Holcus lanatus	I (2–4)	I (1–3)	I (1–4)
Ononis spinosa	I (1)	I (1–4)	I (1–4)
Danthonia decumbens	I (3)	I (1–3)	I (1–3)
Ophrys apifera	I (1–3)	I (1–3)	I (1–3)
Achillea millefolium	I (1)	I (1–2)	I (1–2)
Number of samples	55	72	127
Number of species/sample	24 (9–40)	26 (15–43)	26 (9–43)

a Typical sub-community
b *Hieracium* spp. sub-community
5 *Bromus erectus-Brachypodium pinnatum* grassland (total)

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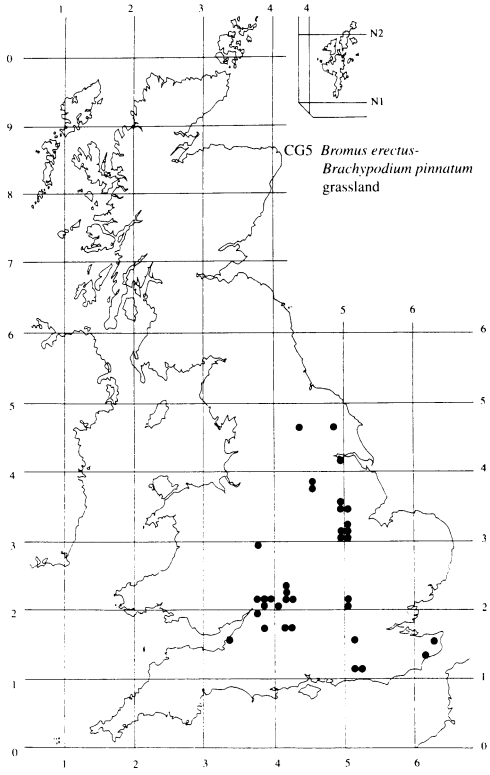

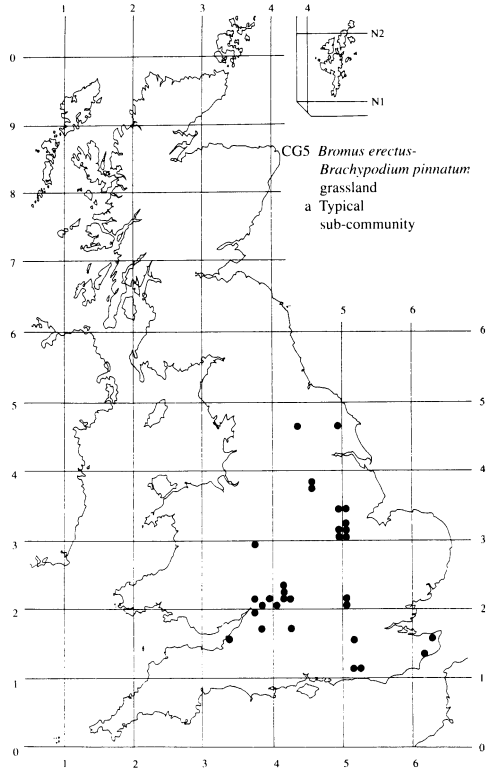

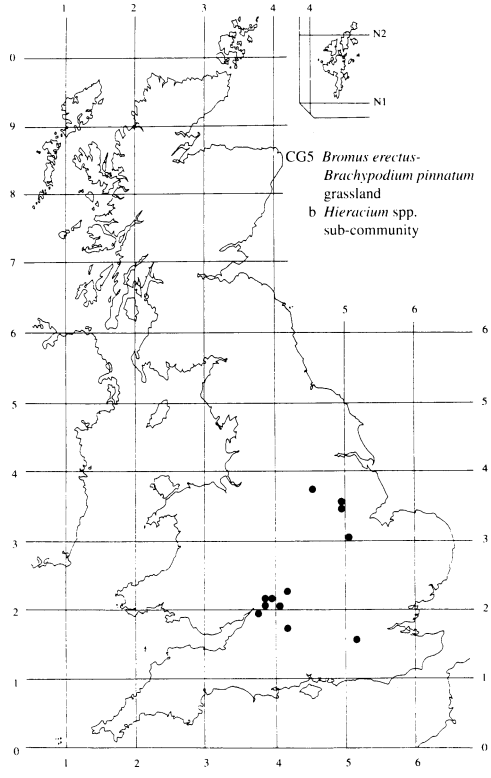

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