An assessment of the status of *Gaudinia fragilis* (L.) P. Beauv. (Poaceae) in the British Isles

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ABSTRACT

Gaudinia fragilis (L.) P. Beauv. (French oat-grass) has usually been considered an introduction in the British Isles. Until the early 1970s it had been recorded in our area mainly as a casual of waste and cultivated ground and dock quaysides, apart from on the Isle of Wight where it was recorded from 1917 onwards in apparently unimproved grassland. In the last 30 years it has been found to be locally well established in neutral grasslands, particularly those on heavy clay soils, across a wide area of central southern and S.W. England. Its occurrence in "old", often herb-rich pastures and hay meadows, including many sites of high conservation value, led to *G. fragilis* being given a status of "native or alien" in the *New Atlas of the Flora of Britain and Ireland*. In this paper we summarise the history and recent upsurge in records of *G. fragilis* in the British Isles, and describe its habitat preferences and the plant-communities in which it occurs. We then weigh up the evidence for and against it being viewed as a native species – at least within the core of its range in southern Britain – and explain why, on balance, a rather unsatisfactory "native or alien" is probably the best that can be offered.

KEYWORDS: distribution, conservation, native or alien status, French Oat-grass.

INTRODUCTION

The genus *Gaudinia* P. Beauv. (Poaceae) comprises four species centred on the Mediterranean region and the Azores. *G. fragilis* (L.) P. Beauv. (French oat-grass) is the most widely distributed member of the genus, occurring in S. Europe, and in N.W. Africa, the Aegean, Turkey, Syria, Lebanon and the Crimea (Davis 1985). We have seen no map of the world distribution, though Zohary (1986) describes the range as Mediterranean, extending into the Euro-Siberian. It is also found as a casual or naturalised introduction in other non-tropical regions, well beyond its presumed native range (e.g. Tsvelev 1983).

The northern limit of *G. fragilis* as a native species in Europe is unclear, but most of our Floras, describing it as an established alien in Britain and Ireland, go on to summarise its distribution in mainland Europe as being essentially "southern" (e.g. Stace 1997) or "Mediterranean" (e.g. Clapham *et al.* 1987; Sell & Murrell 1996). In the species account in the *New Atlas of the British & Irish Flora* (Leach 2002), *G. fragilis* is assigned to the Submediterranean-Subatlantic floristic element, one of three Mediterranean elements recognised by Preston & Hill (1997).

Within its presumed native range we have found very little information on its habitat preferences and ecology. Davis (1985) described the habitat in Turkey as "lightly grazed damp grassy slopes on volcanic rocks, and sandy soil near the sea", while one of us (D.A.P.), with A. J. Byfield in Turkey, found it not infrequently in a community we described as "damp *Gaudinia fragilis* – *Trifolium campestre* dune-slack grassland", a habitat echoed by the Floras of other Mediterranean countries, and by Tutin *et al.* (1980) who cite it as a species of "grassy, usually damp habitats".

The species is generally regarded as an alien in mainland N.W. Europe, possibly coming in with imported seed (e.g. Hegi 1935; Fournier 1946). It is patchily distributed in France, away from the

south, but frequent to common up the western seaboard to Brittany (Bonnier 1934, des Abbayes 1971). We have no more recent information from northern France, but understand that, as in Belgium (Mullenders 1967), it is usually viewed there as an introduction. Interestingly, Bonnier (1934) describes three varieties (vars *breviopica*, *linearis* and *nardoides* (i.e. like *Nardurus maritimus* = *Vulpia unilateralis*)), and gives the habitat of var. *linearis*, the variety that seems to fit our specimens, as "pastures by the sea".

In the British Isles, *G. fragilis* was first recorded in the wild in 1903, as a casual in Surrey and Mid-Lothian (McClintock 1972). Many of the earliest records were of casual plants from dock quaysides, waste ground and other artificial habitats, and this certainly helped to give the impression that it was an introduction. Until the 1970s the species received scant attention from botanists which was hardly surprising, given its omission from the 1st edition of *Grasses* (Hubbard 1954), and just the briefest of mentions in the 2nd edition (Hubbard 1968). Despite a minor "rush" of Irish records in the 1960s, it was only when McClintock (1972) reviewed the historical records, and in particular noted its occurrence in long-established grassland on the Isle of Wight, that British field botanists sat up and took notice. There followed a spate of new records, most of them from old, apparently unimproved and often species-rich pastures and hay meadows in southern England. Unlike so many of the early records, in these grasslands *G. fragilis* had every appearance of being native: Green *et al.* (1997), for example, expressed the view that in Somerset "as the majority of… sites are in old herb-rich pastures it is difficult to imagine it is not a native species". Thus, while most 20th century Floras dismissed *G. fragilis* as an introduction, the species account in the *New Atlas* broke with tradition, describing it more equivocally as "native or alien" (Leach 2002).

The purpose of this article is to review the history of the discovery of *G. fragilis* in the British Isles, to summarise what we now know of its distribution and ecology, and to re-assess its status in the light of this new information. We trust that the evidence presented here will, at the very least, help to explain why the *New Atlas* dared to suggest that *G. fragilis* "…might be native, at least in its core areas".

A COUNTY-BY-COUNTY REVIEW OF *G. FRAGILIS* IN THE BRITISH ISLES

The early records of *G. fragilis* in the British Isles were well summarised by McClintock (1972), who, in addition to some comment on its occurrences on the Isle of Wight, and in the Channel Islands and Ireland, listed all records, including all the casual records, then known.

In the present paper we give a résumé of the discovery of *G. fragilis* in those vice-counties that together form the core of its distribution in Britain, or in which it has been reported as occurring in old, agriculturally unimproved grassland. These are the vice-counties for which records were tentatively mapped "as if native" in the *New Atlas* (v.cc. 3, 5, 6, 7, 8, 9, 10, 11, 13, 14 & 44). We also consider the history of *G. fragilis* in the Channel Islands, where some consider it to be possibly native, and in the south of Ireland, where it is generally regarded as a recent introduction.

We do not give details of casual records here, unless they happen to be from within areas now forming part of the core range. For casual records in other vice-counties (v.cc. 1, 4, 17, 34, 41, & 74), readers should refer to McClintock (1972), but we are also aware of casual records from the following vice-counties that are additional to those given in that paper: v.c. 2 (SW94, Tregony, 1981–1988); v.c. 18 (TQ88, Daws Heath, 1948); v.c. 24 (SP91, Steps Hill, 1970+); v.c. 33 (SO81, Gloucester Docks, 1974); v.c. 59 (SJ89, 1997); v.c. 83 (NT27, Leith Docks, 1903, 1920).

A distribution map, amended and updated from the one given in the *New Atlas*, is presented in Figure 1.

V.C. 3. SOUTH DEVON

G. fragilis was first recorded in 1998, a small colony growing on a damp grass verge adjoining a minor road between Chudleigh Knighton and Bovey Tracey (SX837776). The discovery was made by Ms E. J. McDonnell, a botanist already well acquainted with the species in Somerset. In 1999 R. E. N. Smith located a second site, near Bickington, "…where it occurs in two fields on either side of the A38, and on adjacent verges (SX793727 & SX796727). It is locally abundant, even dominant in closed grassland" (Ms E. J. McDonnell, in litt. to S.J.L.).

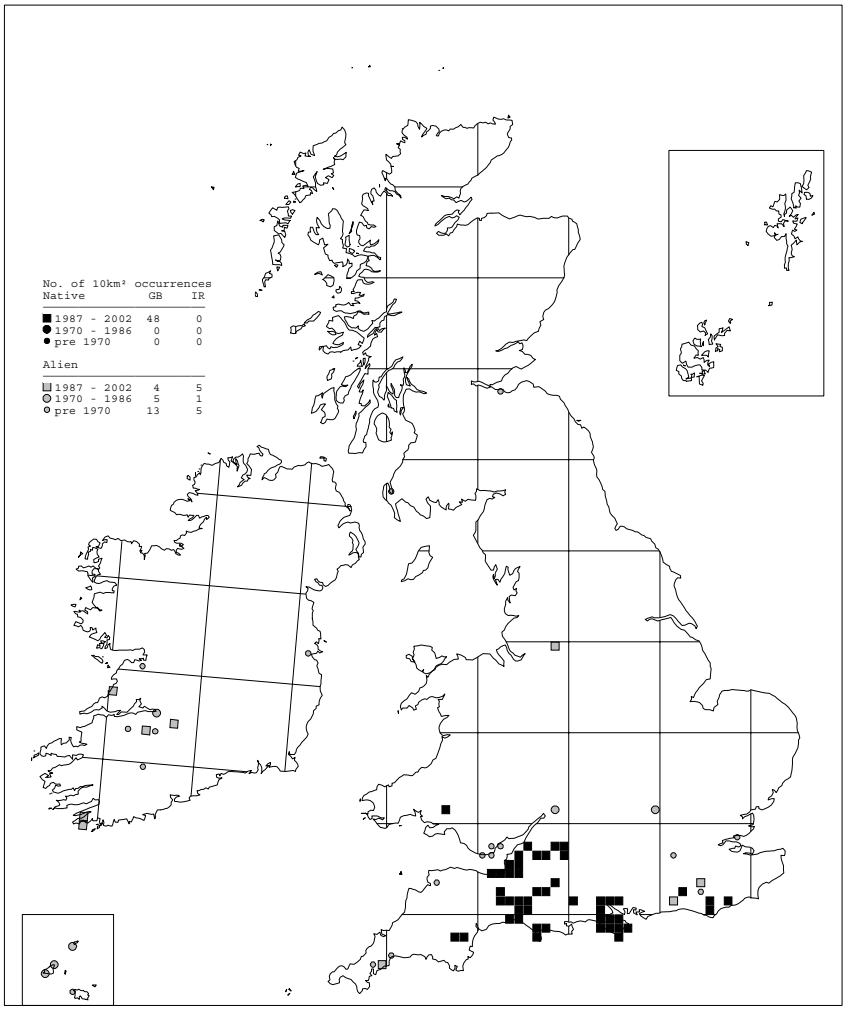

FIGURE 1. 10 km square distribution of *Gaudinia fragilis* in Britain and Ireland, amended and updated from that given in the New Atlas (Leach 2002).

V.C. 5. SOUTH SOMERSET

To anyone familiar with *G. fragilis* in v.c. 5 it seems remarkable that the earliest record of it was not until 1970, when J. G. Keylock found it growing along a ride in a forestry plantation near Haselbury Plucknett (ST491108). In 1972 the same botanist located it at a second site, about a mile away from the first, in a stand of what appeared to be recently sown grassland. Then, in 1974, he found it to be well established near Halstock (ST501087) in old species-rich grassland (now a Site of Special Scientific Interest (S.S.S.I.)) within two miles of the first site and thought to be "… probably the source of the earlier sightings" (Roe 1981). Interestingly, according to the farmer, this field "had not been ploughed in living memory" (J. G. Keylock, unpubl. note to D.A.P.), and R. G. Corns (pers. comm.) was told in the late 1970s that *G. fragilis* already occurred in the field when the present family started farming there, in the 1920s – almost half a century before it was discovered there by a botanist! John Keylock subsequently found it in more fields in the same general area, and formed the opinion that *G. fragilis* was a "…natural component of these 'ancient' neutral grasslands" (J. G. Keylock, in litt.).

From 1989 onwards field botanists in Somerset began intensive survey work for a new county Flora and they found *G. fragilis* to be a locally frequent constituent of old grasslands over a wide area of v.c. 5. By 2002 it had been recorded from at least 21 tetrads in v.c. 5, with most populations occurring in fairly species-rich hay meadows and pastures, including several S.S.S.I.s and two National Nature Reserves (Barrington Hill N.N.R. and Hardington Moor N.N.R.), and also on track-ways, green lanes and roadside banks and verges.

It is not infrequent, and locally abundant, in coastal pastures and on roadsides in the area around Hinkley Point (ST14, ST24), where it was first noted in 1985, and it appears to be spreading there. It also occurs along the northern edge of the Blackdown Hills in the Thurlbear-Barrington area (ST21, ST22 & ST31), where it is now known from numerous localities following its discovery at Barrington Hill N.N.R. in about 1990 (though we suspect it had long been present, but overlooked, at this site), and in grassland adjoining Thurlbear Wood S.S.S.I. in 1992. In both these clusters of sites, *G. fragilis* is a feature of unimproved or "semi-improved" grassland underlain by calcareous clays derived from rocks of the Lower Lias. A third cluster – including the meadows found by John Keylock in the 1970s – lies between Crewkerne and Yeovil, close to the border with Dorset (ST40, ST41, ST50 & ST51). These meadows too are on clay soils, this time overlying Fullers' Earth. All three groups of sites, along with two outliers near the eastern edge of the vice-county, are on heavy Jurassic clays prone to waterlogging in winter, but often baked dry in summer. The only record "off the clays", as far as we are aware, is from the verge of the A38 at Thurloxton, near Taunton (ST280299), where it was found in 1999 by P. R. Green.

V.C. 6. NORTH SOMERSET

The earliest records of *G. fragilis* in v.c. 6 were in 1986 and 1988, when it was found in several fields of damp neutral grassland and rushy pasture at Max Bog S.S.S.I. (ST409574), by S. M. Hedley, J. P. Woodman, T. N. Twiggs and others. One of the main colonies was described at the time as being in "pasture… on calcareous peat, scattered over several hundred square yards" (S. M. Hedley, field notes).

G. fragilis is now known from at least a dozen localities in v.c. 6 (Green *et al.* 1997; Green *et al.* 2000). These sites include two on an outlier of the Lower Lias, near Wedmore: at Barrow Hill, Panborough (ST474444), where it was recorded by P. R. Green in 1992, and at Yarley Fields (ST496447), a nature reserve of the Somerset Wildlife Trust, where it was discovered in 1998 by Mrs A. W. Bodley. Interestingly, she noted (in litt. to S.J.L.) that, "…I see from my records that I first found *Gaudinia* [at Yarley] on May 15th, just after we'd been to Max Bog – otherwise I probably wouldn't have recognised it". A survey of Yarley Fields in 1999 by S.J.L. and Somerset Rare Plants Group showed *G. fragilis* to be locally abundant across 4 ha of species-rich grassland, and present too along the verges of an adjoining green lane. It was also found nearby, around the (unimproved) fringes of several fields that had been recently re-seeded.

There are three recent records of *G. fragilis* from grasslands on the Carboniferous limestone: at Uphill S.S.S.I. (ST316581) from 1993 onwards (Dr N. J. Chaffey, P. R. Green, S. J. Parker, S.J.L. and others), The Perch S.S.S.I. (ST4555) in 1997 (M. J. Edgington), and Hellenge Hill (ST346574) in 1999 (Ms E. J. McDonnell/Somerset Rare Plants Group). It was also seen in 1999 in a hay field near Publow (ST619657), where it was reported to occur in "species-rich, semi-improved calcareous grassland" with *Anacamptis pyramidalis* and *Oenanthe pimpinelloides* (P. Quinn, unpubl. site report); and, again in 1999, in short grassland beside an old railway line at Easton-in-Gordano (ST505759) (Green *et al.* 2000; I. P. Green in litt. to D.A.P.).

As in v.c. 5, it continues to be found at new sites, the most recent being in 2002 when it turned up in a new 10 km square "…near junction 22 of the M5, on the side of a track beside Burnham Moor Lane (ST337485)" (Ms E. J. McDonnell, in litt. to S.J.L.).

Regarding its status in v.c. 6 and beyond, Green *et al.* (2000) think that *G. fragilis* is more likely to be a recent introduction than an overlooked native, suggesting that "it comes in with grass seed or bird feed and becomes naturalised if it reaches suitable habitats".

V.C. 7. NORTH WILTSHIRE

The first record in Wiltshire was made by J. D. Grose in 1951, from waste ground at Sandridge Hill, near Melksham (ST96), and it was recorded nearby in a "carrot field" and "allotments", by Miss M. McC. Webster, in 1957. Mrs J. Swanborough was the first to find it in grassland, when she came across it in 1978 in "a damp, grazed meadow", again near Melksham, while Mrs O. M.

Stewart noted it in pasture "near Melksham" (possibly the same site?) in 1980. Between 1984 and 1989 it was recorded by D. E. Green from a "cluster" of unimproved meadows in the Bowden Hill-Frogditch area (ST96), along with further sites across ST96 and two neighbouring 10 km squares (ST87 & ST97), comprising 21 fields in all (Green 1990; Gilham 1993). "Of the 21 fields known, nine are improved leys or recent permanent pasture; eleven are species-rich, semi-improved or unimproved neutral pasture; the final site is a hill pasture containing eighteen grass species… The majority of the localities – thirteen in fact – lie on the heavy Jurassic clays [Oxford Clay]. A further six are on the junction of the clay and the greensand. One site is on the oolitic limestone" (Green 1990).

V.C. 8. SOUTH WILTSHIRE

The only record is from the Kimmeridge Clay, at West Swainsford, near Mere (ST807313), where it was found in 1995 by Mrs P. Palmer and P. Wilson during an English Nature-funded survey of Wiltshire grasslands. P. Wilson (in litt. to D.A.P.) reported that "…it was growing in superb quality MG5a, *with every appearance of being native*" [our italics].

V.C. 9. DORSET

The first record of *G. fragilis* in v.c. 9 was in 1980, at Chickerell (SY646800), when Dr H. J. M. Bowen found it in an area of damp neutral grassland (now built over) about 2 km from the sea (Bowen 1981). In 1989 Miss A. Horsfall discovered it beside a green lane in the Marshwood Vale, at Mutton Street (SY391989), while in 1994 D. E. Green and D.A.P. found it in north Dorset in "semi-improved" grassland at Westbrook Farm (ST783252), not far from to the v.c. 8 site at West Swainsford.

Then, in the late 1990s, D.A.P. and others found it to be far more widespread than previously thought. It occurred not only in several old meadows overlying the Liassic clays in the Marshwood Vale but also on the Oxford Clay, in numerous grassy herb-poor (and possibly semi-improved and/or re-seeded) fields along the coast, from a single site to the west of Weymouth (SY658770), and then in many fields over a 4 km stretch from Bowlease (SY705819) to Ringstead (SY749814). In 1998 J. H. S. Cox located it on Tertiary clays near Edmonsham (SU074105). The following year, Ms L. Warman discovered *G. fragilis* at Marshwood (SY385982), where it was said to be "frequent in hay meadows and quite common but less obvious in cattle-grazed pastures" (Ms L. Warman, field card), while Mrs F. Greenshields saw it in quantity nearby in a meadow at Crabbs Bluntshay (SY415970); recent searches by D.A.P. have turned it up in at least six other fields in this area. Almost all the Dorset sites are on heavy clay soils.

The spate of new records since 1998 could indicate that *G. fragilis* is becoming more frequent in v.c. 9, though it is just as likely that the apparent increase is due to botanists "getting their eye in"; indeed, many of these sites have large and well-established populations that must surely have been present for some considerable time prior to their discovery. Regarding its status, Bowen (2000) describes the grass as "rare and inconspicuous, *but apparently native*, in fairly damp neutral grassland on clay" [our italics].

V.C. 10. ISLE OF WIGHT

The early history of *G. fragilis* in v.c. 10 was summarised by McClintock (1972). Briefly, the first record for the island was in 1917, when J. W. Long discovered it in a meadow near Ryde (SZ59), where it "quickly became firmly established" (Bevis *et al.* 1978). In 1937 it was collected by Miss G. Bullock from another meadow in the same 10 km square, at Havenstreet, in which there was "quite as much *Gaudinia* as any other grass" (McClintock 1972). From 1950 onwards the grass was recorded from numerous other localities overlying the (often lime-enriched) Tertiary clays to the north of the chalk ridge.

One of the best sites in the early 1970s was a 16-acre field "that had not been ploughed since the current farming family took over the farm in 1919. Here the *Gaudinia* is not merely present each year, but dominant in some parts" (McClintock 1972). Several populations lie within S.S.S.I.s or N.N.R.s, including Locks Farm Meadow S.S.S.I. (SZ449908), "a small [2·3 ha] meadow situated on poorly draining neutral clay soils", which has "…been managed without the application of herbicide or artificial fertiliser. [This site] represents one of only six areas of this type of meadow on the Isle of Wight" (English Nature, unpubl. S.S.S.I. citation). Other species of note on this S.S.S.I. include *Spiranthes spiralis, Genista tinctoria, Oenanthe pimpinelloides, Ophioglossum*

vulgatum and *Silaum silaus*, along with one of the largest populations on the island of *Orchis morio*.

G. fragilis certainly seems to have become more frequent on the Isle of Wight in recent decades, and is now a prominent component of neutral grasslands (and green lanes and road verges) on the clay belt: by 2000 it had been recorded from at least 39 1-km squares, with the main concentration of sites being to the west of Newport, in the area around Shalfleet, Newtown, Porchfield and Calbourne (SZ48, SZ49).

There has been some uncertainty, and not a little conjecture, as to its origins and status on the island. The then vice-county recorder, B. Shepard, wrote to D. McClintock, "it is not conceivable that it existed in anything like the present abundance… and was overlooked by earlier recorders" (McClintock 1972). Thus, the general consensus – despite its occurrence in old grassland – is that the grass must have been originally introduced. As B. Shepard (in litt. to D. McClintock) commented, "it may be significant that [the] first record was during the First World War, when there was considerable movement of men and material between here and the Middle East".

V.C. 11. SOUTH HAMPSHIRE

The first record was in 1993, when J. Rowe discovered "a small patch" of *G. fragilis* in grassland on Tertiary deposits at Curdridge (SU5213) (Rowe 1995; Brewis *et al.* 1996). The field had been horse-grazed since before the First World War, and "no sprays or fertilizers have been applied; [it] has merely been spring grazed and topped… The field is probably directly descended from Curdridge Common… [and] is most notable for [the] large numbers, certainly hundreds, of *Orchis morio*" (J. Rowe, unpubl. report), along with abundant *Danthonia decumbens*, *Rhinanthus minor* and *Oenanthe pimpinelloides*. A second population found in 1997 at Hounsdown (SU353117), again by John Rowe, was in "horse pasture in…fairly rich area of grassland, on clay" (Rowe 2001). It has since been located at two further sites in v.c. 11, by P. Stanley in 1998 (SU475148), and by Miss M. E. Young in 1999 (SU344093).

Regarding its status in Hampshire, Brewis *et al.* (1996) listed *G. fragilis* as a "colonist", which they defined as "an invader [that] arrived in the county unintentionally as a result of human activity… and now normally present in open and artificial habitats". However, John Rowe (in litt. to D.A.P.) observed that the sites at Curdridge and Hounsdown were both "high quality neutral grassland, and the *Gaudinia* was growing in 'rough', but by no means degraded or disturbed, closed perennial vegetation".

V.C. 13. WEST SUSSEX

There are three records. B. Bishop discovered *G. fragilis* in a "new car park area" at Wiston (TQ165128) in 1998, while A. W. Jones, again in 1998, found it in "nice" grassland at Cowfold (TQ229205) that looked as if it had been sown in the not too distant past. A. W. Jones located it at a third site, at Twineham (TQ240213), in 1999, in an area of "semi-improved" grassland. The first of these records was mapped as "alien" in the *New Atlas*, but its occurrence in TQ22 was mapped, perhaps a little optimistically, "as if native".

V.C. 14. EAST SUSSEX

There was a relatively early record of *G. fragilis* by D. W. Parry, from a roadside at Camp Hill, Ashdown Forest (TQ4628) in 1960 (McClintock 1972). In 1993 T. C. G. Rich found it in a car park, again in Ashdown Forest (TQ469307) and, while presumed to be "casual" at this site, it was still present in 2000. More interestingly, Ms K. Ryland discovered it in 1998 in neutral grassland on the Wealdan clays at Lower Dicker (TQ550108) and Upper Dicker (TQ553102). Kate Ryland (in litt. to S.J.L.) commented that, at Lower Dicker, it "certainly looks native" but, although the fields have not been cultivated or re-seeded in living memory, it is possible that *G. fragilis* could have been introduced "in the early part of the century under the previous owner". Associated species at Lower Dicker include *Genista tinctoria*, *Ophioglossum vulgatum* and *Silaum silaus*. Since the *New Atlas* it has been found in improved grassland at Polegate (TQ577060), and on a newish road verge, adjoining old grassland, near Crowhurst (TQ778118).

Regarding its status in v.cc. 13 and 14, Briggs (2001) noted that "…at some locations, especially Upper and Lower Dicker, [*G. fragilis*] occurs in meadows that have been unimproved for more than 130 years, giving rise to the possibility that *it could be native*" [our italics].

V.C. 44. CARMARTHEN

The first record of *G. fragilis* for v.c. 44 was in 1942, when it was discovered by F. E. Williams to be "fairly abundant in a wettish hay meadow" (McClintock 1972). Unfortunately no locality details exist for this record. However, in 1988 Ms S. M. Gooch found it in a "flowery meadow" at Cefn Goleu, Garnant (SN696139). The site also supported populations of several other interesting species, including *Carum verticillatum*, *Cirsium dissectum* and *Sanguisorba officinalis*. There are no other recent records, and these are the only Welsh records from apparently unimproved grassland; the Garnant record, despite being some considerable distance from the core range in England, was mapped "as if native" in the *New Atlas*.

V.C. 113. CHANNEL ISLANDS

The first record of *G. fragilis* in the Channel Islands was in 1928, when A. J. Wilmott and I. A. Williams found it "in great quantity in part of the Grande Mare, Guernsey" (WV27). It was re-found there in 1971 (McClintock 1972). *G. fragilis* turned up at a second site in Guernsey in 1970, when Mrs P. Garratt found it in short, sandy turf near Doyle Rock on L'Ancresse Common (WV38). "It would be surprising if this grass had not been here for some considerable time, in an area moreover where no grass mixture would have been sown and no other possible introductions are to be seen" (McClintock 1972). There have been no more recent records.

It was discovered on Alderney in 1933, by A. B. Jackson, "in a grassy cutting in a field near Whitegates" where it was "associated with *Lolium* [and] apparently well established" (WA50). It was also recorded from two further sites on Alderney (McClintock 1972): from 1963 onwards (but now extinct) on rough, disturbed ground "near the States Dairy" (WA50); and in 1967 on a roadside at Bray (WA50). We do not have any more recent records than these for Alderney.

On Jersey there have been just two records: in sandy turf at Pont Marquet, in 1954 (Mrs F. le Sueur, Miss K. Rob and D. McClintock), and on a rubbish dump at St Ouen, in 1958 (D. McClintock) (McClintock 1972; Le Sueur 1984). Neither population persisted.

These records suggest that *G. fragilis* has probably only occurred as a "casual" in the Channel Islands, though its status in a few of the more "native-looking" sites, especially those on Guernsey, is hard to assess.

IRELAND

The first record of *G. fragilis* in Ireland was as a casual at Ringsend, near Dublin (O13) in 1906 (Scannell 1973). There were no further sightings until 1963, when Miss M. Scannell and J. E. Donovan discovered it growing on a road verge in West Cork (v.c. H3), at Toomore, west of Schull (V83). Scannell (1964) speculated that its presence there could have been "due to the activities of Spanish and French fishing trawlers in the area". In 1965 three further sites were found in Co. Limerick (v.c. H8), in an "intensively farmed pasture" at Patrickswell (R55), near Croom (R53), and at Newcastle West (R23) (O'Sullivan & White 1967). McClintock (1972) noted that, while "one of the three stations in Co. Limerick, so Dr A. M. O'Sullivan tells me, has been recently re-seeded… two were very old pastures", although the age of the latter was subsequently disputed. At about this time it was also found in Mid Cork (v.c. H4), at Lombardstown, west of Mallow, on the edge of a "relatively new ley" (W49) (Farragher 1968; McClintock 1972). Finally, in 1966 Miss E. M. Booth found *G. fragilis* in Co. Clare (v.c. H9), on a "roadside at 300 ft… four miles S.W. of Kinvarra" (M30) (Booth 1967).

G. fragilis has evidently persisted at several of these sites, including that at Toormore (V83) where it was seen again in 1992 (Ó Críodáin 1992). Meanwhile, there have been recent records of it from three further localities in v.cc. H8 and H9: on a B.S.B.I. Field Meeting at Cleedagh Bridge, v.c. H9 (R039797), in 1988 (Reynolds & Skeffington 1989); "by main road" near Pallas Grean, v.c H8 (R780450), in 1997 (Reynolds 1998); and at a second site near Croom (R43), in 2000, "numerous plants on compacted gravelly soil beside unoccupied house, growing with common native grasses – not obvious how it got there" (Ms S. Reynolds).

Despite its occurrence in (arguably) old grassland, *G. fragilis* is considered by most Irish botanists to be alien in the south of Ireland (Ms M. J. P. Scannell, in litt. to D.A.P.). It is widely believed to have arrived there as a contaminant of grass-seed. As McClintock (1972) noted, "Miss Scannell sent me a copy of a letter… from Mr J. Mullin, of the Irish seed-testing station, who had reports of it from other counties, e.g. Wexford, and expected it to be much more widespread. He

recorded that in the early 1960s some inferior rye grass seed had been 'dumped' from Portugal with such weeds as *Gaudinia* and *Chrysanthemum myconis* [= *Coleostephus myconis*]. The trade was stopped, but started again for a short while in Dutch bags via Holland".

HABITATS AND PLANT-COMMUNITIES

GENERAL OBSERVATIONS

G. fragilis occurs predominantly in species-rich agriculturally unimproved or "semi-improved" neutral grasslands. It was this, more than anything else, that led us to toy with the notion that *G. fragilis* might be native in the British Isles, at least in parts of southern England, and persuaded us to take a fresh look at the evidence (Leach & Pearman 1997). These grasslands are generally managed as hay meadows or pastures, with hay meadows having their aftermath grazed by cattle in the traditional fashion. Pastures are usually grazed year-round by cattle or horses (rarely sheep), with additional grazing pressure at some sites from rabbits. A substantial number of sites are on roadsides and "green lanes", and these are frequently left largely unmanaged, apart from periodic mowing and hedge trimming. Most sites are in fairly open and sunny situations; *G. fragilis* avoids tall, rank grassland, and shows a distinct preference for shorter, rather "thin" or "patchy" swards. It tends to occur on neutral to calcareous clay soils that are frequently wet in winter, but quickly dry out in summer.

All the Floras we have consulted suggest that *G. fragilis* is an annual, though *Flora Europaea* (Tutin *et al*. 1980) describes the genus as a whole as "annual or biennial" and Sell & Murrell (1996) refer to it as comprising "annual herbs *sometimes lasting a few years*" [our italics]. In the British Isles, at least, several observers – ourselves included – have come to the conclusion that *G. fragilis* frequently behaves as a perennial, though possibly only a short-lived one (McClintock 1967; Bevis *et al.* 1978; B. Edwards, E. J. Clement & C. Pope pers. comm.).

When we began this investigation there was little information available on the species composition of grasslands supporting *G. fragilis*, and the species fails to get a single mention in the grassland accounts of the National Vegetation Classification (N.V.C.) (Rodwell 1992). However, our impression was that most stands containing *G. fragilis* belonged to the "mesotrophic grassland" (MG) section of the N.V.C., and we had records of it from vegetation that was clearly referable to MG5, *Cynosurus cristatus-Centaurea nigra* grassland.

QUADRAT SURVEY

To provide a fuller description of our "*Gaudinia* grasslands", between 1997 and 2001 we recorded a total of 102 quadrats from 25 sites in S. Devon (v.c. 3), Somerset (v.cc. 5 and 6), N. Wiltshire (v. c. 7), Dorset (v.c. 9) and the Isle of Wight (v.c. 10). Quadrats of 2 × 2m (occasionally 4 × 1m along road verges) were located non-randomly within patches of homogenous vegetation containing *G. fragilis*, care being taken to ensure that they were representative of the wider vegetation in which they occurred.

An initial examination of the quadrat data confirmed that *G. fragilis* generally occurred in fairly species-rich grassland. The average number of species per quadrat was 26 (range 10–53), slightly higher than the figure for MG5 in Rodwell (1992). A total of 192 species (including bryophytes) were recorded in the quadrats; 21 were frequent – that is, they occurred in more than 40% of the quadrat sample – and, apart from *G. fragilis*, there were nine "constants" (in >60% of quadrats), namely *Anthoxanthum odoratum, Cynosurus cristatus, Festuca rubra, Holcus lanatus, Lolium perenne, Lotus corniculatus, Ranunculus acris, Trifolium pratense* and *T. repens*. Of these, only *L. perenne* and *R. acris* are not MG5 constants, although they do appear as constants in the MG5a *Lathyrus pratensis* sub-community, the commonest and most widely distributed of the three sub-communities (Rodwell 1992).

One further point: grasslands containing *G. fragilis* are composed almost entirely of native species. Indeed, of the 192 species recorded just three are aliens – two archaeophytes, *Geranium dissectum* (18 quadrats) and *Picris echioides* (four quadrats), and one neophyte, *Crepis vesicaria* (one quadrat).

VEGETATION CLASSIFICATION

The quadrat data were examined more closely by means of a two-way indicator species analysis (TWINSPAN) (Hill 1979; Gauch & Whittaker 1981), and we have used this to distinguish several floristically distinct grassland types.

The indicator species at divisions 1 and 2 of TWINSPAN are shown in Fig. 2. The first division distinguishes a large group of samples containing *Holcus lanatus*, often at high cover, and lacking *Leontodon saxatilis, Medicago lupulina, Daucus carota* and *Agrimonia eupatoria*. This group (Group A) is generally "grassier" – with several graminoids, including *G. fragilis*, frequently occurring at high cover – than the second group (Group B). The species composition of each of the four final groups of division 2 of the TWINSPAN analysis is summarised in Table 1.

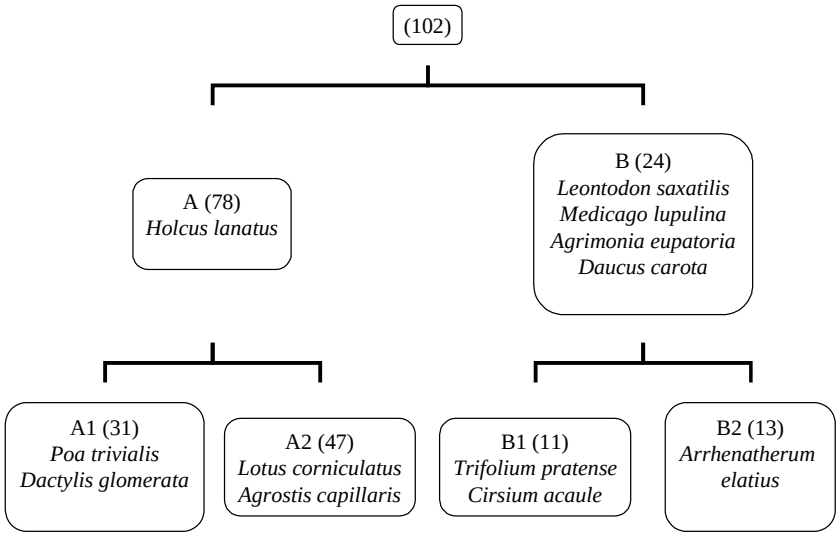

FIGURE 2. Indicator species of the TWINSPAN hierarchy for the first two divisions. The number of quadrat samples in each group is shown in parentheses.

Group A1 (31 samples) is the least species-rich (average of 21 species/quadrat), being distinguished from Group A2 by the high frequency, and occasionally high cover, of *Poa trivialis, Ranunculus repens, Alopecurus pratensis* and *Dactylis glomerata*. There are also occasional records of *Heracleum sphondylium, Arrhenatherum elatius* and *Vicia cracca*, all of which are strongly preferential to Group A1 and rare or absent in Group A2. Seventeen quadrats in Group A1 were from roadside sites, while several others were from "semi-improved" fields or the unimproved borders of fields that had been otherwise agriculturally improved (re-seeded).

Group A2 (47 samples) is best distinguished from Group A1 by the high constancy of *Agrostis capillaris, Centaurea nigra, Festuca rubra, Lotus corniculatus* and *Prunella vulgaris*. In comparison with the other TWINSPAN groups, *Hordeum secalinum, Luzula campestris, Oenanthe pimpinelloides* and *Rumex acetosa* are all preferential to Group A2. Other less frequent species that are nonetheless helpful in distinguishing this group from Group A1 include *Briza media, Carex flacca, Leucanthemum vulgare* and *Phleum bertolonii*. Group A2 tends to be more species-rich than Group A1 (average of 25 species/quadrat), although samples here still tend to be less rich, and more "grassy", than those in Group B. Group A2 quadrats typically came from unimproved hay meadows and pastures – only one quadrat was from a roadside – including several important nature conservation sites, e.g. Barrington Hill N.N.R. and Grove Farm S.S.S.I. (S. Somerset), and Newtown N.N.R. and Locks Farm Meadow S.S.S.I. (Isle of Wight).

Group B1 (11 samples) is best distinguished from the other TWINSPAN groups, and in particular from Groups A1 and A2, by the high frequency of species indicative of more calcareous soils. For example, *Carex flacca* and *Briza media* – both of which helped to distinguish more species-rich Group A2 samples from Group A1 – occur as constants here. *Cirsium acaule* and *Plantago media* are restricted to Group B1, while *Galium verum, Ononis repens, Pilosella officinarum, Pimpinella saxifraga* and *Thymus praecox* are occasional but preferential to this group. Of the grasses, *Trisetum flavescens* occurs here at high frequency and is strongly preferential, while *Bromopsis erecta* and *Helictotrichon pratense* are rare but restricted to this group. *G. fragilis* does not attain here anything like the cover it does in Groups A1 and A2. This is the most species-rich of the TWINSPAN groups (average of 37 species/quadrat). Group B1 samples were recorded from a handful of well grazed or cut-and-grazed unimproved grasslands in Somerset – including Uphill S.S.S.I., Thurlbear Wood S.S.S.I. and the Somerset Wildlife Trust nature reserve at Yarley Fields – and from one site on the Isle of Wight.

TABLE 1. SPECIES COMPOSITION OF GRASSLAND CONTAINING *GAUDINIA FRAGILIS*. ONLY SPECIES WHICH ARE CONSTANT OR FREQUENT (>40% FREQUENCY) IN AT LEAST ONE TWINSPAN GROUP ARE INCLUDED. DOMIN COVER-ABUNDANCE RANGES ARE SHOWN IN BRACKETS

	TWINSPAN group (see Fig. 2)				
	A1	**A2**	**B1**	**B2**	**Total**
Gaudinia fragilis	V (2–7)	V (2–7)	V (2–4)	V (1–4)	V (1–7)
Trifolium pratense	IV (1–6)	V (1–5)	V (2–4)	IV (1–4)	V (1–6)
Lolium perenne	IV (2–7)	IV (1–5)	IV (2–4)	III (1–3)	IV (1–7)
Cynosurus cristatus	IV (1–7)	V (1–6)	V (1–6)	II (1–4)	IV (1–7)
Holcus lanatus	V (2–8)	V (1–8)	III (1–3)	II (2–3)	IV (1–8)
Anthoxanthum odoratum	IV (1–5)	V (1–5)	II (1–3)	II (1–5)	IV (1–5)
Ranunculus acris	IV (1–4)	V (1–5)	II (1–3)	III (1–3)	IV (1–5)
Trifolium repens	III (1–5)	V (1–6)	IV (1–3)	II (2–4)	IV (1–6)
Festuca rubra	III (2–6)	V (1–6)	V (2–4)	V (3–6)	IV (1–6)
Lotus corniculatus	II (1–3)	IV (1–6)	V (2–4)	V (1–4)	IV (1–6)
Poa trivialis	V (1–7)	II (1–4)	I (1)	I (1)	II (1–7)
Ranunculus repens	III (1–7)	I (1–4)	I (1)	II (1–2)	II (1–7)
Alopecurus pratensis	III (1–4)	II (1–4)			II (1–4)
Hordeum secalinum	II (3–6)	III (1–6)	I (1–2)	I (1)	II (1–6)
Luzula campestris	I (1)	III (1–3)			II (1–3)
Oenanthe pimpinelloides	II (1–4)	III (1–4)	I (2)	I (1)	II (1–4)
Rumex acetosa	II (1–3)	III (1–4)		I (1)	II (1–4)
Ranunculus bulbosus	II (1–4)	III (1–4)	V (3–4)	III (1–4)	III (1–4)
Leucanthemum vulgare	I (1–5)	III (1–4)	IV (2–4)	III (1–3)	III (1–5)
Bellis perennis	II (1–3)	II (2–3)	V (1–3)	III (1–3)	II (1–3)
Brachythecium rutabulum	I (3–4)	I (2–4)	IV (1–3)	I (2)	II (1–4)
Trisetum flavescens	I (1–3)	II (1–4)	IV (1–4)	II (1–2)	II (1–4)
Achillea millefolium	II (1–2)	II (1–5)	IV (1–3)	II (1–3)	II (1–5)
Phleum bertolonii	I (1–2)	II (1–4)	IV (2–3)	II (1–3)	II (1–4)
Poa pratensis	I (1–4)	II (1–6)	III (1–2)	I (1)	II (1–6)
Briza media		II (2–4)	IV (1–4)	I (2)	II (1–4)
Leontodon saxatilis		I (2–4)	V (1–5)	III (1–3)	II (1–5)
Leontodon autumnalis	I (1–3)	I (1–3)	III (2–3)	II (1–2)	I (1–3)
Convolvulus arvensis	I (2–4)	I (3)	IV (1–2)	II (2–3)	I (1–4)
Cirsium acaule			IV (1–4)		I (1–4)
Plantago media			IV (1–3)		I (1–3)
Sanguisorba minor			III (1–5)	I (1–4)	I (1–5)

TABLE 1 CONTINUED

	A1	A2	B1	B2	Total
Taraxacum agg.	II (1–5)	III (1–4)	III (1–3)	V (1–3)	III (1–5)
Arrhenatherum elatius	II (1–4)	I (1)		IV (1–5)	II (1–5)
Agrostis stolonifera	II (2–5)	I (1–4)	II (1–3)	IV (2–5)	II (1–5)
Leontodon hispidus		I (2–4)	I (1–5)	III (1–3)	I (1–5)
Rubus fruticosus agg.	I (1–2)			IV (1–3)	I (1–3)
Pseudoscleropodium purum			I (2–3)	III (2–5)	I (2–5)
Dactylis glomerata	V (1–4)	II (1–4)	IV (1–3)	V (1–5)	III (1–5)
Cerastium fontanum	III (1–4)	III (1–3)	II (1–2)	I (2–3)	III (1–4)
Agrostis capillaris	I (2–5)	IV (1–8)	IV (2–3)	I (2–3)	III (1–8)
Centaurea nigra	II (1–7)	IV (1–4)	V (2–5)	II (1–4)	III (1–7)
Prunella vulgaris	II (1–4)	IV (1–4)	V (1–4)	III (1–3)	III (1–4)
Potentilla reptans	III (1–4)	III (1–4)	IV (2–3)	IV (2–3)	III (1–4)
Carex flacca	I (1–4)	III (1–5)	V (1–6)	IV (1–6)	III (1–6)
Plantago lanceolata	III (1–6)	III (1–5)	V (1–6)	V (1–7)	III (1–7)
Trifolium dubium	II (1–5)	III (1–4)	III (1–3)	I (1–3)	II (1–5)
Agrimonia eupatoria	I (1–2)	I (1–3)	IV (1–3)	IV (1–4)	II (1–4)
Medicago lupulina	I (1–4)		IV (2–4)	IV (1–4)	II (1–4)
Daucus carota	I (2)	I (1)	IV (1–4)	IV (1–2)	I (1–4)
Number of samples	31	47	11	13	102
Number of species/sample	21 (12–33)	25 (10–39)	37 (25–50)	32 (20–53)	26 (10–53)

Constancy classes. I: 'sparse', recorded in ≤20% of quadrats; II: 'occasional', 21–40%; III: 'frequent', 41–60%; IV: 'constant', 61–80%; V: 'constant', 81–100%.
Domin cover-abundance values. 1: rare, <4% cover; 2: occasional, <4% cover; 3: frequent, <4% cover; 4: 4–10%; 5: 11–25%; 6: 26–33%; 7: 34–50%; 8: 51–75%; 9: 76–90%; 10: >90%.
Species are divided into blocks as follows: first block, overall constants (though no necessarily constant in all four TWINSPAN groups); second block, Group A1 preferentials; third block, Group A2 preferentials; fourth block, Group B1 preferentials; fifth block, Group B2 preferentials; sixth block, species which are not preferential to any one TWINSPAN group, are frequent and/or constant in two or more TWINSPAN groups, but which are not constant overall.

Group B2 (13 samples) is distinguished from Group B1 by the frequent presence (generally at low cover) of *Arrhenatherum elatius*, and with *Taraxacum* agg., *Agrostis stolonifera*, *Leontodon hispidus*, *Rubus fruticosus* and *Pseudoscleropodium purum* as additional preferentials. There are occasional records of *Festuca arundinacea*, *Elytrigia repens*, *Lathyrus nissolia*, *Knautia arvensis* and *Linum bienne*, all of which help to distinguish this group from Group B1. Group B2 was mainly recorded from roadsides and under-managed, but still herb-rich, grasslands in Somerset, especially in the areas around Hinkley Point and Thurlbear-Barrington. Group B2 thus occurs in similar situations to Group A1 – which also has occasional records of *A. elatius* and constant *Dactylis glomerata* – but Group B2 is more species-rich (average of 32 species/quadrat) and has a stronger representation of calcicoles.

From the above, we suspect that *management* is an important determinant of the species composition in grasslands containing *G. fragilis*. A lack of grazing on roadsides and, in meadows and pastures, a degree of agricultural improvement, appear to be two of the main factors leading to the development of Group A1 grasslands as opposed to Group A2; equally, Group B2 is, in essence, a "less managed" (ungrazed or lightly grazed) version of Group B1.

N.V.C. COMMUNITIES

Quadrat samples were assigned to N.V.C. communities/sub-communities with the aid of the published keys (Rodwell 1991, 1992) and the computer programs MATCH, version 2 (Malloch 1997) and TABLEFIT, version 1 (M. O. Hill, unpubl.). It often proved impossible to assign quadrats neatly to a particular community or sub-community, and many stands were considered to be intermediate between two N.V.C. categories.

The relationships between the TWINSPAN-derived grassland types and the various N.V.C. communities, sub-communities and "intermediates" are summarised in Table 2. Nine of the 14 N.V.C. categories, and 81·2% of the quadrat samples, were either MG5 or intermediate between MG5 and another community, while exactly half these quadrats were assigned to MG5a, the *Lathyrus pratensis* sub-community of the *Cynosurus cristatus-Centaurea nigra* grassland community. This sub-community appears to be largely analogous to our Group A2, although the latter also included a few quadrats referred to other N.V.C. categories, including several from wet grassland that were judged to be intermediate between MG5 and either MG9, *Holcus lanatus-Deschampsia cespitosa* grassland, or MG8, *Cynosurus cristatus-Caltha palustris* grassland. One quadrat, from Max Bog S.S.S.I. (N. Somerset), was quite unlike the rest and – despite lacking *Juncus subnodulosus* – appeared to be floristically closest to M22b, the *Briza media-Trifolium* spp. sub-community of the *J. subnodulosus-Cirsium palustre* fen-meadow community.

In contrast, none of the samples in Group B1 were assigned to MG5a. Not surprisingly, given the large contingent of calcicoles, Group B1 mainly comprised quadrats referable to MG5b, the *Galium verum* sub-community of the *Cynosurus cristatus-Centaurea nigra* grassland, or to an intermediate category between MG5b and the calcicolous community CG3, *Bromus erectus* [=*Bromopsis erecta*] grassland. There was also one sample, from the Carboniferous limestone at Uphill S.S.S.I., which was intermediate between CG1, *Festuca ovina-Carlina vulgaris* grassland and CG2, *F. ovina-Avenula pratensis* [=*Helictotrichon pratense*] grassland.

Group A1 seems to encompass a wide array of N.V.C. types, including less species-rich examples of MG5a, but there does appear to be a slight bias towards MG1, *Arrhenatherum elatius* grassland (especially on roadsides), and MG6, *Lolium perenne-Cynosurus cristatus* grassland (in "semi-improved" meadows and pastures). Two road verge samples were tentatively assigned to MG7, *Lolium perenne* grassland.

Group B2 also shows a slight bias towards MG1, but three samples here were assigned to MG5b, while the two intermediate samples between MG1 and MG5 were floristically much closer to MG5b than MG5a.

INFLUENCE OF GEOLOGY

Grassland management is clearly important, but an obvious floristic difference between quadrat samples at the first division of the TWINSPAN (i.e. between Groups A and B) was the much higher frequency of calcicoles in Group B. This suggests that soils, and therefore underlying geology, could be having an influence on species composition.

This is indicated in Table 3, which summarises the occurrence of quadrat samples within each TWINSPAN group across the various geological formations encountered during the quadrat survey. As already noted, most grassland supporting *G. fragilis* overlies heavy clay soils. However, whilst Group A samples occurred on almost all geological formations, they were clearly predominantly on the Tertiary clays and Oxford Clay. In contrast, Group B samples were centred on the calcareous clays of the Lower Lias, with outliers on the Fullers' Earth and Carboniferous limestone, and a single sample from a Tertiary deposit – the Bembridge Limestone and Marls – on the Isle of Wight.

DISCUSSION

When confronted by *G. fragilis* growing in what appears to be an ancient, herb-rich and agriculturally unimproved meadow, it is hard not to imagine that it must be native there. As we have discovered, there is a wide scatter of such sites across southern England, and a wide scatter too of puzzled botanists, each of them wrestling with the apparent contradiction between their own experience of the grass and the general consensus of the Floras that it is a recent, albeit well established, introduction. Here we examine the evidence for and against it being considered a native species.

TABLE 2. NUMBER (AND PERCENTAGE) OF QUADRAT SAMPLES FROM EACH TWINSPAN GROUP ASSIGNED TO DIFFERENT N.V.C. COMMUNITIES AND SUB-COMMUNITIES

N.V.C. code	N.V.C. community/sub-community (Rodwell 1991, 1992)	TWINSPAN group (see Fig. 2)				
		A1	**A2**	**B1**	**B2**	Totals
MG1a + MG1e	*Arrhenatherum elatius* grassland, *Festuca rubra* and *Centaurea nigra* sub-communities	3 (9·7%)	-	-	4 (30·8%)	7 (6·9%)
MG1/MG5	Stands intermediate between *Arrhenatherum elatius* grassland and *Cynosurus cristatus-Centaurea nigra* grassland	8 (25·8%)	-	-	2 (15·4%)	10 (9·8%)
MG5a	*Cynosurus cristatus-Centaurea nigra* grassland, *Lathyrus pratensis* sub-community	7 (22·6%)	32 (68·1%)	-	2 (15·4%)	41 (40·2%)
MG5b	*Cynosurus cristatus-Centaurea nigra* grassland, *Galium verum* sub-community	1 (3·2%)	-	6 (54·5%)	3 (23·1%)	10 (9·8%)
MG5a/MG5b	*Cynosurus cristatus-Centaurea nigra* grassland, stands intermediate between *Lathyrus pratensis* and *Galium verum* sub-communities	-	3 (6·4%)	1 (9·1%)		4 (3·9%)
MG5b/CG3	Stands intermediate between *Cynosurus cristatus-Centaurea nigra* grassland, *Galium verum* sub-community and *Bromus erectus* grassland	-	-	3 (27·3%)	-	3 (2·9%)
CG1/CG2	Stands intermediate between *Festuca ovina-Carlina vulgaris* grassland and *Festuca ovina-Avenula pratensis* grassland	-	-	1 (9·1%)	-	1 (1·0%)
MG5a/MG5c	*Cynosurus cristatus-Centaurea nigra* grassland, stands intermediate between *Lathyrus pratensis* and *Danthonia decumbens* sub-communities	-	2 (4·3%)	-	1 (7·7%)	3 (2·9%)
MG5c/MG9	Stands intermediate between *Cynosurus cristatus-Centaurea nigra* meadow, *Danthonia decumbens* sub-community and *Holcus lanatus-Deschampsia cespitosa* grassland	-	5 (10·6%)	-	-	5 (4·9%)
M22b	*Juncus subnodulosus-Cirsium palustre* fen-meadow, *Briza media-Trifolium* spp sub-community	-	1 (2·1%)	-	-	1 (1·0%)
MG5/MG8	Stands intermediate between *Cynosurus cristatus-Centaurea nigra* grassland and *Cynosurus cristatus-Caltha palustris* grassland	-	1 (2·1%)	-	-	1 (1·0%)
MG5/6	Stands intermediate between *Cynosurus cristatus-Centaurea nigra* grassland and *Lolium perenne-Cynosurus cristatus* grassland	6 (19·4%)	-	-	-	6 (5·9%)
MG6a + MG6b	*Lolium perenne-Cynosurus cristatus* grassland, Typical and *Anthoxanthum odoratum* sub-communities	4 (12·9%)	3 (6·4%)	-	-	7 (6·9%)
MG7	*Lolium perenne* leys and related grasslands, including *Lolium-Plantago lanceolata* verges and lawns	2 (6·5%)	-	-	-	2 (2·0%)
-	"Unclassifiable"	-	-	-	1 (7·7%)	1 (1·0%)
	Totals	31	47	11	13	102

TABLE 3. NUMBER (AND PERCENTAGE) OF QUADRAT SAMPLES FROM EACH TWINSPAN GROUP ON DIFFERENT GEOLOGICAL FORMATIONS

	TWINSPAN group (see Fig. 2)				
Underlying geology	**A1**	**A2**	**B1**	**B2**	Totals
Carboniferous limestone	-	-	2 (18·2%)	-	2 (2·0%)
Lias clays	10 (32·2%)	6 (12·8%)	7 (63·6%)	11 (84·6%)	34 (33·3%)
Fullers' Earth	-	7 (14·9%)	1 (9·1%)	1 (7·7%)	9 (8·8%)
Oxford Clay	5 (16·1%)	6 (12·8%)	-	-	11 (10·8%)
Lower/Upper Greensand	1 (3·2%)	-	-	-	1 (1·0%)
Tertiary clays	13 (41·9%)	26 (55·3%)	1 (9·1%)	-	40 (39·2%)
Others/unknown	2 (6·5%)	2 (4·3%)	-	1 (7·7%)	5 (4·9%)
Totals	31	47	11	13	102

THE CASE FOR *G. FRAGILIS* BEING INTRODUCED

The view that *G. fragilis* is an alien in the British Isles seems to revolve around the following lines of argument.

1. *Date of first record in the wild*. *G. fragilis* was first recorded in the wild – and then only as a "casual" – in 1903, and was not discovered in "semi-natural" habitat until 1917, on the Isle of Wight. Surely, if it were native, there would have been at least a smattering of 18th or 19th century records? However, we have found that *G. fragilis* can be easily overlooked if one is not intentionally searching for it, being missed altogether or else passed off as another species. At first glance it can bear more than a nodding resemblance to *Trisetum flavescens*, while (if one overlooks its hairiness) its flowering stems can frequently be "lost" amongst *Lolium perenne*. Vegetatively, it can be confused with *Bromus commutatus* or *T. flavescens*, and might even be dismissed by some as an odd-looking *Holcus* – although it is easily distinguished once one is familiar with it. Also, its flowering season is usually rather short, and the mature inflorescence soon starts to disintegrate, making it then difficult to spot, especially in "closed" grassland swards. Thus, we are tempted to speculate that earlier botanists may have failed to see it, not because it was not there, but rather because they were unfamiliar with it and were not *expecting* to find it. There are parallels here with *Poa infirma*, an undisputed native species which was not discovered in our area until 1876, and not seen again until 1950 (Hubbard 1954), but which – once botanists had been encouraged to search for it, had a good description (and illustration) of it and had "got their eye in" – was found to be widespread near the sea in S.W. England and the Channel Islands (Takagi-Arigho 1994), with recent records extending its known range eastwards to Hampshire, Sussex and the Isle of Wight. *P. infirma* belongs to a group of "easily overlooked" native species, and we think that *G. fragilis* could fall into the same category.

2. *Earliest records as a "casual" of artificial habitats.* The first records of *G. fragilis* in the British Isles were as a "casual", and the earliest records in several counties, even within its core range, were from artificial or otherwise untypical habitats – e.g. road verges in S. Devon and E. Sussex, a forest ride in S. Somerset, waste ground and cultivated land in N. Wiltshire, a car park in W. Sussex – and it was only later found in these counties in neutral grassland. Yet there are other species, native or possibly so, which show this same pattern of "artificial" first, "semi-natural" later. Take, for example, *Gastridium ventricosum*, thought to be almost exclusively an arable colonist until detailed recording in the 1980s and 1990s revealed it to be widespread in drought-prone grassland on calcareous soils in S.W. England and S. Wales. *G. ventricosum*, like *G. fragilis*, is given as "native or alien" in the *New Atlas*, although recent accounts lean towards the view that *G. ventricosum* is almost certainly native in its grassland habitat, and that its true status had previously been obscured by its widespread occurrence as a cornfield weed (Trist 1983, 1986; Green & Pearman 1999).

3. *Evidence of recent spread.* *G. fragilis* may have been overlooked in the past, but we still suspect that the flood of new records indicates that it is increasing, at least within its core areas. This spread cannot be related to an increase in the area of suitable habitat (on the contrary, there is now much less agriculturally unimproved neutral grassland than there was in, say, the 1930s), and it suggests a recent introduction rather than a native species. However, Preston *et al.* (2002) have shown that "Mediterranean" species have, as a group, considerably expanded their range in our area over the last 40 years, possibly as a result of climate change. Thus, one could argue that the spread of *G. fragilis* is entirely consistent with the recent increases shown by native "Mediterranean" species like *Medicago arabica* and *Crassula tillaea*.

4. *Known (or suspected) sources of introduction.* There is evidence from Ireland to suggest that *G. fragilis* may have been introduced there as a contaminant of imported grass seed, and it seems reasonable to suppose that this could have been a source of introduction in Britain too. Was there, perhaps, a period after the First or Second World Wars, and before the mass ploughing and destruction of old grassland, when "top-up" seeding was carried out (with a seed mix inadvertently containing *G. fragilis*) in an effort to "refresh" worn-out meadows? Yet, if this was the case, why do our records of *G. fragilis* display such a coherent "geography"? Why are there not records of *G. fragilis* turning up in re-seeded grassland in, say, Oxfordshire, Norfolk, Lincolnshire or Warwickshire? And, lastly, if *G. fragilis* did come in with imported grass seed, why is there no evidence of other grassland aliens arriving in this way? It is easier to ask questions than give answers, but we think a study of the history of imported grass-seed mixtures (and their origins and species composition) would help enormously to improve our understanding of the distribution of many grassland species, not least *G. fragilis*.

5. *Status in N.W. Europe.* Whatever its status in the British Isles, we need to remain mindful of the fact that *G. fragilis* is regarded as an introduction in mainland N.W. Europe. This view is indisputable, but it is very difficult to find reliable, recent information from that area in support of it. Recent work on other "Mediterranean" species, for example *Valerianella eriocarpa* (Pearman & Edwards 2002), raises this same point.

THE CASE FOR *G. FRAGILIS* BEING NATIVE

There are several lines of argument that could be used in support of *G. fragilis* being considered a native species in our area. Some have already been introduced as "counter-arguments" in the section above, but there are others that should also be mentioned.

1. *A coherent distribution.* Until the 1960s and 1970s most British and Irish botanists were unfamiliar with *G. fragilis*, but now, after fifteen years of intensive recording, we find that this grass has a remarkably coherent "geography". Compare, for example, its national distribution (Figure 1) with that of *Oenanthe pimpinelloides* (Figure 3), an undoubted native species with which it is often associated; or with that of *Gastridium ventricosum* (Figure 4), a "native or alien" which, while it does not grow directly alongside *G. fragilis* is found occasionally on sites near by. Both these species have distributions that are strikingly similar to that of *G. fragilis*; and both, incidentally, are "Mediterranean" species (Preston & Hill 1997). We accept that there is no reason why an alien should not acquire a coherent distribution, perhaps after an initial flurry of widely scattered records and then a "settling down" period as it becomes well established (persistent) in those areas particularly suited to it. Even so, we would argue that the distribution of *G. fragilis* appears to "make sense" in ways that suggest a native species rather than a recent introduction.

2. *A readily definable semi-natural habitat.* We have found *G. fragilis* in a range of grassland plant-communities, but it seems to show a distinct preference for MG5 *Cynosurus cristatus-Centaurea nigra* meadows and pastures, especially those on sticky, often somewhat calcareous, clay soils. This preference for a semi-natural habitat suggests a native rather than an introduced species; and species-rich neutral grassland is not renowned as a habitat for aliens, although a question mark hangs over *Fritillaria meleagris* (e.g. Oswald 1992; Harvey

1996) which, like *G. fragilis*, is given as "native or alien" in the *New Atlas*. Our own quadrat survey of grassland containing *G. fragilis* produced records for 188 native species and just three aliens.

3. *Occurrence in "ancient" grassland with no history of agricultural improvement.* There is anecdotal evidence pointing to the likelihood that many grassland sites supporting *G. fragilis* are agriculturally unimproved, and we have reports of several that have certainly not been ploughed or otherwise disturbed since at least the 1920s. But looks can be deceptive, and one can be easily misled into thinking that if a sward is species-rich it is therefore "old" and in pristine condition. We know of sites which were converted to arable, or ploughed and re-seeded, at some point in the 19th or 20th centuries, for example during (or after) the First or Second World Wars; as Marren (1999) noted, "…although much of the native flora seems to have survived the temporary ploughing, so much so that today you would never have suspected an arable episode, it does seem possible that *Gaudinia* could be a wartime introduction". Hard

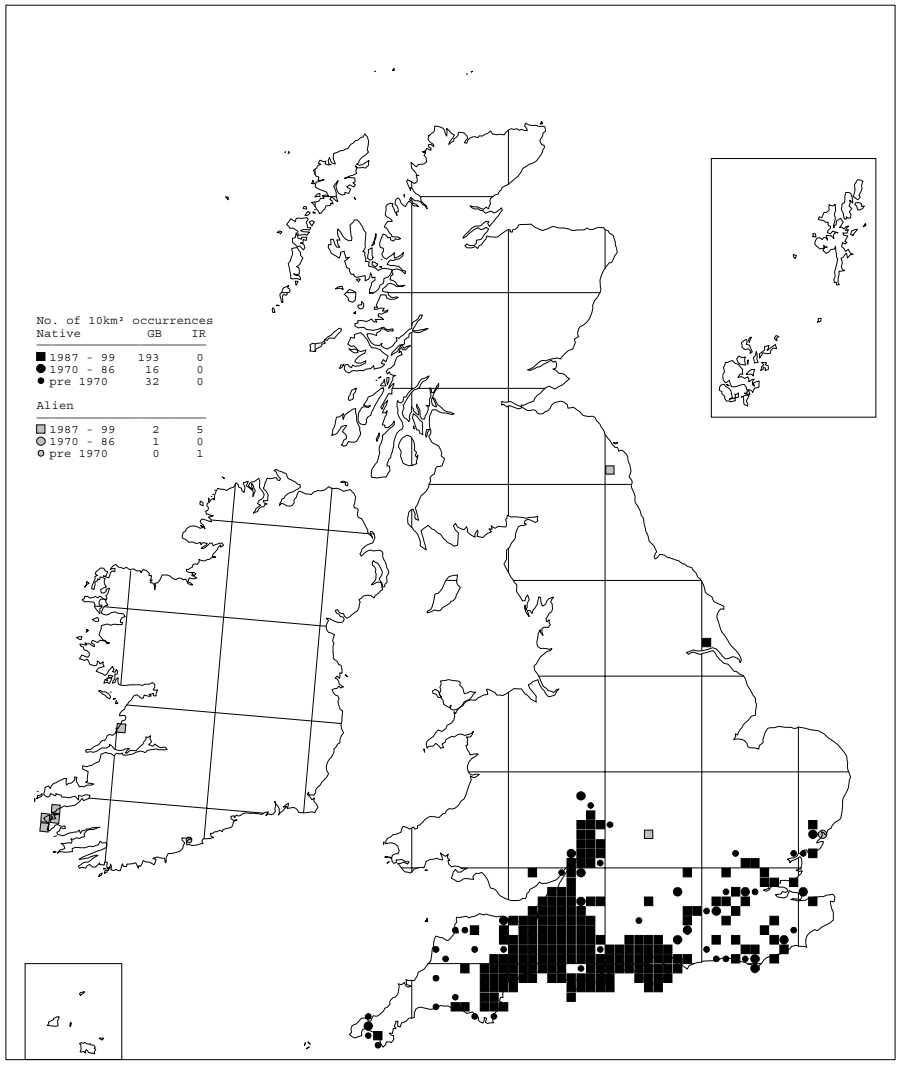

FIGURE 3. 10-km square distribution of *Oenanthe pimpinelloides* in Britain and Ireland.

information is difficult to come by, but Gibson (1998), in a study of selected S.S.S.I. grasslands in S. Somerset, found that *G. fragilis* was especially frequent in fields known to have been "under the plough" at some point in their history. It was particularly associated with younger (or "early successional") swards. He discovered that several of these fields – thought of as prime examples of "ancient" species-rich grassland – were shown as arable on 19th century estate or tithe maps, while one field (with abundant *G. fragilis*) was ploughed after the Second World War, and had 2–3 years of arable cropping in the 1970s before being re-seeded as ryegrass pasture. This might mean that *G. fragilis* was introduced at these sites, yet it was also found (though more sparsely) in fields that were "pasture" in 1808 and with no record of having been subsequently ploughed or re-seeded. Thus its abundance in "early successional" grassland could merely reflect the fact that *G. fragilis* has a preference for open swards; even those kept open by periodic gross disturbance like ploughing.

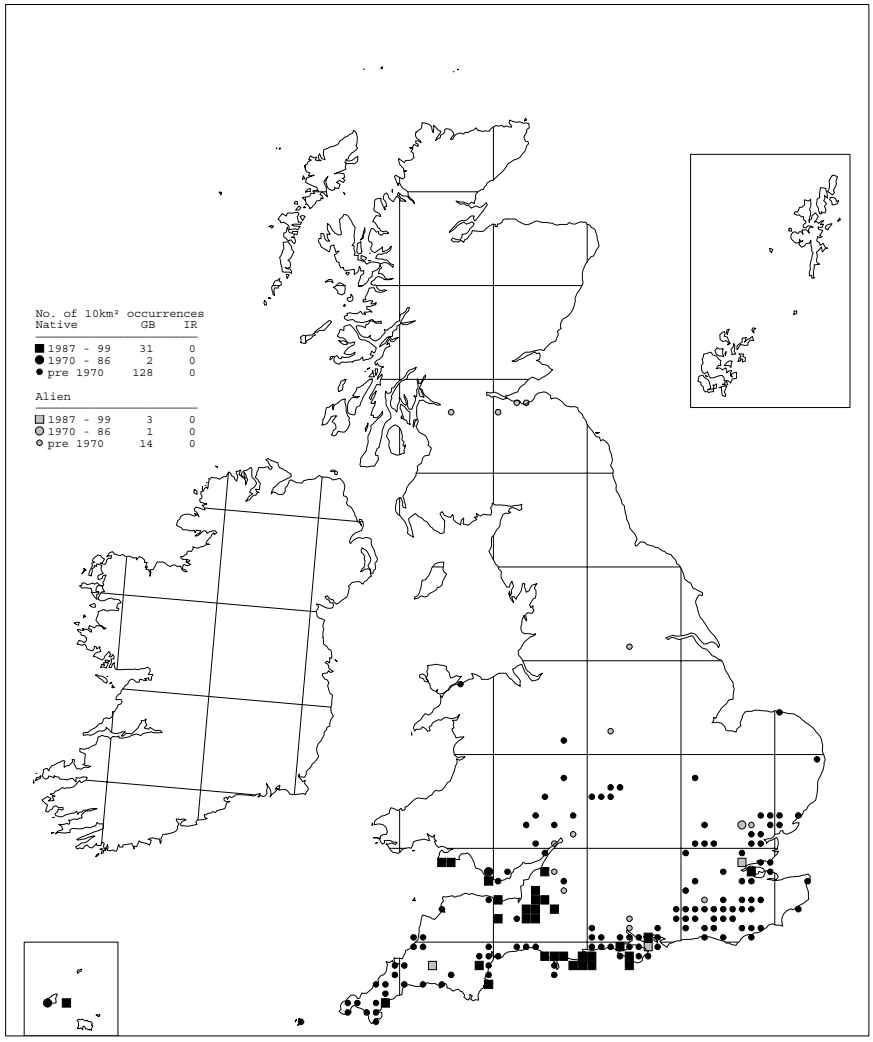

FIGURE 4. 10 km square distribution of *Gastridium ventricosum* in Britain and Ireland.

CONCLUSIONS

With all the evidence before us, we remain uncertain as to the true status of *G. fragilis* in the British Isles. Indeed, when one of us decides it is probably native the other, almost perversely, starts to think it must be introduced, and then when we next meet we discover that each of us has switched to the view of the other! That said, we both agree that, from a conservation standpoint, this grass should be treated "as if native", at least in neutral grasslands in southern Britain, and, as such, should be added to the British list of Nationally Scarce species. High-quality neutral grassland containing *G. fragilis* is already well represented within the protected sites network (including several N.N.R.s and S.S.S.I.s), especially in Somerset and on the Isle of Wight, but there may be a need to consider further site protection in some areas.

It is unlikely that we will ever know for certain whether *G. fragilis* is introduced or native (and even if some populations prove to be alien this does not mean that others cannot be native). But there is considerable scope for further study, particularly relating to management history and the possible use of imported grass-seed mixes, and we are sure there is a wealth of relevant information still to be gathered. For the moment, however, we think an equivocal "native or alien" is probably the best that can be offered. We leave it to others to unearth the evidence that convinces us that "sitting on the fence" can no longer be justified.

ACKNOWLEDGMENTS

We are grateful to all those quoted or referred to in the text, who so generously supplied us with *G. fragilis* records, along with their views on its status in their areas. For help with field surveys and site records, including in some cases details of management history, we particularly thank Anne Bodley, Paul Bowman, Bob Corns, Jonathan Cox, Mike Edgington, Bryan Edwards, Ian Green, Paul Green, Fiona Greenshields, Paul Harmes, John Keylock, Liz McDonnell, Steve Parker, Colin Pope, Richard Pryce, Phil Quinn, Sylvia Reynolds, John Rowe, Kate Ryland, Maura Scannell, Roger Smith, Flemming Ulf-Hansen, Liz Warman and Phil Wilson. For assistance with the quadrat recording we are especially grateful to Jonathan Cox, Dave Green, Colin Pope and Robin Walls, and members of the Somerset Rare Plants Group. We thank Charlie Gibson (Bioscan UK) for carrying out the TWINSPAN analysis in double-quick time, and Chris Preston and Henry Arnold for producing the maps. S.J.L. also wishes to thank English Nature, and in particular Jill Sutcliffe, for allowing certain aspects of this study to be done within his official work programme.

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(Accepted March 2003)