

***Bromus interruptus* (Hack.) Druce (Poaceae) - an extinct English endemic**

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ABSTRACT

Bromus interruptus, Interrupted Brome, is a grass endemic to England but which is extinct in the wild. The aim of this paper is to raise awareness of its records and ecology in the hope that it can be refound. It is related to *B. hordeaceus*, but differs in its contracted inflorescence (which makes it easy to pick out in the field), longer glumes and bifid paleas. The 169 historical records traced show it has been recorded in at least 106 sites in 73 hectads in v.cc. 6–9, 11–29, 32–34, 37, 53 and 63. It was last seen in Cambridgeshire in 1972. It is an annual in cultivation which produces abundant seed. It has mainly been recorded from fields, especially those sown with sainfoin, but also in a range of other situations. It was abundant and persistent in at least some of its localities. Plants should be looked for on disturbed edges of arable and hay fields and roadsides in its original localities and elsewhere in May–July onwards.

KEYWORDS: biodiversity, Gramineae, re-introduction, Interrupted Brome.

INTRODUCTION

Of the 21 non-critical species extinct in the British Isles, only *Bromus interruptus* (Hack.) Druce, Interrupted Brome, is endemic (Rich 2001). Fortunately, it has survived in cultivation, and as such is a high priority for re-introduction to restore a lost part of England's biodiversity.

The history of *Bromus interruptus* has been described by Druce (1897), Perring (1962), Donald (1980) and Lyte & Cope (1999). It was noticed by G. C. Druce in 1888 in considerable quantity in a fallow field in Berkshire and specimens were distributed through the Botanical Exchange Club as a possible new variety, though specimens had previously been collected in Cambridgeshire in 1849 and named as *Bromus pseudo-velutinus* Barnard ex Watson (this name is illegitimate; Druce 1904a, b). One specimen was sent to the expert Prof. E. Hackel, who accepted it as a new taxon and described it as a variety of *B. hordeaceus* L. (*B. mollis* L. var. *interrupta* Hack.) in Druce (1889). After further studies, Druce raised it to species status (Druce 1895). By the 1930s it had been found quite widely in England, often associated with sainfoin crops and hay meadows, and may have been passed around with seed from farm to farm. However, following the introduction of seed cleaning techniques it appears to have declined, and Druce (1932) described it as a diminishing species. By the 1960s it was virtually extinct; Perring (1962) listed the six records made since 1936, and suggested that it should be searched for again at known sites. It was subsequently rediscovered in one of its former sites on a field margin at Pampisford in Cambridgeshire in 1962 (Perring & Sell 1963), and material was taken into cultivation at Cambridge Botanic Garden. It continued to reappear on its field margin and conservation work was carried out on the site during 1965–1968. It was last seen in 1972 by C. Shaw and D. A. Wells. Later that year a four metre strip along the edge of the field was mown and the cuttings removed, and it was then scarified during the winter (G. Crompton, D. A. Wells *in litt.* at Biological Records Centre (B.R.C.)), but no plants reappeared. Further management attempts to resurrect the species in 1978 also failed.

In 1973 it was discovered that the seed held at Cambridge was no longer viable, and the species was thought to be extinct. Miraculously, seed had survived in cultivation; at a B.S.B.I. conference in Manchester in April 1979, P. M. Smith dramatically produced some plants which had been grown from seed he had originally collected from Pampisford on 23 July 1963 (Smith 1980; Donald 1980). Plants were subsequently again bulked up at the Cambridge Botanic Garden and have been widely distributed since. Seed also appears to have survived in cultivation since at least 1954 via Prof. Gailin at N.I.A.B. in France (D. E. Coombe, pers. comm., 1995).

In 1995, T.C.G.R. began collating data on this species and researching its ecology with P. G. Angold with a view to re-introducing it to the wild. The first step was to resurvey the historical sites in case it had survived unnoticed, but funding was not forthcoming from the three sources tried. To date only a few sites have been revisited (e.g. Rich 1999), and as it is now unlikely that we will be able to search the old localities, the aim of this paper is to present the information we have collated about *B. interruptus* to stimulate its rediscovery and to provide information for a re-introduction programme.

TAXONOMY AND IDENTIFICATION

Bromus interruptus is a distinct, little variable species, and grows true from seed. It is closely related to *B. hordeaceus* and is probably derived from it, perhaps by mutation, and it has been suggested to be an ecotypic subspecies selected in crops (Smith 1972, 1981; Ainouche & Bayer 1997; Oja 1998). Smith (1972) investigated seed protein serology and found *B. interruptus* shared the protein spectrum of *B. hordeaceus* almost completely; he later reported 75–80% similarity in serological and electrophoretic analyses of seed proteins (Smith 1980). Ainouche & Bayer (1997) found only one base-pair difference between internal transcribed spacer regions of nuclear ribosomal DNA of *B. interruptus* and *B. hordeaceus*. Oja (1998) found very close affinities in isozymes between *B. interruptus* and *B. hordeaceus*, the latter differing in being more polymorphic though more samples were studied.

L. M. Spalton has kindly proved an updated description as follows:

Culm to 100 cm. Panicle to 8 cm, erect, narrow, dense with many spikelets, often shortly interrupted below. Spikelets c. 10–12.5 mm long, elliptical, quickly divaricating to obdeltoid; often some in groups of three. Glumes conspicuously long, the lower lanceolate, the upper ovate, more than 2/3 as long as the lemma. Lemmas c. 7.4–8.5 mm, papery with prominent veins when dry, pubescent. Paleas bifid, reduced to two, frequently unequal, long hyaline strips c. 0.4 mm wide (development can be variable). Anthers to 1.5 mm.

Bromus interruptus is readily recognisable in the field, and differs from other annual brome grasses in having a contracted inflorescence, broader deltoid spikelets, long glumes and the bifid palea. The inflorescence is often described as 'interrupted' (hence its name) but only a few larger plants tend to have the lower cluster of spikelets separated, and in many specimens the outline is more-or-less continuous. Likely *B. interruptus* plants are most easily picked out from the contracted inflorescence, and then confirmation can be sought from examination of the palea. Paleas are most easily seen in fresh material, and are bifid from the start (note that paleas may become bifid in *B. hordeaceus* as they age). In ripe spikelets the palea may be wrapped around the back of the seed, and sometimes in *B. hordeaceus* the palea becomes fused to the seed making it difficult to observe without a microscope and careful dissection of the florets. A photograph and an illustration showing these features are given in Figures 1 and 2; another illustration by G. M. S. Easy is given in Donald (1980), where the inflorescence is shown more lax than is our experience.

A chromosome number of $2n=28$ (tetraploid) has been reported by Maude (1939), Smith (1973) and Dempsey *et al.* (1994). *Bromus hordeaceus* is also tetraploid with $2n=28$ (Smith 1973). No hybrids have been reported.



FIGURE 1. Photograph of *Bromus interruptus* by J. E. Lousley; herbarium specimen in **RNG** (courtesy of S. L. Jury).

DISTRIBUTION IN THE BRITISH ISLES

Data have been compiled from the literature, herbaria (confirmed material from **BEL**, **BIRM**, **BM**, **BRISTM**, **CGE**, **DBN**, **E**, **K**, **L**, **LTR**, **NMW**, **OXF**, **RNG**, and **SLBI**, other records included from **HCMS**, **LIV**, **NWH**, **SDN**), B.R.C. and correspondence with botanists. Determinations by G. C. Druce, C. E. Hubbard, P. M. Smith, L. Spalton, P. J. O. Trist and T. G. Tutin have been accepted directly, with other material determined by T.C.G.R. Full details are held in the Threatened Plants Database and are available from A.J.L. on request.

We have given best approximate 1 km squares for many records to help locate sites, though it should be noted many of these are best guesses, and should not be taken to indicate the exact original locations. We have also grouped together records from the same locality, though in some cases we know these represent more than one site. Different sources for the same record often hold different information, which we have endeavoured to summarise into one form.

V.C. 6. NORTH SOMERSET

Failand, field of sown fodder/in a grass field, June 1913, J. W. White (**BM**, **BRISTM**, **CGE**).

Field near ... I have only found this grass in fields sown for fodder, and with sainfoin, 16 June 1913, C. I. Sandwith (**L**). ST5271.

V.C. 7. NORTH WILTSHIRE

Aldbourne, 1929, E. S. M. Todd (**OXF**, **SDN**; Grose 1957). SU2376.

Allington, 1891, E. J. Tatum (Preston 1892). SU2039.

Colerne, wall top/old wall, 28 May 1903, E. S. Marshall (**BM**, **CGE**, **E**, **NMW**, **OXF**; Marshall 1904). ST8171.

V.C. 8. SOUTH WILTSHIRE

Bratton, sown grass field above/field at foot of chalk down near, 30 May 1903, E. S. Marshall (**BM, DBN, NMW**; Marshall 1904, Grose 1957). ST9152.
Salisbury, 1919, H. J. Goddard (**OXF**). SU1430.

V.C. 9. DORSET

Edmondsham, 1/2 – 3/4 mile from Verwood Station, 9 June 1902, E. F. Linton (**BM, DBN, OXF**). SU0710.

V.C. 11. NORTH HAMPSHIRE

Cross Mill, Winchester, 10 June 1910, G. C. Druce (**OXF**). SU4727.

Winchester, grass field near the Downs ...sown with *Lolium*, 30 May 1898, A. B. Jackson (**BM, OXF**; Townsend 1904). SU42.

Farley Chamberlayne, undated, G. C. Druce (Rayner 1929). SU4026.

Totton, 1906, probably collected by J. F. Rayner or H. G. Sadler (**HCMS**; Rayner 1929; Brewis *et al.* 1996). SU3513.

V.C. 12. SOUTH HAMPSHIRE

Andover, 1908, A. Wedgwood (Wedgwood 1945). SU3645.

Buryfields, Odiham, 19 June 1894, C. E. Palmer (**OXF**). It grows scattered in patches in the clover fields about here, its heads towering far above all other grasses. In abundance, 23 June 1902, C. E. Palmer (**BEL, BM, BRISTM, DBN, E, K, NMW, OXF, SLBI**; Rayner 1929). SU7450.

Ecchinswell, cultivated field near, 1906, A. B. Jackson (**BM**). SU5059.

North Warnborough [West Warnborough], near Odiham, by roadside, July 1911, G. C. Druce (**OXF**; Rayner 1929). SU7350.

Sydmonton, 1906, H. G. Sadler (**HCMS**; Brewis *et al.* 1996). SU4857.

Watership Down, chalk pit, 5 June 1906, A. B. Jackson (**OXF**). SU4957.

V.C. 13. WEST SUSSEX

Haslingbourne [Haslingford], old chalk pit, 30 June 1913, A. G. Gregor (**K**). SU9820.

V.C. 14. EAST SUSSEX

Glynde, with sainfoin, 23 June 1931, K. Pickard (**OXF**; Wolley-Dod 1937). TQ4508.

Woodingdean [Woodendean], near Brighton, amongst sainfoin, abundant, 9 June 1904, T. Hilton (**BM, E, SLBI**; Wolley-Dod 1937). North of Rottingdean, undated, E. Ellman (Wolley-Dod 1937). TQ3605.

V.C. 15. EAST KENT

Preston, 1890, G. Dowker (**CGE**). TR2360.

Snodland, cultivated field, 2 June 1923, I. M. Roper (**BM, BRISTM, K, NMW, OXF, SLBI**). TQ7061.

Whitstable, June 1897, E. Ellman (**OXF**). TR1066.

V.C. 16. WEST KENT

Kelsey Park, Beckenham, 23 May 1942, W. Howell (**K**). TQ3769.

Between Shinglewell and Cobham, in sainfoin field, 19 May 1912, C. E. Britton (**BM, K**). TQ6768.

Dartford Hospital, plentiful in sainfoin near, 21 May 1893, A. H. Wolley-Dod (**BIRM, BM, DBN, NMW, OXF, SLBI**; NB some collections are *B. hordeaceus*; Hanbury & Marshall 1901). Chalky field of sainfoin, June 1893, A. H. Wolley-Dod (**BM**). TQ5374.

Eltham, near, 1894, A. H. Wolley-Dod (Hanbury & Marshall 1899). TQ4274.

Halling, 23 May 1893, F. J. Hanbury (**BM**). TQ7064.

Hayes, gravel pit, 1 June 1906, possibly collected by W. H. Griffin (**SLBI**). TQ4066.

Keston, near, June 1921, J. A. Pratt (**SLBI**). TQ4164.

Lads Farm, Upper Halling, sainfoin field near, 14 June 1936, J. P. M. Brennan and J. E. Lousley (**K**). Clover ley, 14 June 1936, J. E. Lousley (**RNG**). TQ6836.

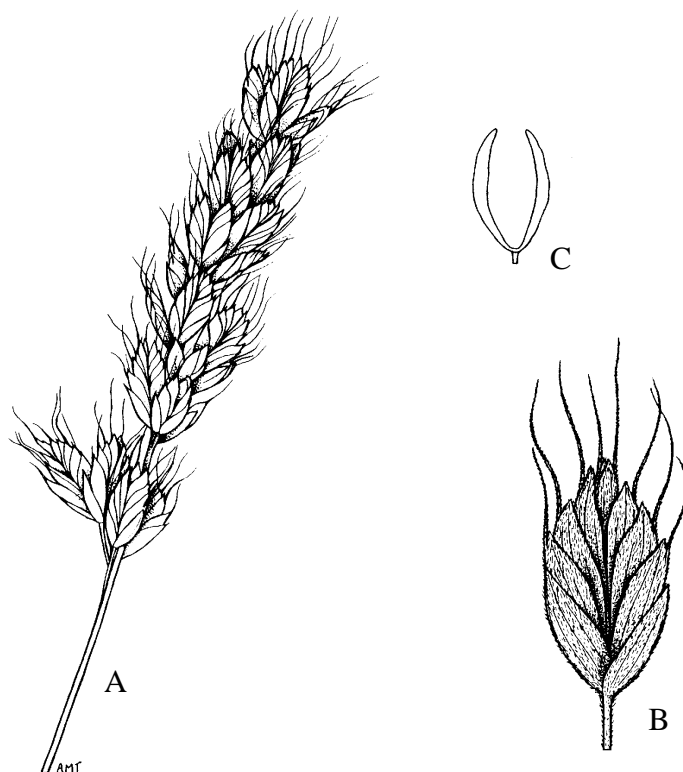


FIGURE 2. *Bromus interruptus* (del. A. Townsend). A. Inflorescence ($\times 1$); note contracted inflorescence (rarely some pedicels are slightly more lax), and spikelets are often in groups of three. B. Spikelet ($\times 3$), showing ovate shape when ripe. C. Palea ($\times 3$); this is usually reduced to simple membranous tissue.

V.C. 17. SURREY

Bank of River Thames at Mortlake, July 1879, G. Nicholson (**BIRM, BM, OXF, SLBI**). TQ2076. Selsdon, Sanderstead, in fields, 4 June 1899, J. Fraser (**K**). TQ3562.

Tot Hill, Headley, in heavy soil overlying chalk. Abundant in derelict field, 15 June 1930, C. I. Meikle (nee Dickinson) (**K, NMW**). Sainfoin field near, 17 July 1931, I. A. Williams (**K, OXF, SLBI**). June 1932, A. H. Carter (**BM**). June 1932, E. Nemes (**K**). In chalky field opposite High Ashurst, 3 and 4 June and 2 July 1932, 4 June 1932, J. E. Lousley (**BIRM, BM, CGE, K, LTR, NMW, RNG, SLBI**). 12 June 1932, J. E. Lousley (**RNG**). In derelict hay field, very abundant near remains of old haystack, on heavy soil overlying chalk, 15 June 1932, C. E. Hubbard, C. V. B. Marquand and H. K. Airy Shaw (**BM, CGE, E, K, LTR, SLBI**). 27 June 1932, R. B. Ullman (**SLBI**). Fallow field, 1 or 11 July 1932, E. C. Wallace (**E, LTR, RNG**). Abundant in neglected arable land, 2 July 1932, J. E. Lousley (**NMW, RNG, SLBI**). Headley Lane, June 1933, E. Vachell and E. Knowling (**NMW**). Cultivated land, 3 June 1933, E. C. Wallace (**RNG**). Near larch plantation on the hill, 11 July 1936, N. D. Simpson (**BM**). TQ2054.

V.C. 18/19. ESSEX

Appeared in sainfoin crop, "common mess ?" Hasler and Clapham, Essex, undated, no collector (**K**). Further details not traced.

V.C. 18. SOUTH ESSEX

Ongar, roadside north of Moreton, 2 July 1932, A. H. Carter (**BM**). TL5306.

V.C. 19. NORTH ESSEX

Great Dunmow, in sainfoin, undated, A. R. Clapham (**K**). TL6221.
Hadstock, side of field near, 19 June 1926, H. Gilbert-Carter (**CGE**). TL5544.

V.C. 20. HERTFORDSHIRE

Asbury, May 1904, G. C. Druce, Dr Ashby and D. P. Stanfield (**OXF**). Not traced.
Haley Hill, near, July 1909, G. C. Druce and A. Trower (**OXF**). TL3728
Odsey, June 1849, A. M. Barnard (**BM, CGE, K**). TL2938.

V.C. 21. MIDDLESEX

Acton, c. 1900–1910, A. Loydell (**SLBI**). TQ2080.
Birchfield, Southall, May 1903, A. B. Jackson (**OXF**). TQ1280.
Uxbridge, near, in rough cornfield among rye, etc./in an arable field, July 1898, G. C. Druce (**BIRM, BM, NMW, OXF, SLBI**). On waste, 19 September 1907, A. Loydell (**BM**). TQ0584.
Yiewsley, 28 May 1912, J. E. Cooper (**BM**). TQ0680.

V.C. 22. BERKSHIRE

Aston Tirrold, chalky field between Unhill [Druce wrote Unwell] Wood [SU5682] and Blewburton Camp [SU5486], field was fallow following a crop of barley the previous year, July 1888, G. C. Druce (**BIRM, OXF**). SU5584.
Moulsford, in an arable field near, undated, G. C. Druce (Druce 1897). SU5983.
Park Place, Henley, on the Upper Chalk in a sainfoin crop, July 1894, G. Stanton and F. Tufnail (**BM**; Druce 1897). SU7782.
Streatley, among seeds near, undated, G. C. Druce (Druce 1897). SU5980.
Upton, near, June and August 1895, July 1896 and 31 May 1898, G. C. Druce (**BEL, BM, CGE, NMW, OXF, SLBI**). SU5186.
Windsor, near, undated, J. G. Everett (Druce 1918). SU9676.

V.C. 23. OXFORDSHIRE

Barton, in clover field, June 1906, G. C. Druce, Lord Bridport and A. W. Hill (**OXF**). SP5507.
Benson, near, June 1907, W. C. Barton (**BM**). SU6191.
Britwell Salome, June 1901, G. C. Druce (**BM, CGE, NMW, OXF**). SU6793.
Elsfield, 1894, G. C. Druce (**BM**). sown in large quantities with a form of *Bromus commutatus* and flourishing amazingly in spite of the intensive drought in a dry sandy field on the Coralline Oolite, 27 and 30 May 1895, L. V. Lester-Garland (**BEL, BIRM, BM, CGE, E, K, NMW, SLBI**; Druce 1897). July 1895, G. C. Druce (**OXF**). SP5410.
Eynsham, July 1915, G. C. Druce (**BRISTM**). June 1916, J. White (**BM**). June 1916, G. C. Druce (**BM, NMW, OXF**). SP4309.
Fowy, 1889, Anon. (**BM**). Not traced.
Between Goring and Gatehampton, in a clover field, June 1888, G. C. Druce (**OXF, RNG** - 1885 date at latter assumed an error). June 1889, G. C. Druce (**BM**). June 1915, F. J. Smith (**OXF**). SU6080.
Henley-on-Thames, among sainfoin, 16 June 1903, E. Armitage (**BM**). SU7682.
Taynton, June 1931, G. C. Druce and J. F. G. Chapple (**OXF**). SP2313.

V.C. 24. BUCKINGHAMSHIRE

Bailey Hill [Bailey Wood], with *B. secalinus* and *B. hordeaceus* in a field with sainfoin between Denham and Denham Marsh, June and July 1898, G. C. Druce (**BM, OXF**; Druce 1926). TQ0486.
Lane End, undated, G. C. Druce (Druce 1926). SU8091.
Prestwood, undated, G. C. Druce (Druce 1926). SP8700.
Princes Risborough, July 1895, July 1898, June 1900, August 1900, June 1904, July 1904, June 1913, G. C. Druce (**BM**). In the greatest abundance in a sainfoin field near ..., when I gathered over a hundred specimens in the area of a few yards, July 1898, G. C. Druce (**BM, CGE, DBN, E, LTR, RNG**). SP8003.
Rush Green, near, 13 June 1905, J. Roffey (**BM**). TQ0285.
West Wycombe, fields above, June 1903 (+1902?). G. C. Druce (**BM, E, OXF**; Druce 1926). SU8294.
Tring, very fine near, undated (Druce 1926). SP91.

V.C. 25. EAST SUFFOLK

Lowestoft, 'F. Tufnail tells me he saw it rather plentifully near Lowestoft in Suffolk' (Druce 1897). TM59.

Saxmundham, abundant in sainfoin fields near, June 1911, G. C. Druce and C. E. Moss (Druce 1911). TM3863.

Woodbridge, abundant in sainfoin fields near, June 1911, G. C. Druce and C. E. Moss (Druce 1911). TM2649.

V.C. 26. WEST SUFFOLK

Bury St Edmunds, in clover fields near, 27 May 1907, J. Rasor (**K**). TL8564.

Elmswell, clover field beside the railway, May 1908, J. Rasor (**BM**, **OXF**). TL9964.

Great Waldingfield, roadside, 28 May 1916 and 4 June 1916, G. C. Brown (**BM**, **CGE**, **LIV**, **LTR**, **NMW**, **OXF**). TL9043.

Hadleigh, abundant in sainfoin fields near, June 1911, G. C. Druce and C. E. Moss (**BEL**, **NMW**, **OXF**, **SLBI**; Druce 1911). TM0242.

Lakenheath, 6 June 1928, T. J. Foggitt (**BM**). TL7182.

Mildenhall, roadside, 12 or 26 June 1916, W. C. Barton (**BM**, **K**, **NWH**, **OXF**). Roadside, 12 June 1916, C. E. Britton (**CGE**, **K**, **NMW**). 1957, E. Q. Bitton (Simpson 1982). TL6974.

Risby/Risby Poors Heath, field near, 7 June 1908, H. and J. Groves (**BM**). 8 July 1928, R. W. Butcher (**CGE**). TL7966.

Tuddenham, 'This must be pretty plentiful about Tuddenham for Cross first sent me a few heads and at my request had no difficulty in twice sending me large roots of it. S. H. Bickham' 20 June 1900, W. J. Cross (**NWH**). 3 July 1900, W. J. Cross (**CGE**). Sandy waste, 26 June 1901, W. J. Cross (**CGE**). In fallow S.E. of, 6 June 1933, J. E. Lousley (**RNG**). TL7371.

V.C. 27. EAST NORFOLK

Great Yarmouth, undated but pre-1905, F. Townsend (**SLBI**). TG5207.

Sprowston, 12 June 1882, E. F. Linton (**LIV**). TG2511.

V.C. 28. WEST NORFOLK

Anmer, sainfoin field, 16 June 1946, E. L. Swann (**L**). In sainfoin fields, scattered plants, 4 August 1946, C. E. Hubbard (**K**). TF7429.

Great Massingham, sainfoin field near, 1 July 1946, R. P. Libbey (**LTR**). TF7922.

Rockland All Saints, sainfoin field, 20 May 1916, F. W. Robinson (**BM**). Sainfoin field, in abundance, 25 May 1916, F. W. Robinson (**BM**, **K**, **NMW**, **OXF**). TL9996.

Thetford, chalky field side, 24 June 1882, E. F. Linton (**BM**, **SLBI**; Nicholson 1914). TL8586.

West Newton, in field of sainfoin, 25 May 1946, E. L. Swann (**K**, **LTR**; Petch & Swann 1968). TF7027.

Watton, 12 July 1915, F. W. Robinson (**LIV**); possibly unreliable as Robinson often confused herbarium labels; this is where Robinson lived and may not be where the plant was found. TF9200.

V.C. 29. CAMBRIDGESHIRE

Cambridge, 18 June 1857, C. C. Babington (**CGE**). TL4458.

Carlton Grange, sainfoin field, June 1932, T. G. Tutin (**CGE**, **LTR**). TL6453.

Dullingham, field near Dullingham Station, May 1904, E. J. Allard (**K**). Sainfoin and clover fields ... in quantity and growing with *B. mollis*, *B. sterilis* and *B. commutatus*, 29 May 1904/in sainfoin fields, very abundant and quite distinct, even at a distance, June and July 1904 and 2 July 1904, A. J. Hosking (**BEL**, **BM**, **BRISTM**, **CGE**, **DBN**, **E**, **K**, **LTR**, **NMW**, **SLBI**). TL6257.

Abington. Between Hildersham and Abington, Lucerne field, 6 June 1953, R. E. Parker (**BEL**). Little Abington, arable field near, 8 June 1953, R. E. Parker (**BM**, **CGE**, **E**, **K**, **LTR**, **NMW**, **RNG**). Meadow by field near Great Abingdon, 15 June 1953, P. D. Sell (**CGE**, **LTR**). Cornfield, chalk soil, 18 June 1957, C. C. Townsend (**K**). TL5349.

Pampisford, field S.W. of Brent Ditch, 11 June 1943, W. H. Mills (**CGE**). Abundant in a sainfoin field in the SW angle of the crossing of the disused old railway and the Granta, about one third of a mile north of Pampisford Station. (The farmer, who distinguished between it, *B. commutatus* and *B. sterilis*, keeps his own sainfoin seed and complains he cannot get rid of the

weeds. It doubtless occurs each year in his sainfoin). 1952, J. E. Raven (card index). Bourn Bridge, Pampisford, 17 July 1952, D. E. Coombe. Near Pampisford, 23 May 1953, J. E. Lousley (**LTR, RNG**). An agriculturally poor semi-permanent ley grassland with much *Bromus mollis*. *B. interruptus* was scattered over about 100 yards towards the middle of the field; several hundred plants were noticed. There was also one very luxurious plant in the rough field (abandoned arable?) immediately next to the A11, 14 June 1962, F. H. Perring, S. M. Walters, C. T. Prime and J. G. Faulkner (**CGE**). Abundant in hay fields, Pampisford/persistent in the sown fields near Pampisford, 22 June 1962, J. E. Lousley (**BM, CGE, K, RNG, SLBI**). On a post and wire fence line in field of old pasture, 25 June 1963, P. J. O. Faulkner (**CGE**). Some 25 seeds collected from beside a fence in a cut hay field where a number of plants were growing, together with *B. hordeaceus* and *B. commutatus*, 23 July 1963, P. M. Smith. Some 62 spikes this year, 28 June 1966, F. H. Perring and S. R. Payne. Sainfoin crop, immediately south of W.-E. track, on east a field of broad beans and on west a field of Hop Trefoil. I saw five plants altogether scattered over the field, each plant with many stems. One of the plants is very conspicuous as it grows right by the east side of another track way crossing the field of sainfoin diagonally from N.W. to S.E., June 1968, J. R. Palmer. Only two plants in each plot where turf had been removed, 20 June 1968, F. H. Perring. (A 1971 record attributed to R. J. Pankhurst was of a report of failure to find it; pers. comm., 2001). Present, August 1972, C. Shaw and D. A. Wells (Cambridgeshire Wildlife Trust files, pers. comm. N. Millar 2001; English Nature files). (Unattributed sources are pers. comm. G. Crompton 2001). TL5047 to TL5149.

V.C. 30. BEDFORDSHIRE

Listed by Druce (1904a, 1932). No source traced.

V.C. 32. NORTHAMPTONSHIRE

Coppice Moor, September 1907 (1901?), G. C. Druce (**OXF**; Druce 1930). SP74? Precise location of Coppice Moor unknown.

Moor End, July 1908, G. C. Druce (**BM**). SP7544.

Rainsborough [Rainham Camp], 1 June 1907, J. Cryer (**E**). In a field at Rainham Camp, 6 June 1907, H. J. Riddelsdell (**BIRM, BM, CGE**). Clover field by Rainsborough Camp, 6 June 1907, H. N. Dixon (**BM**). SP5234.

Between Morehay and Walton, near Peterborough, in a field of sainfoin on the cornbrash, 1910, G. C. Druce (**OXF**; Druce 1930). TF1702.

V.C. 33. EAST GLOUCESTERSHIRE

Cirencester, undated, W. J. H. Greenwood (Riddelsdell *et al.* 1948). SP0202.

Cold Aston, in a field, cultivated subsequently, 1915, C. I. Sandwith (**OXF**). Sainfoin field near, 12 June 1918, C. I. Sandwith (**BM, L**; Riddelsdell *et al.* 1948). SP1219.

Northleach, undated, G. C. Druce (Riddelsdell *et al.* 1948). SP1114.

Rendcombe, 18 June 1920, W. J. H. Greenwood (**BM**; Riddelsdell *et al.* 1948). SP0209.

V.C. 34. WEST GLOUCESTERSHIRE

Avonmouth Docks, 1930, C. I. and N. Y. Sandwith (Sandwith 1933; Riddelsdell *et al.* 1948). ST5380.

Bristol, 1930, C. I. and N. Y. Sandwith (Sandwith & Sandwith 1931). ST57.

V.C. 37. WORCESTERSHIRE

Malvern Common, one plant by side of road across common, 28 June 1911, R. F. Towndrow (Towndrow 1911). SO7744.

V.C. 53. SOUTH LINCOLNSHIRE

Druce (1897) stated that Mr F. Tufnail has seen specimens from Lincolnshire, and later cited it as v.c. 53 (Druce 1904a, 1932). No specimens have been traced.

V.C. 63. SOUTH-WEST YORKSHIRE

Dewsbury district, wood waste, 1905, P. F. Lee (**BM**). SE22.

Ossett, manure heap, July 1909, P. F. Lee (**BM**). SE2820.

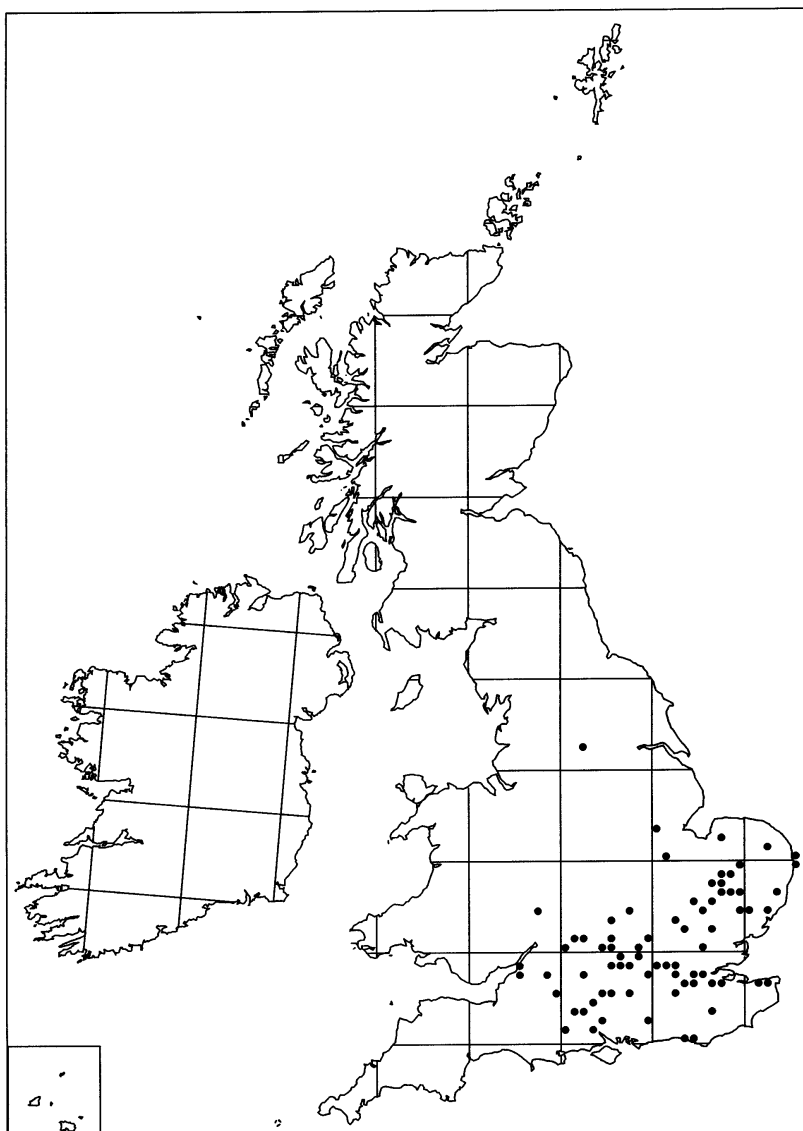


FIGURE 3. 10-km square distribution of *Bromus interruptus*.

DISTRIBUTION IN EUROPE

The UK Biodiversity Group (1998) stated that it was introduced to the Netherlands and was apparently well-established there. However, there are only two old records in the Rijkskherbarium at Leiden (L) and the Dutch do not have any other records (R. van der Meijden, pers. comm., 1998). The details of the two records are:

Ermelo, langs de weg naar de Zuiderzee [clover field], July 1933, Jansen & Kruseman.

Amsterdam, langs de Coenhaven [docks], July 1934, Jansen & Wachter.

Druce (1897) was unable to find any material from the continent, and P. M. Smith has similarly seen no other material (pers. comm., 1999).

LIFE CYCLE

Bromus interruptus in cultivation is a strict winter- or spring-annual. Observations of plants in T.C.G.R.'s garden in Cardiff 1997–2001 show that germination occurs in both spring and autumn, with autumn germinating plants flowering first and producing more inflorescences. Some plants have also been observed germinating in early summer, but tend to be small and flower with only 1–3 spikelets. G. C. Druce cultivated it in his garden (**OXF**) but oddly described it as a biennial or sub-perennial (Druce 1897).

The main flowering period is from May to July (Table 1). If the weather is suitably warm and damp, further inflorescences may be produced later through to September. Anthers may be exerted or included; Hubbard (1984) notes that as with other annual bromes, pollination may take place in unopened florets if the anthers are enclosed by the lemma and palea at the hairy top of the grain. Abundant seed is set. As the inflorescences ripen they become somewhat top-heavy, and have a tendency to lodge in wind and rain. The spikelets often remain intact rather than dehisce, and plants often occur in small clumps from groups of germinating seeds as a consequence. There is some indication that seeds may be short-lived.

Specimens in cultivation in greenhouses and gardens are susceptible to mildew (D. E. Coombe, pers. comm., 1995, and T.C.G.R., pers. obs.). Material in cultivation in Cardiff in 1999 had a powdery mildew *Erysiphe graminis* DC. (det. A. Orange; **NMW**). Specimens may also be susceptible to aphid infestation in cultivation; aphids collected on plants cultivated in Cardiff were determined by J. Martin in 1998 as *Sitobion fragariae* (Walker), a generalist species of grasses.

ECOLOGY

The historical records have been analysed to try to characterise its habitat more precisely (Table 2). These indicate that the main habitat was fields, of which it was most frequently found in sainfoin. However, it also occurred in a range of other habitats. It often appeared in abundance and was relatively persistent in its localities, dependent on the nature of crops (e.g. Druce 1889). According to notes in J. E. Raven's card index about the site near Pampisford, Cambridgeshire 'the farmer, who keeps his own sainfoin seed ... complains he cannot get rid of the weeds. It doubtless occurs each year in his sainfoin'. It seems to have been distributed in sainfoin crops (e.g. Perring 1962) and it was found as an impurity in sainfoin seed by the Seed Testing Station (**CGE**), but its seeds are not specifically adapted for dispersal as a sainfoin mimic (Smith 1980). It may have been most frequent in sainfoin and clover due to the rotation length of the crops which suited its life cycle.

Smith (1980) noted that its distribution was largely one of a calcicole, which is based on the predominance of records from chalk and limestone areas. It also grows readily in more neutral soils (pers. obs.), and was recorded from sandy soils and clays. Druce (1932) gave its altitudinal range as 30–215 m and it has also been recorded near to sea level at Avonmouth Docks (Sandwith 1933).

Other than crop plants, there are only a few records of *B. commutatus* Schrad., *B. hordeaceus* L. and *Anisantha sterilis* (L.) Nevski specifically noted as occurring with it (e.g. Druce 1897; Perring 1962 and notes on herbarium specimens). D. E. Coombe also noted it with *Cirsium arvense* (L.) Scop. and *Sanguisorba minor* Scop. subsp. *muricata* (Gremli) Briq. near Abington (Perring 1962).

TABLE 1. NUMBER OF RECORDS FOR EACH MONTH FOR
BROMUS INTERRUPTUS IN ENGLAND

Month	Number of records (%)
May	21 (15%)
June	82 (60%)
July	30 (22%)
August	3 (2%)
September	2 (1%)

TABLE 2. NUMBER OF RECORDS FOR EACH HABITAT FOR *BROMUS INTERRUPTUS* IN ENGLAND

Habitat	Number of records
Fields - all records	55
(sainfoin	24)
(clover	8)
(hay/pasture	8)
(fallow	6)
(arable - corn etc.	5)
(unspecified	9)
Roadsides	4
Chalk or gravel pit	2
Waste ground/waste	6
Other (wall/riverbank/docks/manure heap)	4
Not noted	35
Total	106

Repeated records from the same habitat and site are not included.

DISCUSSION

We have traced 169 records, indicating it has been recorded from at least 106 sites in 73 hectads in v.cc. 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 33, 34, 37, 53 and 63. The records are mapped in Fig. 3.

Plants should be looked for on disturbed edges of fields and roadsides between May and July. As sainfoin is rarely grown these days, any such field should be checked carefully. Searches should not be restricted to the 1 km squares we have indicated, as these are simply to help locate records. The only sites probably not worth checking are those around Pampisford in Cambridgeshire where it was last seen; these have been searched on many occasions up to 1987 by G. Crompton and J. Green (pers. comm., 2001). Its clustered heads are distinctive, and C. E. Palmer noted they 'towered above all other grasses' (c.f. above). T.C.G.R. will be happy to check identification of any specimens.

Given its association with clover and sainfoin fields and a decline matching that of a number of other casuals, the pattern is more indicative of an alien than a native species. However, Druce (1897) noted it did not occur with other casuals in sainfoin fields, and it has not been found elsewhere in the world (cf. above), and must therefore be accepted as an endemic.

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