The distribution, ecology, history and status of *Gastridium ventricosum* (Gouan) Schinz & Thell. in the British Isles

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ABSTRACT

Gastridium ventricosum (Gouan) Schinz & Thell. (Nit-grass) is a native of south-western England and occurs as a casual in the Channel Islands. From herbaria and manuscript records, it appears that it has been recorded from 34 vice-counties in Britain over the past 200 years. Few records have been reported since the publication of the *Atlas of the British Flora* (Perring & Walters 1962). At the request of the Nature Conservancy Council, a field survey of its current status was carried out in July and August 1980, 1981 and 1982. Habitat descriptions, plant associates, estimated populations, soil textures and conservation status were recorded.

INTRODUCTION

Perring & Walters (1962) give dots for records of *Gastridium ventricosum* in 107 10 km squares for pre-1930 and 18 post-1930 records for England and Wales and two in the Channel Islands. With three exceptions, all records were south of the Wash and 98% were south of the line between the River Severn and the River Blackwater. Hubbard (1968) records that it is "probably native in short grassland on limestone and chalk: elsewhere a weed of arable land, occasionally locally abundant in corn fields on light or heavy soils". Perring & Farrell (1977) report "At one time it was recorded from about 28 vice-counties extending as far north as Yorkshire, though it was undoubtedly only casual in many inland stations. Since 1960 it has only been reported from six localities in Cornwall, Dorset, Somerset, Hampshire, Gloucestershire and Glamorgan, and from Guernsey and Sark".

The current native sites of *G. ventricosum* are found in short virgin grassland on limestone or soils derived from limestone. It can no longer be regarded as a weed of arable land. As such, in 1980 it was only known in a small arable area of S. Hants., v.c. 11 (Trist 1983). Considering its isolation in the native sites, it is unlikely that we shall see many more casual plants.

METHODS

Inquiries on the location of known sites were made from members and county recorders of the B.S.B.I. Old records in herbaria were examined, together with numerous county Floras and other manuscripts. Many arable sites which have been recorded in the past 50 years in southern England have been recently surveyed. The last known records from vice-counties have been listed. Soil samples were taken within and without the area of $2m^2$ quadrats to a depth of c. 10 cm. For pH determination, dry soil was treated with a soil indicator containing bromothymol blue and methyl red. The method does not match the accuracy of the use of the glass electrode but it does give an indication of a pH range, which is given in the text.

DISTRIBUTION

Perring & Walters (1962) show that *G. ventricosum* formerly had a wide distribution over the southern half of Britain. The greater majority of these records were referable to arable colonists and casuals. The author has only been able to trace 22 records since 1950, of which 50% were casuals or colonists.

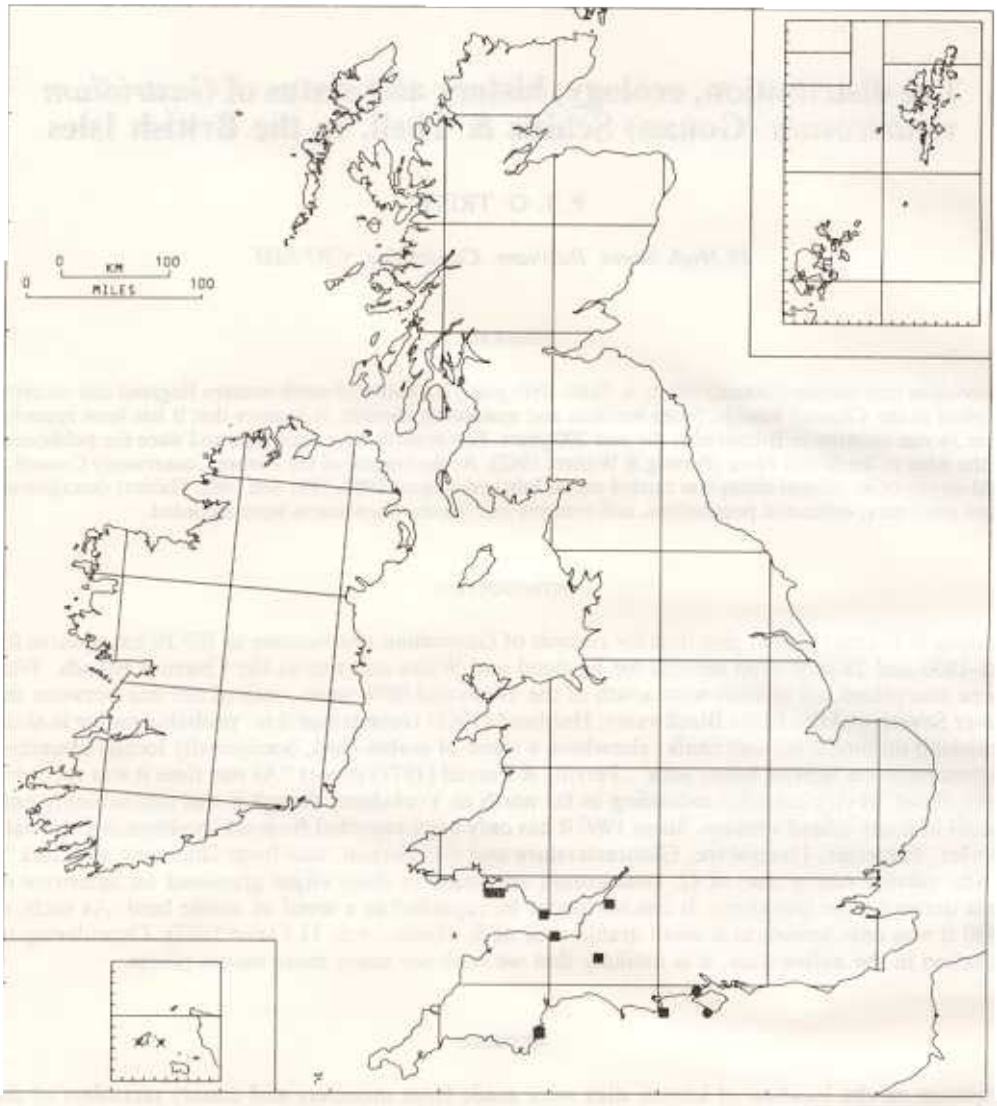

FIGURE 1. Distribution of *Gastridium ventricosum* in the British Isles, based on the author's 1980–82 survey ■ native sites; circles denote arable colonists and casuals.

The field surveys of 1980–82 have revealed two facets in the history of the distribution of this grass. Firstly, its former status as an arable colonist is almost lost and will inevitably disappear. Secondly, there are a number of native sites on coastal downland, which have previously only been recorded on one or two occasions and some which have not been previously recorded. The records of 1982, compared with those of 1960, are predominantly native.

Recent fieldwork reveals that *G. ventricosum* occurs in only nine vice-counties, in 11 10-km squares with 36 sites in 24 1-km squares. In southern Wales there are five sites in the Gower Peninsula and one near Cardiff. In England there is one site in North Somerset, three in South Somerset, one in South Devon, ten in Dorset, two in West Gloucestershire and one in the Isle of Wight. In South Hampshire, there are five sites of arable colonists. In the Channel Islands there

TABLE 1. *GASTRIDIUM VENTRICOSUM* LOCATIONS

Vice-County	Location	Grid (10 km)	Aspect	Slope	Distance from sea km	Altitude m	Habitat*
3	South Devon	20/9.5.	SE	30°	0·10	60	G
[illegible]	South Somerset A	31/0.4.	S	20	0·5	60	G
	South Somerset B	31/0.4.	SE	20	0·8	45	G
	South Somerset C	31/0.4.	S	20	0·8	30	G
	North Somerset	31/4.2.	SSW	20	20·0	50	G
	Dorset A	40/0.7.	S	10	0·25	60	G
	Dorset B	40/0.7.	S	10	0·25	60	G
	Dorset C	40/0.7.	SSW	40–60	0·19	30	G
	Dorset D	40/0.7.	S	30–55	0·19	30	G
	Dorset E	40/0.7.	S	25–30	0·25	83	G
	Dorset F	40/0.7.	S	30	0·25	170	G
	Dorset G	40/0.7.	S	10	0·03	100	G
	Dorset H	40/0.7.	S	5	0·20	100	G
	Dorset I	40/0.7.	S	30	0·20	100	G
	Dorset J	40/0.7.	S	20	0·20	100	G
10	Isle of Wight	40/9.7.	S		0·003	5	C
34	Clifton A	31/5.7.	SSE	15–20	8·0	100	C
	Clifton B	31/5.7.	SSW	35–40	8·0	30	C
	Gower A	21/5.8.	SSE	30	0·95	50	G
	Gower B	21/4.8.	SSW	30–35	0·35	30	G
	Gower C	21/4.8.	WSW	20–25	0·09	35	G
	Gower D	21/4.8.	ESE	20	0·10	35	G
	Gower E	21/4.8.	S	15	0·85	40	G
	Nr Bridgend	21/9.6.	S	35–40	0·40	40	G
	Lymington A	40/3.9.	Level arable		0·05	<3	A
	Lymington B	40/3.9.			0·50	<3	A
	Lymington C	40/3.9.			0·50	<3	A
	Lymington D	40/3.9.			0·50	<3	A
	Lymington E	40/3.9.			1·80	<3	A
S	*Sark*						
	La Collenette	WV/4.7.	S		0·92	98	R
	By School	WV/4.7.	S		0·47	100	R
	By Chapel	WV/4.7.	N		0·92	104	R
	Mill Lane	WV/4.7.	W		0·14	94	R
	La Coupée	WV/4.7.	S		0·80	98	R
	Near Mill	WV/4.7.	W		0·70	102	R
	Guernsey						
	Le Douit, St Peter's	WV/3.7.	S		1·00	15	R

* Habitat key: G, Grassland; A, Arable; C, Cliffs; R, Ruderal.

are six sites in Sark and one in Guernsey: these have not been seen by the author but the sites, soil and plant associates indicate that the plants are casuals.

Fig. 1 shows the distribution of *G. ventricosum* in the British Isles plotted from the 1980–82 survey by the author. Table 1 gives the location, aspect and slope of the habitats and the distance from, and the height above, the sea.

PHENOLOGY

G. ventricosum is an annual grass with a life cycle spanning twelve months. It sets seed in September–October and germination takes place in six to eight days. Within 14 days of germination, the single-leaf seedling is 1–1·5 cm long. In the first winter of this work, it was

TABLE 2. *GASTRIDIUM VENTRICOSUM*: SIZE OF PLANTS IN DIFFERENT HABITATS

	Native plants		Arable colonists
	Downland	Rabbit grazed	In wheat
Height, cm	5–50		37–97
Spike length, cm	2·5–8·5		3·5–16·5
Blade length, cm	0·5–6·5		4·5–20·0
Ligule length, mm	0·5–3·2		2·0– 4·2

recognized that seedling development would be subject to climatic conditions of habitat. From November to April 1980–81, a night frost was recorded on 58 occasions at Balsham, Cambridge, of which 21 were in February. In the autumn of 1980, seeds were sown in pots at Balsham and, during the above period, most of the seedlings in pots were either directly killed or unseated by frost: this climate would not have been experienced in a native coastal habitat.

In cultivation, the single leaf growth remained static until late April and remained slow until late in the spring. By mid-May, the characteristic leaf curl developed and in the following three weeks into June there was a gradual acceleration of tillering up to early July, when the spikes broke the sheath. The long period of low temperatures, when a range of 1–10°C of frost was recorded, would have retarded leaf development until late April.

From year to year it appears that spike exsertion may take place any time from mid-June to mid-July. D. E. Coombe (in litt. 1980) reported anthesis from plants in Dorset on 29th June 1952 and, following a mild winter at Balsham in 1983–84, I recorded first spike exsertion on 19th June. Coombe (in litt. 1984) reported spike exsertion in the Avon Gorge on 6th July and, from my survey of 1980–82, I found exsertion from the first to the third week of July. The variation in date of spike exsertion is at least partly due to variation in the date of germination, which is influenced by climatic conditions. Seed sown at Balsham on 24th March 1981 produced plants which exserted spikes after 23rd September. The late period of growth of this grass is marked. In the Gower Peninsula in August 1980, fresh green spikes had developed on new branches of a culm where the primary spike had already gone to seed.

The culm has a final height range according to habitat, and detailed measurements are given in Table 2. In an open association of grasses and herbs, the height varies between 5 and 40 cm; and where an open sward has the occasional low gorse bushes or hawthorn on the perimeter of the *G. ventricosum* colony, the several influences discussed in the notes on native habitats will increase the height to c.50 cm. The height of the arable colonist plants varies between 37 and 97 cm and is often about twice that of the average downland plant and is related to both height and density of the wheat crop; and no doubt there is also some growth response from fertilizers applied to the wheat. Culms are frequently branched even among the smallest plants, but rarely so in the tall arable plants.

ECOLOGY

SOILS AND GEOLOGY OF THE NATIVE SITES

The soils to be described were taken from a depth of 10–15 cm. The Somerset sites are found on isolated deposits derived from the Rhaetic Limestone which is a junction-bed between the Lower Lias and the Keuper Marl; they contain inter-bedded limestone beds and clay or shale. At one, the soil is a chocolate-brown silty clay loam with a low clay fraction. The soil aggregates are up to 2·5 cm across and break readily into fine granules and contain small rounded fragments of hard limestone and red-brown shale. At another, the soil is similar and is a grey-brown silty clay loam with a low clay fraction. The aggregates are up to 1·3 cm across, breaking readily into fine granules and contain fragments of limestone and grey shale. At both sites, the soils contain fibrous roots and are stable to water.

At the Dorset sites the soil is a brown silty clay loam with a low clay fraction and overlies the

Purbeck Limestone. Much of the area has in the past been shallow quarried and outcrops of rock and small stones are much in evidence on the surface. It was difficult to uncover a profile and the interpretation of a halt to an auger may be a large stone or flat stone platform. Much loose rock is encountered and soil depth may vary from 10–60 cm. On a higher part of this area, soil depth is very shallow and most augerings indicate c.10 cm over hard limestones. The silty clay loam samples comprised mainly small aggregates of 1–5 mm of angular fragments with partly rounded edges and angular blocks of 1–2 cm across, together with flat limestone flakes of 3–10 mm. These soils wet slowly, are stable to water and are free-draining.

On the cliffs of the Avon Gorge and on the Gower coast, the soils overlie Carboniferous Limestone. At the former sites, the soil is a red-brown sandy loam with granules up to 2 cm across. At the latter, the texture is more or less similar but three of the sites have more fine sand and one a little more clay. The aggregates break easily, are stoneless and contain many fibrous roots; they wet easily and are stable to water.

The soil descriptions clearly have much similarity and are considered to be from native sites of *G. ventricosum*. No soil at any site showed any evidence of wetness or indication of impeded drainage. The aggregates have a good granular structure, break readily and are friable, making a good open medium for root growth. All sites are on slopes where rainfall has a steady run-off and, with good drainage, less calcium is leached or being made soluble.

The soil samples taken from each site show that, with two exceptions, the pH range of 6·5–7·0 is common to all sites: the exceptions being 7·8 at the Clifton A site and 8·3 at Clifton B (Lovatt 1981). The soil is naturally well drained on all of the native sites and is shallow, c.10 cm, and in the absence of rainfall, soon becomes dry. The breakdown of plant remains is mainly by insects and under dry conditions they become the main agents in preventing acidity. Woodlice were recovered from the Dorset and Somerset samples. Trist (1983) has recorded variation in soil pH tolerance by *G. ventricosum* in arable from 5·8–6·5 and as low as 5·0–5·8 in a local condition in an old stackyard.

THE NATIVE HABITAT

Many records in county Floras erroneously give the impression that *G. ventricosum* is native in arable and woodland margin habitats. In the literature dating back to the 19th century there is scarcely any mention of our native sites or descriptions of our native habitats. Trow (1911), recording for Glamorgan, had no knowledge of native plants in the county which had been collected by *Groves*, 1903 in **BM**, **OXF** and **NMW**, and *Riddelsdell*, 1907 in **BM**. This latter record and that of *Druce*, Monknash Cwm, 1929, together with *White*, Clifton, 1912, all refer to sites as native but give no specific description of the native habitat. It appears that only four of the 22 native sites now known were recorded prior to c.1912 and the only native sites which had any attention were in the Avon Gorge.

There are features of habitat which are common to all native sites of *G. ventricosum* in England and Wales. There is an open sward of short calcareous grasses and herbs. The soil has good drainage properties and the texture only varies slightly from a silty clay loam to a sandy loam. The depth is shallow and frequently overlies rock. The surface, often littered with loose stones, has rock exposure and is open to the wind which contributes to erosion. The sites are on slopes, some of which are steep, or often on the brow of the slope. Such areas have well defined transverse tracks or sections of exposed bands of rock, adjacent to which the ground is bare through climatic and rabbit erosion. The slopes are in general facing south and normally in close proximity to the sea or a tidal estuary.

At most of the Dorset sites, the rabbit is the conservationist and, in its absence, there would be considerable change in the open grassland conditions. *G. ventricosum* occurs in small patches of broken ground between stones and surface rocks where the turf is heavily grazed and eroded by rabbit scratching. It only grows to a height of 1–8 cm between patches of open, non-aggressive grasses. On one Dorset site, a grass enclosure presented a varied habitat: small gorse was dispersed and there was little broken ground. Three small sites of *G. ventricosum* were found where the soil depth was c.10 cm, while over most of the enclosure there was a depth variation up to 60 cm. Gorse was at each site and had been periodically controlled by fire. This retards the gorse in the first year and allows an open area for the autumn germination of *G. ventricosum* which later attains a height of 15–20 cm; but where germination has taken place below the gorse, the seedlings have to compete with the gorse recovery and the light factor gives growth up to 47 cm.

In the Gower Peninsula, a site on a slope overlooking the sea had a shallow soil with rock exposure. The calcareous sward had scattered small gorse which had been fired. In the open sward, *G. ventricosum* of 12–18 cm high had no competition with its associate grasses but, within gorse patches, its height doubled to 18–38 cm.

The taller plants of *G. ventricosum* within gorse areas may, in part, be attributed to the light factor but in these coastal gorse habitats the height may also be influenced by gorse management. The habitat is frost free but exposed to wind and sea spray. In the micro-climate between gorse cover, there is less exposure to wind and variation in temperature. Where gorse is periodically fired there would be an increase in available phosphorus from the gorse ash in the top few centimetres of soil and a release of nitrogen from the breakdown of nodules on the gorse roots. This small addition of P and N could make some contribution to the growth height of *G. ventricosum* found within areas of low gorse, which at 10 sites have been noted to occupy 25–65% of ground cover in $2m^2$.

At the Somerset sites, the slopes have much broken ground largely due to weathering. The broken ground provides the open requirement of *G. ventricosum*, in spite of *Sanguisorba minor* making some ground cover and *Hypericum perforatum* creating low shade and competition. On the margin of the colonies of this grass there were hawthorn, blackthorn and dog-rose, 1·5–2 m high (1980). At a metre distant from the scrub, *G. ventricosum* was 15 cm high and, under scrub shade, it had grown out to the light to 43 cm high. Similar growth has been recorded on wheat headlands; where this grass is in competition and deprived of light it will grow to 97 cm (Trist 1983). There is a big difference between the 55 cm height of gorse in the Gower and the 2 m height of hawthorn at the Somerset sites, but the deprivation of light has a similar effect on the growth of *G. ventricosum*.

If scrub is not controlled, there is a gradual loss of habitat caused by the advancing growth of parent scrub and seedlings. While *G. ventricosum* can withstand some light deprivation, responding by increased growth height, colonies adjacent to expanding scrub move their ground to more open sites. At one of the Somerset sites it is likely that an extension of the *G. ventricosum* area has occurred over a number of years, during which time the scrub has increased its growth following the abandonment of livestock grazing. Recorders in the past have noted fluctuations in site populations and positions. While the climatic influence on seed production is of great significance, this is only one facet. The survival of populations is dependent on seed germination in an open habitat and this latter is more important. In 1981, R. G. B. Roe (in litt.) reported "there was a good crop this year again in the same general area but not specifically in the same places as in 1980".

WOODLAND HABITATS

Where *G. ventricosum* has been recorded from woodland margins and rides, it can only be considered as a short-lived casual introduction. This is supported by herbarium sheet annotation. As examples we have "borders of a wood, Twine Hills, near Wells", 1883, sheets in **CGE** and **BM**; and "a clearing in woodland, near Buck's Green, Sussex", 1941, sheets in **BM** and **K**. In the former, the wood border record is giving the impression of a habitat but the site no doubt refers to an arable headland bordering a wood. In the latter, it is known that there are arable lands on either side of the wood. There seems little doubt that the grass was introduced on boots or on wheels from the arable land. The only record for Yorkshire is from a ride in Brocodale Wood, Wentvale, 1937, recorded by W. A. Sledge who considered it a gamekeeper's introduction.

THE ARABLE HABITAT

The movement of *G. ventricosum* seed from its native habitat and its establishment as a colonist in arable cultivation is discussed by Trist (1983). All of the features of the native habitat are absent from the arable habitat.

Although this grass as an arable colonist is now only known in South Hampshire, it was formerly reported from many counties some 50–150 km from the sea. In arable land it survives under very different conditions and there is no preference for slope or aspect. It has been found in a wide range of soils from light gravel sands to heavy clay, which in turn have poor to satisfactory drainage. Its tolerance to a lower pH has been recorded. Its arable weed associates are naturally different from those of its native grassland. Probably the most significant native habitat factors are the maximum light requirement and an absence of plant competition; under cereals both of these

factors are restricted, especially during the early phases of establishment. The author has surveyed a large number of cereal crops from Dorset to Surrey where *G. ventricosum* was formerly reported: in all fields, the crop density made it impossible for this grass to survive and no plants were seen.

SALT TOLERANCE

A feature of the habitat of *G. ventricosum* is proximity to the sea. In the majority of sites, this has been found to be between 30 and 100 m, although one Somerset site is 500 m and another 20 km from a tidal estuary. Many of the cliff sites are subject to sea spray and there is evidence that this grass has a tolerance to a low degree of salinity. To the east of Lymington, plants were found in arable land which had recently been flooded with sea water and had good growth (Trist 1983). This area may be the reference given by Johns (1893) under *Gastridium lendigerum* "growing in fields near the sea occasionally overflowed in the south of England". Other saline habitat records include "sea shore near Brighton" *J. Hardy*, 1840 (in **MANCH**) and Hanbury & Marshall (1899) record "edge of low marshy ground above the sea shore", Eastwear Bay, Kent; these sites could have been subject to high tides. Swete (1854) records in the tidal Avon Gorge, "side of the river below Cook's Folly"; White (1887) records that it was refound on the "bank of Avon" by W. E. Green prior to 1882.

THE PLANT ASSOCIATES OF *G. VENTRICOSUM*

The associated species set out in Table 3 do not include species occurring less than four times. The total species recorded at 22 native sites was 110. The records from the Rhaetic Limestone show numbers of less than half those recorded from the Purbeck and Carboniferous Limestone, but it is known that the species on the former were under-recorded. The species list reflects a dry, well drained, calcareous soil which is common to all sites. *Sanguisorba minor* occurred in 18 sites, *Thymus praecox* subsp. *arcticus* in 13 and *Koeleria macrantha* and *Pilosella officinarum* in 11 sites. Where *G. ventricosum* can be presumed to be native, the site is generally species rich. Some of the associated flora is rare and is exemplified by *Althea hirsuta*, first found in 1875 near one of the Somerset sites and refound in 1950 in a similar habitat of "open stony pasture" (Roe 1981). Further examples of other interesting species are found in *Ophrys sphegodes, Linum bienne* and *Gentianella anglica* in Dorset; *Bromus madritensis, Potentilla tabernaemontani* and *Rubia peregrina* in the Avon Gorge; and the last two species which also occur with *Scilla verna* in the Gower. The associated flora of the arable colonist *G. ventricosum* included *Agrostis gigantea, Cirsium arvense, Polygonum aviculare* and *Veronica persica*, a collection of arable weeds which reflects the alien habitat.

BRIEF HISTORY OF RECORDS

The earliest known record of *G. ventricosum* in Britain is given by Ray (1688), "near Tunbridge Wells, Kent", found by a Mr Doody who assisted Ray with his *Synopsis* and *Historia Plantarum*. There is no account of the habitat but, 200 years later, Wolley-Dod (1937) recorded "locally plentiful in cornfields between Tunbridge Wells and Eridge Rocks, 1883". In 1726, Dillenius found at Norton St Philip "in a field sown with trefoil", the first record for North Somerset. There are no further early records until we have the first from North Devon at Woodbury and Cornwood, 1784 (Martin & Fraser 1939); the first record in the Avon Gorge is by Dyer, 1789 "near the New Hotwell, Clifton" (Shiercliff 1789) and Mansel-Pleydell (1895) gives the first record for Dorset as 1799.

Since about 1850 up to modern times there have been very few records described from native habitats, but there has been much recorded error in describing arable land and woodland as native habitats. Perhaps with the exception of the Avon Gorge, there has been no continuity of records in the 34 vice-counties in which *G. ventricosum* has been recorded; and only two to three records per county are known for 14 vice-counties, which were widely dispersed from Herefordshire to Yorkshire. The distribution illustrates the movement of the cereal colonist by seed corn transportation. The recognized seasonal fluctuation in the germination of this grass would also lead to the abandonment of search for records. Over the period 1850–1950 there were considerable fluctuations in the national acreage of cereals and, where *G. ventricosum* had become established in arable land, there would be frequent loss of the habitat by land going down to grass. In the past 30

TABLE 3. RELATIVE FREQUENCY, USING THE DOMIN SCALE OF COVER ABUNDANCE, OF PLANTS IN 2×2 M QUADRATS AT 22 NATIVE *GASTRIDIUM VENTRICOSUM* SITES

		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Dactylis glomerata	3	4			3		5	5	6	4	4	1	8	7	3	1	2	2	3	3	2	2
Sanguisorba minor	6	5					1	5	1	4	4	5	2	2	3	1	4	4	3	2	2	1
Plantago lanceolata	4	5			3	5	4			2		3	7	3		3	3	3	3	3	1	
Festuca ovina			2	2					5	7	6	5	10	5				4	4	4	3	3
Thymus praecox subsp. *arcticus*		2	2					1	1	4	2	4	3	4				3	3	2		2
Holcus lanatus					3	3	2	4	2		3		3	4			2	1			2	1
Bellis perennis								2	5	2	4		4	3					2	1		
Koeleria macrantha			2	2				1	2	1			6	5					4	3	2	
Pilosella officinarum			2	2					3	3	4	4	7	3					3	4		
Centaurium erythraea		2	2						1	2	2	2	2			4						
Ulex europaeus					8	6	8										5	4	1	4	2	5
Agrostis stolonifera						3	3	2	4				6				4	3		1		
Brachypodium sylvaticum		2				3	3	2				5					1	1				3
Carex flacca							1		2			2	5	3			3	2				1
Cynosurus cristatus	3	3				2	1	3	6			1	4	4								
Leontodon taraxacoides					3	4	2	3			1	5	3	8					2			
Linum catharticum			2	4							2		3						2			
Trisetum flavescens	3	4	2			2	2	3			2				3			4				
Anagallis arvensis	1	1											3				4	1	2	1	1	
Galium verum										4	3		3	9				2		3	1	
Helianthemum nummularium															3		2	4	3	3	2	3
Lotus corniculatus									3		3	2					1			1	2	
Daucus carota	2				3	4	3		1					3				1				
Festuca rubra subsp. *rubra*									2	8			7	5				2				
Salvia horminoides		1							2				2	2								
Senecio jacobaea								1	2				3	3				1				
Brachypodium pinnatum									2	2	4		3	4								
Bromus hordeaceus subsp. *hordeaceus*		1				1			2		3		4									
Cerastium fontanum subsp. *triviale*						2			1					2								
Desmazeria rigida		2														1					2	1
Medicago lupulina								9								4					1	1
Rubia peregrina															3	4	3				1	2
Danthonia decumbens																	3	2		5	1	
Agrimonia eupatoria																						
Anthoxanthum odoratum																		3		2	1	
Blackstonia perfoliata		2																				
Bromus hordeaceus subsp. *ferronii*									5				3									

TABLE 4. *GASTRIDIUM VENTRICOSUM*: LAST KNOWN RECORDS IN VICE-COUNTIES, 1823–1979

Vice-county		Location	Source	Habitat	Year
Pembs.	45	?	*J. L. Knapp*, **BRIST**	arable	1824
E. Norfolk	27	Gillingham & Cley	Smith (1824)	arable	1823
Hunts.	31	Monks Wood, Abbots Ripton	*A. Fryer*, **OXF**	arable	1882
Caerns.	49	Aber	*A. Ley*, **BM**	waste	1886
E. Kent	15	Staplehurst	*E. S. Marshall*, **BM, BRIST, OXF**	arable	1893
Merioneth	48	Aberdovey	*D. A. Jones*, in MS *Flora of Merioneth*, **NMW**	waste	1907
Selkirks.	79	Galashiels	*I. M. Hayward*, **OXF**	waste	1916
Scilly	1b	Old Town, St Mary's	H. Downes, in Thurston & Vigurs (1922)	roadverge	1922
E. Cornwall	2	Nr. St Austell railway station	W. Tresidder, in Thurston (1929)	waste	1928
Surrey	17	By the Way & Arun Canal	*J. E. Lousley*, **RNG**	arable	1936
S.W. Yorks.	63	Brocodale Woods, Wentvale	*W. A. Sledge*, **herb. W.A.S.**	woodland	1937
N. Essex	19	Gosfield	*C. E. Hubbard*, **K, OXF, herb. E. C. Wallace**	arable	1939
Herts.	20	Near Cowheath Wood, Bayford	S. Phelp, in Dony (1967)	arable	1946
N. Devon	4	Northam Burrows	Wright (1949)	waste	1948
S. Essex	18	West of Hadleigh Castle	*E. C. Wallace*, **K, OXF, herb E.C.W.**	grassland	1950
W. Suffolk	26	Lakenheath	*J. E. Lousley*, **BM**	waste	1952
W. Kent	16	Chattenden Wood	*F. Rose*, **MNE**	woodland	1954
W. Sussex	13	Between Crawley & Horsham	*B. Welch*, **BM**	arable	1954
Herefs.	36	Eywas Harold Common	*F. M. Day*, **K**	waste	1955
Worcs.	37	Evesham	*C. W. Bannister*, **BM**	waste	1958
Mons.	35	Near Raglan	E. K. Horwood, B.R.C. field record	arable	1958
Warks.	38	West of Alcester	*M. Clarke & J. Kiernan*, **WAR**	arable	1960
E. Suffolk	25	Clapper Farm, East Bergholt	*P. H. Raven & J. F. M. Cannon*, **BM**	grassland	1961
Beds.	30	Ampthill	*H. J. M. Bowen*, **K**	waste	1962
W. Cornwall	1	Trelissick Gardens, King Harry	B. E. M. Garratt, no voucher, Margetts & David (1981)	wall	1979

years there have been very few reports of *G. ventricosum* but an understanding of the native site has been developing while the arable colonist has been disappearing. Apart from the last remaining arable colonist stronghold in the Lymington area, where this grass has been known for over 100 years, there has been only one recent report of an arable colonist: "arable between Preston and Osmington, Dorset", *B. Marcan*, 1972 in **BM**. This record from arable land was adjacent to a cliff path where H. J. M. Bowen recorded a native site in 1955. The improved technology of cereal production has by its crop density made it impossible for this grass to continue to thrive in the cereal habitat (Trist 1983). The modern study of the native habitat has led to increased observation within areas where sites have previously been recorded. While there are still relatively few known sites, this grass can be found with large populations.

The last known records of *G. ventricosum* from 25 vice-counties over the period 1823–1979 are given in Table 4.

CLIMATIC INFLUENCE ON PLANT POPULATIONS

The average annual rainfall at the rain gauge stations nearest the *G. ventricosum* sites is given in Table 5 and shows a significant variation in its range of 752–1178 mm. From records of height growth and plant populations recorded at the native sites, there is no indication that either of these factors are influenced by total annual rainfall.

Lovatt (1981) records that the Avon Gorge populations have mainly been found in unshaded,

TABLE 5. ANNUAL RAINFALL AVERAGES FOR 1941–1970 TAKEN FROM THE NEAREST APPROPRIATE RAIN GAUGE STATION TO THE *GASTRIDIUM VENTRICOSUM* SITES AND ADJUSTED FOR ALTITUDE DIFFERENCE

Location		Rain Gauge Station		
Site	Altitude m	Site	Altitude m	Average Annual Rainfall mm
N. Somerset	50	The Grange, Somerton	32	752
S. Somerset	60	Chapel Cleeve	27	793
Avon Gorge, W. Gloucs.	30–100	Oakfield Road, Clifton	61	851
Dorset	50–100	Panorama, Swanage	37	906
S. Devon	54	Rea Barn Road, Brixham	50	950
Gower Peninsula, Glam.	30–50	Penmaen	87	1178

south-facing rocky habitats, prone to desiccation. The 'rocky habitat' is common to most of the known native sites and, as the grass has continued to survive in this habitat, it is some indication of its ability to withstand dry conditions. This is further exemplified by Lovatt when he comments that long droughts and high temperatures, causing moisture deficit, kill out competitors to the advantage of *G. ventricosum*: the resulting bare ground provides an opportunity for the survival of more plants in the following season. However, where this grass is associated with scrub, a dry year may have some affect on other grasses and herbs but not very much effect on scrub seedlings and the increase in *G. ventricosum* plants in the following year, encouraged by bare ground, may be temporary. In the end, the advance of scrub defeats this grass, not by deprivation of moisture but by crowding out and excessive shade, in fact by the loss of essential open habitat.

Lovatt in the same paper says "that lack of rain is the most important weather factor but long periods of sun and high temperature are also required". The question of amounts of rain and periods of sunshine has to be related to the seasonal demands in the development of the plant. It is the relative absence of rain in a hot dry summer which gives the right conditions for good seed production and some amount of rain in the autumn to encourage germination.

If the climatic conditions for seed production can be met, then the extreme exposure of native cliff habitats, which are frost free, can be tolerated, and if rabbits are present, the loss of some seedlings by grazing or disturbance is compensated by grazing control of other plants and seed burial.

If a grazing site is abandoned, such as is the case at one Somerset site, and runs to scrub, long grass and herbs, the chance of existing populations surviving in later years will not only depend on climatic influence but on grass and scrub control by man and animal. At the same site in 1980, there was a colony of 18 *G. ventricosum* plants spread over $30m^2$ on a steep slope with broken ground and with 2m high thorn scrub creating a fair amount of shade. At an adjacent site 35 m along the slope where the grass was much shorter, the herbs smaller and there was no scrub, there was a colony of 70 plants in $0{\cdot}25\ m^2$. This discussion follows the conditions required for the maintenance of a population, give or take the annual differences caused by 'climatic influence': a good or poor seed year. It does not explain the very wide annual variations in populations which occur.

Of 22 native sites, all but three are less than 1 km from the sea and this affinity appears as a strong feature in the habitat requirement of this grass. Two of these three sites are in the Avon Gorge, and both are 8 km from the sea. One of the Somerset sites that probably represents the eroded remains of a cliff, is now some 20 km from the sea. It is of interest to consider that in Britain, *G. ventricosum* is probably at its northern limit in the south-west and prefers a mild coastal habitat. By contrast, in early July 1983, the author found this grass at Le Chateau Bonaguil in Lot-et-Garonne which is c. 100 km from the tidal estuary of the R. Garonne. This surprise is explained if we turn to Rouy (1913) who records a wide distribution "dans une grande partie de la France".

Table 6 gives population estimates of *G. ventricosum* at 24 native sites in Britain. The causes of the variation in populations from site to site are manifold.

TABLE 6. POPULATION ESTIMATES AT 24 NATIVE SITES OF *GASTRIDIUM VENTRICOSUM* IN BRITAIN

Locality	V.c.	Estimated number of plants	Year
Clifton B	34	4	1980
Dorset F	9	15	1981
Dorset G	9	20	1981
Is. of Wight	10	20	1982
Gower D	41	20	1980
Gower E	41	25	1980
Clifton A	34	25	1980
Dorset A	9	25	1980
Dorset J	9	30	1980
S. Somerset A	5	45	1980
Dorset I	9	65	1980
Gower C	41	80	1980
S. Somerset B	5	100	1982
S. Somerset C	5	100	1982
Dorset B	9	100	1981
Nr. Bridgend	41	100	1982
Dorset H	9	110	1980
N. Somerset	6	150	1980
Gower B	41	155	1980
Gower A	41	330	1980
Dorset D	9	730	1980
Dorset C	9	870	1980
Dorset E	9	1000+	1981
S. Devon	3	1000+	1983

CONSERVATION

The conservation status of *G. ventricosum* is generally satisfactory. Most sites are off the beaten track, often in areas of rough walking, and have some difficulty of access, which would deter the average rambler. It can therefore be said that public pressure is not a problem.

The Dorset sites are wardened and the rabbit is allowed to survive and act to advantage as a grazier. Sites with encroaching hawthorn and those with gorse do present a threat to habitats, but some control is being exercised. At the Somerset sites, in the absence of livestock grazing, animal droppings and inorganic fertilizers, the phosphorus status is lowered and unchecked hawthorn and dog rose is encouraged. However, at one site, some action has been taken recently by the County Trust for Nature Conservation and plans are in hand to control scrub at another.

Gorse is a frequent associate of *G. ventricosum* but, on the coastal habitats of the Gower, there has been a time-honoured custom of burning the gorse annually or at least every 2–3 years. An additional control is the fact that sites are on shallow soils over rock, so that growth height and total cover is checked. Also in the Gower, there is control of reversion to rough grazing by sheep. On one of the Dorset sites, a large ungrazed enclosure has three colonies of *G. ventricosum* associated with gorse. The latter is to be controlled and cattle grazing re-introduced.

The small colony on a cliff face in the Isle of Wight is probably made up of colonists from a native site further back on the slopes, not yet found. The site is in danger of wind and wave erosion and no action can be taken.

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