

**Further observations on the ecology and distribution of
Cardamine bulbifera (L.) Crantz (Brassicaceae) in the British Isles**

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ABSTRACT

The distribution of *Cardamine bulbifera*, a Nationally Scarce species, is updated. It has been found as a native in 143 tetrads in 25 10-km squares in south-east England. It is now regarded as introduced to v.c. 39 Stafford. 32 sites recorded in 1989–1992 in East Sussex were revisited in 1999–2002, and it had increased in 50% of the sites though there were some problems in consistency of surveys. The increases may be a consequence of increased woodland light levels resulting from storm damage in 1987 and 1990.

KEYWORDS: Coralroot, Great Storm, scarce plant, Sussex.

INTRODUCTION

Cardamine bulbifera (L.) Crantz, Coralroot, is a Nationally Scarce plant in Britain (Stewart *et al.* 1994). It is a very locally distributed native herb of dry and wet woodlands, shady stream-sides and roadside banks on sand, clay or chalk soils (Showler & Rich 1993). It mainly reproduces vegetatively by axillary bulbils which usually fall near the parent and which may also be locally dispersed by water, but significant fruit set may also occur; the seeds are dispersed by explosive dehiscence of the fruit valves. It is native from England and southern Scandinavia south to the Mediterranean and eastwards to the Black Sea, the Caucasus and northern Iran. It was first recorded in Britain in 1634 and has been known for many years to occur in south-east England, with a possible disjunct series of sites in Staffordshire, central England. It is widely introduced as a garden plant elsewhere in England, Scotland and Ireland (for a recent national map incorporating records up to the end of 1999, see Preston *et al.* 2002).

Showler & Rich (1993) reviewed its distribution and listed all known sites. Since then, new sites have been found and other records have come to light. The Staffordshire sites were revisited by J. Hawksford in 2002, and their status has been reviewed in the light of further information. In addition, R. A. Nicholson has revisited many of the old sites in East Sussex to note any changes after ten years.

NEW AND ADDITIONAL HISTORICAL RECORDS

Since 1992 a number of new and additional historical records, obtained mainly through correspondence with vice-county recorders, other botanists and through personal observations, have been compiled, together with some corrections to Showler & Rich (1993). The records are

summarised in Appendix 1; fuller details have been deposited in the library of the National Museums and Galleries of Wales, Cardiff and with the Sussex Botanical Recording Society. It has now been recorded as a native in c. 143 tetrads in 25 10-km squares and has been seen in 114 tetrads in 22 10-km squares since 1987. Three sites where it was thought to be extinct have been refound. A map showing the tetrads in which it is considered native is given in Fig. 1.

Following additional specimens and information from J. Hawksford about the v.c. 39 Stafford sites, indicating that all material is the alien forma *ptarmicifolia* (DC.) O. E. Schulz, including that from Needworth Forest (cf. Showler & Rich 1993), it is now considered to be introduced in all v.c. 39 sites, updating Showler and Rich's (1993) opinion.

There are five corrections to Showler & Rich (1993). V.c. 14, E. Sussex: Lawyers Wood should be Fir Toll Lane (TQ52). Rivenhall should read Riverhall (TQ63). Goodyer's record for 1634 for Foxhole Wood is more likely to be the Foxhole Wood in TQ72D than TQ62G. V.c. 24, Bucks: The Warren Wood (SU88U) plants were found by M. Walker in 1993 at SU868897. V.c. 62, N.E. Yorks: The Scalby site was first recorded in 1946 (not 1964) and the reference to *The Dalesman* should be 1990 (not 1900). Stace (1994) suggested that K. E. Bull's Tunbridge Wells Common site was not the same as Showler & Rich's (1993) site; the sites are in fact the same, the different interpretation resulted from the use of local place names by Stace and Ordnance Survey map names by Showler & Rich.

There is obviously scope for finding new sites for this remarkably attractive plant. The fact that among the post-1992 records three 'new' sites were large areas of *C. bulbifera* in woodland crossed by public footpaths indicates that there may be many smaller populations to be found either on private land or near less-frequented paths.

SUSSEX SITES REVISITED

The population sizes given in Showler & Rich (1993) were estimated from relatively brief searches between 1989 and 1992. Field work by R. A. Nicholson in East Sussex approximately ten years later revealed many sites where the populations had apparently increased, and therefore a more detailed investigation was carried out.

METHODS

32 sites, mainly in the area of East Sussex with the highest concentration of records in hectads TQ52, TQ62 and TQ72 (Showler & Rich 1993), were visited between March and May in the years 1999–2002. At each locality, a rough estimate of the area occupied was made and the density of the plants noted. As the proportion of plants flowering varied from year to year and site to site, both flowering and vegetative plants were included, though it was not always easy to spot juvenile plants among thick undergrowth. The 1999–2002 data were compared with the Rare Species forms completed during the previous surveys.

RESULTS

Details of the population sizes at the revisited sites are given in Table 1. One or two localities could not be identified but, whilst searching for known places, six new sites were recorded, indicating that more may still be found.

At one site where the plant was thought to be extinct due to the removal of part of a wood for road widening, it was refound in the undisturbed remainder. At the 2/32 (6%) sites where no plants could be found, the most likely reason was that the exact location was not refound as the sites were still intact, or plants were vegetative and overlooked. 1/32 (3%) sites showed a decrease in the number of plants, 11/32 (34%) sites showed little or no change, and 16/32 (50%) sites showed an increase, sometimes dramatically so.

DISCUSSION

There are a number of possible reasons for the apparent changes in population sizes between 1989–1992 and 1999–2002 of which a key one is subjective differences between observers (Rich & Woodruff 1991, Rich & Smith 1996). Whilst we cannot rule this out as a contributing factor in some cases, the large increases observed at some sites are undoubtedly real.

TABLE 1. COMPARISON OF POPULATION SIZES 1989–1992 (CF. SHOWLER & RICH 1993) WITH FIELD SURVEY IN 2000–2002

LOCALITY	1989–1992 STATUS	2000–2002 STATUS	CHANGE
Banky Wood	Four scattered patches 140 plants	Widespread, covering woodland floor Scattered small groups, c. 400 plants, 40 flowering	Increase Increase
Bateman's, dense hedge	500 plants	Plants over almost entire floor of wood and onto verge	Increase
Bateman's, wood to N.	One large patch near wet hollow	Three small patches and scattered plants near wet hollow. 3 × 2 m patch, c. 200 vegetative on animal track between wet hollow and wood boundary	Increase
Bodiam Wood		Patches both sides river and into field Vegetative plants only, 1 × 1 m	Little or none Little or none
Bog Wood, R. Dudwell	100 flowering on S. bank, 60 on N. bank	Patches 20 × 3 m, 2 × 2 m. A few plants in new locality bottom of hill	Small increase
Brookside Farm	10+ plants		
Burwash Weald	325 plants		
Coggins Mill, bridge	Present by bridge	Patches by bridge, and downstream both banks	Increase
Coggins Mill, stream	Present	Small patch 0.5 × 0.5 m	Little or none
Crossroads Farm	c. 200 plants in wood by A229	Patch 0.5 × 2 m, spreading into wood	Little or none
Fleet Wood	c. 40 flowering plants at bridleway edges	Patches on both sides of bridleway	Increase
Fonthill Farm	60 plants	On bank at edge of copse and onto verge, c. 60 vegetative, 20 flowering	Small increase
Furnace Wood	6 m ² patch, E. verge	100 m patch E. verge, small patches W. verge	Increase
Gigmore Wood	20 plants in ancient woodland	c. 2000 plants, 50 flowering	Large increase
Hawksden Wood	c. 15 plants	Large patch 5 × 5 m and more down stream	Increase
Heronry Wood	15 plants	Two large patches E. verge, several patches W. verge	Increase
Little Boartzell	c. 120 flowering, more vegetative in wild garden and on verge	Scattered plants for 300 m along verge and into woodland Patch 4 × 2 m	Increase
Mayfield, Fir Toll Rd	Fruiting plants seen 1992		Little or none
Merriments Shaw	Several patches, 400 flowering and vegetative plants	Scattered patches throughout wood near road junction	Little or none
Mousehall	110 plants	Scattered on S. side, a few plants on N. side	Little or none
Old Place Farm	One plant on E. verge, present in copse; a few plants W. verge	Area 2 × 100 m E. side, scattered in copse	Large increase
Peagle Wood	85 plants	Wide belt of plants for c. 200 m woodland edge; two large patches on opposite verge Patch 1 × 1 m	Large increase
Rye Green Farm	100 scattered flowering plants		Decrease
Sharnden	c. 40 plants	One patch, 2 × 2 m	Little or none
Terrace Wood	c. 200 plants each side	Several extensive patches each side	Little or none
Tidebrook, roadside	Large nos plants, 50–100 m S. side 20 flowering N. side	Patches 3 × 2 m, 6 × 4 m, 2 × 1.5 m, S. side scattered plants for 50 m N. side	Little or none
Wardsbrook Farm	c. 500 plants	Two large areas, 5 × 8 m, 4 × 5 m	Little or none
Wet Wood	c. 500 plants	Widespread over woodland floor & on verge; 1 × 1 m on opposite verge	Increase
Wood, N. W. Stonegate Station	c. 100 plants	Patch 7 × 4 m and scattered plants	Little or none

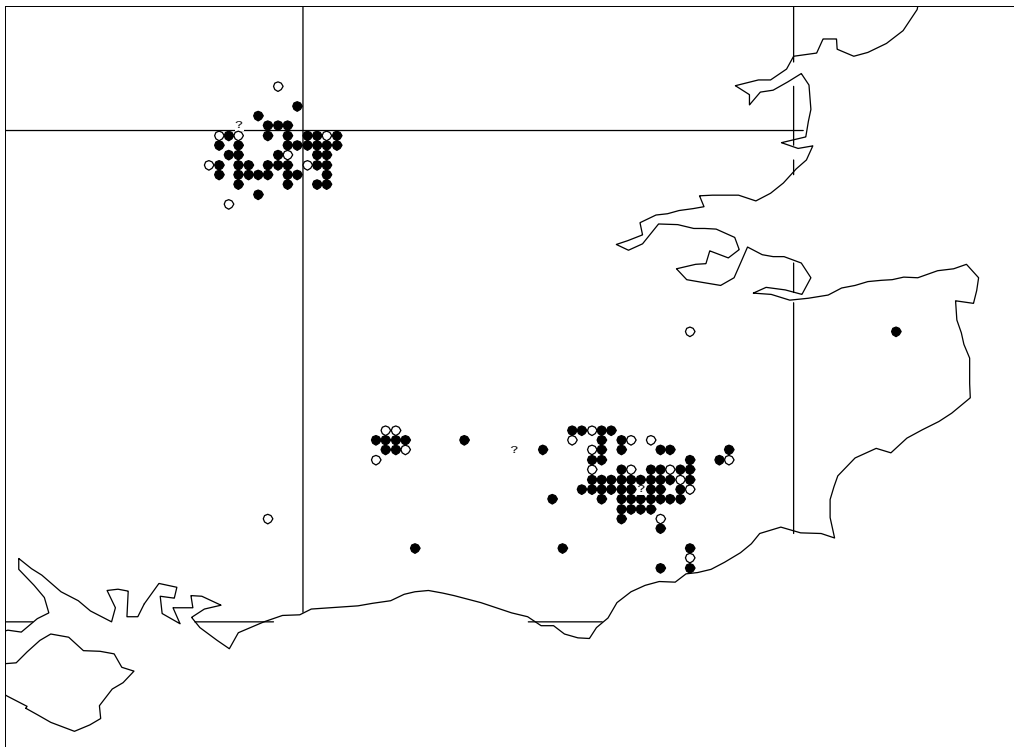


FIGURE 1. Tetrads in which *Cardamine bulbifera* is considered native. ● 1987 onwards, ○ pre-1987, ? location uncertain.

Cardamine bulbifera is a typical vernal, woodland-gap plant, and is noticeably more frequent along streams, by footpaths, animal tracks and at woodland edges where light levels are enhanced compared with the general woodland floor. Any changes in the light regimes by management or natural events might therefore be expected to benefit the species. Stace (1994) stressed that the demise of coppicing was a major factor in the decline of *C. bulbifera*, a practice which had largely ceased in the Weald by the 1960s. Several observations confirm this was an important factor but do not explain the widespread increase as coppicing has not been resumed at most of the sites investigated. A regular increase in the number of flowering stems was noted when Clay Wood, Bivelham Forge Farm was coppiced in the past and the flowers diminished as the trees grew up again (J. Simes, pers. comm., 2000). At Little Calem Wood, one population was flourishing where a tree had fallen, and in Streaks Gill, some tree thinning was carried out in 1996 which may have encouraged the growth of colonies in the wood. Where plants occur on the edges of woods or wide rides, they often flower much more prolifically.

The Great Storms of 1987 and 1990 caused much disturbance in the High Weald woods, especially letting light into over-grown coppice (Kirby & Buckley 1994). At Minepits Shaw several large trees blew over possibly causing an increase from the few plants in 1993 to the hundreds of young plants and many in flower in 2000. As *C. bulbifera* is known to start flowering in its third or fourth year with plants living for about seven years before declining (Pauca-Comanescu 1993), the expansion of the population here may have resulted from the extra availability of light penetrating the woodlands after the storms. The fact that the populations in the Chiltern woodlands, which were relatively unaffected by the storms, do not seem to have increased in the same manner as the Wealden populations, also suggests an increase related to the 1987 and 1990 storms. The field work carried out in 1989–1992 by Showler & Rich (1993) may have been too soon after the storms to see any responses to enhanced light levels. If this is the case, the populations will be expected, in the absence of woodland management or further storms, to decrease over the next decade or so.

C. bulbifera may also have benefited from the recent rise in temperature of about 1.5°C across the British Isles as it is widespread and more abundant in parts of Europe where the climate is warmer. There may also be local increases as plants are dispersed into new places. For instance, flash floods in May 2000 caused many Wealden streams to rise more than two metres overnight, leaving debris high up in trees and over a wide area in fields and woods beside the ghylls; this may have washed bulbils into new places. Similarly, at two flourishing colonies around rabbit warrens, plants were spreading along rabbit runs, and in at least four other places, along badger paths. At several sites on roadsides, the introduction of the Protected Verge Scheme by East Sussex County Council, where flower-rich verges are mown in the autumn rather than the spring, may have helped plants grow as well as allowing production of more bulbils, which have then been dispersed in the slipstreams of local traffic or along the verge edges by road runoff (e.g. along Little Trodgers Lane).

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APPENDIX 1. NEW AND ADDITIONAL RECORDS OF *CARDAMINE BULBIFERA*.

Records are given in order of tetrads (tetrad nomenclature following Ellis 1996) within vice-county. *Sites of the alien introduced forma *ptarmicifolia*. Recorders are listed in the acknowledgements.

V.C.	GRID REF.	LOCALITY	DATE(S)	SOURCE/NOTES
9	SY39	Near Lyme Regis	1939	LIV
13	TQ13N	Tickfold Gill, woodland	1997, 1999	
	TQ13X	Rusper, on verge	1995, 2000	Extension of known site
	TQ23D	Rusper, woodland stream bank	1999	
14	TQ33I	E. of Rowfant, on trackside	1995	
	TQ43H	Forest Row, damp woodland	1977	Not refound despite intensive searches
	TQ52C	Buxted Wood, Hadlow Down, hedgebank, ancient woodland, and nearby hedge	2000, 2002	
	TQ52Y	Mayfield, Little Trodgers Lane, verge and bordering woodland	1999	
	TQ52Y	Mayfield, woodland S. E. of Long's Farm	2002	Site known for some time
	TQ52Z	Little Trodgers Lane, Longham Wood, gateway into wood and in wood	1994, 2000	
	TQ52Z	Little Trodgers Lane, by former Mayfield College, hedge and wood	2001	
	TQ52Z	Mayfield, in wood N. of Vicarage Wood and along stream	2002	
	TQ53W & TQ63B	Near Frant, S. of B2099, woodland stream	1995	
	TQ62C	Great and Little Calem Woods, Broad Oak	1995	
	TQ62E	Mayfield, Lake St., copse and field	2002	Site known for some time
	TQ62E	Mayfield, Minepits Shaw, top of stream bank, in gullies and open area between two sections of woodland	1993, 1995, 2000	
	TQ62E	Sharnden, hornbeam wood with wet gullies	1995	
	TQ62E	Coombe Wood, near footpath	2000	
	TQ62I	Rolf's Farm, streamside	2000	
	TQ62J	Manor Farm, Coombe Wood, riverside	2000	
	TQ62J	Tidebrook, Riseden Road, verge	1999	
	TQ62J	Bivelham Forge Farm, Clay Wood, edge of wood	2002	Site known for some time
	TQ62J, N & P	Dens Wood, S. of Wadhurst Park, wood and scattered down stream and near paths	2000	
	TQ62K	Dallington Forest, N. of Glazier's Forge, by footpath and under hornbeam	2000	Possibly P. Hall's 1980 site.
	TQ62K	Blackbrooks, sides of wet track and wood edge	2000	
	TQ62M	Coalpit Wood, by footpath in wood	2000	
	TQ62M	Burwash Common, Brockwood, by path in wood	2002	
	TQ62N	Bivelham Forge Farm, Newbridge Wood, wood and edge of sunny ride	2002	
	TQ62P	Stonegate, Hoadley Wood N. E. section	1996	
	TQ62P	Stonegate, Hoadley Wood, S. E. section, stream junction	2002	
	TQ62S	Burwash, Spring Lane, shaded verge	2001	
	TQ62T	Stonegate, Church Wood Shaw, wet woodland	1994, 2002	
	TQ62U	Stonegate village, wood	1996	
	TQ62W	Brightling, Brown's Oak Farm, shaw between track, by stream and on verge	1998, 2002	

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V.C.	GRID REF.	LOCALITY	DATE(S)	SOURCE/NOTES
	TQ62X	Etchingham, Borders Lane near March Farm, wood	1998	
	TQ62Z	Ticehurst, Streaks Gill, wood and verge	1996, 2000	
	TQ63B	N. W. of Wadhurst, wooded stream bank	1995	
	TQ63C	Bell's Yew Green, Manor Farm, damp woodland	1995	
	TQ63K	Shover's Green, shaw on N. side of B2099	2001	
	TQ71F	Bexhill, Park Wood near Watermill, wooded streamside	1996	
	TQ71V	Hastings, Churchwood S.N.C.I.	1993, 1996	Possibly one of the 'about Hastings' sites (Showler & Rich 1993)
	TQ71X	Screen Wood, Beauport Park, clearing under pylons	1993, 1996	Possibly Peatfield's 1943 Beauport Park site (Showler & Rich 1993)
	TQ72B	W. of Robertsbridge, Burgh Wood, by footpath	1997	
	TQ72B	Robertsbridge, Ludpit Lane, shaw	1997, 2000	
	TQ72B	Robertsbridge, Wyland Wood, woodland	1970	
	TQ72D	Lane to Burgham, verge and wood	2000	
	TQ72D	Fleet Wood, west side, track and wood	2000	
	TQ72D	Foxhole Wood, Sheepstreet Lane, Etchingham, ancient woodland and road verge	1993	Probably Goodyer's 1634 long-lost site
	TQ72H	Etchingham, Gimore Wood, damp hollow	2000	
	TQ72H	N. of Robertsbridge, Park Wood near Bush Barn, wood	2002	Site known for some time
	TQ72I & J	Near Hurst Green, Burgh and Bellhurst Wood, wood and stream	1997, 2000	
	TQ72J	Near Hurst Green, N. of Bellhurst Farm, trackside shaw	1997	
	TQ72J	Copse in fork of A265 and Merriments Lane, wood	2000	Site previously thought extinct
	TQ72M	Salehurst, Rocks Hill, shady wet verge and bank	1993, 2001	
	TQ72P	Merriments Lane, hedge and verge	1996, 2002	
	TQ73A	Flimwell, woodland both sides of the A21	1968	Old site.
15	TQ72Z	Downgate Wood	1999, 2000	
	TQ73Q	N. E. of Highgate, damp woodland	1986	Not refound 2000
	TQ73V	Hawkhurst, Roughland Wood	1999	
	TQ73V & W	Near Iden Green, White Chimney Wood, 2 small colonies in wet woodland by stream	2000	
	TQ83S	Near Tenterden, W. of St Michael's, edge of lane on wooded stream bank	1999, 2000	
	TR25E	Trenleypark Wood, roadside bank	2002	New native eastern limit in England
16	TQ53P	Near footpath to Rusthall Common	1997	
	TQ73K	Mopesden Gill, conifer plantation	1997	Replanted with conifers in 1991
17	TQ13N	Near Oakwoodhill, ancient woodland ghyll	1999	
	TQ13U & Z	S. of Capel, bank of stream N. of Ridge Farm	1942	LIV
20	TQ09P	Sawpit Spring, remnant of wood destroyed by M25	1992	Not refound 2002
	TQ09T & U	Blackets Wood	1992	
	TQ09U	Chandlers Cross, Blackets Wood	1992, 2002	
24	SU79X	Piddington, Bottom Wood	1999, 2002	
	SU89G	Sands, Spring Coppice, patch on road verge	2002	
	SU89T	Hughenden Valley, Provost Wood	1993	

V.C.	GRID REF.	LOCALITY	DATE(S)	SOURCE/NOTES
	SU89T	Great Kingshill, beech wood	1998	
	SU99A	Holtspur	1993	
	SU99L	Hodgemoor Woods	1999	
	SU99Q	Seer Green, by footpath to station under beech	1993	
	SU99U	Chesham Bois, beech wood by road	1993	
	SU99Y	Amersham, lane verge	1993	
	SP 90B	Ballinger Common, by footpath on edge of beech wood	2000	
	TQ08J	Denham, Northmoor Hill Wood, edge of old damp chalkpit	1994	
	TQ08P	Denham Common	1988	
39	SJ84Q	*Trentham, Ash Green	2002	
	SK11C	*Rileyhill, Slaish Wood	1994, 2002	
	SK12L	*Newchurch, Slade Covert, woodland and roadside	1972, 2002	
	SK12L	*Yoxall Lodge, replanted ancient woodland near stream	2002	
60	SD74	Clitheroe	1960	LIV
64	SE26	*Holden Clough, near Sawley	1961	LIV
91	NO89U or 80Q	*Kingussie House, Maryculter, grounds	c. 1980	
113	WV75	*Ivy Castle, Guernsey	1893	LIV