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Errata

p. 32	table line 13 up	For: <i>caespitosa</i> read: <i>cespitosa</i>
p. 78	line 2	For: kamschaticum read: kamtschaticum
p. 82	line 11	For: sylvatica read: silvatica
p. 83	line 1	For: M. × smithii read: M. smithii
p. 129	line 4, col. 2	For: <i>spirodella</i> read: <i>spirodela</i>
p. 190	line 18, col. 1	For: <i>artemisifolia</i> read: <i>artemisiifolia</i>
p. 195	line 6, col. 2	For: spp. read: subsp.
p. 221	fig. caption	For: <i>proctoris</i> read: <i>proctoriana</i>
p. 226	line 15 up, col. 1	For: <i>proctoris</i> read: <i>proctoriana</i>
p. 227	line 2, col. 1	For: <i>proctoris</i> read: <i>proctoriana</i>
p. 227	fig. caption	For: <i>proctoris</i> read: <i>proctoriana</i>
p. 249	table line 3 up	For: <i>rivinianna</i> read: <i>riviniana</i>
p. 250	line 8 up, col 2	For: <i>Petastites japonicus</i> read: <i>Petasites japonicus</i>
p. 252	table line 5 up	For: <i>sylvatica</i> read: <i>sylvestris</i>
p. 253	line 3 up, col. 2	For: <i>erectus</i> read: <i>erecta</i>
p. 277	bottom line, col. 2	For: <i>Hypochoeris</i> read: <i>Hypochaeris</i>
p. 311	line 3 up, col. 1	For: <i>S. vagensis</i> read: <i>S. x vagensis</i>
p. 327	table line 11 up	For: <i>Buddleia</i> read: <i>Buddleja</i>
p. 329	table line 15	For: <i>Buddleia</i> read: <i>Buddleja</i>
p. 331	table line 1	For: <i>Buddleia</i> read: <i>Buddleja</i>
p. 335	line 15	For: <i>Hypocharis</i> read: <i>Hypochaeris</i>
p. 335	line 25	For: <i>capraea</i> read: <i>caprea</i>
p. 335	line 16 up	For: <i>hordaceus</i> read: <i>hordeaceus</i>
p. 335	line 13 up	For: <i>Cystisus</i> read: <i>Cytisus</i>
p. 338	line 17 up	For: <i>Rumexs</i> read: <i>Rumex</i>
p. 338	line 14 up	For: <i>hordaceus</i> read: <i>hordeaceus</i>
p. 338	line 14 up	For: <i>sivatica</i> read: <i>silvatica</i>
p. 338	line 12 up	For: <i>capraea</i> read: <i>caprea</i>
p. 338	line 7 up	For: <i>Elytrigia canina</i> read: <i>Elymus caninus</i>
p. 357	line 18	For: CARDUUS read: CIRSIUM
p. 360	table line 3	For: <i>Carduus heterophyllus</i> read: <i>Cirsium heterophyllum</i>
p. 361	table line 3 up	For: <i>idaeus</i> read: <i>idaeus</i>
p. 382	line 12	Insert: * 64 , before: *Mid-W.
p. 387	line 8 up	For: Sisyrrhinchium read: Sisyrrinchium

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The cover illustration of *Potentilla anglica* Laich. (Trailing Tormentil) was drawn by Rosemary Wise.

Is spur length of *Platanthera* species in the British Isles adaptively optimized or an evolutionary red herring?

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ABSTRACT

A consistent methodology was used by the authors, and by several volunteers lacking experience of morphometrics, to measure the length of the nectariferous labellar spur in populations of two sister species within the orchid genus *Platanthera*, *P. bifolia* and *P. chlorantha*. Although they differ morphologically, primarily in details of the column and labellar spur, these two species appear molecularly identical. Much previous research using *Platanthera* as an evolutionary model system assumed that spur dimensions play a critical role in attracting specific pollinators and thus in determining fitness. The present analysis of data from 1876 individuals of 73 *Platanthera* populations from the British Isles, plus 10 populations from Continental Europe, suggests that spur length in both species follows a latitudinal cline, diminishing northward at an average rate of 2.2% per 100 km. More southerly populations are more likely to occur in shaded habitats, where their spurs (especially *P. bifolia*) are on average longer than in open habitats. The present data are insufficient to determine whether this trend is adaptive and pollinator-limited, as traditionally believed, or allometric and resource-limited, as suggested here. Most previous floras and monographs (a) offer ranges for spur length that are seriously erroneous, and (b) are surprisingly reluctant to admit the occurrence of hybrids between the two species, preferring to prioritise speculative assertions of strong fidelity between pollinator and orchid above field observations recording morphologies intermediate between the two parental species. Statistical comparisons of various kinds of duplicated datasets show that, given an explicit protocol, acceptably consistent measurements can be achieved among multiple, largely inexperienced, analysts. The main source of potential measurement error, premature measurement of flowers prior to full anthesis, is easily avoided. The success of this project should open the way for more ambitious initiatives that recruit substantial numbers of

inexperienced researchers into morphometric investigations of the British and Irish flora.

KEYWORDS: adaptation, allometry, citizen scientist, co-evolution, geographic cline, measuring error, morphometrics, nectar spur, orchid, *Platanthera chlorantha*, *Platanthera bifolia*, pollinator attraction.

INTRODUCTION

THE GENUS *PLATANTERA* AS AN EVOLUTIONARY MODEL SYSTEM

The Butterfly Orchids (genus *Platanthera* Rich.) have benefited from recent molecular phylogenetic studies (based on the nuclear ribosomal ITS region: Hapeman & Inoue 1997; Bateman *et al.* 2003), which have resolved the genus into six monophyletic sections (including *Piperia*, which was previously widely recognized as a separate genus in North America: Bateman *et al.* 2003; Lauri 2007). Several species of *Platanthera* have increasingly been used as models of evolution in general and putative adaptation in particular. In North America, hybridization, allopolyploid speciation and facultative autogamy have been documented in the *P. dilatata*–*P. aquilonis* aggregate of Section *Limnorchis* (Wallace 2004, 2006), while in Section *Lacera* inbreeding depression and mutational processes were described in *P. leucophaea* (Wallace 2003; Holzinger & Wallace 2004) and pollination frequency, outcrossing-to-inbreeding ratio and selection for spur length were explored in *P. lacera* (Little *et al.* 2005).

The remaining evolutionary studies have focused on Section *Platanthera* – specifically, on the classic Eurasian pairing of *P. bifolia* and *P. chlorantha*. The former has been used to

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investigate variable selection for male and female function (Maad 2000; Maad & Alexandersson 2004), while the latter has yielded details of nectar secretion and resorption (Stpiczynska 2003a, b). Perhaps the most interesting investigations have compared and contrasted aspects of the two species. A few studies have explored the potential of these species for non-adaptive macroevolution through saltation (a heritable, genetic or epigenetic modification that is expressed as a profound phenotypic change across a single generation and results in a potentially independent evolutionary lineage), notably via modification of the labellum to resemble the sepals (a transition termed pseudopeloria: Bateman 1985; Bateman & DiMichele 2002; Bateman & Rudall 2006b). However, most studies have focused on aspects of presumed adaptation. Nilsson (1978, 1983) used morphometric measurements from both herbarium collections and *in situ* populations in Scandinavia to quantify the features that encouraged placement of the pollinia on the tongues of pollinating moths in *P. bifolia* and the eyes of other, closely related moths in *P. chlorantha*. As predicted from morphological observations by Summerhayes (1951), optimization of morphological characters across ITS-based phylogenies suggested that the eye attachment of pollinia in *P. chlorantha* evolved from the more conventional proboscis attachment that characterizes *P. bifolia* (Hapeman & Inoue 1997; Bateman 2005). The two species differ in fragrance chemotypes (Tollsten & Berstrom 1993). Admixed populations of these two species containing phenotypic "intermediates" (i.e. presumed hybrids) have been studied in the Low Countries (Claessens & Kleynen 2006) and Scandinavia (Nilsson 1985), where the efficiency of pollinium import and export between the two species was estimated (Maad & Nilsson 2004). Thus far, DNA sequencing studies have revealed extraordinary similarity between the two taxa, despite the fact that they are morphologically distinct and so universally accepted as *bona fide* species (Bateman 2005; Bateman, James & Rudall in prep.).

Most of the evolutionary scenarios emerging from these studies paid particular attention to the key role of the morphology of the column (and, to a lesser degree, of the pollinia themselves) in placing the pollinia at appropriate locations on visiting Lepidoptera, and on the role of the nectar-secreting spur in initially

attracting those pollinators and persuading them to probe sufficiently deeply to acquire pollinia. Only a minority of terrestrial orchid species in the Northern Hemisphere offer their pollinators a genuine food reward (usually nectar); the remainder deceive insects into mistakenly believing that they will be rewarded with food or, less frequently, sex (e.g. van der Cingel 1995; Cozzolino & Widmer 2005). Although there have been repeated evolutionary transitions between the rewarding and non-rewarding conditions (Bateman *et al.* 2003; Cozzolino & Widmer 2005), the genus *Platanthera* appears to be uniformly rewarding (Hapeman & Inoue 1997), substantial quantities of nectar being secreted by labellar spurs (Stpiczynska 2003a, b) that differ considerably in mean length among the many species in the genus.

RATIONALE OF THE PRESENT STUDY

Not surprisingly, given their reputedly strong influence over pollination efficiency, the spurs of orchids in general (Darwin 1877; Rudall & Bateman 2002; Box *et al.* in press), and of *Platanthera* in particular (Nilsson 1983, 1985; Maad & Nilsson 2004; Little *et al.* 2005; Claessens & Kleynen 2006; J. Maad pers. comm. 2007), have long received considerable attention from evolutionary biologists.

The present authors independently established projects that involved extensively measuring the labellar spurs of the Greater Butterfly-orchid (*Platanthera chlorantha* (Custer) Rchb.) and Lesser Butterfly-orchid (*P. bifolia* (L.) Rich.) in the UK. Working with Paula Rudall, Bateman began his project in 2003 and focused on southern England (Bateman 2005). This study, which sought to better delimit the presumed boundary separating the two species, involved measuring 42 characters from each plant, which limited the number of individuals that could realistically be studied. In addition, many of the plants subjected to morphometric analysis were also subjected to sequencing of the nuclear ribosomal ITS region (Bateman, James & Rudall in prep.). Bateman subsequently added some data on spur lengths of *P. bifolia* from northwest Scotland.

Sexton's project began in 2005 and focused on south-central Scotland (Sexton & McQueen 2005). Having summarized prior evidence of considerable variation in the spur length of *P. chlorantha* across Europe, this project sought to uncover and explain local variation in spur

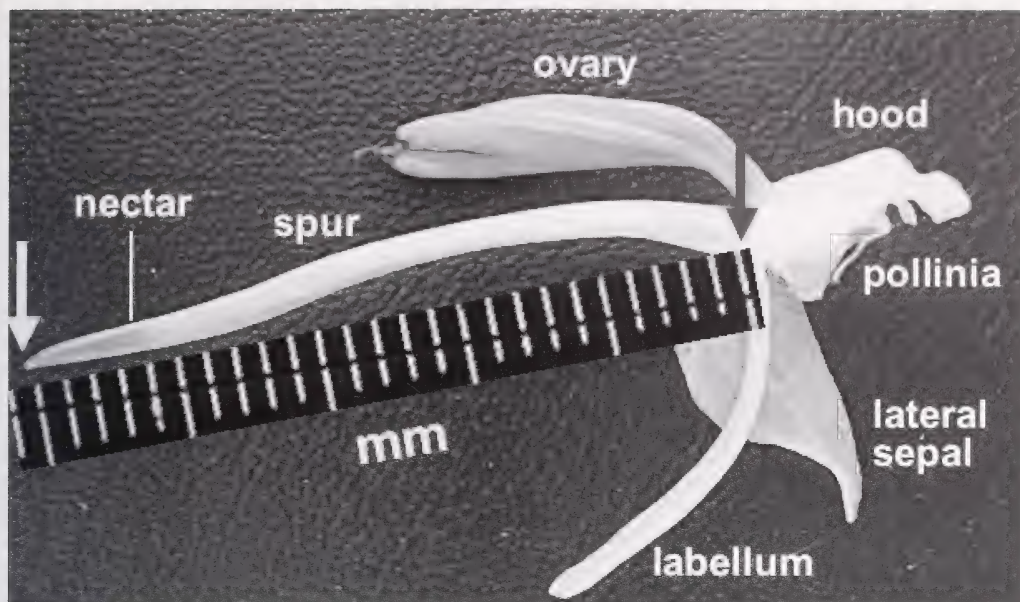


FIGURE 1. Lateral view of flower of *Platanthera chlorantha*, illustrating the method used to measure spur length in the present study (note that in the actual study the flowers remained attached to their parent plants). Photo: Roy Sexton.

lengths within the chosen study area. Other likely factors attracting pollinators to the flowers, including the volume of nectar and composition of scent, were considered. Success in attracting pollinators was judged indirectly, through frequency of fruit set and frequency of viable seed within individual fruit (Sexton & McQueen 2005).

It soon became evident that, given their contrasting geographical foci, our respective datasets on spur length would increase considerably in value if pooled. In addition, it was clearly highly desirable to extend the geographic coverage of the project to encompass the whole of the British Isles, and ideally to expand into mainland Europe. The most obvious way of achieving these more ambitious goals within a reasonable timescale was to involve substantial numbers of inexperienced researchers (often described as 'interested amateurs' or, more recently in science policy circles, "citizen scientists" – we recognize that neither term is especially appropriate). Therefore, in April 2007 we asked members of the UK's Hardy Orchid Society to measure *Platanthera* populations in their local area and donate the resulting data to us for collation (Bateman & Sexton 2007).

MATERIALS AND METHODS

We made considerable efforts to formulate clear instructions that contained sufficient detail to ensure consistency of measurement among different analysts (Bateman & Sexton 2007). Spur length is a more obviously self-defining parameter than, for example, spur width (see below). It is most readily measured by placing a 150 mm steel rule against the back of one of the lateral sepals (Fig. 1), with the flower still firmly attached to the inflorescence. As flower size has recently been shown to decrease considerably from the base to the apex of the inflorescences of several European orchid species (Bateman & Rudall 2006a), we specified that the measured flower should be chosen from the middle of the inflorescence and be fully open. We requested that analysts gather a sample of 20 individuals, though the small size of most *Platanthera* populations in the UK meant that some sample sizes were appreciably smaller (in partial compensation, other samples were substantially larger). Datasets were submitted electronically by most analysts, and were collated by Bateman in an Excel spreadsheet immediately after the 2007 flowering season had ended.

TABLE 1. SIGNIFICANCE TESTS OF COMPARISONS OF DUPLICATED ESTIMATES OF MEAN SPUR LENGTH OBTAINED FROM THE SAME POPULATION OF *PLATANThERA*

Locality	Species	Analyst(s) and Year(s)	Difference between mean values (mm)
<i>(a) Same analyst, same year (4)</i>			
Wolstenbury	<i>chlorantha</i>	Stott/Pearce, 2007	0.79
Latterbarrow	<i>chlorantha</i>	Fenton, 2007	1.83
Levens Wood	<i>chlorantha</i>	Fenton, 2007	0.37
Qquoigs Meadow	<i>chlorantha</i>	Sexton, 2007	0.42
<i>(b) Different analysts, same year (5)</i>			
Newtimber Hill	<i>chlorantha</i>	Stott vs Pearce, 2007	1.12
Latterbarrow	<i>chlorantha</i>	Gendle vs Fenton, 2007	0.48
A590/A591 junction	<i>chlorantha</i>	Gendle vs Fenton, 2007	2.33*
Waitby Greenriggs	<i>chlorantha</i>	Gendle vs Fenton, 2007	0.11
Kernsary	<i>bifolia</i>	Bateman vs D.+C. Hughes, 2007	0.17
<i>(c) Different analysts, different years (1)</i>			
Pewsey	<i>bifolia</i>	Bateman, 2004 vs A. Hughes, 2007	1.35
<i>(d) Same analyst, successive years (10)</i>			
Bomains Meadow	<i>chlorantha</i>	Sexton, 2005 vs 2006	0.68
Bomains Meadow	<i>chlorantha</i>	Sexton, 2006 vs 2007	0.91
Plean Park	<i>chlorantha</i>	Sexton, 2005 vs 2006	1.56
Plean Park	<i>chlorantha</i>	Sexton, 2006 vs 2007	1.06*
Kippen (A)	<i>chlorantha</i>	Sexton, 2006 vs 2007	2.26**
Kippen (B)	<i>chlorantha</i>	Sexton, 2006 vs 2007	1.65*
Wester Balgair	<i>chlorantha</i>	Sexton, 2006 vs 2007	1.34*
Braeleny Farm	<i>chlorantha</i>	Sexton, 2006 vs 2007	0.99
Qquoigs Meadow	<i>chlorantha</i>	Sexton, 2006 vs 2007	0.49
Qquoigs Meadow	<i>bifolia</i>	Sexton, 2006 vs 2007	2.21*
<i>(e) Same analyst, same year, different stages of anthesis (1)</i>			
Carnan	<i>bifolia</i>	Bateman, 2007	3.38**

Significance: * = $p < 0.05$, ** = $p < 0.01$

RESULTS

The results of the study are summarized in Appendix 1 and Tables 1–2. By the close of the 2007 field season, our combined database of spur lengths contained 120 datasets (49 for *P. bifolia*) totalling 1876 individual plants (624 for *P. bifolia*); datasets ranged in sample size from a single plant to 118 plants (Appendix 1). Of these 120 datasets, 33 were generated by Bateman, 26 by Sexton and the remaining 61 by other recorders (notably two from southern England and five from Austria by Tony Hughes, four from southern England by Katherine Stott and David Pearce, 11 from Cumbria by Alan Gendle, a further four from Cumbria by James Fenton, seven from west-central Scotland by Sarah Longrigg, and 15

from Scotland by David and Christine Hughes). The net result was clustering of data-points in the Alps, southern England, Cumbria, southern Scotland and northeastern Scotland (interestingly, the middle three areas constitute the geographical ‘hot-spots’ for *P. chlorantha* explicitly identified in the UK by Foley & Clarke [2005]).

Fifteen datasets consisted of only one or two plants, and so yielded data of very limited value. Each of the remaining 105 datasets yielded values for the mean and sample standard deviation, omitting a few rare plants wherein spur development was clearly seriously retarded. A further 21 datasets (four for *P. bifolia*) duplicated other datasets based on the same locality (Table 1). Most duplications of measurement were intentional,

TABLE 2. COMPARISON OF SPUR LENGTHS FROM THE LOWERMOST, MIDDLE AND UPPERMOST FLOWERS IN TEN PLANTS OF TWO POPULATIONS OF *PLATANThERA* FROM SOUTHWEST ENGLAND

Measurement	Locality					
	Bull's Cross			Pewsey		
	Mean	SD	CV	Mean	SD	CV
Species	<i>bifolia</i> + hybrids			<i>bifolia</i>		
Flowers per inflorescence	14.20	3.08	21.7	11.30	3.56	31.5
Spur lengths (mm)						
lowermost	23.50	1.73	7.4	18.80	1.75	9.3
middle	23.80	1.58	6.6	19.75	1.32	6.7
uppermost	22.67	2.19	9.7	18.75	3.60	19.2

None of the pairwise comparisons of positions on the inflorescence is statistically significant. (Data collected by Tony Hughes).

though three duplicated datasets from Cumbria, one from Wiltshire and one from northeast Scotland resulted from wholly accidental (but nonetheless welcome) convergences between two independent analysts (Gendle vs Fenton, Bateman vs A. Hughes, Bateman vs D. and C. Hughes, respectively). Five duplications were conducted by different analysts in the same year, one by different analysts in different years (Bateman vs A. Hughes), four by the same analyst in the same year, and ten by the same analyst (Sexton) in different years. Another kind of duplication study (Bateman) compared plants within the same population that had at least 50% open flowers with those where the lowermost flower was just beginning to open. The last category of duplication study (by A. Hughes) compared the spur lengths of flowers at the specified position in the middle of the inflorescence with the lowermost and uppermost flowers of the same inflorescence, focusing on two populations of *P. bifolia* from southwest England (Table 2).

These duplicate datasets, summarized in Table 1, allowed us to infer how much of the observed variation in spur length could be attributed to measuring error or non-genetic (i.e. environmental and/or developmental) factors rather than genetic factors. Subsequently excluding duplicated datasets (retaining the dataset from the site that was based on the largest sample size) left 83 datasets that could be statistically analyzed and so used to seek geographically related patterns in spur length variation for each species.

DISCUSSION

INTRAPOPULATION VARIATION AND POTENTIAL ANALYTICAL ERROR

Values for mean and sample standard deviations were used to calculate coefficients of variation for each usable dataset. Coefficients of variation ranged from 6 to 15% and were typically 8–12%; this moderate level of variation relative to other features of the plant suggests a considerable degree of functional latitude rather than the constraints inherent in strong selection pressure (cf. Bateman, James & Rudall in prep.). There were, however, two exceptions. The unusually low coefficient of variation (2%) for Murroch is probably an artefact of the unusually small sample size (Appendix 1). However, the exceptionally high coefficient (23%) for the Bix Bottom population of *P. bifolia* may be biologically meaningful, indicating that hybridization at the site is more extensive than was previously supposed, and that some of the plants designated “pure” by us on the basis of overall morphology may actually have experienced introgression (see below). Indeed, since this statement was first written, multivariate analysis required re-identification of one of the Bix plants originally assigned to *P. bifolia* as the hybrid between *P. bifolia* and *P. chlorantha*.

Comparison of mean values and sample standard deviations for different phases of measurement of the same population (Tables 1,

2) provided much useful information. Four populations were measured by the same analyst in the same year, the two phases of measurement typically occurring about a week apart. The mean values differed on average by 3.2% of the total spur length (range 1.3–6.3%), much of which can presumably be ascribed to sampling error. None of the disparities between these pairs of means was statistically significant (Table 1).

A further five populations were analyzed by different analysts in the same year; four pairs of measurements were taken within a week of each other but the fifth pair, at Kernsary, were separated by a remarkable three-week period. The mean values differed on average by only 0.4% more than when the same analyst collected both tranches of data (3.6%, range 0.6–7.8%), suggesting that our efforts to ensure consistency among analysts in the way that they measured spurs had been successful (but see below). Admittedly, one such population (A590/A591 junction near Kendal, Cumbria) showed a difference between the two population means that was marginally statistically significant, but contrasting subpopulations may have been sampled in this extensive, linear roadside population, which encompassed a range of habitats.

More interesting are ten comparisons made by Sexton in south-central Scotland, where in each case the same population was sampled (in most cases extensively) in successive years. These comparisons showed typical mean length differences of 5.1% (range 1.8–10.3%), and five of the ten comparisons were statistically significant, one strongly so (Table 1). In four of these five cases, spurs were on average shorter in 2007 than in 2006, suggesting that there is a significant environmental influence on mean spur length from year to year; presumably, this discrepancy primarily reflects local weather conditions. The single comparison of means determined by different analysts in different years (Pewsey) also fell naturally into this category; although strictly not statistically significant, the two means differed by 6.8%.

Another interesting experiment was conducted by Katherine Stott and David Pearce, who independently measured the same small number of plants at Newtimber Hill, Sussex. For most plants examined their respective estimates of spur length differed by at most only one unit of measurement (i.e. 0.5 mm), but in a few cases measurements differed by up to a worrying 3 mm (i.e. c. 10% of the

overall length of the spur in question). We initially suspected that, in these cases of divergence between analysts, different flowers had been measured on the same inflorescence. Our original emphasis on measuring flowers at consistent position in the middle of the inflorescence was prompted by the study of Bateman & Rudall (2006a), who demonstrated that spur and especially labellum dimensions decreased significantly from the base to the apex of the inflorescences of several species of European orchids. In contrast, these trends were barely evident in the single inflorescence of *Platanthera chlorantha* studied by them; indeed, spur length appeared to peak slightly in the middle of the inflorescence (Bateman & Rudall 2006a, fig. 9).

This pattern seemed most likely an artefact. However, data collected for the present study by A. Hughes show that this is in fact a genuine trend in *P. bifolia* that can be detected (albeit without statistical significance) at the population level. Table 2 shows maximum spur length in the centre of the inflorescence in both study populations, with lower coefficients of variation than are evident in either the lowermost or the uppermost flowers. We suspect that the unusually large, widely spaced flowers of these *Platanthera* species permit the development of a cylindrical rather than a conical inflorescence. Whatever the reason, there is evidently less risk of positional differences causing measuring error in *Platanthera* than in most other European orchids.

Our data suggest that the largest potential source of error is the stage of anthesis reached by the inflorescence. At the Carnan (Benbecula) population of *P. bifolia*, Bateman sampled 20 inflorescences where at least the lower half of the inflorescence bore fully open flowers, and a further 10 inflorescences where even the lowermost flowers were only just beginning to open or were about to open. We estimate that anthesis in the two cohorts of inflorescences only differed by less than a week, yet there was a statistically highly significant difference of 24% in their respective mean spur lengths (10.9 mm vs 14.2 mm: Table 1). This observation supports recent scanning electron microscope studies which suggested that spur elongation occurs surprisingly late in the development of the flowers of European orchids (Box *et al.* in press); it clearly demonstrates that the measured flower must be fully open before relevant and reliable spur dimensions can be obtained.

TABLE 3. RANGES OF SPUR LENGTHS GIVEN FOR *PLATANThERA* SPECIES IN FLORAS OF THE BRITISH ISLES AND CONTINENTAL EUROPE

Flora/monograph	Spur length (mm)	
	<i>P. bifolia</i>	<i>P. chlorantha</i>
<i>(a) British Isles</i>		
Godfery (1933)	15–25	25–30+
Clapham <i>et al.</i> (1962)	15–20	19–28
Sell & Murrell (1996)	15–20	19–28
Stace (1997)	15–20	19–28
Harrap & Harrap (2005)	13–23(–27)	19–35
<i>(b) Europe</i>		
Webb (1980)	25–30	18–27
Davies <i>et al.</i> (1983)	25–30	18–27
Baumann & Künkele (1988)	13–40	20–40 ¹
Buttler (1991)	12–23	18–40
	23–41 ²	
Bournérias & Prat (2005)	20–30	20–45
Delforge (2006)	13–23	18–41
	20–41 ²	

¹Given erroneously in the original text as 2–4 mm.

²Both authors distinguished a short-spurred calcifugic ecotype in northwest Europe from a longer-spurred calcicolous ecotype occurring further south and east.

Lastly, conducting our own measurements led to a better appreciation of qualitative differences in spur morphology between the two species. In particular, Ettlinger (1997) noted that the spur of *P. bifolia* appears to be a simple cylinder, whereas that of *P. chlorantha* is expanded towards the apex. We found spurs of both species to be bilaterally compressed (i.e. oval rather than circular in transverse section), but in *P. chlorantha* there was also a significant dorsiventral increase in wall thickness in the distal half to two-thirds of the spur. This often conferred on the spurs of *P. chlorantha* a gently sigmoid shape when viewed laterally (Fig. 1); these then require straightening prior to measurement.

PREVIOUS REPORTS OF SPUR LENGTH IN *P. CHLORANTHA* AND *P. BIFOLIA*

Appendix 1 and Figure 3 summarize our extensive data on *Platanthera* spur lengths for the British Isles and our more sporadic data obtained from populations occurring in Continental Europe. For comparison, in Table 3 we have abstracted ranges of spur lengths given for the two species in several widely-read general floras and orchid monographs

covering (a) the British Isles and (b) part or all of Continental Europe.

Within the British Isles, Sell & Murrell (1996) and Stace (1997) followed the dimensions given for spurs of both species by Clapham *et al.* (1962), but their ranges are too narrow for *P. bifolia* and are skewed toward the lower end of the scale for *P. chlorantha*, failing to accommodate the long-spurred (mean >32 mm) populations that predominate in southern England (Fig. 3). Only the ranges given by Harrap & Harrap (2005) match our own observations for both *Platanthera* species, though we have not yet located any of the short-spurred (mean <23 mm) populations of *P. chlorantha* reported by all authors except Godfery (1933).

Moving on to mainland Europe, Webb (1980, echoed by Davies *et al.* 1983) gave lower and upper limits to *P. chlorantha* that were less than those for *P. bifolia*, apparently having given undue emphasis to the extraordinary reversal in this character reported along the Baltic coast by Nilsson (1978, 1985). The ranges fail utterly to accommodate British populations. The remaining authors (Baumann & Künkele 1988; Buttler 1991; Bournérias &

Prat 2005; Delforge 2006) succeeded in encompassing variation in both species, but only by offering ranges of spur length that are so broad that they lose any potential for being diagnostic of either species (and even then, Bournérias & Prat failed to accommodate the lower end of the spectrum of spur length recorded by us in both British and Continental *P. bifolia*).

Perhaps the most interesting decision was that taken by Buttler (1991) and Delforge (2006) to separate two putative ecotypes of *P. bifolia*, partly on the basis of ecological preference and partly on the basis of vegetative vigour and spur length. Delforge (2006) offered slightly more liberal spur-length ranges than Buttler (1991), allowing the northwestern, later flowering, calcifugic ecotype (subsp. *graciliflora* Bisse, ? = var. *robusta* Seemen) to extend from 13–23 mm and the southern and eastern calcicolous ecotype to cover the range 20–41 mm. However, calcicolous populations from the UK approximate both the upper boundary of the smaller ecotype and the lower boundary of the larger ecotype (cf. Appendix 1 and Table 3). In Continental Europe, the four calcicolous populations of *P. bifolia* measured by Bateman & Rudall in southeastern France occupy the lower part of the range of the calcicolous ecotype, whereas the calcicolous population measured by Sexton in the Dolomitic Alps of northeastern Italy shows a typical “calcifugic” mean spur length of 17 mm. At best, the delimitation of these infraspecific taxa clearly requires further refinement.

The above discussion may appear to have become enmeshed in unnecessarily fine details. However, our aim is to address a broader underlying theme. Specifically, spur length is in fact diagnostic of the two northern European species of *Platanthera*, but only if the latitude of populations is taken into account (Fig. 3). When latitude is not taken into account, the majority of the published ranges of spur length either fail to accommodate a substantial proportion of *Platanthera* populations, if they are too narrow, or fail to suggest any diagnostic potential, if they are too broad. We suspect that similar patterns are commonly reflected in quantitative characters presented in diagnoses of herbarium-based floras. There is no substitute for access to geographically and ecologically extensive field data.

MUTATION

Visual inspection of the data matrix suggested that frequencies of both presumed hybridization and presumed mutation radically reducing spur length were surprisingly low.

With regard to putative mutation, of 1876 plants measured, only four plants (0.21%), apportioned equally between *P. chlorantha* and *P. bifolia*, yielded abnormally short spurs (defined as those less than 60% of the mean length for the population). This result contrasts with, for example, data for *Gymnadenia conopsea* and its close relatives, where the frequency of abbreviated spurs is substantially greater and has been inferred as a likely driver of speciation within the genus (Bateman 2005). Pseudopeloric individuals of *P. chlorantha*, possessing only simplified sepal-like labella bearing greatly reduced (essentially vestigial) spurs, have previously been reported from Keltneyburn, near Perth (averaging approximately 3% of the population: cf. McKean 1982; Bateman 1985) and Kennishead, Glasgow (averaging approximately 6% of the population: Dickson 1990). During the present study in 2007, Sexton identified 21 widely distributed pseudopeloric individuals out of 802 *P. chlorantha* flowering at Bomains Meadow, Falkirk (i.e. 2.6%).

Recent assertions that these pseudopeloric plants could constitute incipient species (Rudall & Bateman 2002; Bateman & Rudall 2006b) have arguably been weakened by Sexton's observation that the Bomains mutants verge on being male-sterile. We suspect that they are epimutants, reflecting hypermethylation of the DNA bases rather than non-synonymous mutation of the bases themselves; a project is underway to test this hypothesis (Bateman, Rudall, Kidner & James, unpublished).

HYBRIDIZATION

Only five (0.27%) of the measured *platantheras* were accused by us of being hybrids between the two study species, identified primarily on the basis of their intermediate pollinaria positions. All five plants were reported by Bateman & Rudall: four from Bix Bottom, Oxfordshire (Fig. 2), plus one less certain identification from St Anne's Chapel, Cornwall (regrettably, no data were obtainable from its gynostemium). Disappointingly, our published request for data from additional mixed

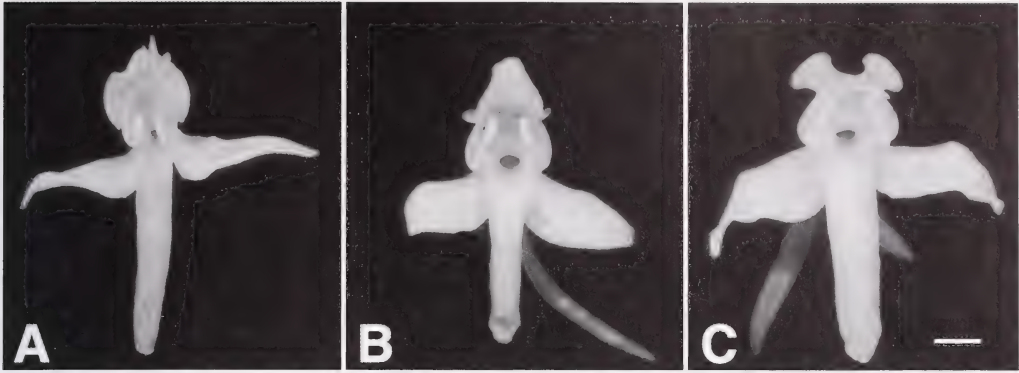


FIGURE 2. Flowers of *Platanthera bifolia* (A left), *P. chlorantha* (C right) and a putative hybrid (B centre) from the Warburg Reserve, Bix Bottom, Oxfordshire. Scale bar = 5 mm. Photos: Richard Bateman.

populations (Bateman & Sexton 2007) yielded only one new dataset (gathered near Perth, by Sexton), and no putative hybrids were reported from this locality. On the other hand, the Bull's Cross locality studied by Tony Hughes contained convincing hybrids, though they were not reliably separated from their co-occurring parents.

The hybrids recorded from southern England by Bateman & Rudall (Fig. 2), Tony Hughes (Hughes 2007) and Sarah Whild (Whild & Lockton 2007) during the present survey have some significance, as most authors of floras have been uncharacteristically reluctant to accept the occurrence of hybridization between the two species of *Platanthera*, especially within the British Isles. For example, Godfrey (1933) reported an occurrence of a putative hybrid from Sligachan, Skye, but then qualified this observation by noting that the "hybrid" had co-occurred with a pseudopeloric mutant (*sensu* Bateman 1985). This sceptical viewpoint was adopted by most subsequent authors, who argued that evidence of hybridization in British *platantheras* was inconclusive and that most if not all putative hybrids were actually aberrant individuals of one of the parents (cf. Hunt 1975; Sell & Murrell 1996; Stace 1997, in press; Foley & Clarke 2005; Harrap & Harrap 2005). Further questionable arguments frequently deployed against the existence of hybrids included supposed differences in habitat preference, peak flowering period and, most bizarrely, the presumed reduced fitness of the hybrids caused by suboptimal presentation of the viscidia to pollinators. (This is actually an argument against introgression, rather than against hybridization *per se*, since the key assumption is that primary hybrids could only act as pollen recipients, not as pollen donors

[Nilsson 1983]. However, recent field observations question this assumption, as moths have been photographed removing pollinia from hybrids: Claessens *et al.* in press.)

In adopting this sceptical viewpoint, these authors were echoing Charles Darwin, who took considerable exception to the decision of Bentham & Hooker (e.g. 1886) to treat the two British *platantheras* as mere varieties of a single species – a decision taken on the grounds that "intermediate" forms occurred between them (cf. Summerhayes 1951). Darwin was driven to uncharacteristically waspish exaggeration in his opposition, stating that "the two forms differ in a large number of characters, not to mention general aspect and the stations inhabited", and that "these two forms certainly differ from one another more than do most species belonging to the same genus". Having noted that loose waxy scales on the heads of visiting moths most likely confine placement of pollinia to the proboscis (*P. bifolia*) or eyes (*P. chlorantha*), Darwin (1877, pp. 73–4), apparently prompted in part by Muller (1865), concluded that there is no "doubt that the Larger and Lesser Butterfly Orchids are distinct species, masked by close external similarity" (thereby somewhat undermining his own earlier statement regarding their appreciable morphological distinctness). Given the continuing uncertainties over the nature of morphological intermediates between these species, the surprising failure thus far of molecular systematists to identify genetic markers that reliably separate the two species is particularly unfortunate – indeed, it once again raises questions regarding the now generally accepted status of these taxa as separate species (Bateman 2005; Bateman *et al.* in prep.).

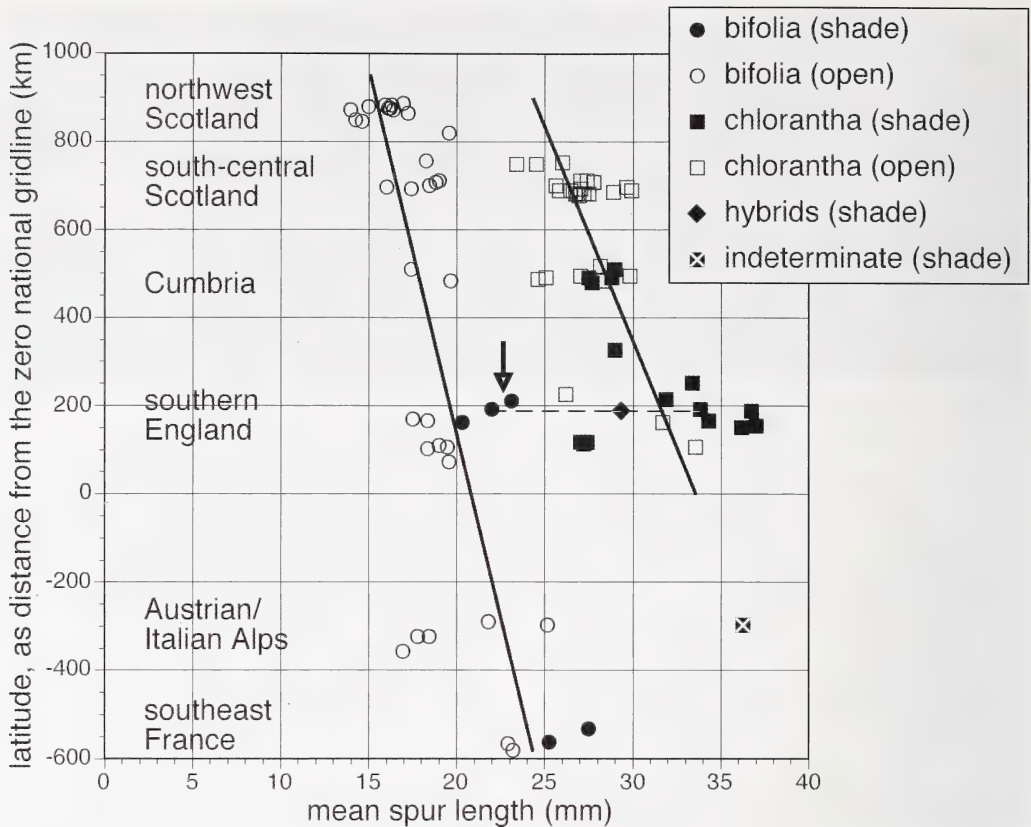


FIGURE 3. Mean spur length (mm) regressed against latitude for populations of *Platanthera bifolia* (left, $n = 38$, $r^2 = 0.56$) and *P. chlorantha* (right, $n = 43$, $r^2 = 0.42$). Shade and open habitats are also distinguished. The dashed line connects mean values for both parents and the putative hybrids at the Bix Bottom locality; the two juxtposed arrowed populations of *P. bifolia* show evidence of introgression. The Alpine population of three flowering plants labelled "indeterminate" was reported as *P. bifolia* but has a mean spur length more characteristic of *P. chlorantha*; this, together with the hybrid group, was omitted from the regression analysis.

Returning to the present study, the putative hybrids from Bix had spur lengths intermediate between those of the parental species co-existing at the two relevant localities (Appendix 1, Fig. 3). Indeed, we suspect that hybridization in the Bix and Bull's Cross populations may be more extensive than we originally believed, since spur-length measurements for supposedly pure plants of *P. bifolia* in these two populations are the longest of any in southern England (Fig. 3), suggesting the genetic influence of co-occurring *P. chlorantha*. Similar observations of spur intermediacy in hybrids were made on larger numbers of putative hybrids of *P. chlorantha* $\times$ *bifolia* ($= P. \times hybrida$ Bruegger) along the Baltic coast of Sweden by Nilsson (1985), though here *P. bifolia* typically has spurs that are substantially longer than those of *P.*

chlorantha – an extraordinary character reversal relative to the more typical condition (Bateman 2005). Indeed, intermediacy of spur dimensions has characterized all of the many quantitative case-studies of hybridization among spurred European orchids known to us (reviewed by Bateman & Hagger in prep.). This reliable intermediacy renders extraordinary the report of extensive hybridization in two mixed populations of *Platanthera* in the Netherlands, where the putative hybrids show longer average spur lengths (32 mm) than co-existing populations of both *P. chlorantha* (26 mm) and *P. bifolia* (23 mm) (Claessens & Kleynen 2006; Claessens *et al.* in press). It seems likely that the evolutionary processes operating in these ambiguous Dutch populations are more complex than simple introgression.

GEOGRAPHICAL AND ECOLOGICAL TRENDS

Prior to the present survey, we wrote that "as expected, spurs of *P. chlorantha* were typically considerably longer than those of *P. bifolia* (averaging 34 mm vs 19 mm) ... Data from Scotland (very limited in the case of *P. bifolia*) suggest that *P. bifolia* retains its English dimensions there, whereas the spurs of *P. chlorantha* are significantly shorter" (Bateman & Sexton 2007, p. 61). The addition of substantial datasets from southeast France, the Alps, Cumbria and Scotland requires substantial revision of that preliminary viewpoint. Regression of mean spur length against latitude (Fig. 3) revealed strong correlation coefficients, especially for *P. bifolia* ($r^2 = 0.56$, vs 0.42 for *P. chlorantha*), and suggested similar trends in both species; each shows a reduction in mean spur length of approximately 2.2% per 100 km of increasing latitude. Figure 3 also demonstrates that spur length distinguishes the two species only if latitude is taken into account, as populations of *P. bifolia* from the Vercors in southeast France show similar mean spur lengths to populations of *P. chlorantha* occurring approximately 1300 km to the north in southern Scotland (c. 26 mm). Those occurring a little further north of the Vercors in the Alps also fit into the general trend, though the spread of populations appears relatively wide (even discounting the exceptional mean length of 35 mm obtained in Pettneu, western Austria, which is rendered suspect by both the unusually small sample size of three plants and uncertain species assignment).

The obvious temptation is to interpret these latitudinal trends as reflecting adaptation of the spur to proboscis length in the respective pollinators of these two orchid species. However, data gathered by Bateman and co-workers from all major features of the plants of both species suggest that, at least in southern England, most features of *P. bifolia* are on average only two-thirds of the dimensions of equivalent features in *P. chlorantha* (Bateman 2005; Bateman *et al.* in prep.). A similar ratio was evident among floral dimensions recorded in south-central Scotland by Sexton (unpublished). If this ratio is repeated across most of the (largely coincident) ranges of the two species, the latitudinal gradient in spur length observed in this study (Fig. 3) could simply represent an allometric ratio across most organs of the plant that is merely reflected in spur length. In this case, the overall size

differences could, for example, ultimately reflect the greater relative degree of insolation impacting on the (usually paired) leaves of plants at lower latitudes (though note that, during the summer months when *Platanthera* leaves are fully expanded, day length at least is longer in higher latitudes). Spur length would then be inferred to be under at most relatively weak and/or sporadic selection pressure (a conclusion reached, on the basis of more sophisticated data, for the North American *P. lacera* by Little *et al.* 2005).

Furthermore, re-examination of the present data (Fig. 3) suggests that application of more complex algorithms for fitting curves to the spur-length data might ultimately achieve a more exact fit. For example, the spur-length data for *P. bifolia* could legitimately be interpreted as showing a constant size of approximately 18 mm for most of the latitudinal range, deviating only at the two extreme ends of the latitudinal gradient (i.e. upwards in southeast France and downwards in northwest Scotland). Similarly, data for *P. chlorantha* could be considered to be constant for most of its latitudinal range, plateauing at approximately 28 mm (a similar figure also characterizes this species in the Low Countries: Claessens & Kleynen 2006), but to have deviated upward to values of 32–37 mm over much of southern England (a mean spur length of 32 mm was also reported for a co-latitudinal population of *P. chlorantha* from Poland by Stpiczynska 2003a). Positive deviations in the spur length of *P. bifolia* (mean values 27–34 mm) characterize much of Scandinavia, falling to 18–21 mm in the birch forests of the north (Nilsson 1983, 1985; Tollsten & Berstrom 1993; Maad 2000). Moreover, on the Baltic island of Oland there has been divergence between short-spurred populations of *P. bifolia* in grassland (means 19–23 mm) and those occupying deciduous woodland (means 28–40 mm) (Nilsson 1983; J. Maad pers. comm. 2007).

This observation suggests that, beyond latitude, the other extrinsic factors that could potentially have influenced spur length are those relating to habitat preference, particularly soils (pH and moisture content) and degree of shade experienced by the orchids. Our present data for soils are inadequate, though there exists much anecdotal evidence that *P. bifolia* is more tolerant than *P. chlorantha* of wet acidic soils. In contrast, we were able to amalgamate the habitat descriptions listed in Appendix 1 into two broad categories of

exposure to light: shaded (woodland and scrub) and open (grassland, heathland and moorland).

Among our sampled populations, shaded populations do not extend northward beyond southern England for *P. bifolia* and beyond northern England for *P. chlorantha*. In the case of *P. bifolia*, within specific latitudinal zones, all populations occurring in shade have longer spurs than those occurring in the open (all occur on the positive side of the regression line in Fig. 3). The pattern is less clear for *P. chlorantha*, for which in addition we presently lack data from Continental Europe. In southern England, shaded populations appear to span a wider range of spur lengths than exposed populations (only shaded populations span the upper end of the range of means, at 34–37 mm). However, no significant difference between shaded and open populations was observed in northern England, and no shaded populations were recorded in Scotland. Nonetheless, potential correlations between average spur length and environmental parameters evidently merit more detailed scrutiny.

Lastly, we note that although some of our study populations of both *Platanthera* species encompassed several hundred flowering plants, the majority were small, many typically yielding less than ten flowering plants in any one year. Where such small effective population sizes pertain, deviation from previous distributions of spur length can be readily achieved via genetic drift, whereas the potential for long-term directional or disruptive selection is greatly reduced (e.g. Tremblay *et al.* 2005). Genetic drift merits consideration in any study of spur-length variation in *Platanthera*, though its random effects might have been expected to obscure the apparent correlation between habitat preference and mean spur length.

POLLINATOR SPECIFICITY REVISITED

As noted earlier, past assertions of strong selection pressure on spur length have focused on morphological and ecological data for the two *Platanthera* species in Scandinavia (Nilsson 1978, 1983, 1985; Maad 2000; Maad & Nilsson 2004), where mean spur length of *P. bifolia* in particular appears to show greater regional variation than is evident in our measurements taken elsewhere in western Europe. The Swedish data suggest that strong pollinator specificity among different species of sphingid moth provides a meaningful level

of reproductive isolation separating the two species and different geographic/ habitat races within *P. bifolia*; indeed, the observed mechanism has become a model system of plant–pollinator co-evolution (e.g. Hapeman & Inoue 1997).

The classical model states that *P. bifolia* places its pollinaria anywhere along the length of the moth's proboscis, whereas *P. chlorantha* requires the moth to ram its head into the column in order to attach the viscidia to the surface of its eyes. This contrast in the mechanism of pollinium placement would suggest that spur length should be more critical to the reproductive success of *P. chlorantha* than to that of *P. bifolia*. Setting aside sites that yielded very small sample sizes and those showing evidence of introgression, coefficients of variation for spur length within our study populations range from 5–18% for *P. bifolia* (typically approximately 11%) and 6–14% for *P. chlorantha* (typically approximately 9%; Appendix 1). Thus, if there is a contrast in selective pressure on spur length between the two species it does not appear to be a strong one.

Darwin (1877) and subsequent commentators (e.g. Summerhayes 1951; Nilsson 1983) argued adamantly that only long-tongued moths effect pollination in European *Platanthera*. However, Darwin also persistently rejected observations of other natural historians, notably Müller (1865), that many European orchids did not actually reward their pollinators, whereas subsequent studies have proven Müller right; many orchid species succeed by deceiving rather than rewarding pollinators (e.g. van der Cingel 1995; Neiland & Wilcock 1998; Cozzolino & Widmer 2005). Many authors have noted that species offering genuine rewards to pollinators generally achieve substantially higher frequencies of pollination than do co-existing food-deceptive species (Neiland & Wilcock 1998; Cozzolino & Widmer 2005). However, fewer authors have noted that this comparatively successful pollination rate has not translated into greater numbers of rewarding than non-rewarding species or to greater average size or number of populations per rewarding species. And even fewer authors have noted that there is no obligation on pollinators to accept any reward offered. Surely, an insect that is demonstrably willing to be duped into pollinating an unrewarding orchid will not balk at the prospect of

pollinating a species that offers a reward that the insect cannot satisfactorily exploit?

Having thus hypothesized that at least some occasional pollinators of *Platanthera* would show behaviour patterns that are unlikely to be influenced by spur length, we were briefly excited when our 2007 spur-length survey prompted Tony Hughes (2007) to capture daytime images in Gloucestershire of a distinctive *Oedermera* beetle transporting pollinia across a putatively hybrid *Platanthera* inflorescence at Bull's Cross. Unfortunately, more careful scrutiny suggests that the pollinia in question were obtained from adjacent plants of *Neottia* (*Listera*) *ovata*. Feasibility studies using moth traps at *P. chlorantha* sites in south-central Scotland showed that moths with pollinia attached to their eyes were caught fairly readily (Sexton & McQueen 2005). Moreover, John Knowler (pers. comm. 2006) reported that catches included the Beautiful Golden Y (*Autographa pulchrina*), Silver Y (*A. gamma*) and Gold Spangle (*A. bractea*); all three moths are prominent pollinators of *P. chlorantha* in Sweden (Nilsson 1978).

Nonetheless, recent combined population genetic and morphological studies of gene flow in other groups of European orchids also counsel caution when assuming strong pollinator specificity. Even in the notionally most pollinator-specific genus, *Ophrys*, natural hybrids occur among all major species groups, demonstrating both their interfertility and the fact that pollinators frequently transfer pollinia between species (cf. Paulus & Gack 1990; Devey *et al.* in press; S. Cozzolino pers. comm. 2007). In addition, the ability to identify pollinia through DNA sequencing (e.g. Soliva & Widmer 2003) means that we can assess pollinator error rates, which even in *Ophrys* are proving to be relatively high. Also, artificial crosses among *Ophrys* species have demonstrated fertility in F₁s, F₂s and backcrossed progeny (S. Malmgren pers. comm. 2006; S. Cozzolino pers. comm. 2007). Current (albeit limited) evidence suggests that *P. bifolia* and *P. chlorantha* may similarly introgress whenever they co-exist in substantial numbers in the same or immediately adjacent habitats.

For the present, the jury is out regarding the degree of reproductive isolation enjoyed by the two European *Platanthera* species. Clearly, it is desirable to gather data on the range and frequency of success of pollinators from other regions of Europe to test the long-standing hypotheses of strong specificity.

CONCLUSIONS

We have confidently identified latitudinal and habitat influences on mean spur length in *Platanthera bifolia* and *P. chlorantha*. Once these factors have been compensated for, *P. chlorantha* maintained spurs approximately 50% longer than those of *P. bifolia* throughout our latitudinal transect, though previous studies (Nilsson 1983, 1985; Maad & Nilsson 2004; Boberg *et al.* 2007; J. Maad pers. comm. 2007) suggest that this apparently linear relationship breaks down in parts of Scandinavia. We recognize that detection of further patterns of regional highs and lows would once again encourage consideration of potential local adaptation of spur length to optimally fit the morphology of co-evolving pollinating moths, and that our observations do not necessarily reject previous selectionist interpretations. However, we do suggest that, in future, potential non-adaptive causes of variation in spur length, relating to allometric relationships with other structures of the plant and/or to vigour of growth influenced by habitat and latitude, are considered alongside more conventional co-evolutionary explanations.

The new data have allowed us to formulate more precise questions regarding the evolution of spur length in the study species, even if they have not provided unequivocal answers. Adding further spur-length data, preferably targeted to fill current geographical lacunae in our trans-European sampling, should help to clarify patterns of variation. However, the above hypothesis of a non-adaptive allometric relationship between spur length and other parts of the plant can only be tested effectively by expanding the study to encompass measurements of other characters from the same plants that are presently yielding spur-length data. Top priority for such supplementary characters would be metric measurements of the column/pollinia, labellum and (typically paired) expanded leaves. Data on the ontogeny of the spurs of *Platanthera*, and on the underlying developmental genetic mechanisms, would also be welcome. Similarly, data on pollinator specificity are needed across the full geographical ranges of both species before meaningful interpretations of the possible relationship between adaptation and speciation can be made.

More generally, we hope that we have successfully demonstrated that field-oriented projects recruiting inexperienced researchers

can be successfully extended beyond the conventional limit of simply recording the presence of a particular species, into the realm of quantitatively measuring features of potentially high biological significance. Returning to butterfly-orchids, we note that it is B.S.B.I.-inspired field surveys that identified *Platanthera bifolia* as one of the most rapidly declining species of flowering plants in the British Isles (Preston *et al.* 2002; Braithwaite *et al.* 2005), and led to a subsequent resurvey of its localities in Scotland that relied largely on "amateur" botanists (Farrell 2006; Lavery 2007). It would therefore be appropriate if inexperienced researchers also contributed further scientific data with the potential to explain those declines. Such an explanation should be facilitated by the co-occurrence of a very closely related species, *P. chlorantha*, that does not appear to be experiencing a rapid decline and therefore constitutes an ideal comparative yardstick. Comparison of rare and/or rapidly declining species with closely related species that are common and/or rapidly expanding is presently an under-exploited approach to exploring the British and Irish flora.

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APPENDIX 1. DETAILS OF LOCALITIES AND SPUR MEASUREMENTS ENCOMPASSED BY THE PRESENT STUDY OF BRITISH AND IRISH *PLATANThERA*, LISTED ACCORDING TO INCREASING LATITUDE

Species	Recorder(s), Date(s)	Locality	Habitat	Shaded	N	Mean	SSD	CV (%)
ALPS								
bifolia	R Bateman/P Rudall, 2007	S BARNAVE, S Die, SE of Vercors, SE France	coarse grassland/ scrub	N	10	23.2	3.79	16.3
bifolia	R Bateman/P Rudall, 2007	Robinia site, S CHAMALAC, SE of Vercors, SE France	coarse grassland	N	20	22.98	2.75	12
bifolia	R Bateman/P Rudall, 2007	TRESANNE Road, NW Clieles, SE of Vercors, SE France	open scrub	Y	20	25.25	2.97	11.8
bifolia	R Bateman/P Rudall, 2007	Croix des Toutes AURES, NE Royans, NW Vercors, France	mixed woodland	Y	11	27.55	2.07	7.5
bifolia	R Sexton, 2006	CORVARA, SE Brixen, Dolomites, Italy	calcareous flush	N	48	17	2.44	14.4
bifolia	A Hughes, 2007	Main road, OBERGURGL, NW Bozen, W Austria	open rocky slope	N	5	17.8	1.64	9.2
bifolia	A Hughes, 2007	Road W from VENT toward Rofen, NW Bozen, W Austria	grassland	N	6	18.5	3.39	18.3
indeterminate	A Hughes, 2007	PETTNEU, 10 km E St Anton, E Bludenz, W Austria	dense woodland	Y	3	36.33	4.62	12.7
bifolia	A Hughes, 2007	MOOS, NW outskirts of St Anton, E Bludenz, W Austria	grassland (hay meadow)	N	5 ³	25.2	1.3	5.2
bifolia	A Hughes, 2007	OBERLECH, 13 km NW St Anton, E Bludenz, W Austria	grassland (hay meadow)	N	5 ³	21.8	1.64	7.5
UK								
bifolia	R Bateman/P Rudall, 2003	Sylvia's Meadow, ST ANNE'S Chapel, Tavistock, Cornwall	coarse grassland	N	8	19.63	1.41	7.2
chlorantha ¹	R Bateman/P Rudall, 2003	Sylvia's Meadow, ST ANNE'S Chapel, Tavistock, Cornwall	coarse grassland	N	1	26	NA	NA
hybrids ¹	R Bateman/P Rudall, 2003	Sylvia's Meadow, ST ANNE'S Chapel, Tavistock, Cornwall	coarse grassland	N	1	23	NA	NA
bifolia	R Bateman/P Rudall, 2003	Elkham's Grave, MEAD END, Rhinefield, S Hants	wet heath/bog	N	8	18.38	1.51	8.2
chlorantha	R Bateman/P Rudall, 2004	BADBURY Rings, Shapwick, NW Wimborne, Dorset	coarse grassland	N	9	33.56	3.57	10.6
bifolia	R Bateman/P Rudall, 2003	PIG BUSH, Denny Lodge, S Hants	heath	N	10	19.5	2.07	10.6
bifolia	R Bateman/P Rudall, 2003	STEPHILL Bottom, Denny Lodge, S Hants	heath	N	4	19	1.83	9.6
chlorantha	K Stott/D Pearce, 2007	NEWTIMBER Hill, Sussex	woodland	Y	4 ³	27.2	1.78	6.5
chlorantha	K Stott/D Pearce, 2007	WOLSTENBURY Hill, Sussex	woodland	Y	37	27.46	3.24	11.8

¹not plotted, as sample size only one or two plants; ² not plotted, as these datasets duplicate other larger datasets; ³ mean excluded one plant with an exceptionally short spur.

Appendix 1 continued on next page

APPENDIX 1 CONT....

Species	Recorder(s), Date(s)	Locality	Habitat	Shaded	N	Mean	SSD	CV (%)
UK								
chlorantha ²	K Stott/D Pearce, 2007	WOLSTENBURY Hill, Sussex	woodland	Y	12	26.58	3.6	13.5
chlorantha	K Stott/D Pearce, 2007	CLAYTON Hill, Sussex	woodland	Y	5	27.1	3.15	11.6
chlorantha ¹	R Bateman/P Rudall, 2004	Broad Down, WYE Downs, SE Wye, E Kent	coarse grassland	N	1	28	NA	NA
chlorantha ¹	R Bateman/P Rudall, 2004	PARK GATE Down, Elham, E Kent	grassland	N	1	28	NA	NA
chlorantha	R Bateman/P Rudall, 2003/4	YOCKLETT'S Bank, Waltham, E Kent	open woodland	Y	5	36.2	3.03	8.4
chlorantha	D Johnson, 2007	BONSAI BANK, SE Canterbury, E Kent	chalk scrub	Y	20	37	2.55	6.9
chlorantha ¹	R Bateman/P Rudall, 2003	SHEEPLEAS Wood, West Horsley, Surrey	coarse grassland/ scrub	N	1	36	NA	NA
bifolia ¹	R Bateman/P Rudall, 2004	Great CHEVERELL Hill, SW Lavington, Wilts	coarse grassland	N	1	17	NA	NA
bifolia ¹	R Bateman/P Rudall, 2004	Coppice NW SHELDWICH, S Faversham, E Kent	woodland	Y	1	23	NA	NA
chlorantha	R Bateman/P Rudall, 2004	Traffic island, LONGREACH Wood, Stockbury, W Kent	coarse grassland/ scrub	N	10	31.7	4.47	14.1
bifolia	R Bateman/P Rudall, 2003/4	STOCKBURY Hill Wood, Elham, W Kent	open woodland	Y	3	20.33	1.53	7.5
bifolia	R Bateman/P Rudall, 2004	Walkers Hill, PEWSEY Downs, N Alton Barnes, Wilts	grassland	N	5	18.4	1.95	10.6
bifolia ²	A Hughes, 2007	Walkers Hill, PEWSEY Downs, N Alton Barnes, Wilts	grassland	N	10	19.75	1.32	6.7
chlorantha	D Johnson, 2007	CULVERSTONE Woods, Mccopham, NW Kent	woodland	Y	20	34.3	2.3	6.7
bifolia	R Bateman/P Rudall, 2004	MORGAN'S HILL, Calstove Wellington, SE Calne, Wilts	grassland	N	10	17.5	1.58	9
chlorantha	R Bateman/P Rudall, 2003/4	HOMEFIELD Wood, Medmenham, Bucks	woodland/scrub	Y	8	36.75	3.2	8.7
bifolia	R Bateman/P Rudall, 2003/4	Warburg Reserve LNR, BIX Bottom, Oxon	woodland/scrub/ grassland	Y	4	22	4.24	19.3
chlorantha	R Bateman/P Rudall, 2003/4	Warburg Reserve LNR, BIX Bottom, Oxon	woodland/scrub/ grassland	Y	11	33.91	3.42	10.1
hybrids	R Bateman/P Rudall, 2003/4	Warburg Reserve LNR, BIX Bottom, Oxon	woodland/scrub/ grassland	Y	3	29.33	2.08	7.1
chlorantha ¹	P Daltry, 2007	Near Great MISSENDEEN, Bucks	?woodland	?Y	2	29.25	NA	NA
bifolia	A Hughes, 2007	BULL'S CROSS, B4070, NE Stroud, Gloucs	woodland	Y	5	23.1	1.52	6.6
hybrids? ²	A Hughes, 2007	BULL'S CROSS, B4070, NE Stroud, Gloucs	scrub	Y	5	24.5	1.46	6
chlorantha ¹	R Bateman, 2004	DANCERS END LNR, Aston Clinton, Bucks	scrub/open woodland	Y	1	34	NA	NA
chlorantha	R Bateman/P Rudall, 2004	ASTON CLINTON Ragpits LNR, Bucks	scrub/coarse grassland	Y	10	31.9	2.23	7

Species	Recorder(s), Date(s)	Locality	Habitat	Shaded	N	Mean	SSD	CV (%)
UK								
chlorantha	R Bateman/H+J Lambert, 2004	Ty-Commins, LLANBEDR, Crickhowell, Powys	coarse grassland	N	10	26.2	3.05	11.6
chlorantha	R Bateman/J Tyler, 2004	Lineage Wood, E Bridge Street, W LAVENHAM, W Suffolk	woodland	Y	9	33.44	4.45	13.3
chlorantha	I Wright, 2004	LLYNCHLYS Common, Oswestry, Shrops	open woodland	Y	26	29.02	2.69	9.3
chlorantha	A Gendle, 2007	ARNSIDE Cemetery	woodland	Y	4	27.75	2.47	8.9
chlorantha ¹	A Gendle, 2007	MEATHROP Quarry	coarse grassland	N	1	28	NA	NA
chlorantha ¹	A Gendle, 2007	SANDSIDE Quarry	coarse grassland	N	2	29.75	NA	NA
bifolia	A Gendle, 2007	OUTLY Moss	valley mire	N	20	19.65	2.27	11.6
chlorantha	J Fenton, 2007	LATTERBARROW LNR, SW Kendal, SE Cumbria	grassland	N	20	28.23	2.73	9.7
chlorantha ²	A Gendle, 2007	LATTERBARROW LNR, SW Kendal, SE Cumbria	grassland	N	12	28.71	2.61	9.1
chlorantha	A Gendle, 2007	Canny Hill, NEWBY Bridge	grassland	N	16	24.63	1.55	6.3
chlorantha	J Fenton, 2007	LEVENS Wood, SW Kendal, SE Cumbria	?woodland	Y?	17	28.85	2.07	7.2
chlorantha	A Gendle, 2007	Piers Gill, DENTDALE	hay meadow	N	12	25.13	3.45	13.7
chlorantha	J Fenton, 2007	A590/A591 junction, SW Kendal, SE Cumbria	woodland	Y	21	27.5	2.47	9
chlorantha ²	A Gendle, 2007	A590/A591 junction, SW Kendal, SE Cumbria	woodland	Y	20	29.83	2.15	7.2
chlorantha	A Gendle, 2007	A6/A591 junction, S Kendal, SE Cumbria	coarse grassland	N	19 ³	29.87	2.61	8.7
chlorantha	A Gendle, 2007	FIRBANK churchyard	coarse grassland	N	6	27.08	1.59	5.9
chlorantha	L+N Harbron, 2007	SMARDALE NNR, W Kirkby Stephen, SE Cumbria	woodland	Y	67	29.04	2.85	9.8
chlorantha	A Gendle, 2007	WAITBY Greenriggs, W Kirkby Stephen, SE Cumbria	grassland	N	20	17.45	2.23	12.8
bifolia	J Fenton, 2007	WAITBY Greenriggs, W Kirkby Stephen, SE Cumbria	(grassland)	N	19	17.34	1.22	7
chlorantha	S Longrigg, 2007	MILGAVIE, East Dumbartonshire	grassland (meadow)	N	6	27	2.3	8.5
chlorantha	S Longrigg, 2007	CARDROSS, W. Dumbartonshire	coarse grassland	N	11	26.73	2.61	9.8
chlorantha	S Longrigg, 2007	MURROCH, Dumbarton, E. Dumbartonshire	grassland (meadow)	N	4	27.25	0.5	1.8
chlorantha	S Longrigg, 2007	RENTON, East Dumbartonshire	coarse grassland (waste)	N	29	27.52	2.23	8.1
chlorantha	R Sexton, 2005	BOMAINS Meadow LNR, Bo'ness, Falkirk, ?Fife	coarse grassland	N	55	26.83	2.23	8.3
chlorantha ²	R Sexton, 2006	BOMAINS Meadow LNR, Bo'ness, Falkirk, ?Fife	coarse grassland	N	19	26.15	2.49	9.5
chlorantha ²	R Sexton, 2007	BOMAINS Meadow LNR, Bo'ness, Falkirk, ?Fife	coarse grassland	N	24	27.06	2.16	8

¹ not plotted, as sample size only one or two plants; ² not plotted, as these datasets duplicate other larger datasets; ³ mean excluded one plant with an exceptionally short spur.

Appendix 1 continued on next page

APPENDIX 1 CONT....

Species	Recorder(s), Date(s)	Locality	Habitat	Shaded	N	Mean	SSD	CV (%)
UK								
chlorantha	S Longrigg, 2007	BALLOCH, East Dumbartonshire	coarse grassland	N	20	28.9	2.51	8.7
chlorantha	S Longrigg, 2007	PIRNIEHALL, Croftamie, Stirlingshire	coarse grassland	N	20	29.98	1.94	6.5
chlorantha	R Sexton, 2007	PLEAN Country PARK	grassland (meadow)	N	75	25.88	1.66	6.4
chlorantha ²	R Sexton, 2005	PLEAN Country PARK	grassland (meadow)	N	28	26.94	2.3	8.5
chlorantha ²	R Sexton, 2006	PLEAN Country PARK	grassland (meadow)	N	6	28.5	2.73	9.6
chlorantha	R Sexton, 2007	PLEAN Primary SCHOOL	grassland (meadow)	N	49	26.53	1.57	5.9
bifolia	R Sexton, 2007	Wester BALGAIR, Stirling	wet meadow	N	22	17.41	1.47	8.4
bifolia ²	R Sexton, 2006	Wester BALGAIR, Stirling	wet meadow	N	15	18.75	1.73	9.2
chlorantha	R Sexton, 2007	Glinns Road, KIPPEN (B), Stirling	coarse grassland	N	25	27.06	2.12	7.8
chlorantha ²	R Sexton, 2006	Glinns Road, KIPPEN (B), Stirling	coarse grassland	N	6	28.71	1.38	4.8
bifolia	S Longrigg, 2007	Glen LUSS, Argyll & Bute	wet meadow	N	20	16.05	1.64	10.2
chlorantha	R Sexton, 2006	KIPPEN (A) Horse Field, Stirling	coarse grassland	N	118	29.65	2.53	8.5
chlorantha ²	R Sexton, 2007	KIPPEN (A) Horse Field, Stirling	coarse grassland	N	24	27.36	2.07	7.6
chlorantha	R Sexton, 2005	Keith Hills, KINROSS	grassland (meadow)	N	47	25.69	2.27	8.8
bifolia	R Sexton, 2006	BALLANGREW Meadow, Stirling	wet meadow	N	5	18.5	1.63	8.8
chlorantha	R Sexton, 2006	ASHFIELD, Dunblane, Perth	grassland (meadow)	N	8	27.78	2.17	7.8
chlorantha	R Sexton, 2007	QUOIGS Meadow, Perth	coarse grassland	N	24	27.8	2.18	7.8
chlorantha ²	R Sexton, 2006	QUOIGS Meadow, Perth	coarse grassland	N	10	27.31	2.11	7.7
bifolia	R Sexton, 2007	QUOIGS Meadow, Perth	coarse grassland	N	36	18.86	2.36	12.5
bifolia ²	R Sexton, 2007	QUOIGS Meadow, Perth	coarse grassland	N	24	18.48	2.49	13.5
bifolia ²	R Sexton, 2006	QUOIGS Meadow, Perth	coarse grassland	N	12	20.6	1.86	9
chlorantha	R Sexton, 2005	FLEECEFAULDS Meadow, Ceres, Fife	grassland (meadow)	N	27	27.09	2.89	10.7
bifolia	R Sexton, 2006	CALLANDER Golf Course, Stirling	coarse grassland	N	8	19	2.1	11.1
chlorantha	R Sexton, 2007	BRAELENY Farm, Callander, W Stirling	coarse grassland	N	99	26.47	2.21	8.4
chlorantha ²	R Sexton, 2006	BRAELENY Farm, Callander, W Stirling	coarse grassland	N	6	27.46	3.45	12.6

Species	Recorder(s), Date(s)	Locality	Habitat	Shaded	N	Mean	SSD	CV (%)
UK								
chlorantha	D+C Hughes, 2007	Roadside, LOCHALINE, Morvern, Westernness	grassland	N	18	23.44	2.45	10.5
chlorantha ¹	D+C Hughes, 2007	Lochside, LOCH ALNE, Lochaline, Morvern, Westernness	moorland	N	1	23	NA	NA
chlorantha	D+C Hughes, 2007	Roadside, ARDTORNISH, Morvern, Westernness	grassland verge	N	8	24.5	3.51	14.3
chlorantha	I Denholm, 2006	KELTNEYBURN LNR, Fortingall, Perth	coarse grassland	N	20	26	2.29	8.8
bifolia ¹	D+C Hughes, 2007	Mountainside, Beinn na h-UAMHA, Morvern, Westernness	moorland	N	2	15	NA	NA
bifolia	D+C Hughes, 2007	Woodside, FORFAR, Angus	marshy meadow	N	22	18.32	2.53	13.8
chlorantha ¹	D+C Hughes, 2007	DRIMNIN, Morvern, Westernness	damp meadow	N	2	24.5	NA	NA
bifolia	I Denholm, 2006	GLENCAIRN, S Boat of Garten, Abernethy, Inverness	coarse grassland	N	20	19.63	1.88	9.6
bifolia	R Bateman/I Denholm, 2007	Loch a Mhuilinn, S APPLECROSS, W Ross	calcareous flush/ heath	N	20	14.6	1.35	9.2
bifolia	R Bateman/I Denholm, 2007	CARNAN, N Benbecula, Outer Hebrides	wet heath/bog	N	20	14.23	2.05	14.4
bifolia	D+C Hughes, 2007	Roadside, KINLOCHEWE, Wester Ross	grassland	N	7	17.29	2.69	15.6
bifolia	D+C Hughes, 2007	Roadside E TALLADALE, S Loch Maree, Wester Ross	grassland	N	12	14	2.09	14.9
bifolia	D+C Hughes, 2007	Loch na h-ORDNACHE, S Flowerdale, Wester Ross	moorland	N	12	16.42	2.71	16.5
bifolia	D+C Hughes, 2007	E DUBH LOCH, S Flowerdale, Wester Ross	moorland	N	20	16.2	2.42	14.9
bifolia	D+C Hughes, 2007	E Kerrysdale, FLOWERDALE, Wester Ross	moorland	N	7	16.14	0.9	5.6
bifolia	R Bateman/I Denholm, 2007	NE Lochdrum Farm, LOCHDROMA, Braemore, W Ross	calcareous flush/ heath	N	7	15	1.91	12.7
bifolia	D+C Hughes, 2007	S Kersnary, NW Loch MAREE, Wester Ross	grassy bog	N	13	16.31	1.8	11
bifolia	R Bateman/I Denholm, 2007	N bank Loch KERNsARY, E Poolewe, NE Gairloch, W Ross	calcareous flush/ heath	N	28	15.93	1.91	12
bifolia ²	D+C Hughes, 2007	N bank Loch KERNsARY, E Poolewe, NE Gairloch, W Ross	calcareous flush/ heath	N	10	16.1	2.92	15.29
chlorantha ¹	D+C Hughes, 2007	Roadside N INVEREWE, Wester Ross	grassland	N	1	22	NA	NA
bifolia	D+C Hughes, 2007	MIDTOWN, NW Poolewe, Wester Ross	meadow	N	3	17	1	5.9

¹not plotted, as sample size only one or two plants; ²not plotted, as these datasets duplicate other larger datasets; ³mean excluded one plant with an exceptionally short spur.

Small Cow-wheat *Melampyrum sylvaticum* L.; Scrophulariaceae in England

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ABSTRACT

Small Cow-wheat (*Melampyrum sylvaticum* L.); Scrophulariaceae occurs in Britain as a rare plant in Scotland and in Northern Ireland. It formerly occurred in North Wales and more recently in northern England (Durham, v.c. 66 and Yorkshire, v.cc. 64, 65). The English distribution and ecology of *M. sylvaticum* are given together with its taxonomy, and the reasons for its decline are discussed.

KEYWORDS: ecology, extinction, hemiparasitism, plant records, rare species, taxonomy.

INTRODUCTION

Small Cow-wheat (*Melampyrum sylvaticum* L.), Scrophulariaceae (or Orobanchaceae, as redefined by Olmstead *et al.* 2001), is an annual, hemiparasitic herbaceous plant of open woodland which has very special ecological requirements. It is a Nationally Scarce Species in Britain (Rumsey 1994) and is classed as Vulnerable in the *Vascular Plant Red Data List* (Cheffings & Farrell 2005). It occurs very locally in submontane habitats throughout most of the Scottish Highlands and in the Scottish lowlands from where it has now largely disappeared. It still occurs very locally in Northern Ireland and quite recently it was found that it had formerly occurred in North Wales (Rich, 1997). It has also been known since the beginning of the 19th Century from northern England, in Durham (v.c. 66) and in Mid-west and North-west Yorkshire (v.cc. 64 and 65), where it is now on the verge of extinction or extinct. A record for Staffordshire (v.c. 39) exists, based on an authentic, but probably mis-labelled, specimen. In spite of the distinctive appearance of *M. sylvaticum*, its characters have been widely misunderstood until comparatively recent times, often by otherwise experienced botanists. This has resulted in *M. sylvaticum* being included in the published records of very many counties throughout England, whereas in nearly all of these cases a form of the commoner *M. pratense* L. was intended. The English

distribution and records are therefore updated here, details of the ecology of *M. sylvaticum* in its former English habitats are given and its past taxonomic treatment briefly considered; the reasons for its decline are also discussed.

Outside Britain, *M. sylvaticum* occurs in Europe from Iceland and Scandinavia to the former U.S.S.R., the Alps, the Pyrenees and extends to central Italy, Bulgaria and the Balkans; it is endemic to this area of distribution.

TAXONOMY

Melampyrum sylvaticum is quite distinctive in its characters, yet surprisingly has previously been widely confused with *M. pratense* in Britain, particularly in English localities. Smith (1961) summarised and illustrated the main character differences between the two species. A further, more extensive list of the important characters of *M. sylvaticum* (Table 1) with illustrations (Fig. 1), which has been compiled from the characters of fresh plants growing in situ in its last known English locality, and a comparison with *M. pratense*, is therefore given below. However, there appear to be no significant differences between plants in this English population and those seen by me in two separate populations in Mid Perthshire (v.c. 88) in the Central Highlands of Scotland. A single gathering of *M. sylvaticum* from a different locality in Upper Teesdale (v.c. 66) made in 1874 (BM) however, does appear to differ from the plants described in Table 1 and from those collected elsewhere in the north of England, and this is discussed below.

Most Scottish and English examples of *M. sylvaticum* have uniformly rather deep yellow flowers which deepen to orange when withering, although a pale-flowered variant was described locally from Scotland, var. *pallidiflora* White, and more variation occurs in mainland Europe (Britton 1943). *Melampyrum pratense* is more variable in this respect, although the majority of variant forms are often somewhat paler yellow, the colour varying

TABLE 1. CHARACTERS SEPARATING *MELAMPYRUM SYLVATICUM* FROM *M. PRATENSE*. BASED ON OBSERVATIONS OF *M. SYLVATICUM* IN SITU IN UPPER TEESDALE, NORTH-WEST YORKSHIRE (V.C. 65), DJT 1975–1980, WITH AMENDMENTS FROM BRITTON (1943), SMITH (1961)

Character	<i>M. sylvaticum</i>	<i>M. pratense</i>
Longest upper bracts	Almost as long as mid-stem leaves, entire except in largest plants	Usually distinctly shorter than mid-stem leaves, dentate except in some small plants
Flowers	Suberect	Spreading to semi-erect
Calyx lobes	Lax to spreading, linear-lanceolate, straight, equal in size and shape, sharply acute; remaining lax and markedly widening in fruit, $\pm$ equal to or exceeding mature capsule	More appressed to corolla, linear-subulate or triangular, upturned, unequal, upper pair usually wider, sharply to very finely acute; remaining $\pm$ appressed, not enlarging in fruit, shorter than mature capsule
Corolla	Typically 8–10 mm long, tapering abruptly to a narrow tube at base, with a pronounced, often bulbous, helmet and wide gape at the mouth; lower lip strongly deflexed with 3 equal, oblong-ovate, obtuse or subacute lobes with distinct, usually rounded basal sinuses	11–20 mm long, tapering gradually to a broader tube at base, helmet less pronounced and gape at mouth narrower; lower lip projecting forward or sometimes deflexed, with 3, often unequal, usually triangular, $\pm$ acute teeth with narrowly acute basal sinuses
Fruit	Ovoid, rather abruptly tapering to a sharp apical point or beak, somewhat flattened (broadly elliptic in cross-section); 2-seeded, dehiscing by dorsal and ventral suture	Ovoid-obpyriform, more gradually tapering to an apical beak, distinctly flattened (narrowly elliptic in cross-section); 2–4-seeded, dehiscing by dorsal suture†

†Smith (1961) stated that the fruits of *M. pratense* contain four seeds, however the capsules examined in this study of the variety *hians* (Druce) contained only two large, unequal seeds (5.0–7.0 $\times$ 2.0–3.0 mm), so this character is variable.

from rather deep yellow in var. *hians* (Druce 1885) to pale yellow or bicoloured with a pale yellow or white tube and deeper yellow or occasionally crimson lip.

Although the Upper Teesdale plants described above from v.c. 65 appear to match Scottish examples of *M. sylvaticum* with no significant differences, one specimen collected in Upper Teesdale (v.c. 66) by F. A. Lees (BM) (undated, but collected with others in 1874 from the same locality, ½ mile above Middleton Bridge) differs considerably from others collected in Upper Teesdale or elsewhere in England. This specimen is robust, up to 30 cm tall, with broad leaves up to 12 mm wide (described as “succulent”, and clearly fleshy) and with large flowers. This BM specimen had also been noted by C. E. Britton (1939: 96) who linked it with similar specimens which had been collected in Northern Ireland (County Antrim, v.c. H39 and County Londonderry, v.c. H40) and he referred these to *M. silvaticum* subsp. *aestivale* Ronn. (*M. aestivale* Ronn. & Schinz) (Britton 1943:

378), but there is no clear inference that Britton ascribed other Teesdale examples of *M. sylvaticum* to subsp. *aestivale*, as stated by Rich *et al.* (1998). C. E. Salmon (1929) sent British material of *M. sylvaticum*, which had been collected by J. Beanland at Colt Park Wood, Mid-west Yorkshire (v.c. 64) (confirmed in Bradford Naturalists report, December 1930), and other specimens from Upper Teesdale, Durham (v.c. 66) to R. V. Soó, who determined all of the plants as *M. silvaticum* var. *subsilvaticum* (*M. silvaticum* subsp. *subsilvaticum* (Schinz & Ronn.) Soó, thus linked English material (except the 1874 Lees specimen mentioned above) with Scottish plants (Salmon 1929), and not with the subsp. *aestivale*.

G. C. Druce suggested that *M. pratense* var. *hians* Druce, which occurs in northern and western Britain was often confused with *M. sylvaticum* (Backhouse 1884), and this statement has been repeated by later authors, most recently Rich *et al.* (1998), however the former is quite unlike *M. sylvaticum* and could

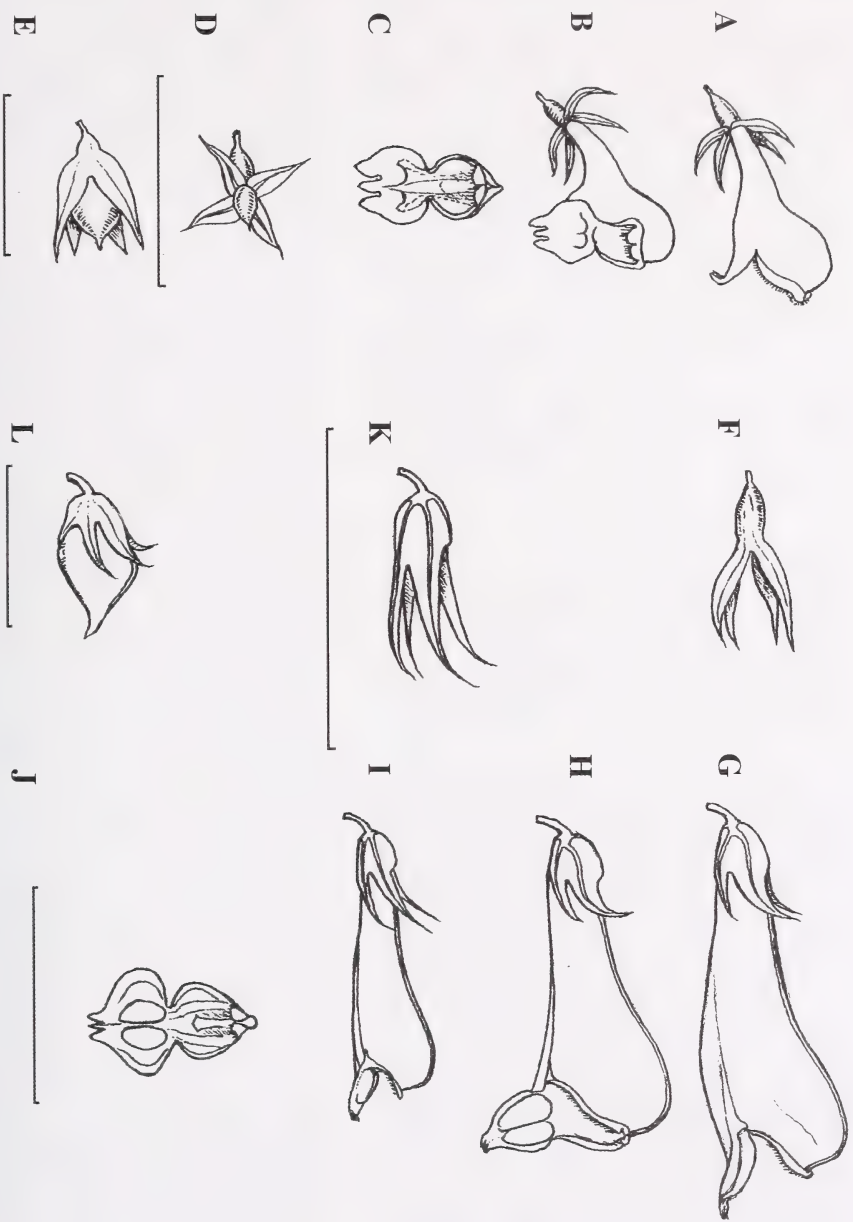


FIGURE 1. *Melampyrum sylvaticum* and *M. pratense*: Flowers, calyx and fruit. A-F. *M. sylvaticum*. Upper Teesdale (v.c. 65); A-C. flower; D. Developing fruit; E. Mature fruit; F. Calyx. G-K. *M. pratense*; G, H, J, L. Var. *hians*; G, H. Typical flower with projecting lip, Ullswater, Cumbria (v.c. 70) and Londonderry; (v.c. H40); H. Flower with deflexed lip, Upper Teesdale (v. c. 65); J. Flower showing typical lip; L. Mature fruit; I, K. Smaller form, Aberfeldy, Perthshire (v.c. 88); I. Flower; K. Calyx (scale bars 1 cm).

not be confused with it by anyone familiar with these two plants. The floral morphology in var. *hians* is typical of that found in other *M. pratense* variants and its flowers are much larger (13)15–20 mm long) than those found in *M. sylvaticum*. The only connection between the two is the deepish yellow flower colour and the deflexed lower lip which can sometimes occur in var. *hians*, as well as the fact that the two taxa have frequently occurred together in northern England. *Melampyrum sylvaticum* is much more likely to be confused with small-flowered variants of *M. pratense*, but the characters of the calyx, widely gaping flower and the capsule will readily separate such plants. Down-turned corolla lips also occur in some Scottish montane variant populations of *M. pratense*, notably small plants from parts of the Cairngorm Mountains and sometimes in a wider-spread Scottish montane variant with a crimson lip, referred to as forma *purpureum* by Smith (1963: 366), and possibly in other variants of *M. pratense*.

DISTRIBUTION IN ENGLAND

The authentic English records of *M. sylvaticum* which are supported by a confirmed specimen seen by me, or based on a reliable source of information are listed below by vice-county. Rich *et al.* (1998: Fig. 1, p.37) showed no post 1969 English records, although the species persisted here until c. 1990.

MID-WEST YORKSHIRE (V.C. 64):

Moors above Middlesmoor, June 1886, R. M. Norman (**BM**) (Rich 1998). Location uncertain, either near Keasden (SD7063), Kettlewell (SD9571) or Nidderdale Head (SE0974), however "moors" a highly unlikely habitat. Specimen confirmed(?). Near Ribblesdale, scars under Park Fell at 1000 ft (305 m), 18 July 1891, J. Beanland (Annotation in G. A. Shaw's copy of Lees (1888) flora (G.A.S. pers. comm.)). Horton in Ribblesdale, July 1891, J. Beanland (Specimen exhibited at B.N.C. meeting, 20 July 1981 (Anon 1891) Ribblesdale at 1500 ft (457 m), August 1891, J. Beanland, herb. C. E. Salmon (**BM**). Ribblesdale District. "Still there 1 July 1905" (J. Beanland, B.N.C. card index, July 1905 (Anon 1905)). Colt Park Wood (Ribblesdale). Specimen sent to C. E. Salmon by J. Beanland in 1907, from this locality. B.N.C. report Dec. 1930 (Anon 1930). West of north slope of Pen-y-ghent, J. Beanland. (F. A. Lees 1939).

Park Scar Scrub (=Colt Park Wood), 1891, J. Beanland (F. A. Lees 1941).

All of the Ribblesdale records in 1891 and 1905 probably refer to Colt Park Wood, SD7777 at 340–350 m, although Lees' 1939 description of the locality is vague, and the altitudes given in G. A. Shaw's annotated flora and on the sheet in C. E. Salmon's herbarium (**BM**) may be errors in the annotations. The B.N.C. report by J. Beanland dated 15 December 1930 confirms that the site was Colt Park Wood and there is no evidence that there was any other site in the area.

Outershaw (=Oughtershaw, Langstrothdale), 30 July 1904, H. Foster, in herb J. Cryer (**LDS**).

Outershaw Wood, 30 July 1904, W. Ingham (**NMW**). Conf. DJT.

Buckden, 30 July 1904, J. Beanland (with F. A. Lees). Yorkshire Naturalists field meeting (*Naturalist* 1904: 279; B.N.C. report November 1904 (Anon 1904)).

Outershaw Wood, 1905, R. Butterfield (Annotation in G. A. Shaw's copy of Lees (1888) flora).

Woods about Buckden. (F. A. Lees 1939).

Oughtershaw Hall, 1904, J. Beanland (F. A. Lees 1941).

These records all refer to Oughtershaw Hall Wood, SD8781, at c. 345 m, and the initial discovery is credited to J. Beanland, although no specimen collected by him here has been traced, nor any further records post 1905 from Mid-West Yorkshire (v.c. 64).

NORTH-WEST YORKSHIRE (V.C. 65):

(A) UPPER TEESDALE RECORDS:

Winch Bridge (near Bowlees, NY9027, at c. 270 m) (Winch 1805; **HAMU**: Baker 1906).

Winch Bridge, 1844, J. Backhouse junior (**BM**); 1850, G. S. Gibson (2 sheets **BM**); Just above Winch Bridge, 1852, A. W. Bennett (**BM**); Winch Bridge, 1884, J. E. Griffith (**NMW**); 1923, A. J. Wilmott (**BM**); Teesbank at Winch Bridge 1968, J. M. Mullin, sighting of single plant (J.M.M. in pers. comm., and not 1969 as hitherto reported. A later visit by DJT & J.M.M. showed that J.M.M.'s exact site, a steep rocky bank immediately above the river by the bridge had been searched carefully by me in the years preceding and following this record, and later, without success, suggesting that this was a stray seedling. Although this record was never officially accepted in the absence of a specimen (A. J. E. Smith and J. Gaman in pers. comm.) it is likely that JMM would have known the true plant.

Holwick, 1853, J. G. Baker (**BM**): Below Holwick (Baker 1906).

Park End Wood, Holwick, NY9225–26, 1888, Yorkshire Naturalists field meeting (*Naturalist* 1888: 279; 1889: 284); F. A. Lees (undated, period 1871–1883) (**LDS**).

Teesbanks near High Force, NY8828, 1934, herb. H. Stanley Redgrave (**BM**).

Between Middleton and High Force, rocky bank above river at 285 m, NY82, 17 June 1975–c.1990, D. J. Tennant, conf. A. J. E. Smith, herb **DJT** (*Naturalist* **104**: 70 (1979)).

(B.) OTHER VICE-COUNTY 65 RECORDS:

West bank of Whitfell (=Whitfield) Gill above the main force, Wensleydale, SD9292, at 400 yards (365 m), 1884, J. Percival, herb. F. A. Lees (**KGY**). Yorkshire Naturalists field visit to Hawes area, 28 June 1884 (*Naturalist* **10**, 1884–1885: 18; December 1890: 368; Baker (1906).

Mill (=Whitfield) Gill, 1892 (?), J. Wheldon (Anon 1892); Baker (1906) Not found here during the Yorkshire Naturalists field meeting in 1934 (*Naturalist* 1934: 161).

Cantley (=Cautley), near Sedburgh (=Sedbergh), 1909, F. Booth (Specimen exhibited at B.N.C. meeting November 1909 (Anon 1909). F. Booth (Vice-president of Bradford Natural History Society at the time) apparently collected the specimen on the Yorkshire side of the vice-county boundary with Westmorland (v.c. 69) near Cautley Spout, SD6897, but the specimen has not been traced and there are no other records from this well visited area, creating slight doubt about the record. However, J. Beanland, as president and recorder for B.N.C. at the time knew the species well and “spared no pains to check the correctness of a record” (*Naturalist*, June 1933: 125). J. Beanland published the record (Beanland 1910) and there was no later suggestion by him that this record was incorrect.

UPPER TEESDALE RECORDS, VICE-COUNTY (65 OR 66) UNSPECIFIED:

The records from various sources all refer to Winch Bridge NY9027, or near Winch Bridge on the boundary of these two vice-counties, but which one is not specified (Records which specifically refer to the island in the River Tees immediately above the bridge, NY9027, have been included in Durham (v.c. 66) records.

1871, F. A. Lees (**BM**); 1873, F. A. Lees (**KGY**); 1886, W. C. Barton (**BM**); 1887, C. A.

Wright (**BM**); E. Backhouse (1810, **E**; **BM**); 1888, H. E. Fox (**BM**); 1889, J. A. Wheldon (**NMW**); 1892, Miss Hazlehurst (**BM**); 1895, F. J. Hanbury (**BM**); 1895, Hanbury (**NMW**).

DURHAM (V.C. 66)

All certain Durham records are from Upper Teesdale, either from the north bank of the River Tees or from the island in the river immediately above Winch Bridge, NY9027. The classic site was the south tip of this island (G. G. Graham in pers. comm.) and E. Vachell noted in her diaries (held at **NMW**) c.1930 that *M. sylvaticum* was fairly abundant there. There was a sighting here in 1927 by G. W. Temperley (Graham 1988) and a final sighting in 1947 (A. J. E. Smith in pers. comm.). An extensive search in the area in 1959 by A. J. E. Smith, D. H. Valentine and party failed to find it here. Other records are:

Winch Bridge. (Winch, 1805; **HAMU**); 1839, R. B. Bowman (?**HAMU**); 1871, J. E. Leefe (**BM**); 1892, H. E. Fox (**E**).

North bank of the Tees below Middleton, c. NY9524, 1874, F. A. Lees (**BM**).

Tees-side at Breckholm, ½mile above Middleton Bridge, NY9325, 1874, F. A. Lees (2 sheets **BM**; **LDS**); Above Middleton Bridge, 1874, F. A. Lees (**BM**); Near Dent Bank Cliff by the Tees above Middleton, NY9325, 1874, F. A. Lees (**BM**); Tees-side 1 mile above Middleton Bridge, NY9325, 1874, F. A. Lees (**KGY**; **LDS**).

Two miles above Middleton, NY9226, 1883, R. P. Murray (**BM**).

The island, Winch Bridge, 1883, H. T. Mennell (**BM**); 1883, F. J. Hanbury (**BM**); 1907, J. F. Pickard (**LDS**); 1913, Mrs Wedgwood (**BM**); 1927, herb. J. E. Lousley (**BM**).

Wood by Tees immediately above High Force (Durham) (Record source mislaid, but seen in 1934 nearby on the opposite river bank, so likely to be correct, NY8728 (c. 315 m).

ERRONEOUS, DUBIOUS OR UNCONFIRMED ENGLISH RECORDS OF *M. SYLVATICUM*

The majority of these records are almost certainly errors for *M. pratense* (other records which certainly refer to *M. pratense* are omitted). In all cases a specimen has not been traced.

MID-WEST YORKSHIRE (V.C. 64):

Grass Woods, Grassington, SD9865, 1881. (Yorkshire Naturalists field meeting 1881; B.N.C. records, per Malins Smith (Anon 1881; 1895), R. Dewhirst, B.N.C. records (Anon

1895); 1905, W. West & C. A. Cheetham, B.N.C. records (Anon 1905); 1905, J. Beanland (Annotation in G. A. Shaw's copy of Lees (1888) flora).

Several correct records for *M. pratense* are known from this locality, e.g. 1902, J. F. Pickard (**KGY**), and a specimen which is named as *M. sylvaticum* collected here in 1882 by P. F. Lee (**NMW**, det. D.J.T.) is *M. pratense*, making all of these records doubtful. However, if the annotation in G. A. Shaw's flora is correct and J. Beanland really did see it in Grass Woods in 1905, then this record could almost certainly have been correct, but the record was never published. (*M. pratense* var. *hians*, which often occurred with *M. sylvaticum* in v.cc. 64, 65, 66, was known in Grass Woods).

Helks Wood, Ingleton, SD6974 (Baines 1840), and repeated in later Yorkshire Floras.

In this former locality for *Cypripedium* both *M. pratense* var. *montanum* Johnston and var. *hians* were recorded by F. A. Lees, so it must remain a doubtful site for *M. sylvaticum*.

Kettlewell, Upper Wharfedale, SD9772, 1864, W. Horsfield (J. Windsor 1873). Very probably an error for *M. pratense*, but neither species appears to be at the described site now.

Feizor Wood, Austwick, SD7668, R. Clapham (undated) (J. Windsor 1873).

M. pratense, which I have seen in this area, has other records here Clapham's record is no doubt an error for this species; about Buckden (F. A. Lees 1939) refers to the correct records at Oughtershaw (v.c. 64).

NORTH-WEST YORKSHIRE (V.C. 65):

Muker Woods, Swaledale, SD9198. (*Naturalist*, **181**, 1890: 254). W. Whitewell (*Naturalist* 183, 1890:305 suggested that this record probably referred to *M. pratense*, which was well known here).

DURHAM (V. C. 66):

Egleston (=Eggleston), near Barnard Castle, NZ0023: Shipley Wood, NZ0120 (Winch 1805: **HAMU**), specimen confirmed?

Dryerdale (Near Hamsterley, NZ0833), Graham *et al.*, (1972). Specimen (DHM) requires confirmation.

Barnard Castle Woods, NZ01, (E. Robson 1794). Specimen not traced.

Traced specimens require confirmation, but Shipley Wood would have been a likely locality at this early date.

NORTHUMBERLAND (V.CC. 67, 68):

V.c. 67: Woods near Hexham, F. Scott (Winch 1831); Newbiggin Scar, NY9449, ? Vachell, 1930 in Swan (1993).

V.c. 68: Lesbury NU2411, 1892 (Luckley 1893); Cheviot, NT9120, H. Thomas (in Swan 1993).

Swan (1993) suggested that all Northumberland records were likely to be errors (for *M. pratense*).

CUMBRIA (WESTMORLAND, CUMBERLAND,

V.CC. 69, 70):

All records from these two vice-counties were regarded as errors by Halliday (1997), as no authentic specimens have been traced. Records from widespread localities throughout v.cc. 69, 70 are now regarded as errors for forms of *M. pratense*. This is perhaps surprising as there appear to be numerous favourable habitats and some of the records for *M. sylvaticum* here were made by very experienced botanists, such as W. Hodgson, W. H. Pearsall, D. A. Ratcliffe and T. G. Tutin, although none of these records are supported by a specimen and more recent searches have revealed only *M. pratense* at the recorded localities. It is suggested below that the more acidic nature of numerous otherwise suitable habitats in Cumbria is the main reason for the absence of *M. sylvaticum* there.

STAFFORDSHIRE (V.C. 39):

Lark (=Park?) Edge, North Staffords., ?G.R., July 1891, J. W. White, in herb Ida M. Roper (**LDS**). The specimen is correctly named (det. DJT), however, assuming the collector was James Walter White there is some discrepancy. White (1912) stated in his *Flora of Bristol* that *M. sylvaticum* "was apparently unknown south of Yorkshire", so he had either forgotten about his 1891 record or the specimen is from some other locality and mislabelled. It is very unlikely that White would have given his only specimen to I. M. Roper, but there are no specimens of *M. sylvaticum* in White's herbarium at Bristol.

Although dismissed as errors for *M. pratense*, records for *M. sylvaticum* appeared in floras of nearby English counties (Gloucestershire (1948) and Shropshire (1841)), but there are no records in the *Flora of Staffordshire* (1972).

Finally, although many older records of *M. sylvaticum* clearly referred to *M. pratense* it is perhaps dangerous to reject all the old records

of the former simply because a more recent visit to the locality concerned only revealed the presence of *M. pratense*. The two species have nearly always occurred together in Britain, and *M. sylvaticum* appears to be the earlier of the two to have declined or disappeared from its confirmed localities. The above records suggest that other small herbarium collections might be worth examination.

ECOLOGY

HABITATS

Melampyrum sylvaticum in Britain has several different specific ecological needs, which explain its local occurrence and its rarity; a change in any one of these requirements may have led to its rapid decline. Its major ecological requirements can be summarised as:

1. Sensitivity to the level of light.
2. High atmospheric humidity.
3. Soil conditions
4. As an obligate hemiparasitic plant, the presence of suitable host species

In Britain, light tree cover, as provided in natural open woodland, at woodland fringes, tree-lined streams in rocky ravines, or tree-lined riverbanks provide the ideal light conditions, and *M. sylvaticum* has disappeared where the tree canopy has increased to give higher levels of shade. The only British records where it has been found in the absence of trees are very few and in Northern Scotland, where it is recorded on rock ledges at fairly high altitude. In Britain it has always been found under deciduous trees, although elsewhere it also occurs in coniferous forests, and I have seen it in such habitats in several places in the Central Alps. In its last known English locality it occurred under *Betula pubescens*, *Corylus avellana* and *Sorbus aucuparia*.

The high level of atmospheric humidity which appears to be necessary for *M. sylvaticum* seems clear from its chosen habitats in partial shade, but especially on sheltered banks or in rocky ravines close to rapidly flowing streams, and it is almost certainly no coincidence that many known sites are close to a substantial waterfall, where the aerosol effect from spray increases the atmospheric humidity very locally, enhanced by shelter from wind in the narrow gorge carved out at the base of a waterfall. In the absence of streams or rivers other English habitats are known to have nearby flushes from

natural springs and are very rich in mosses and hepatics, indicating a significant level of humidity.

Soil conditions where *M. sylvaticum* has been recorded are somewhat acidic but in English localities this invariably appears to be where rather shallow acidic soils have accumulated over more mineral-rich or base-rich rock formations, such as basalt and/or carboniferous limestone, and particularly where the soil is thinner or bare rocks are exposed, this has led to a herb-rich community in the adjacent area. Where the habitat is close to a river there is no doubt that some of these sites are flushed during times of spate by river sand and grit whereas other sites above the flood zone must only be enriched by seepage from the underlying rock. Soils on woodland slopes are probably enriched by flushing from nearby springs. *M. sylvaticum* has not been found on more acidic, herb-poor and mineral-poor soils, habitats in which at least some variants of *M. pratense* often occur, and *M. sylvaticum* never occurs on open moorland soils amongst *Calluna* or *Vaccinium myrtillus* in the absence of trees, where *M. pratense* is often found. There appear to be numerous suitable habitats for *M. sylvaticum* in montane parts of the Lake District in Cumbria (v.cc. 69, 70), and *M. pratense* var. *hians*, which often accompanies it, is still to be found here, but the more acidic, hard, nutrient-poor underlying rocks may be the main reason why *M. sylvaticum* has not been found there. There appear to be at least three differing habitats where *M. sylvaticum* has been recorded in England, although there is some overlap between these.

The first of these is ancient upland open woodland, dominated by *Betula pubescens*, which occurs in England now only as small, isolated relics of former extensive native forest, and it might be speculated that *M. sylvaticum* once occurred throughout this habitat, but as such woodland has declined to small remnants or the shade from tree canopy has increased, it has had nowhere to go and largely become extinct there. The best example of such ancient woodland in England where *M. sylvaticum* formerly occurred is probably Park End Wood (v.c. 65), which J. Backhouse (1896) described as a remnant of the ancient Forest of Teesdale. This small wood occurs on a slightly raised pavement of basalt, and in places carboniferous limestone rock, with scattered tree coverage. *Geranium sylvaticum* and *Paris quadrifolia* were recorded here, showing the presence of

basic habitats, with *M. sylvaticum* (*Naturalist*, Sept.–Oct. 1888:279). Rumsey (1994) noted the similarity of some Scottish sites to montane *Geranium sylvaticum*-rich Birch woodlands found in Norway. In more recent times Park End Wood has been heavily grazed and trampled by cattle and many of its former plant species are no longer present. A second example of such woodland is Colt Park Wood (v.c. 64), a rather unique remnant of woodland situated on a highly raised limestone pavement, the wood being bordered by carboniferous limestone pillars some 3 m high. Many other less common plants have been recorded here, mainly on very shallow limestone soils, including species which are rare in England, such as *Actaea spicata*, *Carex muricata* subsp. *muricata*, *Cardamine impatiens*, *Crepis mollis*, *Polypodium* × *font-queri*, *Potentilla crantzii*, and close by, *Pseudorchis albida* and *Pyrola rotundifolia*. *M. sylvaticum* must formerly have occurred here where slightly deeper, more acidic soils had accumulated over the limestone in places where *Vaccinium myrtillus* and other acid-loving plants can be seen today. There is little doubt that the barrier of vertical limestone rocks surrounding this wood largely prevented access and grazing by sheep, which is responsible for the survival of this woodland and most of its plants. Another remnant of ancient woodland where *M. sylvaticum* formerly occurred is Oughtershaw Hall Wood (v.c. 64), although a small river runs through it and the exact site where *M. sylvaticum* occurred here is not known. *Pyrola rotundifolia*, a rare plant in Yorkshire, occurred here at the time *M. sylvaticum* was discovered in 1891. A major reason for the decline of *M. sylvaticum* here was increasing shade from the tree canopy, probably increased by the introduction of additional tree species, the site being much more open at the beginning of the 20th Century as photographs show (W. A. Sledge in pers. comm.).

Whitfield Gill in Wensleydale (v.c. 65) is another locality which may represent ancient woodland, but is closer to many of the habitats which are found in Scotland where *M. sylvaticum* occurs. The site where *M. sylvaticum* occurred here was well described and is a small area of steeply sloping open woodland over limestone with several wet flushes and a small river below, not far from a large waterfall. *Cypripedium calceolus* once grew here, and other scarce plants in this area,

Persicaria vivipara and *Pyrola minor* are still to be found. The site is especially rich in mosses and hepatics, with over 100 species recorded here, particularly *Eurhynchium striatum*, *Kindbergia praelonga*, *Rhytidiadelphus triquetrus* and many rarer species (*Naturalist*, 1934: 161). This wood is seemingly unchanged, so the reason for the decline of *M. sylvaticum* here is not obvious, but there are no records since 1892, so it must have been very scarce then and a slow decline though climatic factors is the most likely reason.

The second type of habitat for *M. sylvaticum* in England is also similar to many of the habitats known in Scotland: that is, a steep rocky bank above a fast flowing stream, often near a waterfall and fringed by light tree coverage. Examples of this habitat in England occur mainly in Upper Teesdale (v.cc. 65, 66) and, if the record was correct, at Cautley near Sedbergh (v.c. 65). The last known English locality in Upper Teesdale (v.c. 65) for *M. sylvaticum* has been examined in detail by me between 1975 and 1990. This was also found to be surprisingly species-rich, being a very steep bank near a small waterfall with areas of exposed rock, comprised here of Whin Sill (quartz-dolerite, a hard igneous rock) overlying or intruded horizontally into carboniferous (Yoredale) limestone. The small population (c. 20 plants) of *M. sylvaticum* occurred here on ledges in an area rich in both mosses and grass species. The relatively dry, rather acid soil was situated above the normal flood zone, so soil enrichment would be primarily by seepage of ground water from the underlying rock, although not far below the population there was evidence of deposition of river sand and grit left during spate conditions. A list of the species accompanying *M. sylvaticum* here is given in Table 2. The species normally occurring on acidic soils were in most cases close associates, whereas close by on shallower soils or on bare rock a richer flora was present, due to the higher level of nutrients there. It can be seen in Table 2 that almost 90% of the closely associated flowering plant species and many of the grasses at these two v.c. 65 sites alone are also recorded from localities of *M. sylvaticum* in Scotland, showing the close correlation between them in this respect, although no detailed list of bryophytes from Scottish sites has been seen.

There appears to be a third type of habitat in England, possibly confined to Upper Teesdale

(v.cc. 65, 66), which is very similar to that which is described above, being a river-bank site, but in this case very clearly well within the zone of frequent river spates, where a high level of river-deposited sand and grit can be seen in the soil. The upper part of the River Tees is especially prone to sudden and extraordinarily heavy spate floods, as several tragic incidents record, so it is possible that even the habitat described above where *M. sylvaticum* was last seen, although situated above the level of the frequent flood-zone may be flushed very occasionally at times of exceptional river spates. The former main site for *M. sylvaticum* on the island at Winch Bridge, the site where a single plant was seen by J. M. Mullin in 1968, and other sites where specimens were collected downstream from Winch Bridge on the Durham banks of the River Tees would all be subject to such conditions and be affected by flood-water on frequent occasions. F. A. Lees described the habitat of a specimen collected above Middleton (v.c. 66) in an annotation on the herbarium sheet in **BM** as "Tees-side amongst brushwood" and "in sand", both obviously deposited there by floodwater. It is highly unlikely that so many collections made here, so far downstream from Winch Bridge, merely arose from seeds washed down from that location, and therefore waterside locations amongst deposited silt appeared to be one favoured habitat. It is interesting that the unique Lees specimen in **BM** described above (under Taxonomy) and ascribed to *M. sylvaticum* subsp. *aestivale* Ronn. by C. E. Britton (1943) was collected at this site and presumably in this habitat. Few perennial plants could survive long in such a habitat, but the annual *M. sylvaticum* may have some advantage there, and the nutrients released by friction from deposited river grit might result in rapid growth.

The host plants associated with *M. sylvaticum* are discussed later in this paper under "parasitism".

The following species which are less common or rare in Yorkshire and Durham are recorded in more than half of the seven separate localities where *Melampyrum sylvaticum* occurred with certainty in the counties: *Actaea spicata*, *Cardamine impatiens*, *Cirsium heterophyllum*, *Cochlearia pyrenaica*, *Galium boreale*, *Geranium sylvaticum*, *Melampyrum pratense* var. *hians*, *Parnassia palustris*, *Poa nemoralis*, *Persicaria vivipara*, *Potentilla crantzii*, *Pseudorchis albida*, *Rubus saxatilis* and *Trollius europaeus*, and other rare species occur in some of the same localities.

POPULATION SIZES

Apart from the single Upper Teesdale site in v.c. 65 studied between 1975 and 1990 there are no other specific details of population sizes in England and Wales. However, it can be assumed that all Yorkshire populations (v.cc. 64, 65) apart from those in Upper Teesdale were extremely small and had probably declined there through natural factors by the time of their initial discovery. The three definite sites there, Colt Park Wood, Oughter-shaw and Whitfield Gill yielded only single or few specimens in the short period from 1884 to 1905, with no later records, and probably represented relic populations in that period. The same applies to the two less certain records from v.c. 64, Middlesmoor and Cautley, being only single gatherings in 1886 and 1909 respectively. However, *M. sylvaticum* was clearly once widespread in Upper Teesdale, the records showing that it had occurred by the River Tees from above High Force downstream to below Middleton, and at the beginning of the 19th Century possibly further downstream to Eggleston or even as far as Barnard Castle. At least 12 separate collections or accepted sightings were made from four of the known Yorkshire (v.c. 65) sites in Upper Teesdale (Park End Wood, Winch Bridge (2) and DJT's locality) but there is no confirmation available from these localities on population sizes, other than the single plant recorded only once by J. M. Mullin in 1968 at Winch Bridge and DJT's locality described above, where over 20 plants in 1975 were reduced to less than 10 by 1982 and these had probably gone by 1990. In Durham (v.c. 66), where all the records are from the north bank of the River Tees or from an island in the same river at Winch Bridge, there appear to be seven distinct localities where at least 30 separate gatherings or sightings were made. Ten of these collections were from a 6 mile stretch of riverbank in the period 1874–1875 and in 1883, but not since, and although there are no details of population sizes it would seem that *M. sylvaticum* was not infrequent locally there. A detailed search of the north bank of the Tees and adjacent woodland here in 1974–1975 revealed nothing. The remaining 20 or more v.c. 66 collections or accepted sightings were all from Winch Bridge (nearly all from the island immediately above the bridge), where *M. sylvaticum* was known to have been abundant (e.g. E. Vachell diaries (NMW), but diminished rapidly at the end of the 19th Century. The last collection traced from here was in 1927 (**BM**) and the final sighting made there was in 1947 (A. J. E. Smith in pers. comm.).

TABLE 2. SPECIES ASSOCIATED WITH *MELAMPYRUM SYLVATICUM* IN UPPER TEESDALE (V.C. 65)
SPECIES NOTED BETWEEN 1975 AND 1990 BY DJT IN THE TWO MOST RECENTLY KNOWN SITES (NY9027–28)

(a) Close associates	
<i>Anemone nemorosa</i> *	<i>Dicranum majus</i> †*
<i>Betula pubescens</i> *	<i>Dicranum scoparium</i> †
<i>Campanula rotundifolia</i> *	<i>Diplophyllum albicans</i>
<i>Conopodium majus</i> *	<i>Eurhynchium striatum</i> †
<i>Corylus avellana</i> *	<i>Hylocomium splendens</i> *
<i>Dryopteris filix-mas</i> *	<i>Hypnum jutlandicum</i> †
<i>Galium saxatile</i> *	<i>Lophozia ventricosa</i>
<i>Hyacinthoides non-scripta</i> *	<i>Mnium hornum</i> †
<i>Hypericum pulchrum</i> *	<i>Plagiochila asplenoides</i>
<i>Lathyrus linifolius</i> *	<i>Plagiothecium undulatum</i>
<i>Luzula sylvatica</i> *	<i>Pleurozium schreberi</i> *
<i>Melampyrum pratense</i> (incl. var. <i>hians</i>) *	<i>Polytrichum formosum</i> *
<i>Mercurialis perennis</i> *	<i>Pseudoscleropodium purum</i>
<i>Oxalis acetosella</i> *	<i>Rhizomnium punctatum</i>
<i>Polygala serpyllifolia</i> *	<i>Rhytidiadelphus squarrosus</i>
<i>Succisa pratensis</i> *	<i>Rhytidiadelphus triquetrus</i> †*
<i>Teucrium scorodonia</i>	<i>Sphagnum quinquefarium</i>
<i>Viola riviniana</i> *	<i>Thuidium tamariscinum</i> †*
	<i>Tortella tortuosa</i>
	<i>Tritomaria quinquedentata</i>
Grasses	
<i>Agrostis canina</i> subsp. <i>capillaris</i> †	
<i>Agrostis canina</i> subsp. <i>montana</i> †	(b) Species close by
<i>Arrhenatherum elatius</i> *	<i>Allium ursinum</i> *
<i>Brachypodium sylvaticum</i>	<i>Cirsium heterophyllum</i>
<i>Briza media</i>	<i>Cruciata laevipes</i>
<i>Deschampsia caespitosa</i> *	<i>Equisetum pratense</i> *
<i>Deschampsia flexuosa</i> †*	<i>Galium boreale</i> *
<i>Elymus caninus</i>	<i>Geranium sylvaticum</i> *
<i>Festuca ovina</i> subsp. <i>tenuifolia</i> †*	<i>Primula vulgaris</i> *
<i>Festuca rubra</i>	<i>Rubus saxatilis</i> *
<i>Festuca vivipara</i> *	<i>Sanguisorba officinalis</i>
<i>Holcus mollis</i> *	<i>Sorbus aucuparia</i> *
	<i>Trollius europaeus</i> *
Bryophytes:	
<i>Bartramia pomiformis</i>	Grasses:
<i>Calypogeia muelleriana</i>	<i>Helictotrichon pratense</i>
<i>Campylium stellatum</i>	<i>Melica nutans</i>
<i>Dicranum bonjeanii</i>	<i>Poa nemoralis</i> *

Species marked † were abundant or dominant, and those marked * have also been reported from Scottish habitats of *M. sylvaticum* or recorded by DJT there.

ALTITUDE

In England the known altitudinal range of *Melampyrum sylvaticum* lies between c. 210 m and 365 m, the highest localities being at Colt Park Wood and Oughtershaw Wood in v.c. 64,

both 340–350 m, and Whitfield Gill in V.C. 65 at 365m.

In Scotland it has been recorded as high as 760 m (Rich *et al.* 1998).

FLOWERING PERIOD

In Upper Teesdale, flowering commenced in the second or third week in June according to season, at least a week or more earlier than *M. pratense* in the same area. There is one herbarium specimen collected in Yorkshire in advanced bud collected in late May, and several herbarium specimens collected in good flower are dated well into August.

PARASITISM

Melampyrum sylvaticum is an obligate hemiparasitic annual by means of root haustoria (Rumsey 1994) and obtains both nutrients and water from its host plant. Smith (1963) studied the related *M. pratense* and found that the host plants seemed to be either trees such as *Betula pubescens*, *Corylus avellana* and *Sorbus aucuparia*, or woody shrubs such as *Calluna vulgaris* and *Vaccinium myrtillus*, and although herbaceous plants occurred with *M. pratense* he concluded that they were unlikely to be involved as hosts, as *M. pratense* never occurred with these alone, but was always found near either trees or specific woody shrubs. However, Weber (1976) specifically studied *M. sylvaticum* in Europe and found that herbaceous plants including a grass species (*Briza media*) and *Melampyrum pratense* acted as host plants, in addition to the woody shrubs mentioned above. Although *M. sylvaticum* occurs on slightly more nutrient-rich soils than *M. pratense* in some of its habitats, the same tree species, the same woody shrubs, grasses and *M. pratense* are all usual associates of *M. sylvaticum*, and one or more of these probably acts as its host plant. Smith (1963) stated that it was not clear whether *M. pratense* is host-specific but that there was some indication that this might be the case although there is little evidence for this, but if so, this is also likely to apply to *M. sylvaticum*, which would be an additional reason for its localised occurrence. Smith (1963) also suggested that the reliance of a shallow-rooted plant like *M. pratense* on woody plants for water, as well as nutrients, was advantageous in times of drought, and it was noticed that associated herbaceous plants had wilted in such conditions whereas *M. pratense* appeared to be unaffected. The same would no doubt apply to *M. sylvaticum*, through attachment to one of the tree species or woody shrubs listed above.

REASONS FOR THE DECLINE OF *MELAMPYRUM SYLVATICUM*

It is clear the *Melampyrum sylvaticum* must have declined markedly by that time that the majority of the earliest English recordings were made in the relatively short period between 1871 and 1905, and that many of the localities then held only relic populations. The decline in this case is most likely to have been over a very long period through two main causes: gradual climate change and a slow reduction of ancient forests through early forestry and grazing by domestic animals. Many other species of open woodland habitats declined or were lost in northern England in the same period.

FORESTRY

The former extensive ancient upland forests have been reduced in England to small remnants and subsequent grazing has prevented their re-establishment. *Melampyrum sylvaticum* may have thrived in such woodland habitats, but once such woodland was reduced to small, discontinuous remnants there was nowhere for the species to go. There is also evidence in a few former English localities, as well as some in Scotland, that the introduction of non-locally indigenous trees, especially Beech (*Fagus sylvatica*), which cast a deeper level of shade, may have led to a more rapid decline of *M. sylvaticum*. The large-scale planting of coniferous forests which has reduced the number of suitable habitats in Scotland is hardly a factor in England.

GRAZING

The effects of grazing are still apparent in several former English localities of *M. sylvaticum*. In Park End Wood (v.c. 65) both grazing and trampling were very obvious through the access of cattle, and the general flora was adversely affected. Extensive sheep farming in the parts of northern England where *M. sylvaticum* once occurred has prevented the re-establishment of woodland through the grazing of saplings. It is probably no coincidence that *M. sylvaticum* survived longer in Colt Park Wood (v.c. 64) as this wood uniquely has a high perimeter barrier of vertical limestone blocks, largely preventing access by sheep. In the last known v.c. 65 site in Upper Teesdale of *M. sylvaticum* a major factor in its rapid decline there between 1975 and 1990 was undoubtedly an increase in the local rabbit

population. The immediate area was covered in excavations by rabbits and some plants of *M. sylvaticum* itself were seen to be damaged (the single specimen taken from this site and its identity confirmed by A. J. E. Smith had been chewed-off at the base by a rabbit). Little could be done at this site to prevent access by rabbits, such as special fencing, as entry was clearly being gained via the river bed in times of low water level. The same may have occurred in other former localities in Upper Teesdale, as there was ample evidence of rabbit damage even on islands in the river which were largely inaccessible at times when water levels were normal.

CLIMATE CHANGE

Melampyrum sylvaticum may have declined over a very long period through gradual climate change. It is found in Britain only in areas where relatively high rainfall occurs and appears to have a requirement for a high level of atmospheric humidity, so would therefore be vulnerable to a reduction in rainfall. Rainfall records for Yorkshire, kindly provided by William Foggitt, show that there was a more-or-less progressive decrease in precipitation there between 1892 and 1910 when compared with the earlier decade 1882–1891, particularly in summer months. This period coincides with the time that *M. sylvaticum* disappeared in Mid-West Yorkshire (v.c. 64), however, the reduction in rainfall then was not very dramatic (c. 12%), and no figures were available for a longer period, so this may be coincidental. Two successive, abnormally hot, dry summers occurred immediately after *M. sylvaticum* was found in Teesdale in 1975, and thereafter the population was noticeably reduced. Whereas hot dry summers have always occurred periodically, the very unusual effect of two consecutive ones may have played a part in adversely affecting germination of seed or establishment of seedling plants.

AIR POLLUTION

One suggestion for the apparent rapid decline of *M. sylvaticum* in its English localities in the late 19th Century is the effect of acid rain through industrial pollution, as several other rare species from similar upland woodland declined or were lost in the same period in northern England, but this theory must remain speculative.

OVER-COLLECTING

In the vast majority of its former English localities over-collection was not responsible

for the decline or loss of *M. sylvaticum*, as it was already an extremely scarce plant in most localities at the time of its initial discovery. However, in Upper Teesdale (v.c. 65, 66) collecting may have played a part, as there are numerous specimens in many herbarium collections from localities there, as seen in this study.

REPRODUCTION

Melampyrum sylvaticum produces few large seeds with a coating which is attractive to ants, which transport the seeds (Gibson 1993a, 1993b). In the absence of water, such as in ancient woodland habitats, the large seeds are largely dependent on ants for their dispersal and may be continually moved to more favourable habitats in this manner, such as to woodland fringes or clearings as the level of shade from the tree canopy increases. Thus a decrease in the local ant population, perhaps through disturbance by animals such as rabbits, would have an adverse effect.

PARASITISM

Melampyrum sylvaticum, as an obligate hemi-parasite, depends on its host plant for both nutrients and water. The loss of the required host plant or plants would result in immediate extinction. The presence of *Corylus avellana* in many sites where *M. sylvaticum* has occurred may be of significance, as the former is found on more nutrient-rich, less acidic soils than most other tree species under which *M. sylvaticum* usually occurs in Britain, namely *Betula pubescens*, *Quercus petraea* and *Sorbus aucuparia*. *M. sylvaticum* may occur on rather acidic, nutrient-poor soils, but the roots of trees such as *Corylus avellana* penetrate deeper into underlying mineral-rich strata and this would provide the parasitic *Melampyrum* with minerals unavailable at the shallow depth which its roots can reach.

Melampyrum pratense, which usually occurred with *M. sylvaticum* in England is still frequent in Cumbria in Northern England, but has declined or been lost in many of its Yorkshire and Durham localities, including those where *M. sylvaticum* formerly occurred. The reasons for the decline of *M. pratense* are very probably the same as those for *M. sylvaticum*, and where it still survives this was because of its relatively larger population sizes.

CONSERVATION

Finally, it is probably too late to consider conservation measures for *Melampyrum*

sylvaticum in its recorded English localities, as it has not been seen in any of these very recently, the last sighting being in 1990 at a single site in Mid-west Yorkshire (v.c. 65). However, there may be lessons to be learned that can be applied in Scotland and Northern Ireland, where controllable measures involving forestry activities, woodland management, restriction of grazing, research into the preservation of local ant populations and host-specificity of this species would prove to be beneficial. The remarkable assemblage of plant species which are uncommon or rare in northern England which are recorded in Yorkshire localities where *M. sylvaticum* formerly occurred is probably no coincidence, and although many of these species probably occurred in differing habitats there, it shows that these were all special places which would have merited conservation for their rich general botanical diversity.

HERBARIA

The following herbarium collections were examined during this study. **BM**, Natural History Museum, London; **E**, Royal Botanic Garden, Edinburgh; **KGY**, Cliffe Castle Art Gallery and Museum, Keighley, West Yorkshire (includes the herbaria of J. Beanland, J. W. Carter and F. A. Lees (part),

and Bradford Naturalists Club (B.N.C.) records and reports; most of which were formerly held at Cartwright Hall Museum (**CMM**), Bradford); **LDS**, Botany Department, University of Leeds.

The following were also consulted: **BRIST**, Herbarium of the University of Bristol; **DHM**, Botany Department, University of Durham; **HAMU**, Herbarium of the Hancock Museum, Newcastle-upon-Tyne; **NMW**, Herbarium, National Museum of Wales, Cardiff, and the *Naturalist* (Field Meeting reports, plant records and Transactions), Journal of the Yorkshire Naturalists' Union, Hull.

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The distribution, population size and growth of the rare English endemic *Sorbus bristoliensis* A. J. Wilmott, Bristol Whitebeam (Rosaceae)

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ABSTRACT

The distribution, population sizes and growth of the rare endemic *Sorbus bristoliensis* A. J. Wilmott (Rosaceae) are summarised, based on literature and herbarium studies, and field surveys in 2004 and 2005 using GPS to localise trees. It is endemic to the Avon Gorge, where 262 trees are currently known in woodland, on woodland edges, on open rocks and in disused quarries. It occurs on a range of soils derived from carboniferous limestone, plateau clays and more acidic sandstone rocks. Data on height and girth show a continuous range of age classes indicating regular regeneration. Tree ring data suggest that the oldest tree is at least 227 years old, and many trees are more than 100 years old. Comparison against 1970s survey data from Leigh Woods shows the population is increasing at c. 10% per decade. Under the 2001 IUCN Threat Criteria it is categorised as “Vulnerable”.

KEYWORDS: Gloucestershire, Somerset, conservation.

INTRODUCTION

Sorbus bristoliensis A. J. Wilmott, Bristol Whitebeam, is a rare English endemic tree confined to the Avon Gorge, Bristol (Wigginton 1999). Flanagan (1998) listed it as declining and in need of recovery, with most of the plants in the Avon Gorge being mature trees with little natural regeneration, and it was regarded as one of the four species of *Sorbus* with the highest priority for conservation in Britain.

A full history of the discovery of *S. bristoliensis* is in given by Lovatt (2007); here only a summary related to the increase in the number of trees known with time is given. The first record and earliest herbarium specimens of *S. bristoliensis* are those of Miss M. M. Atwood on 10 June 1852 from the summit of Nightingale Valley, Somerset, in herb. Watson at **K** (Lovatt 1982; Swete 1854, as *Pyrus aria* Sm. γ *intermedia* Ehrh.). This tree has been widely suggested (e.g. by Green *et al.* 2000) to be the multi-coppiced tree by the Stokeleigh Camp viewpoint, Leigh Woods, on the north side of Nightingale Valley (grid reference ST56107328), but a large multi-coppice tree hanging over the edge of the cliffs on the south side of Nightingale Valley below North Road (ST56217305) fits the description of the location, and White (1912, as *Pyrus latifolia* Syme) noted that only the tree on the southern edge of the valley was known to the early botanists. White (1912) reported that only two or three trees were known until 1901, when five more were found to the north by A. Ley (“Nightingale Valley, south side, at the edge of the rocks nearly opposite the first cross roads. Also on the north side”; **BRISTM**), and subsequently more were found by J. W. White in 1902 (**BRISTM**, **NMW**, **UPS**; White 1912), but other herbarium specimens suggest it was also found elsewhere despite T. B. Flower’s insistence to White (1912) that there was only one tree. It was reported as first found on the Gloucestershire side in 1909 by White (1912)

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who noted that "a very old tree with several boles overhangs some steep rocks on a thickly wooded slope of Clifton Downs" (a large old tree in a similar location was still present in 2006 but in poor condition). However, there is an earlier specimen in **GLR** which can be traced to a field trip by W. H. Purchas, T. B. Flower and G. A. St Brody to the Gully in 1869 (Lovatt 2007). When Wilmott (1934) described *S. bristoliensis* as a distinct species, he noted that there were "many trees, occurring on both sides of the gorge" but he only noted one tree from the Gloucestershire side in Riddelsdell *et al.* (1948). His type specimen was collected from this tree on Clifton Down in 1933 (**BM**), and not the tree on the summit of Nightingale Valley as often reported (e.g. Hendry & Pearson 1973). Bailey *et al.* (1972) and Hendry & Pearson (1973) noted it was present in substantial quantities in Leigh Woods, both within the National Nature Reserve (N.N.R.) and above Quarries 1, 2 and 3, with smaller numbers between. Russell (1979, Appendix 3) listed 146 trees (80 mature, 66 regeneration) in the Leigh Woods NNR. Nethercott (1998) suggested that there were probably about 100 trees, mainly on the Leigh Woods side. It is difficult to be certain of population trends given the extent of quarrying and destruction of the original woodland vegetation in the gorge, but given how rare White (1912) regarded *S. bristoliensis* as and the frequency with which it has now colonised secondary habitats, it has either increased markedly over the last 100 years or its true extent had simply never been established.

As part of work on the rare *Sorbus* species of the Avon Gorge, we have compiled records of *S. bristoliensis* from herbaria and carried out field work between 1996 and 2005, and here report the first detailed estimate of the distribution and population size. We have also collected some of the data on its growth and performance to assess the population trends. Full details of the records have been lodged with the National Trust, Natural England, Bristol Environmental Records Centre, the Threatened Plants Database and the National Biological Records Centre, Monks Wood.

Sorbus bristoliensis is a relatively distinct member of the *S. latifolia* group, characterised by the obovate, shallowly but sharply lobed leaves with a cuneate base, and the orange ripe fruits (Sell 1989). We have not observed yellow ripe fruits as reported by Sell (1989) and, in exposed sunlit sites, some ripe fruits

can be distinctly reddish on one side at least. *Sorbus bristoliensis* occurs with three other members of the *S. latifolia* group in the Avon Gorge, *S. latifolia* (Lam.) Pers. sensu stricto (occasional), *S. croceocarpa* P. D. Sell (locally frequent), and *S. decipiens* (Bechst.) Irmisch (rare), as well as other *Sorbus* species; they may be identified using the leaf silhouettes in the *Plant Crib* (Rich & Jermy 1998), and T. Rich will be happy to determine specimens, which should preferably consist of leaves from the short lateral rosettes, and fruit if present.

METHODS

Historical records were compiled from herbaria (**BIRA**, **BIRM**, **BM**, **BRISTM**, **CGE**, **E**, **GLR**, **LIV**, **LTR**, **MBH**, **NMW**, **OXF**, **RNG** and **UPS**), published and unpublished literature and reports (e.g. Bailey *et al.* 1972, Hendry & Pearson 1973, Russell 1979, Rich & Houston 1996), and from correspondence with botanists. These records were used to direct field surveys, though most, with the notable exception of Russell (1979), lacked sufficient detail to be any use in the field.

RELIABILITY OF GPS READINGS AND GROWTH MEASUREMENTS

Small, hand-held, cheap GPS units are being widely used to collect botanical survey data, but there are few published estimates of their reliability for repeating survey work. The reliability of the GPS readings was tested by repeat measurements at the same point by the same and different units, and for some individual trees. The repeatability of height and girth measurements was also assessed for some trees.

DISTRIBUTION AND POPULATION SIZE FROM FIELD SURVEY

A detailed survey was carried out between August 2004 and October 2005 by the authors, and on 2 October 2004 with help of 13 volunteers from the Somerset Rare Plants Group and the B. S. B. I. The best time to search for trees was found to be late September and early October, when some leaves have blown to the ground, which can then be traced back to the tree. Towards the end of October, too many leaves of all species cover the ground, making the fallen *S. bristoliensis* leaves less conspicuous and consequently the trees are harder to trace. Fallen fruits, which tend to fall directly under the trees, were also a

useful aid to finding the trees quickly. Efforts were made to avoid recording the same trees twice by temporarily marking the trunks with chalk. Trees and saplings were searched for and their locations pinpointed using five Garmin Etrex units as well one other hand-held GPS.

In general it was straightforward to define an individual. We have only observed *S. bristoliensis* suckering once from exposed roots c. 1 m from the main trunk on the edge of the Gully, and have generally treated separate maiden trunks as separate plants even if very close together. On two occasions, two trees have been observed growing together at the base but with no sign of having been coppiced, so they were treated as maidens.

No seedlings or young *S. bristoliensis* plants less than 0.75 m high were recorded, either because they were difficult to see amongst undergrowth or were difficult to identify, though in general there is good regeneration of most *Sorbus* species in the Avon Gorge, especially in the open areas. Young saplings were difficult to identify as the characteristic short lateral shoot leaves were not developed, and leaves of young, shaded *S. bristoliensis* plants are difficult to tell apart with confidence from leaves of young, shaded *S. latifolia* and *S. croceocarpa*, both of which are also regenerating in the gorge.

GROWTH AND PERFORMANCE

The height of the tree was estimated by eye, the girth of the largest trunk measured with a tape-measure at 1.3 m above the ground, and notes were made on the growth form (maiden or coppiced) and the presence or absence of fruit. Where ivy could not be removed or prised away from the trunk, a visual allowance was made to correct for the increased girth. Coppiced trees may have originated from deliberate coppicing as part of woodland management, or may be naturally coppiced following loss of a trunk in a storm, etc. (*S. bristoliensis*, like many *Sorbus* species, appears to coppice readily from the base of the trunk following damage). Where trees occurred on cliffs or in inaccessible situations, it was not possible to collect some data. Four trees for which girths were measured in 1996 (Rich & Houston 1996) were re-measured in 2004.

AGE OF TREES

Tree ring data were collected to help assess tree ages and trends in the population. One core

was taken from each of 26 trees (22 maidens, 4 coppice) at, with a few exceptions, 1.3 m above the ground using a Haglof 5.15 mm increment borer on 17 March 2005. Trees were selected from a range of growth conditions, from shaded woodland on plateau clays to dry, open rocks, and their girth was noted at the height of coring. Where trees were on slopes or adjacent to wood edges, cores were taken from the side of the trunk parallel to the slope to avoid reaction wood and minimise asymmetrical growth. In total 17 cores reached the middle of the trunk, and nine cores either missed the centre or did not reach it. No core holes were plugged as this is regarded as unnecessary (Grissino-Mayer 2003). In the lab, the annual growth rings were marked with pencil under a microscope and their widths measured with a graduated lens to the nearest 0.1 mm. The rings do not always stand out clearly in this species, and checks showed that rings had occasionally been missed. The most recent rings were the hardest to measure, partly due to their small size in recent years, and partly due to distortion caused by the increment borer. To estimate at what age a sapling would reach 1.3 m tall, six saplings were aged from the annual bud scars.

The girth data were also analysed for maiden trees in eight areas (two woodland, two scrub, two natural cliff and two quarry sites) with reasonable populations of trees. The girths were converted to estimated age from the tree ring data and summarised into age class by decade.

COMPARISON OF 2004–2005 SURVEY DATA WITH RUSSELL (1979) DATA

Russell (1979) mapped 80 mature and 66 regenerating trees in grid squares within Leigh Woods N.N.R. between 1976 and 1978. The 2004–2005 field data for mature and/or fruiting trees were compared with his data to assess loss and gain of mature trees.

RESULTS

RELIABILITY OF GPS READINGS AND GROWTH MEASUREMENTS

For the location and growth data to be useful for monitoring in the future, it is important to have some estimate of their reliability. The 10-figure (i.e. to the nearest metre on the ground) grid references from the Garmin Etrex GPS units were tested for repeatability by recording the coordinates for the gated entrance to Leigh

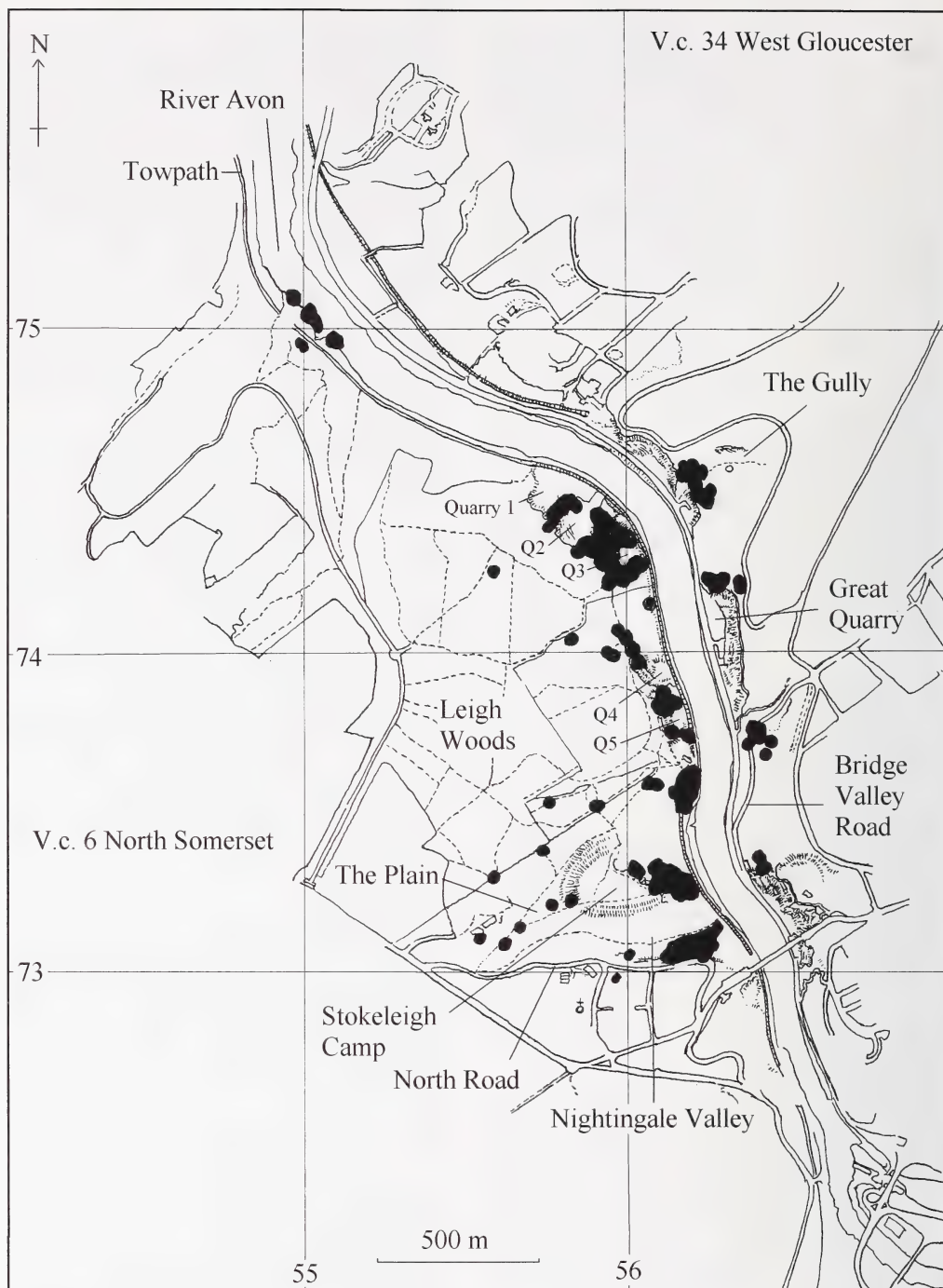


FIGURE 1. Detailed distribution of *Sorbus bristoliensis* in the Avon Gorge, Bristol, 2004–2005.

Woods on North Road at the start and end of the survey on 2 October 2004. The units reported their accuracy as an average of ± 8.6 m (range ± 6 –12 m). Relative to the overall average reading at the start of the day, five units varied by an average of 4.25 m east–west (range 2–10 m) and 8.25 m north–south (range 1–18 m). At the end of the day, three of the units retested varied by an average of 4.33 m east–west (range 0–8 m) and 13 m north–south (range 5–24 m) from their individual readings at the beginning of the day. Readings for the same trees, made on different days by different Garmin units ($n = 12$, mean reported accuracy ± 15.4 m, range ± 6 –47 m), varied by an average of 20 m east–west (range 2–74 m) and 17 m north–south (range 2–47 m).

The accuracy of the GPS unit readings varied depending on the location and canopy cover. Where there was a clear view of the sky and no tree canopy, the accuracy was usually reported on the units as ± 6 –7 m, but under closed canopy in tall woodland, it was much more variable (and often over ± 20 m), and readings for the individual trees varied markedly. Nonetheless, the use of these simple, cheap GPS units provided significantly more accurate locations than could be obtained from traditional maps, and considerably speeded up localising individual trees. Basic GPS readings of this level of accuracy are unlikely to be of significant use for monitoring individual trees in clustered populations, where other means of localising and identification may also be needed. More expensive GPS units with differential correction could be used to give greater repeatability, but are unlikely to be affordable to many amateur botanists.

Repeated height measurements for three trees on different days varied by an average of 0.67 m (range 0–1 m); tree heights are notoriously difficult to estimate reliably by eye. Repeated girth measurements on the three trees varied by an average of 3 cm (range 1–4 cm); the variation may be due to a combination of different people measuring at slightly different heights on the tree and the difficulty of keeping the tape level and tight round large trees.

DISTRIBUTION AND POPULATION SIZE FROM FIELD SURVEY

The distribution of plants is shown in Figure 1 and the number of plants in each area summarised in Table 1. A total of 262 *S. bristoliensis* trees are currently known, but

there is little doubt that there are more on the less accessible parts of cliffs and disused quarries, and in dense woodland. The map shows that most trees occur on the Leigh Woods side of the Avon Gorge in v.c. 6 North Somerset (234 trees), with the highest densities associated with the natural rock outcrops, the quarry tops and edges, and the change of slope from the valley sides to the plateau. On the Leigh Woods plateau there are scattered trees, the lower density in the northern Forestry Commission area reflecting the woodland clearance and replanting undertaken in that area. A total of 28 trees occur on the east side in v.c. 34 West Gloucester, mainly associated with young woodland.

PLANTED TREES

There is one planted tree on The Plain, Leigh Woods, and one outside the former Bristol University Botanic Garden in Church Road on the Somerset side (v.c. 6). There is one planted tree on the Promenade near Merchant's Hall and three trees grafted onto *S. aucuparia* L. rootstock on Durdham Down on the Gloucestershire side (v.c. 34).

OTHER RECORDS

Specimens collected by D. Fry, 1886, Oakleigh, near Keynsham, which had part of a label missing, led Salmon (1899) mistakenly to publish a new locality; it subsequently turned out that the specimens were from a tree in a shrubbery which had been planted by a member of the Fox family (Fry 1899; White 1912).

GROWTH AND PERFORMANCE

Height and girth are highly correlated measurements of growth and performance and, as might be expected, the taller the tree the larger the girth (Figure 2; for maidens alone $r = 0.808$, $n = 170$, $p < 0.001$; for all trees $r = 0.806$, $n = 190$, $p < 0.001$). There is a weak but not significant trend for stems of coppiced trees to have smaller girths than maiden trees of the same height. For trees where measurements were available, height ($n = 241$) and girth ($n = 200$) were analysed separately for the maiden and coppiced trees.

The mean height of maidens was 7.7 m $\pm$ 0.32 m s.e. ($n = 226$), and of coppiced trees 5.9 m $\pm$ 0.54 m s.e. ($n = 35$); these were significantly different ($p = 0.046$, 2-tailed t-test with sample variances assumed to equal). The mean girth of maidens was 40.6 cm $\pm$ 2.5 cm s.e. ($n = 180$),

TABLE 1. NUMBER OF *SORBUS BRISTOLIENSIS* TREES AND SAPLINGS OVER 0.75 M HIGH IN EACH AREA, EXCLUDING PLANTED TREES

V.C.	Locality	No. plants
6	North Road, gardens	2
6	Nightingale Valley, rocks on south side	19
6	Leigh Woods National Trust southern area (including The Plain)	11
6	Stokeleigh Camp	6
6	Stokeleigh Camp, cliffs below viewpoint	48
6	Stokeleigh Camp, valley NE of	1
6	Leigh Woods NT, northern plateau	5
6	Leigh Woods, Donkey Slide/Goat Path south to railway tunnel	17
6	Leigh Woods, Forestry Commission area	1
6	Leigh Woods, towpath north of Quarry 1	9
6	Leigh Woods, north end west of railway	3
6	Leigh Woods, Quarry 2 and top edges	23
6	Leigh Woods, Quarry 3 (Police Quarry) and top edges	42
6	Leigh Woods, ridge between Quarries 1 and 2	10
6	Leigh Woods, towpath near Quarry 3	2
6	Leigh Woods, Quarry 4 and top edges	4
6	Leigh Woods, Quarry 5 and top edges	13
6	Leigh Woods, between Quarries 2 and 3	13
6	Leigh Woods, between Quarries 3 and 4	5
34	Bridge Valley Butress (Jack's Hole, Great Fault)	3
34	Bridge Valley Road, above	5
34	Bridge Valley Road, below	3
34	Clifton Down, wooded slopes north of Great Quarry	9
34	The Gully/Walcombe Slade, south side	3
34	The Gully/Walcombe Slade, north side	5
	Total	262

and of coppiced tree stems $31.8 \text{ cm} \pm 4.8 \text{ cm s.e.}$ ($n = 23$); these were not significantly different ($p = 0.114$). Similar proportions of the maidens (50%) and coppiced (47%) trees were fruiting.

Figure 3 shows the variation in the estimated heights of the maiden trees, with the proportion of trees in each size class with fruit. The graph shows a skewed distribution with most trees in the 2.1–8 m height categories, and progressively fewer larger trees. There are relatively few saplings in the smallest size category up to 2 m tall, either because they were small and overlooked or not identifiable with certainty, or because they may be genuinely rarer. In forest, the tree height tends to match the general height of the canopy, which at the changes of slopes preferred by *S. bristoliensis* is about 10 m high, and in the taller woodland on the plateau about 15 m high. The proportion of trees with fruit increases as the trees get taller, as might be expected. The smallest tree with fruit was 3 m tall with a girth of 12.5 cm. The largest tree without fruit was 18 m tall with a girth of 78 cm; it was growing in a tall area of dense woodland on the plateau and had no leaves in the canopy.

Figure 4 shows the frequency of the different girth sizes (2005 data corrected to 2004). The girth size classes are again strongly skewed towards the smaller size classes (the smallest size class again being under-represented due to the practicalities of survey) but a large range of girth sizes is present, with a few large trees. The proportion of trees with fruit increases as the girth sizes increase, again as expected.

AGE OF TREES

The tree ring growth data for the 26 trees (c. 10% of the population) are summarised in Table 2. The oldest cores were from tree 23 (107 rings) and tree 26 (103 rings). Individual rings varied in width from 0.1 mm to 5.0 mm, with an overall mean of $1.31 \text{ mm} \pm 0.018 \text{ mm s.e.}$ The mean ring width for each tree ranged from 0.75 mm (tree 8) to 3.05 mm (tree 25), with an overall average of $1.53 \text{ mm} \pm 0.092 \text{ mm s.e.}$ a year, suggesting an average increase in girth of 9.6 mm per year. The data for coppiced and maiden trees were lumped together as a t-test indicated no significant differences ($p = 0.46$) between them, though this is partly as only four coppiced trees were cored.

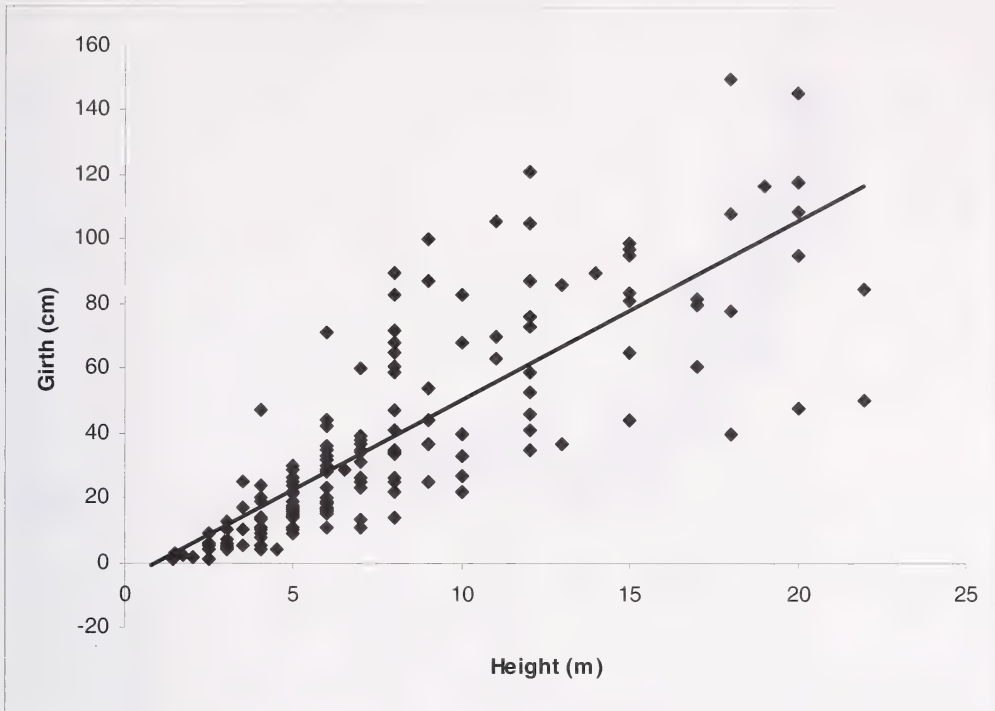


FIGURE 2. Relationship between height and girth of maiden *Sorbus bristoliensis* trees (n = 170). A best fit line is also shown.

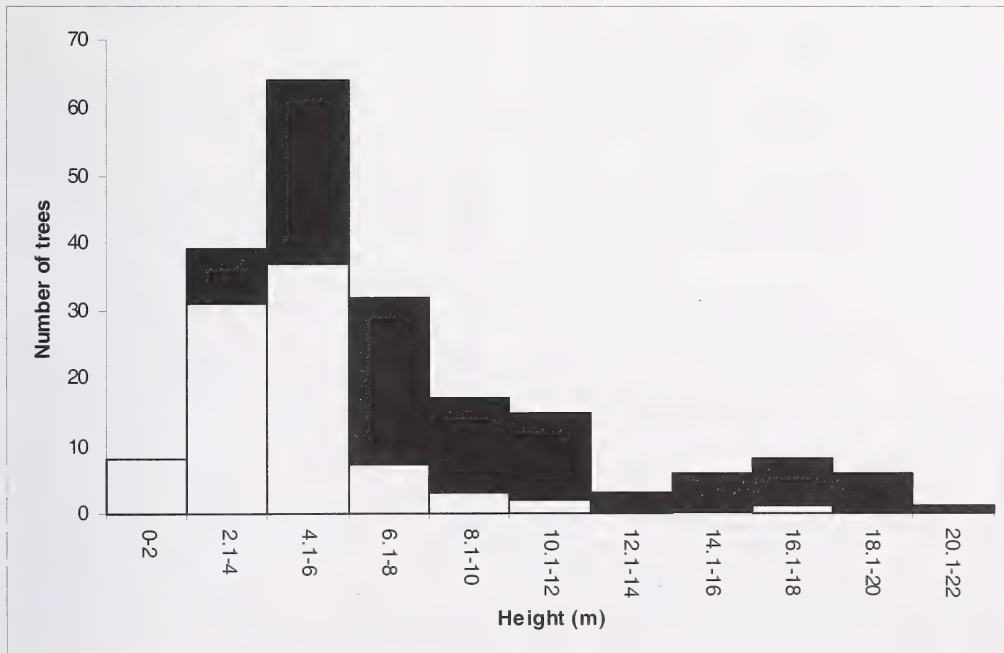


FIGURE 3. Variation in height of maiden *Sorbus bristoliensis* trees. ■ proportion with fruit. □ proportion without fruit.

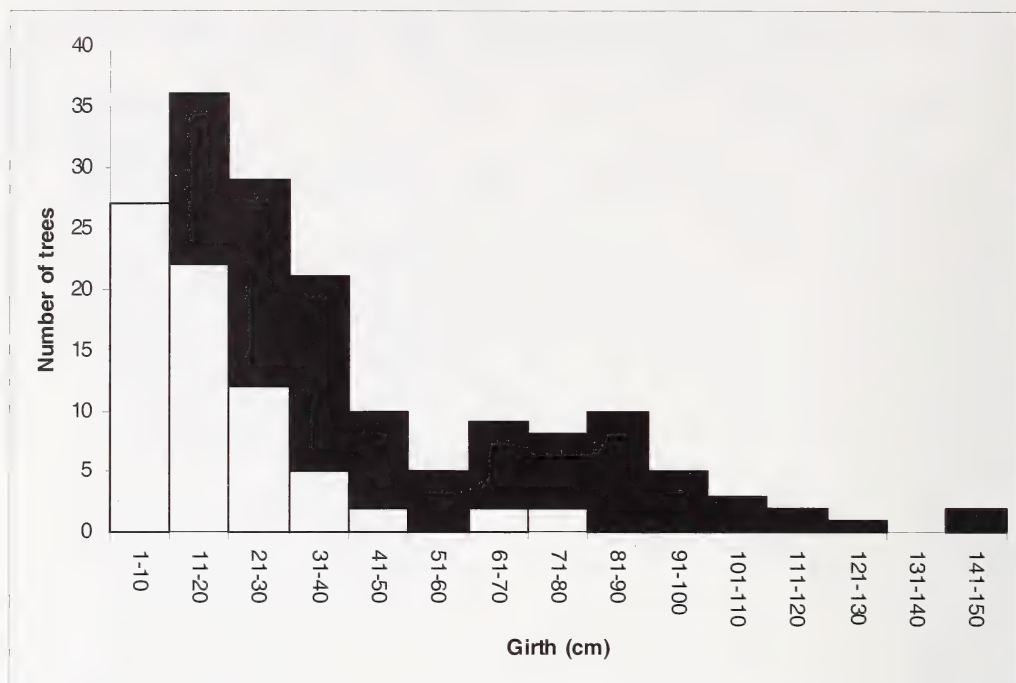


FIGURE 4. Variation in girth of maiden *Sorbus bristoliensis* trees at 1.3 m (data for 2005 corrected to 2004). ■ Proportion with fruit. □ Proportion without fruit.

The age of the individual trees can be estimated from the girth data as the girth and core age data are highly correlated ($r = 0.825$, $p < 0.001$). On average, the bud scars showed that saplings took 14.8 ± 1.6 s.e. years to reach 1.3 m tall (the height at which cores were taken), so 15 years can be added to each age estimated from the cores. Treating the trunks as cylinders, the oldest trees cored, both on the Somerset side, are estimated to be $159 + 15 = 174$ years (tree 26) and $141 + 15 = 156$ years (tree 23). The first tree found on the Gloucestershire side (cf. White 1912) has the one remaining trunk estimated to be potentially 227 years old (currently girth of 93 cm and mean annual ring width of 0.66 mm/year) but the large coppiced base suggests it may be much older. Two trees at the bottom of the woodland slope north of the Great Quarry were estimated to be 160–170 years old. Observations in the field show that the assumption the trunks are cylinders may overestimate the age of some trees, as, for the 17 cores which reached the centre, the actual core length to the centre was 87% of the calculated core length (assuming a cylindrical trunk). This is due to the asymmetrical trunk

growth in natural conditions and the cores being taken from the side of the tree parallel to the slope.

The mean ring growth of trees in woodland was 1.44 mm in width per year, and for trees in the open 1.62 mm per year, but these are not statistically different ($p = 0.38$), suggesting that other unmeasured factors such as climate, soil depth and soil nutrient status may also be important for growth. The ring data for some woodland trees (e.g. tree 2 from the edge of the ramparts of Stokeleigh Camp) also showed that there could be sudden changes from periods of slow growth to fast growth and vice versa, perhaps related to woodland management, loss of adjacent trees or closure of the canopy.

The age distributions of individual trees for four different habitats in eight areas of the gorge are shown in Figure 5. Whilst the age estimates are fairly crude, there are some interesting differences between the habitats. The densely wooded slopes north of the Great Quarry (Figure 5a) have only mature, old trees present (estimated ages 80–170 years) with no regeneration. In contrast, the wooded area of the Leigh Woods plateau (Figure 5b), once pasture woodland, have a broader range of

TABLE 2. TREE-RING DATA FOR 26 CORED *SORBUS BRISTOLIENSIS* TREES

Tree	Maiden or coppice	Girth (mm) at 1.3 m	Habitat	Core length analysed (mm)	No. rings measured	Mean ring width (mm)	Estimated age of tree (years)*
1	Coppice	240	wood	37	35	1.30	44
2	Coppice	390	wood	52	60	0.95	80
3	Coppice	410	open	53	42	1.47	59
4	Coppice	1010	open	112	62	1.72	108
5	Maiden	170	open	42	40	1.51	33
6	Maiden	230	open	29	18	1.87	35
7	Maiden	240	wood	31	52	0.77	65
8	Maiden	340	wood	38	68	0.75	87
9	Maiden	340	open	43	49	1.27	58
10	Maiden	350	open	44	51	1.25	49
11	Maiden	360	open	53	48	1.58	51
12	Maiden	540	wood	79	75	1.46	74
13	Maiden	630	wood	106	58	2.15	62
14	Maiden	770	wood	79	58	1.17	120
15	Maiden	780	wood	117	73	1.71	88
16	Maiden	795	wood	92	68	1.07	133
17	Maiden	810	open	94	59	1.91	83
18	Maiden	870	open	100	75	1.55	104
19	Maiden	920	wood	123	101	1.35	124
20	Maiden	980	clearing	119	93	1.34	131
21	Maiden	1020	open	136	76	2.05	94
22	Maiden	1080	wood	96	75	1.57	124
23	Maiden	1175	wood	121	107	1.33	156
24	Maiden	1190	clearing	154	76	2.11	105
25	Maiden	1380	wood	110	45	3.05	87
26	Maiden	1500	wood	157	103	1.50	174
Mean		707		85	64	1.53	89

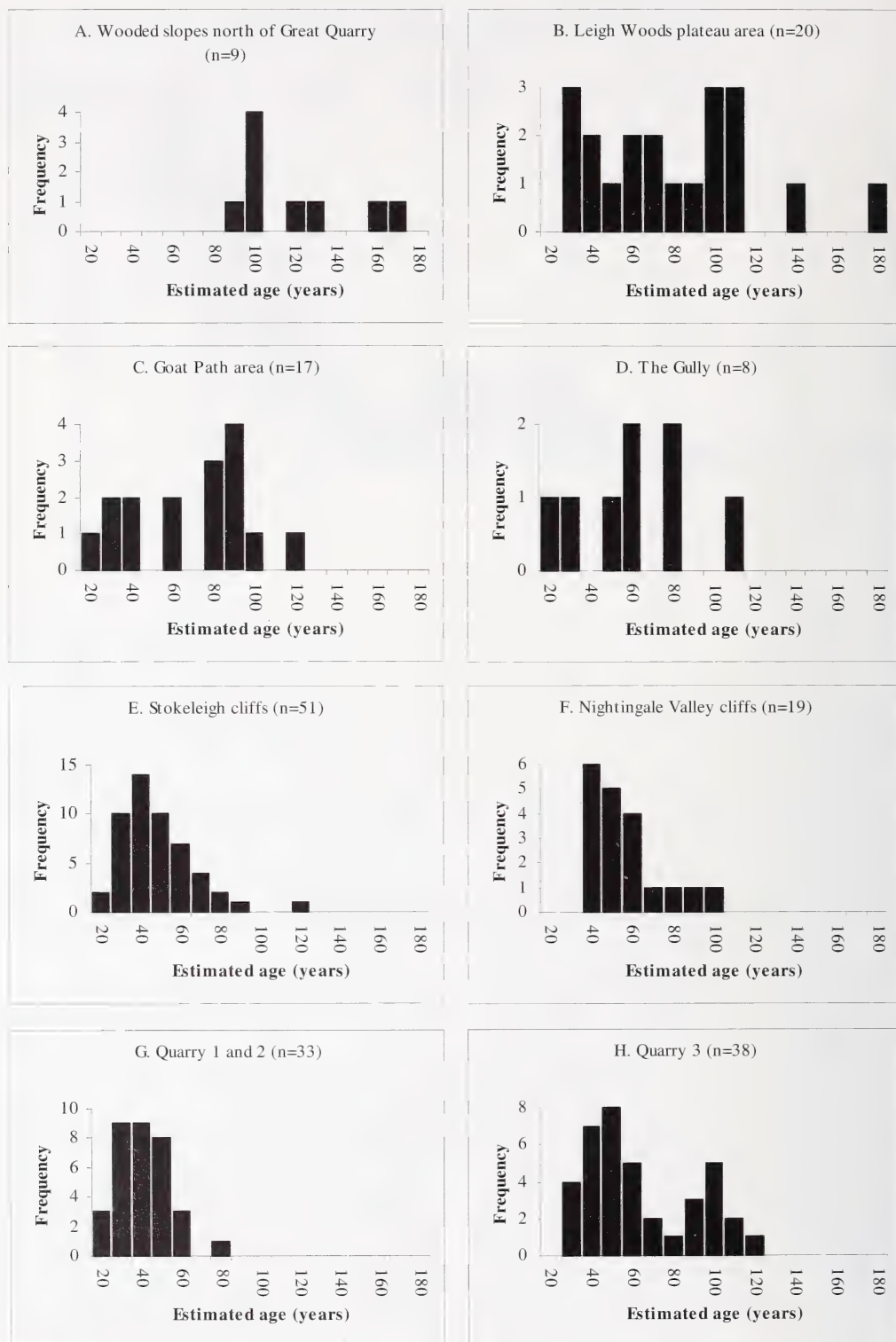
*Age includes 15 years for the trees to reach 1.3 m, and assumes trunks are cylinders; the age is then calculated from the radius and mean ring width.

trees, including some young regeneration, especially along the edges of woodland rides and in some of the slightly more open areas. The open woodland-scrub-grassland areas around the Goat Path and The Gully (Figures 5c, d) both show a range of age classes, with some older trees up to 120 years old. The largely natural cliffs at Stokeleigh Camp and on the south side of Nightingale Valley (Figures 5e, f) show a strongly skewed distribution towards younger plants, with few trees up to 100(–120) years old. This young age distribution may be partly a result of trees on the cliffs often being naturally small and frequently damaged through exposure. The age distribution for Quarries 1 and 2 (Figure 5g) is strongly skewed towards young trees to 60(–80) years old, and indicates colonisation since 1935 following cessation of quarrying. The age

distribution for Quarry 3 (Figure 5h) is bimodal but again skewed towards younger trees which are colonising the gentler northern slopes of the quarry.

COMPARISON OF 2004–2005 SURVEY DATA WITH RUSSELL (1979) DATA

Of the 82 mature trees in total mapped by Russell (1979), it is probable that 61 were refound in 2004–2005. The comparison is difficult because it is not always clear that a mature tree mapped by Russell (1979) is exactly the same as the one refound in the same grid square in 2004–2005, or how Russell defined a mature or a regenerating tree; data for his grid squares OF and NE are not specified, and some trees may have been overlooked. Some 23 trees appear to have been lost

FIGURE 5. Age distribution of maiden *Sorbus bristoliensis* trees in eight different areas of the Avon Gorge

between 1976–78 and 2004–2005. We have observed a few trees with heart-rot during our surveys, but have not seen any dead trees for certain.

In 2004–2005, we found 118 mature trees in the same area covered by Russell (1979). Allowing for growth of trees since 1976–1978 (i.e. excluding trees with a girth of less than 40 cm, our estimate for 28 years old), we found 53 trees which had matured since that time. Some trees apparently additional to Russell's survey partly resulted from more detailed survey of the hazardous cliffs below Stokeleigh Camp and on the south side of Nightingale Valley. The net population increase of 30 trees between 1976–78 and 2004–2005 suggests an increase of c. 10% per decade.

DISCUSSION

The data in this paper are the first detailed population census of *S. bristoliensis*. The census indicates there are at least 262 plants, and their height and girth data, coupled with the population increase observed in Leigh Woods N.N.R. since 1976–1978, suggest that the population is currently healthy and regenerating. We attribute the absence of the smallest size class of plants to their being largely overlooked during our surveys rather than a sudden and recent lack of regeneration; Russell (1979) found frequent regeneration in *S. bristoliensis* and there is no reason for this situation to have changed. These new data allow Flanagan's (1998) assessment of *S. bristoliensis* as 'declining and in need of recovery' to be updated to 'increasing and not in need of recovery'. Similarly, the IUCN Threat Category (I.U.C.N. 2001) of *S. bristoliensis* can now be revised to "Vulnerable" as the population size exceeds 250 plants, updating the "Endangered" assessment in the recent Red Data List by Cheffings & Farrell (2005) which was based on our unattributed, incomplete 2004 survey data and which also lacked our caveats about the data.

The age distribution of the trees estimated from the girth measurements indicates that at least four trees from different areas of the gorge are likely to have been present at the time of Miss Atwood's first record in 1852, suggesting that *S. bristoliensis* had been present for some time prior to the first record and that her tree was not the first to originate; we cannot however say when it did originate. The

number of trees known has increased due to a combination of recruitment and increasing knowledge of its distribution, and it is clear that it has been widely overlooked in the past.

Observations in autumn 2005 and autumn 2006 of the holes created by coring in spring 2005 showed that there were often splits in the trunks up to 20 cm long, and once up to 1 m long associated with the holes (this splitting was not apparent at the time of coring). Few holes had healed fully and a few were still weeping sap by autumn 2006. Observations show that the trees have healed from other wounds and that they survive coppicing, but given this unexpected damage we do not advise coring other rare *Sorbus* unless it is imperative to obtain such data for their conservation.

Sorbus bristoliensis is relatively widespread in the Avon Gorge, where it is probably the second commonest *Sorbus* after *S. aria* (L.) Crantz. It is especially characteristic of Leigh Woods on the upper edges of the open, natural rocks and disused quarries and of the broad ledges and screes in the gorge, where it occurs with many woody species including *Tilia cordata* Miller, *Taxus baccata* L. and other *Sorbus* species over a field layer dominated by *Brachypodium sylvaticum* (Hudson) Beauv. It also occurs on the woodland plateau soils in Leigh Woods where it can occur as a tall tree in ancient woodland with *Fraxinus excelsior* L., *Acer pseudoplatanus* L. and *Quercus* spp. over *Rubus fruticosus* s.l. and *Hedera helix* L. On the Clifton side of the gorge *S. bristoliensis* mainly occurs as scattered trees in secondary woodland and scrub with *Quercus ilex* L., as much of the original vegetation has been destroyed. At the northern end of the gorge some saplings occur on the acidic sandstone slopes with *Quercus* spp., *Betula* spp. and *Luzula sylvatica* (Hudson) Gaudin (soil pH 4.9).

Relatively little detail is known about the ecology of *S. bristoliensis*. Russell (1979) recorded it on shallow to medium depth soils (2–19 cm deep) with a pH range of (5.3)–6.0–7.2. One sapling was seen as an "epiphyte" on a pollarded oak. He noted that, although *S. bristoliensis* occurred on deeper soils than *S. aria*, it seemed less competitive in most situations. Squirrels, blackbirds, thrushes, crows, magpies, tits and finches were seen to take the fruits and, compared to *S. aria*, *S. anglica* Hedl. and *S. wilmottiana* Warb., *S. bristoliensis* had the highest number of viable seeds per fruit in 1976, with a range of (0–)74–182 seeds per hundred fruits ($n = 10$, mean

1–22 seeds/fruit). Seeds had a high mean germination rate of 59%, and germination was higher in sheltered growth conditions than in open growth conditions. Russell found that drought was the biggest cause of mortality in young plants, followed by invertebrate feeding and vertebrate grazing.

Given that virtually all of the trees except those in gardens occur within the statutorily protected areas of the Avon Gorge SSSI and SAC, there are few obvious threats to its long term survival other than mismanagement. Occasional plants have been cleared for public safety or access: Hendry & Pearson (1973) noted that 15 small trees or tall saplings present in May 1969 on the towpath below Stokeleigh Camp had been felled in 1972. Based on past experience with *S. wilmottiana* (Rich & Houston 2004), loss of some trees during conservation work might also be expected but so far this has not been noted and, once cut down, the trees usually respond by coppicing from the base. The development of closed, tall woodland dominated by shade-tolerant species such as *Tilia cordata* and *Fagus sylvatica* could limit *S. bristoliensis* to the shorter, more open areas of woodland at the changes of slope and on open outcrops (cf. Figure 5a). An increase in browsing from deer populations could limit regeneration (we have observed deer several times in Leigh Woods, but not on the Clifton side of the gorge).

Live trees, possibly mostly or all originating from the well known tree at the Stokeleigh

Camp viewpoint, are held in cultivation at Bristol University Botanic Garden, Cambridge University Botanic Garden, Ness Botanic Garden, Westonbirt Arboretum, the National Botanic Garden of Wales, and elsewhere. Some seed has been deposited in the Millennium Seed Bank, Wakehurst Place. *Sorbus bristoliensis* and other rare Avon Gorge *Sorbus* species were distributed by N. J. Wray as part of the Bristol University Botanic Garden Millennium Tree Project in 1999–2000 to the Forest of Avon Project, Bristol Zoological Gardens, Avon & Somerset Police Head Quarters at Portishead, Bristol University Gardens Department, and elsewhere in the UK to members of Bristol University Alumni and a few private collectors; records were kept of where each species of tree was sent (pers. comm. N. Wray 2006).

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Description, ecology and establishment of *Carex salina* Wahlenb. (Saltmarsh Sedge) – a new British species

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ABSTRACT

Carex salina (Cyperaceae) section *Phacocystis* is a species new to the British Isles, first discovered on a saltmarsh on the west coast of Scotland in 2004. Elsewhere it is found in the northern latitudes of western Europe and the north eastern seaboard of North America. The species is distinct from the closely related *C. recta* on the basis of habitat, distribution and morphology. It is also morphologically distinct from other closely related members of the same section. It is a component of saltmarshes similar in composition to those found elsewhere in its distribution. It has a hybrid origin, with neither parent recorded from the British Isles. It is most likely to have colonised following long distance dispersal, its establishment possibly facilitated by isostatic uplift (i.e. rise in land level due to relaxation of ice age conditions) and recent climatic changes.

KEYWORDS: Colonisation, Cyperaceae, hybridisation, saltmarsh, Scotland.

INTRODUCTION

The addition of a new species to the British flora is a rare event. Hence the discovery of a new *Carex* (Cyperaceae) species on the west coast of Scotland by one of the authors (KH) in July 2004 and the subsequent identification of the species as *C. salina* Wahlenb. (Saltmarsh Sedge) by authors JC, MD, ACJ and Arthur Chater is an exciting find and was reported by

Dean *et al.* (2005). *C. salina* is a coastal species with an amphi-Atlantic distribution. It has a hybrid origin, the product of a cross between *C. paleacea* Schreb. ex Wahlenb. and *C. subspathacea* Wormsk., neither of which is recorded from the British Isles. Thus its discovery raises interesting questions on the distribution, dispersal and evolutionary potential of the species. This paper details what is currently known of the ecology, identification and distribution of the British population of the sedge, expanding upon the areas outlined by Dean *et al.* (2005). Additionally, it includes a detailed description of the sedge in Britain and the characteristics that separate *C. salina* from its close relatives. It also discusses the possible origins of the population and speculates on the reasons for its establishment.

DESCRIPTION AND IDENTIFICATION

When seen in its habitat as an extensive colony, *C. salina* can be confused from a distance with *Elytrigia juncea* (L.) Nevski. The following description is expanded from Jermy *et al.* (2007 Jermy *et al.*) following further field studies in Norway (PA) and Scotland (MD) and on N. American material (JC).

Rhizomes far-creeping; shoots tufted; roots rich brown-grey; scales red-brown, often blackened, persistent.

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Stems 16–30 cm, stiff, obtusely trigonous, smooth, spongy, typically shorter than the leaves of the vegetative shoots.

Leaves <30 cm (–60–70 cm where more sheltered) $\times$ 3–4 mm, mid-green, $\pm$ glaucous and matt on both surfaces, stiff, V-shaped, upper $\frac{1}{3}$ – $\frac{1}{2}$ and tip toothed; amphistomous; sheaths herbaceous, pale brown, soon decaying; inner face hyaline, transverse septa distinct; ligule acute, c. 5 mm; apex concave.

Inflorescence $\frac{1}{4}$ to almost $\frac{1}{2}$ length of stem; lowest bract leafy, somewhat invaginated at the base, slightly shorter to slightly longer than inflorescence, often spathe-like, enclosing spike. Male spikes 1–2(–3), 1–2 cm long; male glumes 4–6 mm, oblanceolate-elliptic, blackish-brown; margins hyaline; apex obtuse.

Female spikes 2–3, 1–3 cm, erect; narrow, cylindrical, upper almost sessile, lowest spike with peduncle up to 1.5 cm, sometimes lax-flowered at base; female glumes 4–5 mm, ovate-elliptic, mostly as wide as the utricles or wider, green at the start of flowering and maturing to mid- to dark-brown with broad pale centre with obvious midrib, some glumes three-veined; margins sometimes asymmetrical in upper florets or tending to be retuse; apex of those in upper florets apiculate, lower florets all awned; awn $\pm$ 1 mm long, toothed. Utricles 2.5–3.5 mm $\times$ 1–2 mm, ellipsoid, apex acute, slightly papillose with 0–3 nerves beneath beak; beak 0.2–0.4 mm, mostly cylindrical, sometimes conical, lacking spinules around the beak orifice, obliquely truncate or not; stigmas 2; nut orbicular or obovate, apex truncate, biconvex, glossy, usually deeply constricted on one face. Fruiting occurs in June and July.

C. salina in Scotland is very sparse flowering. No fertile specimens were found in 2004–2006. Therefore the important characteristics of the truncate apex and constricted nut have not been seen in British material. Low fertility may partly be an intrinsic feature of the species. Other maritime members of section *Phacocystis* which have a hybrid origin exhibit lowered pollen fertility, partly as a result of disturbed meiosis (Cayoquette and Morisset 1985). The few Norwegian populations examined failed to produce fertile seed. However, ecological factors may also influence fertility. Tidal inundation may cause a failure in pollination. Canadian *C. salina* populations which are covered by tides during summer exhibit

sterility. By comparison, Canadian populations covered only, or mostly, by spring and autumn high tides can produce good seeds.

Within the British flora *C. salina* is closest in appearance to *C. recta* Boott which, however, has a different ecological niche to *C. salina*. *C. recta* is found along the edges of the higher reaches of estuaries, usually amongst tall vegetation, e.g. in the Oykel estuary it can be dominant with *Phragmites*, *Phalaris arundinacea* and other grasses in species-rich sedge communities of tall-herb fen (S27), with *C. rostrata*, *C. nigra* and *Juncus acutiflorus* (Jermy *et al.* 2007). In other places (e.g. Bonar Bridge) it may form extensive and dense populations, excluding any other species. By contrast, *C. salina* is found on the mid-to-lower saltmarsh where it frequently forms single-species stands up to 10 m by 3 m in the saltmarsh creeks. It also creeps into the *Puccinellia maritima* sward where it has shorter leaves, flowers very infrequently if at all, and is much sparser and could easily go undetected (Dean *et al.* 2005).

In Britain *C. salina* and *C. recta* are also geographically separate, *C. recta* being located on the northeast coast of Scotland, *C. salina* on the west. *C. recta* is a much larger plant typically up to 1 m tall with vegetative leaves up to 130 cm, whereas *C. salina* grows up to 30 cm unless the plant is in the shelter of creek banks where the leaves can be longer. Morphologically the two species are separated by the female spike length (1–3 cm in *C. salina* vs 2–8 cm in *C. recta*), longer and typically narrower female glumes with a more acuminate apex in *C. recta* (4–5 mm long in *C. salina* vs 3–7 mm in *C. recta*); the beak of *C. recta* tends to be shorter and narrower (0.2–0.4 mm in *C. salina* vs c. 0.2 mm in *C. recta*). Both have apiculate or awned female glumes, with the glumes from the lowest florets usually awned in both species.

Two other species within the same section, *C. subspathacea* and *C. vacillans* Drejer are broadly similar to *C. salina*, but a third species, *C. paleacea*, is relatively easy to distinguish. None of these three species have been recorded from Britain (Dean *et al.* 2005). *C. salina* is a larger plant than *C. subspathacea*, which is typically a very short stemmed (3–15 cm, although in some Hudson Bay and north-eastern North American populations it can grow as tall as 25–30 cm), narrow leaved (1–3 mm), low growing early flowering species of

saltmarshes. *C. paleacea* is a larger species than *C. salina* but smaller in stature than *C. recta*. *C. paleacea* is distinguished by its pendent female spikes and pale brown female glumes with a long, finely serrated awn 6–15 mm long (Mossberg & Stenberg 2003).

In size *C. vacillans* is closest to, but typically taller than, *C. salina*. The two species are also separated by utricle appearance. Specifically, *C. vacillans* has densely papillose and nerved utricles, with spinules around the beak orifice, dark pistillate glumes with a narrow central band, sometimes incomplete (not reaching the apex) on unawned glumes, usually a scabrous

stem, and dull surfaced nuts. It also has some divergent to even drooping spikes and usually a sharp trigonous stem. *C. salina* lacks this suite of characters. Both share the characters of frequently scabrous awned glumes and constricted nuts.

Small plant size, spathe-like lowest bract and the female glumes, which are mostly found with a short to long scabrous awn, are the best character to identify *C. salina* and are consistent across specimens of *C. salina* in northern Europe (including Scotland) and eastern North America. A key to *C. salina* and closely related, potent-ially confusing species is given below.

KEY

A key to *Carex salina* and related coastal species in *Carex* section *Phacocystis* in northwest Europe.

This section is identified by separate male and female spikes with the upper usually entirely male and the lower usually entirely female, two stigmas, and utricles and nuts biconvex or planoconvex.

1. Vegetative leaves involute and 1–3 mm wide; leaves lying on substrate surface; on lower reaches of saltmarsh. *Carex subspathacea*
1. Vegetative leaves keeled or V-shaped or widest more than 3 mm; leaves clear of substrate surface; on lower or upper reaches of saltmarsh or adjacent landward vegetation. 2
2. Stomata predominantly or exclusively on one leaf surface only 3
2. Stomata abundant on both leaf surfaces 6
3. Leaves with stomata predominantly or exclusively on upper surface; female glumes obtuse or acute, without awns 4
3. Leaves with stomata predominantly or exclusively on lower leaf surface; female glumes with prominent awn at least on lower florets 5
4. Lowest bract from shorter to slightly longer than inflorescence; stem usually scabrous below lowest spike; nuts dull *Carex nigra*
4. Lowest bract (usually greatly) exceeding inflorescence; stem usually mostly smooth below lowest spike; nuts glossy or mostly so *Carex aquatilis*
5. Almost all female spikes pendent; all female glumes with prominent awn; awn up to 15 mm *Carex paleacea*
5. Female spikes erect or semi-erect; usually only lower florets awned; awn <5 mm *Carex recta* (part)
6. Proximal bract often spathe-like, enclosing spike; nuts glossy *Carex salina*
6. Proximal bract not spathe-like; nuts glossy or dull 7
7. Female glumes with papillose midrib, midrib of unawned glumes not always reaching apex; nut dull *Carex vacillans*
7. Female glumes with midrib not or slightly papillose, midrib of unawned glumes reaching apex; nut usually glossy *Carex recta* (part)

DISTRIBUTION

C. salina is currently known from a single site in the British Isles, at Morvich at the head of Loch Duich (v.c. 105, Map ref. NG 9520, NG 9521). In 2006 17 other locations on the west coast of Scotland across two vice-counties (v.c. 98 and 105) were examined (Table 1 in appendix) but *C. salina* was not found at these sites.

The species is also recorded from the western and northern coasts of Norway and northwestern Russia, from Hudson Bay and St Lawrence River and the eastern coastal area of Canada (Chater in Tutin *et al.* 1980; Hultén & Fries 1986; Standley *et al.* 2002; Mossberg & Stenberg 2003).

There are also records from Greenland (Hultén & Fries 1986) and Iceland (Chater in Tutin *et al.* 1980; Hultén & Fries 1986). However, reports of *C. salina* from Greenland are based upon misidentifications. Cayouette & Catling (1992), reviewing Greenland *C. salina* specimens, considered them primarily to be *C. lyngbyei* × *nigra* hybrids with some *C. subspathacea* individuals. Reports of *C. salina* from Iceland are probably based upon Ostenfeld & Grøntved (1934) and Grøntved (1942) and reflect an earlier taxonomic treatment. More recently Löve (1983) did not report *C. salina* from Iceland and Hylander (1982) considered that *C. salina* from Iceland could perhaps refer to *C. lyngbyei* × *subspathacea* hybrids.

ECOLOGY

In its single Scottish locality, *C. salina* is present in creek channels, although it is absent in the main river channel, and along the low banks of the creeks, growing in the mid-lower region of the saltmarsh zonation (Dean *et al.* 2005). Associated plant species on the saltmarsh include: *Armeria maritima*, *Glaux maritima*, *Plantago maritima*, *Aster tripolium*, *Triglochin maritimum*, *Juncus gerardii*, *Blysmus rufus*, *Eleocharis palustris*, *E. uniglumis*, *Festuca rubra*, *Puccinellia maritima* and *Agrostis stolonifera*. In N.V.C. terms, this site consists of mainly SM13 *Puccinellia maritima* saltmarsh and SM16 *Festuca rubra* saltmarsh but also some patches of SM19 *Blysmus rufus* saltmarsh and S19 *Eleocharis palustris* swamp. *C. salina* plants are scattered over a wide area of the lower saltmarsh. It

occurs as single-species stands on the silt and, more frequently, less densely as shoots among the *Puccinellia* sward. The sparsely flowering clones are growing near enough to mean high tide level to be regularly inundated.

The above is a very similar habitat to those where *C. salina* is found along the St Lawrence River, in eastern Québec, with many companion species in common. These include *Glaux maritima*, *Plantago maritima*, the *Triglochin maritimum* group, *Juncus gerardii*, *Blysmus rufus*, *Eleocharis palustris*, *Festuca rubra*, *Puccinellia* subsp. and *Agrostis stolonifera*. Not found alongside *C. salina* in Britain but frequent associates in the Canadian communities are: *Ranunculus cymbalaria*, *Salicornia* spp., *Argentina egedii* agg., *Carex paleacea* and *Hordeum jubatum*. By comparison, at the margins of pools in saltmarshes in James Bay and Hudson Bay, *Carex salina* grows with *Argentina egedii* agg., *Calamagrostis deschampsoides*, *Carex mackenziei*, ×*Dupoa labradorica*, *Festuca rubra*, *Montia fontana*, *Parnassia palustris*, *Rhinanthus minor* agg., *Stellaria crassifolia*, and *Triglochin maritimum* (Cayouette & Darbyshire 1993).

In Norway the species occurs as uniform stands on saltmarshes fed by river water and as tussocks at the back of coarse sandy beaches. It also occurs among *Puccinellia* dominated saltmarsh communities where *Puccinellia phryganodes*, *P. retroflexa*, *Triglochin maritimum*, *Plantago maritima*, *Aster tripolium*, *Agrostis stolonifera*, *Argentina egedii* agg. and *Stellaria humifusa* are associates (Nordhagen 1954; Fremstad 1997).

ORIGIN AND ESTABLISHMENT

The flora of any area is a dynamic entity with both losses and gains occurring over time due to stochastic effects (random or chance events) and changes mediated through biotic (the living components of the environment) and abiotic (the non-living components) factors. Nevertheless, it is tempting to speculate on both the origin of *C. salina* in Scotland and the reasons for its colonisation.

C. salina has evolved following hybridisation between two other members of *Carex* section *Phacocystis*, *C. paleacea* and *C. subspathacea* (Cayouette & Morisset 1985, 1986a, 1986b; Standley 1990). This mode of speciation is common in this group of sedges.

For instance, *C. recta* is a product of a cross between *C. paleacea* and *C. aquatilis* Wahlenb. (Cayouette & Morisset 1985, 1986a, 1986b; Standley 1990) while *C. vacillans* is the result of a cross between *C. paleacea* and *C. nigra* (L.) Reichard (Chater in Tutin *et al.* 1980; Cayouette & Catling 1992). Almost all the species above (*C. salina*, *C. recta*, *C. vacillans*, *C. paleacea* and *C. subspathacea*) inhabit saline and brackish seashore and estuarine habitats with the other two species, *C. aquatilis* and *C. nigra*, sometimes found on upper saltmarshes. The close proximity of the various species allows hybridisation to occur. This then provides an evolutionary mechanism through which the niches available in these open, dynamic, recently disturbed and glaciated areas can be exploited. These are of course classic conditions for hybrid speciation and establishment (Grant 1981).

With this mode of speciation it is possible that *C. salina* has evolved in situ. However, this seems distinctly improbable as neither of the parental species has been recorded from the British Isles. The absence of *C. subspathacea* from the British flora might be artificial, remaining undetected due to a combination of geographic isolation, unprepossessing habitat and predominantly very low-growing vegetative habit. By comparison, *C. paleacea* is highly unlikely to have escaped discovery, being a large, distinctive sedge occurring in single species stands on the strandline, although the presence of *C. recta* in Scotland, may mean that *C. paleacea* was part of the British flora in the past.

In general maritime habitats provide open niches that may be colonised by the limited number of species adapted to such harsh environments. Some species are able to rapidly exploit these niches and become widespread, for example *Spartina anglica* which has spread by natural colonisation and planting from its origin in about 1890 to cover a large part of the English and Welsh coastline (Leach 2002). *C. salina* may have been present on the west coast of Scotland for a long time especially as the species is very hard to detect, particularly when not growing in pure stands, a result of the inflorescence being markedly shorter than the vegetative shoots. However, the saltmarshes of western Scotland were extensively surveyed by Adam between 1972 and 1975 when neither *C. salina* nor either of its parental species were recorded (Adam 1978, 1981). The implication

therefore is that *C. salina* has become established at Morvich following long-distance dispersal from Scandinavia or North America, possibly during the last thirty years. The Scottish location is probably the first area in the world where *C. salina* is apparently growing outside the ranges of both parental species.

Little is known of the dispersal ability of saltmarsh species, although the wide distribution of many saltmarsh species suggests that they are relatively easily dispersed (Adam 1990). It is possible that *C. salina* has spread through seed or rhizome via the sea. Praeger (1913) noted a high proportion of sedges with buoyant seeds, while Leck & Schutz (2005) list adaptations such as inflated utricles, corky pericarp and pericarps with air cells which enable the utricle to remain buoyant. Some dispersal of patches of vegetation by ice movement are common along the St Lawrence River, and parts of populations of *C. salina* and other rhizomatous species are moved locally (Cayouette & Morisset 1985). It is also possible that seeds or vegetative material could be transported by birds. Mueller & van der Valk (2002), in a study of wetland seed dispersal, found viable seed of *Carex* species in duck faeces. Migration routes of mallard (*Anas platyrhynchos*), for example, include Scandinavia to Scotland (Wernham *et al.* 2002). Due to the short retention time of seeds within the gut of waterbirds most seeds are expected to be ejected on route (Clausen *et al.* 2002) but Figuerola & Green (2002) consider that long-distance dispersal by endozoochory (internal dispersal of seeds) can occur. Epizoochory (dispersal of seeds externally attached to feathers, bills or feet) is also possible although there are no studies with precise data on distances and movements of birds (Figuerola & Green 2002). It is also possible that some plant material could be transported by boats, possibly in ballast, at least for part of the journey, with currents and tides doing the rest.

Assuming propagules of *C. salina* have been continually dispersed since the species' origin it is interesting to consider why the plant has possibly become established only recently. Saltmarshes are dynamic habitats and it is possible that postglacial isostatic rise may have facilitated sufficient change to allow *C. salina* to become established, although this may be offset by eustatic (worldwide) sea level

increases in the near future. Perhaps more likely candidates as agents of saltmarsh change are the climatic factors beginning to influence the British Isles. Western Scotland is experiencing increasing extremes of rainfall with longer and heavier spells of precipitation occurring more frequently (Fowler & Kilsby 2003) along with generally stormier winters and calmer summers (Lozano *et al.* 2004). It is possible that these conditions cause disruption to the habitat akin to the effect of annual ice movement in Canada, which has allowed *C. salina* to become established.

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APPENDIX 1. SALTMARSHES SURVEYED ALONG THE WEST COAST OF SCOTLAND IN 2006

Saltmarshes	10 km square	1 km square(s)	v.c.
<i>Carex salina</i> present			
Morvich, eastern head of Loch Duich	NG92	NG9520, NG9521	105
<i>Carex salina</i> not found			
Nostie, Loch Duich	NG82	NG8526	105
Ardelve, Loch Duich	NG82	NG8726	105
Slumbay, Loch Carron	NG83	NG8939	105
Loch Kishorn	NG84	NG8341	105
Head of Loch Torridon	NG85	NG8854, NG8954, NG8955	105
Shiel Bridge, southern head of Loch Duich	NG91	NG9318, NG9319	105
Head of Loch Long	NG93	NG9230	105
Head of Loch Carron	NG94	NG9241	105
Head of Loch Craignish	NM80	NM8205	98
Head of Loch Melfort	NM81	NM8412	98
Kilninver	NM82	NM8222	98
Dunstaffnage	NM83	NM8733, NM8833	98
An Seilan	NM83	NM8939	98
Balure of Shian	NM94	NM9041	98
Portnacraish	NM94	NM9246	98
Dalrannoch	NM94	NM9340, NM9341	98
Head of Loch Creran	NN04	NN0044, NN0045	98

Conservation of Britain's biodiversity: *Hieracium pseudoleyi* (Asteraceae), Purple-flushed Hawkweed

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ABSTRACT

Reviews of historical data were combined with field surveys to assess the status of *H. pseudoleyi*, Purple-flushed Hawkweed, a rare endemic of North Wales. It has been recorded historically in three sites, and there are doubtful or erroneous records from four sites. In 2006, 798 plants were found on the Great Orme and 53 plants on the Little Orme. It was not re-found at Pydew. It occurs on limestone rocks and in crevices in open vegetation. Under the I.U.C.N. (2001) threat criteria it is probably best regarded as "Vulnerable".

KEYWORDS: endemic, I.U.C.N. Threat Criteria, Wales.

INTRODUCTION

Hieracium pseudoleyi, Purple-flushed Hawkweed, is a rare endemic plant confined to North Wales. Although it is a Red Data Book species (Wigginton 1999), relatively little is known about it. As part of a project into conservation of Welsh plants, historic data has been combined with field surveys to assess its needs for conservation and to provide an I.U.C.N. Threat Category as required under the Global Plant Conservation Strategy (Secretariat for the Conservation of Biodiversity 2002). In this paper the data are summarised; full details are given in Sawtschuk (2006), updated with additional field work in 2007.

The history of *H. pseudoleyi* is somewhat confusing as it has been named twice independently. It was collected regularly from the Great Orme from the 1890s onwards, initially under the name *H. caesium* Fries which was broadly interpreted at the time. Linton (1905) noted that some plants from the Great Orme and West Yorkshire differed from *H. caesium* in having leaves more attenuated below and densely glandular involucre bracts, and described it as a new variety, var. *decolor* W. R. Linton, also noting that the Great Orme plant had leaves fringed with strong hairs. Specimens were sent by Linton to the Scandinavian expert Dahlstedt, who commented "not *H. caesium* Fries ..." so Ley (1909) raised Linton's variety to species rank as *H. decolor* Ley, and it was recorded under that name for many years. However, the Yorkshire and Great Orme plants recorded under this name are now regarded as different species, and as *H. decolor* is typified on Yorkshire material, the name *H. decolor* is no longer applicable to the Great Orme taxon. The current name *H. pseudoleyi* is a new combination by Roffey (1925) of the name coined by Zahn (1921) for material distributed as cultivated *H. leyi* in the Set of British Hieracia no. 128 from Ysgolion Duon. Material distributed with this set is composed of both *H. leyi* F. Hanb. (wild plants, mostly collected by

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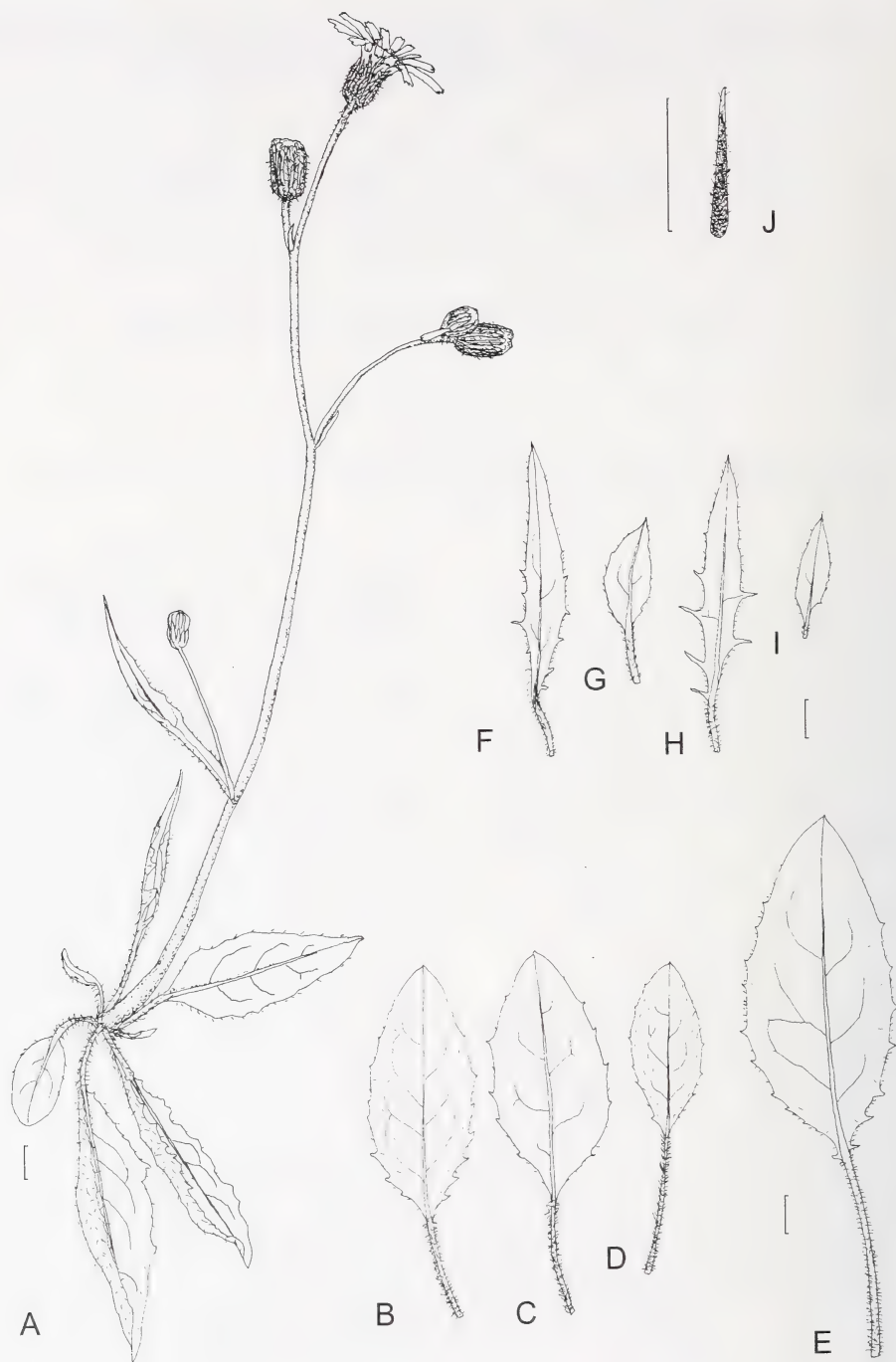


FIGURE 1. *Hieracium pseudoleyi* (del. T. Rich). A, Whole plant. B-E, Outer rosette leaves, upper surfaces. F-I, Stem leaves. J, Involucral bract. Scale bars 1 cm.

A. Ley or W. R. and E. F. Linton) and *H. pseudoleyi* (cultivated plants, grown by E. F. Linton), the latter being cited as types by Zahn. It is not clear if *H. pseudoleyi* has ever occurred at Ysgolion Duon or whether this was a result of confusion of labels on specimens; irrespective of their origin, they are the types (Sell & Murrell 2006).

Hieracium pseudoleyi is now included in section *Stelligera* Zahn by Sell & Murrell (2006). It has previously been included in section *Vulgata* (Griseb.) Willk. & Lange and section *Oreadea* (Fries) Dahlst. (Linton 1905; Ley 1909; Pugsley 1948; Sell & West 1968).

Summary of synonymy:

Hieracium pseudoleyi (Zahn) Roffey in F. Hanb., *Lond. Cat. Brit. Pl.*, ed. 11, 26 (1925).

=*H. caesium* Fries var. *decolor* W. R. Linton, *Brit. Hier.* 59 (1905) *pro parte*.

=*H. decolor* Ley, in *J. Bot.* 47: 10 (1909), and *auct.*

=*H. saxifragum* Fries subsp. *pseudoleyi* Zahn in Engl., *Pflanzenreich* IV, 280 (Heft 75): 251 (1921); basionym. Type *H. leyi* (f. cult.) Set of British Hieracia no. 128 *pro parte*. Ystolion [sic] Duon.

=*H. smithii* (Baker) Druce, *List Brit. Pl.*, ed. 2, 67 (1928), *pro parte*?

Hieracium pseudoleyi is illustrated in Figure 1, and a full description is given by Sell & Murrell (2006). Key identification features are the basal rosette of narrow, purple-flushed, weakly glaucous leaves typically with the margins up-curved, the outer rosette leaves oblong-lanceolate, toothed to sharply toothed and cuneate at the base, the usually solitary stem leaf, the forking inflorescence with 1–6 medium-sized heads, the dense stellate hairs on the involucre bracts and yellow styles (Pugsley 1948). It is quite variable, probably related to the environment; robust plants to 35–40 cm with strongly toothed leaves in sheltered places contrast with smaller plants to 15 cm with few, sparsely toothed leaves on windswept crags.

Other glaucous-leaved species which may grow with it are *H. cambricum* (Baker) F. Hanb. which has deeply lacinate rosette leaves, *H. holophyllum* W. R. Linton which has much broader, ovate-lanceolate basal leaves, and *H. britannicoides* P. D. Sell which has sparse stellate hairs on the involucre bracts. *Hieracium vagense* (F. Hanb.) Ley is very similar and also grows in the area but has not yet been found growing with *H. pseudoleyi*; it has sparse stellate hairs on the involucre bracts and usually lacinate leaves.

METHODS

Historical data were compiled from herbaria (mainly BM, CGE and NMW, with some records from BIRM, LIV and MANCH), the literature and correspondence with local botanists.

Field surveys were carried out mainly in 2006 using the historical records to target areas to search. As *H. pseudoleyi* occurs on carboniferous limestone cliffs and quarries, it was searched for by walking along the tops and bottoms of the cliffs, and by using binoculars. Reasons for possible loss of populations and threats to extant populations were assessed in the field. Voucher specimens and photographs are deposited in NMW.

Associated species were recorded in estimated 2 × 2 m quadrats around the species. Soil pH was measured with a pHep2 Hanna pocket-sized pH meter in a 50:50 mixture with distilled water on soil samples collected from around the roots.

RESULTS

DISTRIBUTION

The historic records traced are listed in Appendix 1, which show *H. pseudoleyi* has been recorded in three sites, and there are doubtful records for four sites. These records were used to direct the field surveys in 2006; all sites were visited with the exception of Ysgolion Duon.



FIGURE 2. Distribution of *Hieracium pseudoleyi*. ■, 2006. □, pre-2006. X, doubtful or error.

GREAT ORME (SH78; V.C. 49)

There are many records of *H. pseudoleyi* from the southwest, south and southeast sides of the Great Orme over approximately 4 km of slope cut by numerous cliffs at different levels. Indeed W. McCarthy has reported seeing many plants in these areas during the last 20 years.

Surveys were carried out by in June 2006 by W. McCarthy and J. Sawtschuk. All 10 precisely localised historic records were refound, with many new subpopulations. Although the whole population could be regarded as one large site, it can be conveniently broken down into six main subpopulations.

The first subpopulation occurred on southwest facing cliffs to the south of Great Ormes Head above and below the marine drive at Gogarth. A total of 114 plants were counted, and there were no obvious threats other than over-grazing by goats.

The second subpopulation occurred on cliffs from the east of Gogarth to the west of Pen-y-ffridd farm and near the old copper mine. At least 145 plants occur with *H. britannicoides* and another species. Again there were no obvious threats other than over-grazing by goats.

The third subpopulation occurred on the cliffs above Cwlach east of Pen-y-ffridd Farm. The 51 plants counted are potentially threatened by scrub expansion.

The fourth subpopulation occurs on the rocks from the West Toll Gate Lodge to Haulfre Gardens above Llandudno. A total of 132 plants occurred on rocks and path sides where there is significant encroachment of vegetation and scrub. Some areas have already been cleared for conservation of other grassland species such as *Hypochaeris maculata*, which has benefited *H. pseudoleyi* too.

The fifth subpopulation occurred on cliffs above Ty-Gwyn Road and Wyddfyd Road. 171 plants were counted, mostly on inaccessible cliffs where it is not threatened.

The final subpopulation of 185 plants occurred on rocks and cliff above Happy Valley. This site is not threatened.

Thus at least 798 plants have been recorded across most of the south side of the Great Orme. Given the difficulty of covering such a large area of cliffs and rocks thoroughly, this is clearly a conservative estimate.

LITTLE ORME (SH8182; V.C. 49)

Hieracium pseudoleyi was first found on the Little Orme in May 1953 by V. Gordon, and was refound by W. McCarthy in 2002.

Three sub-populations of *H. pseudoleyi* were found on 8 June 2006 by W. McCarthy and J. Sawtschuk. A total of 35 plants occurred in a small, amphitheatre-shaped cliff with *H. holophyllum*, and another five plants occurred in a second amphitheatre 100 m to the north. Six plants occurred on a small, northwest facing cliff, above a bigger cliff above the sea. Thus at least 53 plants occur.

There are no obvious threats to this site as the plants are mostly on low cliffs inaccessible to sheep, though there is a longer term potential for expansion of scrub on some of the more sheltered cliffs.

PYDEW (SH8179; V.C. 49)

J. M. Brummitt collected plants on limestone pavement at Pydew on 27 June 1969 at SH816797. The site is now a nature reserve.

On 8 June 2006 W. McCarthy and J. Sawtschuk searched the site, but found only two other *Hieracium* species. Although the site is difficult to search thoroughly and *H. pseudoleyi* could still be present, the amount of scrub has increased significantly during the last 30 years, and it may have been shaded out. Some areas have been opened up recently, but it has not yet been refound.

DOUBTFUL OR ERRONEOUS RECORDS

The cultivated type specimens from Ysgolion Duon (SH66; v.c. 49) may be the result of confused labelling (Sell & Murrell 2006), and some records are errors for *H. leyi*. *Hieracium pseudoleyi* has not been refound there amongst the many other *Hieracium* species collected during many visits.

A specimen collected in a slate quarry in April 1968 by W. E. Hughes at Llanllechid (c. SH6268; v.c. 49) has been ascribed to *H. pseudoleyi* (Sell & Murrell 1968). The area was surveyed on 10 June 2006 by J. Sawtschuk. Two plants similar to *H. pseudoleyi* and the Hughes material were found at SH62846770 but differed in having too many stem leaves. Re-examination of the Hughes herbarium specimen suggests it is not *H. pseudoleyi*. *Hieracium carneddorum* Pugsley occurs in other quarries.

Some material from Gloddaeth (SH88; v.c. 49) collected by A. Ley on the 19 June 1901 has been named *H. pseudoleyi* but is *H. vagense*.

Material collected by A. Ley at World's End, Eglwyseg (SH78; v.c. 50) on 16 July 1903 has been treated as *H. pseudoleyi* (Sell & Murrell 1968). The material is very similar to *H. pseudoleyi* in many respects but differs in

having discoloured styles and involucre bracts with sparse to medium stellate hairs and few, short glandular hairs. There are about 40 plants at World's End, and whilst obviously closely related to *H. pseudoleyi* these would be best treated as a separate taxon.

ECOLOGY

Hieracium pseudoleyi, like other British *Hieracium* species, is a polycarpic perennial, and is probably apomictic. Its chromosome number is not known. Flowering often begins in April (or exceptionally in 2007 in March), which is early for *Hieracium* in Britain, continuing into June and possibly July depending on the weather. About 46% of the plants were flowering in 2006. Seeds are wind-dispersed. Its populations are probably somewhat dynamic and it spreads readily from seeds.

Hieracium pseudoleyi typically occurred on steep to vertical slopes (40–90°) on west, south and east facing slopes, in short (up to 40 cm tall), open vegetation with cover 5–50% associated with *Dactylis glomerata* L., *Festuca ovina* L., *Helianthemum canum* (L.) Hornem., *Lotus corniculatus* L., *Sanguisorba minor* Scop., *Scabiosa columbaria* L., *Sonchus oleraceus* L., *Teucrium scorodonia* L., *Thymus polytrichus* A. Kern ex Borbás, and sometimes other *Hieracium* species. It occurred in a range of calcicolous vegetation types from upper maritime cliffs communities to droughted calcicolous grasslands, which mainly were in terms of British Plant Communities (Rodwell 1992, 2000) CG1 *Festuca ovina* – *Carlina vulgaris* grassland, MC4 *Brassica oleracea* maritime cliff-edge vegetation and the OV39 *Asplenium trichomanes* – *A. ruta-muraria* community, but the presence of a rocky, open limestone habitat seems more important than the community and associated species per se.

Plants were rooted directly into crevices in the limestone rocks, or into shallow soil pockets.

Two soil samples collected from around the roots had pH values of 7.0 and 7.4.

DISCUSSION

A total of 851 plants of *H. pseudoleyi* were recorded in 2006 and 2007 in one large population scattered across the south side of the Great Orme and in a small population on the Little Orme. It was not refound at Pydew, which may have been a transient, wind-blown colonist from the large population at the Great Orme. These sites are difficult to search thoroughly, and the population estimates are conservative.

Under the IUCN (2001) threat criteria, *H. pseudoleyi* is probably best categorised as “Vulnerable”. However, the large, widespread population on the Great Orme (virtually all within the Great Orme's Head SSSI) and the second population on the Little Orme (also an SSSI) without any obvious current threats suggest that *H. pseudoleyi* is actually not very threatened in the short term. Longer term, the main threats are potentially over-grazing, scrub invasion or spread of alien species such as *Cotoneaster*. We suggest that monitoring the populations every 10 years would be adequate to keep a watching eye on its populations.

Seeds from different sites were sent to the Millennium Seed Bank, and it is planned to cultivate the material at the Great Orme Visitor Centre.

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(Accepted September 2007)

APPENDIX 1 – DETAILS OF *HIERACIUM PSEUDOLEYI* RECORDS TRACED

V.C. 49 CAERNARFON

Great Orme. Near old copper mines, July 1891, J. E. Griffith (**BIRM, BM, CGE, LIV, NMW**). 31 May, 18 and 28 August 1892, J. A. Wheldon (**NMW**). 1896, A. Ley (**CGE**). July 1900, G. C. Druce (**BM**). 20 June 1901, A. Ley (**BM, LIV, NMW, CGE**; Set of British *Hieracia* no. 179). South side, 21 and 22 June 1901, A. Ley (**CGE**). July 1901, H. J. Riddelsdell (**BM**). 4 September 1902, H. W. Pugsley (**BM**). 9 July 1904, A. Ley (**BM, CGE**). Small quarry near Gogarth Abbey, 15 May 1905, A. O. Hume (**BM**). Cliffs above Gogarth Abbey end of Marine Drive, 25 May 1905, A. O. Hume (**NMW**). SW corner, higher cliffs, 27 May 1905, A. O. Hume (**BM**). Quarry adjoining Happy Valley, 29 May 1905, A. O. Hume (**LIV**). 26 July 1905, H. W. Pugsley (**BM**). Rocks, 19 June 1908 and 2 October, T. J. Foggitt (**BM**). 26 June 1910 and 21 July 1911, J. W. Ellis (**LIV**). September 1910, N. D. Simpson (**BM**). 2 July 1912, W. A. Shoolbred (**NMW, CGE**). 2 July 1912, S. H. Bickham (**CGE**). Shaded limestone quarry and shaded gully, 2 July 1912, Linton, Marshall (**BM, CGE**). Exposed cliffs, west side, 9 July 1912, W. A. Shoolbred & E. S. Marshall (**BM, CGE, NMW**). Cottage, stony patch, 1918, S. H. Bickham, flowered in cultivation 5 August 1919 Ledbury (**BM, NMW, CGE**). 31 July 1922, H. W. Pugsley (**BM**). 31 July 1936, H. S. Redgrove (**BM**). Above Haulfre Gardens, 10 July 1942, H. W. Pugsley (**BM**). Quarry on landward side, June and 13 July 1948, K. G. Payne (**CGE**). Southwest side, 26 June 1952, P. D. Sell (**CGE**). June 1953, C. West (**CGE**). Limestone cliff, Marine Drive, 26 June 1953 and wall at Craigsidde Hydro, 25 June 1955, C. A. E. Andrews (**BIRM**). SH7683, 25 September 1954, V. Gordon (**NMW**). 28 July 1955, F. R. Browning (**BM**). Roadside cliffs, SH760832, 24 June 1961, J. N. Mills (**MANCH**). 8 June 1964, U. K. Duncan & E. P. Beattie (**BM**). 11 September 1977, B. R. W. Fowler (**BIRM**). SH755835, limestone rocks at 130 m, 24 July 1977, R. J. Pankhurst (**BM**). Rocks above Haulfre, SH774824, 2000, W. McCarthy (herb. McCosh). Cliffs above Ty-Gwyn Road, SH775829, cliffs above West Shore toll house, SH768823, cliffs at top of zigzag path on Invalids Walk, SH772824 W. McCarthy.

Little Orme (SH8182). 25 May 1953, V. Gordon (**NMW**). SH813823, 2002, W. McCarthy.

Pydew (SH8179). SH816797, 27 June 1969, J. M. Brummitt, thin soil in pockets of limestone pavements (**NMW, CGE**).

DOUBTFUL OR ERRONEOUS RECORDS

Llanllechid (v.c. 49). Slate quarry near, April 1968, W. E. Hughes (**NMW**).

Carnedd Dafydd/Ysgolion Duon (v.c. 49). Carnedd Dafydd, 29 Jul 1892, W. R. Linton (**NMW**). Ysgolion Duon, July 1893, J. E. Griffith (**NMW**); both probably *H. leyi*.

Gloddaeth. 19 June 1901, A. Ley (**CGE**; redetermined T. Rich 2007).

Eglwyseg (v.c. 50). Bluff next north of the church; World's End, 16 July 1903, A. Ley (**CGE**; redetermined T. Rich 2007).

CULTIVATED

Ysgolion Duon, cultivated 23–28 June 1896, 1898 & 1899, E. F. Linton (Syntypes. Set of British *Hieracia* no. 128. **BM, CGE, NMW**, and no doubt elsewhere too).

Great Orme, 8 June 1908, A. Ley. Great Ormes Head, August 1915, S. H. Bickham cultivated at Ledbury (**NMW, CGE**). Great Ormes Head, 16 September 1925, origin 1922 H. W. Pugsley (**CGE**).

Notes

EPILOBIUM TETRAGONUM SUBSP. *TOURNEFORTII* NATURALISED IN BRITAIN

In the context of the British flora, issues regarding the infraspecific treatment of *Epilobium tetragonum* (Square-stalked willowherb) centre on whether the segregate *Epilobium lamyi* F. W. Schultz should be treated as a separate species, a subspecies or not afforded any distinct rank. There is, however, a further segregate within *E. tetragonum* which, until 2007, had apparently not been recorded in the British Isles, namely the large-flowered *Epilobium tetragonum* subsp. *tournefortii* (Michalet) Léveillé.

This subspecies has a Mediterranean distribution, being known in southern Portugal, Spain and France; also Sicily, Corsica, Sardinia and Malta. In Africa it ranges from Tangier to Tunisia; and in the east, it is found in Turkey, ranging to eastern Anatolia, Syria and Lebanon (Raven 1967).

On 6 August 2007, an unusual willowherb was found by A.C.L. (in the company of A. Stevenson) growing in quantity along the banks of the A505 Royston by-pass in Cambridgeshire, v.c. 29, approximately at TL364421. A further visit undertaken by G.D.K. and A.C.L. on 12 August 2007 confirmed the identity of the plant as *Epilobium tetragonum* subsp. *tournefortii*. Voucher material has been placed in **CGE** and **herb. G.D.K.**

The find location (site 1) was a steep south-west facing chalk slope, up to 7 m high, and on the northeast side of the bypass. Erosion maintained a semi-open habitat which provided opportunities for *Epilobium* seedling establishment, although occasional plants were to be found in the coarser grassland at the foot of the slope. The flora of the slope otherwise consisted of native calcicoles, with some neophytes or introductions, none of which suggested any particular association with introduction of the *Epilobium* – viz. *Sedum rupestre* L., *Centranthus ruber* (L.) D.C. and *Conyza sumatrensis* (Retz.) E. Walker. There were hybrids between the latter and *Erigeron acer* L., of which an account is to be published separately. The colony of *Epilobium tetragonum* subsp. *tournefortii* extended from TL36594196 to TL36394213 alongside the carriageway, with the main grouping concentrated within 45 m of that length. The population appeared well established, with

several thousand plants present. A small scattering of plants was also present on the opposite side of the carriageway.

Further investigation by ACL later on 12 August revealed the existence of a further population by the A505, approximately 1 km to the northwest of site 1, and located on a similar southwest facing bank alongside a layby (site 2). At least a thousand plants were present.

Because of the size of the rose-purple flowers, 2.0–2.5 cm in diameter, their appearance was quite distinctive. The impression given was of numerous *Epilobium hirsutum* flowers borne by robust *E. tetragonum* plants; but the taxon was readily distinguishable from *E. hirsutum* × *tetragonum* by a number of factors. The stem hairs were short and appressed, as with *E. tetragonum* subsp. *tetragonum*, whereas the hybrid carries some glandular hairs as well as long hairs influenced by *E. hirsutum*, which are upwardly deflexed (and so intermediate between the spreading hairs of *E. hirsutum* and the closely appressed hairs of the other parent). The hybrid carries a confused stigma, intermediate between 4-lobed and clavate stigma types, whereas *Epilobium tetragonum* subsp. *tournefortii* bears a clavate stigma. The hybrid also occurs as single plants, potentially with variable characteristics between the parents, and with reduced fertility; the Royston populations, however, were fully fertile and, except for one plant mentioned below, uniform.

Various authors have remarked on distinguishing features of subsp. *tournefortii*, summarized in Table 1.

The key in *Flora Europaea* (Raven 1968) describes petals as 7.0–11.5 mm long (in contrast to other *E. tetragonum* subspecies recognized, which carry petals 2.5–7.0 mm long), with the stigma elevated above the anthers at anthesis. Flower length for subsp. *tournefortii* has also been described by Raven (1962) as 8–13 mm. None of the authorities cited in Table 1 attributes a measure greater than 8.5 mm for the petal length of the remainder of *E. tetragonum*. Petals from the Royston populations measured 11–13 mm; flowers were held horizontally at anthesis, with the stigma clearly projecting beyond the anthers.

Nieto Feliner (1996) considered that anther

TABLE 1. TAXONOMIC COMPARISON

	Flower/petal length	Anther length	Seed length
<i>E. tetragonum</i> subsp. <i>tournefortii</i>			
Raven (1962)	Flowers 8.0–13 mm		
Raven (1968)	Petals 7.0–11.5 mm		
Smejkal (1995)		(1.9)2.0–2.3(2.4) mm	
Nieto Feliner (1996, 1997)	Petals 6–11 mm	(1.3)1.5–2.4(2.7) mm	(1)1.1–1.3 mm
Remaining segregates of <i>E. tetragonum</i> , including <i>E. lamyi</i>			
Raven (1968)	Petals 2.5–7.0 mm		
Smejkal (1995, 1997)	Petals 4–8(8.5) mm	(0.8)0.9–1.1 mm	1.0–1.2(1.3) mm
Nieto Feliner (1996, 1997)	Petals 3–5.5(6.5) mm	0.7–1.1(1.3) mm	0.8–1(1.1) mm
Oredsson & Snogerup (1976)	Petals (4.5)5.0–8.0 mm	0.7–1.0 mm	(0.85)1.0–1.1 mm
Royston plants			
	Petals 11–13 mm	(1.5–)1.7–2.2 mm	1.1–1.3 mm

length was significant, with subsp. *tournefortii* measuring (1.3)1.5–2.4(2.7) mm, as distinct from 0.7–1.1(1.3) mm for the remainder of *E. tetragonum*. Measurements for the Royston populations are (1.5–)1.7–2.2 mm, well within the range of subsp. *tournefortii*. The distinction in anther length is also one made by Smejkal (1995), although the figures used by him for subsp. *tournefortii* are (1.9)2.0–2.3(2.4) mm, and for the remainder of *E. tetragonum* (0.8)0.9–1.1 mm.

Nieto Feliner (1996) also commented on the longer seeds of subsp. *tournefortii* (1.1–1.3 mm), and those of the Royston populations replicate this range. His account in *Flora Iberica* (Nieto Feliner 1997) recognises a slightly wider range – (1)1.1–1.3 mm. The seeds of British *E. tetragonum* do not normally exceed 1.1 mm (observations by G.D.K.), and this is in accordance with data from some regions where subsp. *tournefortii* is not present, e.g. (0.85)1.0–1.1 mm in Scandinavia including the segregate *E. lamyi* (Oredsson & Snogerup 1976), although Smejkal (1997) identified a range of 1.0–1.2(1.3) mm from the Czech Republic.

The characteristics of subsp. *tournefortii* as regards flower and anther size and the relative position of stigma and anthers are indicative of a taxon which is out-crossing, as distinct from the remainder of *E. tetragonum* (and, indeed, most species of *Epilobium*), which is commonly self-pollinated. Raven (1967, 1968) remarked on the existence of intermediates between subsp. *tournefortii* and subsp. *tetragonum* and their complete interfertility. The Royston population at site 1 appeared

uniform. Some plants of *E. tetragonum* subsp. *tetragonum* were noted on the margins of the population of subsp. *tournefortii* but there were no indications of interbreeding or intermediacy. At site 2, however, where subsp. *tetragonum* was also present, one plant was noted with characteristics bearing a degree of intermediacy: flower diameter was 15 mm, petal length 9.5 mm, anther length 1.0–1.2 mm and seed length 0.7–1.1 mm; some of the smaller seeds appeared to be flattened and empty and perhaps indicate some reduced fertility. The data for this specimen are not included in the general measurements given above for the Royston populations.

Vigorous *E. tetragonum* subsp. *tetragonum* often takes a bushy form, with strong flower production resulting in a massed appearance of long upright capsules. It does not often exceed 80 cm in height, although it may occasionally reach 110 cm. The Royston plants appeared less bushy, more robust, and regularly exceeded 110 cm, the tallest specimen being measured at 123 cm.

There is no evidence of the basis of introduction of this taxon to Royston, although the original seeding of the roadbanks or carriage by vehicles both constitute possibilities. Spread has evidently occurred to a degree, but the appearance of *E. tetragonum* subsp. *tournefortii* in the British Isles at present comprises an isolated record without suggestion of invasiveness, although affording evidence that this Mediterranean taxon is capable of establishing in the British Isles and thriving.

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NEW WILLOW HYBRID

Salix × *permixta* J. Webb hybrid. nov*S. caprea* L. × *S. cinerea* L. × *S. repens* L.

Type : British Isles, North Devon (v.c. 4), Branton Burrows, SS4629234468, 27 August 2007, J. Webb 001 (TTNCM: Taunton County Museum Herbarium).

Frutex multiramis tholiformis, circiter 1–1.5 m altus, e surculis subterraneis exoriens; rami numerosi, ascendentes, teretes, primo dense appresso-pubescentes, in maturitate glabri vel subglabri, saturate brunnei, decorticati obscure et sparsissime striatuli; folia late ovata, acuta vel obtusa, breviter apiculata, 2.5–4 × 1.3–2.8 cm, brevissime petiolata, lamina supra saturate viridi sparsissime puberula, subtus pallide grisea dense et appresse sericeo-tomentella, nervis prominentibus ascendentibus conspicue ornata, marginibus subintegris vel remote serrulatis; stipulae plerumque minutae, subintegrae vel obscure glanduloso-serrulatae. Amenta foeminea (masculina non visa) praecocia vel cum foliis juvenilibus evoluta, cylindrica, subsessilia vel breviter pedunculata, suberecta, primo probabiliter 2.5 cm longa, in maturitate usque ad 6 × 1.3 cm, bracteis basalibus ovatis 0.5 cm longis, dense sericeo-pilosis, amentorum bracteolae ovatae, obtusae, 3 × 1.2 mm, subfuscae, pilis sericeis conspicuis vestitae; ovarium attenuato-ovoideum, usque ad 3–5 × 1.3–2 mm, in maturitate breviter

stipitatum, viride, indumento sericeo subsparsim vestitum; stylus brevis, vix 0.5 mm longus; stigmata 2, parva, obtusa, indivisa. Semina matura non visa.

British Isles, N. Devon, (v.c. 4) Branton Burrows.

All specimens in Taunton County Museum Herbarium (TTNCM)

001: 27/08/07 002: 17/06/04 003: 04/05/07

Shrub, about 1–1.5 metres high, arising from suckers and forming a much branched dome-shaped bush; branches numerous, ascending, terete, at first densely appressed-pubescent, later glabrous or almost glabrous, dark brown, when the bark is removed obscurely and very sparsely striatulate; leaves broadly ovate, acute or obtuse, shortly apiculate, 2.5–4 × 1.3–2.8 cm, very shortly petiolate, with lamina dark green above, very sparsely puberulous, pale grey below, densely appressed-silky-tomentellous, with nerves prominent, ascending, and margins subentire or remotely serrulate; stipules generally very small, subentire or obscurely glandular-serrulate. Female catkins (males not known) precocious or developing with the young leaves, cylindrical, subsessile or shortly pedunculate, suberect, at first probably 2.5 cm long, at maturity up to 6 × 1.3 cm, with basal bracts ovate, 0.5 cm long, densely sericeous-pilose;



FIGURE 1. *Salix* $\times$ *permixta*. A: leaves $\times 1$; B $\times 3$; C: underside of leaf $\times 1$; D: leaf base $\times 2$.

catkin-scales (bracteoles) ovate-obtuse, 3×1.2 mm, darkish, clothed with conspicuous silky hairs; ovary attenuate-ovoid, up to $3-5 \times 1.3-2$ mm, at maturity shortly stalked, green, rather sparsely clothed with silky hairs; style short, scarcely 0.5 mm long; stigmas 2, small, obtuse, not divided. Mature seeds not seen.

NOTES

This willow was first seen on 5 June 2004 in a clearing of the wet-slack habitat that borders the dune system of Branton Burrows. The 970

hectares of Branton Burrows, and the surrounding coastline, have been declared a UNESCO Biosphere Reserve.

On the eastward margins of the dune system *Salix repens* carpets the sandy slacks with tall scrub and small trees forming small woodland glades. *S. cinerea* (presumably subsp. *oleifolia*) is not uncommon in the area but pure *S. caprea* is rather rare, as is *S. aurita*. Where *S. caprea* and *S. cinerea* co-exist, the hybrid between the two species, *S. $\times$ reichardtii*, is common and a whole range of intermediates is found. Whilst in one such area, Hog Wood, to the south of Sandy Lane car park, we came across a patch

of willow we could not immediately identify. The upright stems were relatively polished and glabrous, the leaves were broadly ovate with the underside distinctly softly pubescent and demonstrating the reticulate venation of *S. caprea*. Although *S. aurita* had been found nearby, the stipules of the unidentified plant were small, not at all resembling the large conspicuous stipules of the hybrid between *S. repens* and *S. aurita*, nor were the leaves in any way rugose which one would expect in an *aurita* hybrid. We were certain it was not a hybrid between *S. caprea* and *S. repens*, *S. × laschiana*, as at no stage had it the dense indumentum of *S. caprea* and if it was a direct hybrid the leaf margins would have been undulate serrate rather than relatively entire. The hybrid between *S. cinerea* and *S. repens*, *S. × subsericea*, was ruled out as its leaves are much narrower and more oblong.

S. repens was abundant all over the clearing, which covered an area approximately 75 m × 75 m, and there was a very large conspicuous bush or small tree of *S. caprea* × *S. cinerea*

(*Salix × reichardtii*) in the immediate background. We have come to the conclusion that we have identified a new triple hybrid (Webb 2005.)

A visit early the following year (2005) found that the clearing had been cut during management works to clear scrub, this prevented catkins forming so our information was incomplete. Subsequent discussion with the site manager prevented this happening again and catkins were collected in 2006 and 2007 and we are thus able to confirm the identification of the triple hybrid.

Five separate bushes of the new willow have been found, but all in the same area. It is hoped to engage the active interest and co-operation of the landowner in order to conserve the single location. However, a number of cuttings have been taken and new plants grown; these have been planted in the Community Orchard, Old Cleeve, beside a natural pond where we hope they will thrive.

This report has been prepared in consultation with R. D. Meikle.

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CHROMOSOME NUMBERS IN *SORBUS* L. (ROSACEAE) IN THE BRITISH ISLES

In the British Isles, the genus *Sorbus* L. is composed of four sexual diploid species and at least 19 apomictic polyploids (Stace 1997). Many of the polyploids are endemic, and have arisen from hybridisation between a sexual diploid and a polyploid. Knowledge of the cytology of the endemics can help interpret their origins.

The following chromosome counts for *Sorbus* taxa from Britain and Ireland have been compiled from the literature, the B.S.B.I. Cytological Database (www.bsbi.org.uk) and our own data.

Many of the first counts for the British endemics were given by Warburg (1952) and details for some of these have been traced in A. J. Wilmott's notes held in BM which show that they were from seedlings grown from fruit

collected in 1933; Warburg's vouchers for many of the parents are in BM. Counts marked QK were made by Q. O. N. Kay in the 1970s (some vouchers in NMW). Counts marked JB were made on material collected by TR in 2002 and 2003 (vouchers in NMW).

In most cases, counts have been made on root-tips from seedlings, which might differ in ploidy level from the mother depending on whether pollen of a different ploidy level had fertilised the ovules or not. A few counts from flow cytometry are also included at the gross ploidy level. Some counts are approximate due to the difficulty of counting lots of small chromosomes and should be taken to indicate approximate ploidy level, not exact counts. Counts of $2n = 34$ are usually regarded as diploid, $2n = 51$ as triploid and $2n = 68$ as tetraploid.

Sorbus anglica Hedl.

2n = 51: Bottom of gorge ('one plate seemed 2n = 52'), Cheddar v.c. 6, E. F. Warburg (BM notes); Ban-y-gor cliffs, Woodcroft v.c. 34, JB. 2n = c. 49–53: Craig y Cilau, v.c. 42, QK.

2n = 68: Pant Trystan (=Llanymynech Hill) v.c. 40, E. F. Warburg (BM notes); Darren Cilau v.c. 42, Avon Gorge v.c. 6/34, and Kinkerswell v.c. 3, HMCA; Craig Breidden v.c. 47 and (2n = c. 68) Piercefield Cliffs v.c. 35, JB.

Sorbus aria (L.) Crantz subsp. *aria*

2n = 34: Cultivated material, Kew Gardens (Moffett 1931); Leigh Woods v.c. 6, and Lord's Wood v.c. 36, E. F. Warburg (BM notes); The Gully, Avon Gorge v.c. 34, and Piercefield Cliffs v.c. 35, JB. 2n = c. 32–34: 2 plants, Tidenham v.c. 34, QK (collected as *S. eminens*; NMW). A tree with sharply lobed leaves from The Gully, Clifton Downs v.c. 34, suggested to be a *S. aria* × *latifolia* backcross by T. Rich, is 2n = 34, and may simply be *S. aria*; further investigation of this tree is under way.

Sorbus aria var. *longifolia* Pers.

2n = 34: Aberystwyth v.c. 46, HMCA (collected as *S. rupicola*).

Sorbus aria is widely reported as 2n = 34 in Europe (e.g. Liljefors 1953; Jankun & Kovanda 1988).

Aldasoro *et al.* (1998) have recently reported both diploid 2n = 34 and tetraploid 2n = 68 *S. aria* s.l. from Spain, though how their tetraploid plants relate to British *S. aria* s.s. remains to be clarified.

Sorbus arranensis Hedl.

2n = 51: two plants from Glen Diomhan v.c. 100, HMCA.

Sorbus aucuparia L. subsp. *aucuparia*

2n = 34: Cultivated material, Kew Gardens (Moffett 1931); Silverdale v.c. 60 (Al-Bermain *et al.* 1993); Cwm Clydach v.c. 42, JB.

Bolstad & Salvesen (1999) reported 2n = 33 (1 plant) and 2n = 34 (3 plants) from Norway.

Sorbus bristoliensis Wilmott

2n = 51: Leigh Woods v.c. 6, E. F. Warburg (BM notes); Avon Gorge v.c. 6/34, ex Cambridge Botanic Garden, HMCA; Avon Gorge v.c. 6/34, QK; Clifton Down v.c. 34, JB.

Sorbus croceocarpa P. D. Sell

2n = 59 (aneuploid): Church and Hazelwood Roads, Clifton v.c. 34, QK.

2n = 68: Lemche (1999); Avon Gorge, Clifton v.c. 34, JB.

Sorbus decipiens (Bechst.) Irmisch

2n = 51: Stoke Bishop v.c. 34, JB.

Sorbus devoniensis E. F. Warb.

2n = 68: Loxhore v.c. 4, QK; Woody Bay v.c. 4, JB.

Plants of the 'No Parking' form from Watersmeet v.c. 4, 2n = c. 68, QK (cited as for typical form in Sell 1989).

Sorbus eminens E. F. Warb.

2n = 68: Symonds Yat top v.c. 34, E. F. Warburg (BM notes); Police Quarry, Avon Gorge v.c. 6, JB.

2n = c. 68: Cheddar, QK; Seven Sisters, Great Doward v.c. 36, JB.

2n = c. 71: Seven Sisters, Great Doward v.c. 36, JB.

Trees with 2n = c. 51: Sea Mills v.c. 34 and Worle Hill v.c. 6, QK, may be hybrids of *S. aria* and *S. eminens*.

Sorbus hibernica E. F. Warb.

2n = (c. 50–)51: Rathdrum, Wicklow v.c. H21, QK.

Sorbus lancastriensis E. F. Warb.

2n = 68: Arnside Knott, Humphrey Head and Low Frith, all v.c. 60, HMCA.

Sorbus latifolia (Lam.) Pers.

2n = 34: two seedlings from planted tree in Newnham College, Cambridge, QK.

2n = 68: seed from planted tree in Newnham College (Lemche 1999); Fairyland, Avon Gorge v.c. 34, QK; Fairyland, Avon Gorge v.c. 34, JB.

The difference between the two counts from Newnham College where there are two trees (Sell 1989) is interesting. De Pouques (1951) reported 2n = 34 for *S. latifolia* originating from Fontainebleau, France (the original locality), and for *S. confusa* (widely treated as a synonym of *S. latifolia*) from the Malzéville. The triploid count for *S. latifolia* from the Menai Straights in the B.S.B.I. Database refers to another taxon whose identification remains to be resolved.

Sorbus leptophylla E. F. Warb.

2n = 68: Unlocalised, Britain, Warburg (1952); Craig Breiddan v.c. 47, HMCA. Craig-y-Cilau v.c. 42, and Craig Rhiwarth v.c. 42, JB.

2n = 67–68: Craig y Cilau v.c. 42, QK.

Sorbus minima (Ley) Hedl.

2n = 51: Darren Cilau v.c. 42, HMCA; Craig y Cilau v.c. 42, JB.

[2n = 68; Coed Pen Pwyr (=Craig y Cilau), E. F. Warburg (**BM** notes), possibly an error in the notes, as this sample was cited as 2n = 51 in Warburg 1952].

Sorbus porrigentifformis E. F. Warb.

2n = 51: Big tree on rock, road below Yat Top, Symonds Yat v.c. 34, E. F. Warburg (**BM** notes); Crawley Cliff, Gower v.c. 41, HMCA; Crawley Cliff, Gower v.c. 41 QK; Burrington Combe v.c. 6, M. Chester *et al.* (flow cytometry, unpublished); Craig y Cilau v.c. 42, Seven Sisters v.c. 36, and Blaise Castle, Bristol v.c. 34 (2 trees, one 2n = c. 51), JB. These triploid counts may refer to hybrids with *S. aria*.

2n = 68: Near Observatory, Cheddar v.c. 6, and Dan y Graig v.c. 42, E. F. Warburg (**BM** notes); Stokeleigh Camp v.c. 6 and Craig y Cilau v.c. 42, JB; Craig y Cilau v.c. 42, QK; Babbacombe v.c. 3, Avon Gorge v.c. 6/34, and Aberdur Rocks v.c. 43, HMCA.

2n = (67–) c. 68 (–69) Heale Ladders v.c. 6, Wick Rocks v.c. 34, Craig y Cilau v.c. 42 (both forms), Craig y Castell v.c. 42, Craig Rhiwarth v.c. 42, Cwm Clydach v.c. 42, Darren Disgwylla v.c. 42 and Woody Bay v.c. 4, QK (some counts reported in Proctor & Groenhof 1992). Plants from Nantporth, Menai Straits v.c. 49, often included under *S. porrigentifformis* but probably more closely related to *S. eminens*/*S. hibernica* (Proctor & Groenhof 1992), are also 2n = 68, HMCA; 2n = c. 66–68, QK.

2n = 87: Craig y Cilau v.c. 42, JB; this is the first 'pentaploid' count in wild *Sorbus*, though this has also been seen in cultivated material by HMCA.

Sorbus pseudofennica E. F. Warb.

2n = 68: Glen Catacol v.c. 100, from buds, P. Harrold (annotated specimen in **E**); Glen Diomhan v.c. 100, HMCA (McAllister 1986).

Sorbus rupicola (Syme) Hedl.

2n = 68: Cefn Fedw v.c. 50 and Craig Eglwyseg v.c. 50, E. F. Warburg (**BM**

notes); Malham Cove v.c. 64, and Tighnabruaich v.c. 98, HMCA; Craig y Cilau v.c. 42, JB.

Liljefors (1953) also reported 2n = 68 for a plant from Gotland.

Sorbus subcuneata Wilmott

2n = 51 and 2n = c. 67–70: Watersmeet v.c. 4, QK. These counts were made in different seed from the same parent; the seedlings were morphologically similar in cultivation.

Sorbus torminalis (L.) Crantz

2n = 34: Cultivated material, Kew Gardens (Moffett 1931).

Aldasoro *et al.* (1998) have recently reported both diploid 2n = 34 and tetraploid 2n = 68 material from Spain.

Sorbus × *vagensis* Wilmott (= *S. aria* × *torminalis*)

2n = 34: Coldwell Rocks v.c. 34, E. F. Warburg (**BM** notes).

Aas *et al.* (1994) report one triploid and 12 diploid counts from three seed families from the primary *S. aria* × *torminalis* hybrid from Birnberg, Germany.

Sorbus vexans E. F. Warb.

2n = 68: Woody Bay v.c. 4, JB.

Sorbus wilmottiana E. F. Warb.

2n = 51: Avon Gorge v.c. 6/34, HMCA; material from type tree, Clifton Downs v.c. 34, JB.

Sorbus whiteana T. Rich & L. Houston

2n = 51: Police Quarry, Avon Gorge v.c. 6, and Ban-y-Gor cliffs v.c. 34, JB.

In conclusion, three sexual diploids, seven triploids, eight tetraploids and one hybrid are reported as having one ploidy level. *Sorbus anglica* and *S. subcuneata* are reported as both triploid and tetraploid, and *S. latifolia* as diploid and tetraploid. *Sorbus porrigentifformis* has triploid, tetraploid and pentaploid counts. There are no counts for *S. domestica* L., *S. leyana* Wilm. or *S. × thuringiaca* (Isles) Fritsch.

ACKNOWLEDGMENTS

TCGR would like to thank Wolfgang Bopp and Jessica Gould, National Botanic Garden of Wales for their expertise in growing *Sorbus*, and Mark Spencer for finding Wilmott's notes at **BM**.

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*Department of Biodiversity and Systematic Biology, National Museum of Wales, Cardiff CF10 3NP*SERIES REASSIGNMENT OF *RUBUS CERDICII*

In describing a conspicuous reddish-flowered bramble mainly confined to the north half of the New Forest, v.c. 11, as *R. cerdicii* (Allen 2004), I assigned it to series *Vestiti* (Focke) Focke. Further study, however, has shown that to be unsustainable. Instead, despite the presence of scattered glands and acicles, it seems best in series

Rhamnifolii (Bab.) Focke. It has a sufficiently marked phenotypic resemblance to *R. nemoralis* P. J. Mueller, a member of the *Rhamnifolii* very common in the New Forest, to suggest that that may have been one of its ancestral progenitors, the other presumably having been a member of one of the less strongly glandular series.

REFERENCE

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Plant Records

Records for publication must be submitted to the appropriate Vice-county Recorder (see *BSBI Year Book 2005*), and not to the Editors. Following publication of the *New Atlas of the British & Irish Flora* and the *Vice-county Census Catalogue*, new criteria have been drawn up for the inclusion of records in *Plant Records*. (See *BSBI News* no. 95, January 2004 pp10 & 11). These are outlined below:

- First records of **all** taxa (species, subspecies and hybrids) included in the VCCC, designated as native, archaeophyte, neophyte or casual.
- First record since 1970 of the taxa above, except in the case of *Rubus*, *Hieracium* and *Taraxacum*.
- Records demonstrating the rediscovery of all taxa published as extinct in the VCCC or subsequently.
- Newly reported definite extinctions.
- Deletions from the VCCC (e.g. through the discovery of errors, the redetermination of specimens etc.) **NB** – only those errors affecting VCCC entry.
- New 10km square records for Rare and Scarce plants, defined as those species in the *New Atlas* mapped in the British Isles in 100 10km squares or fewer. (See *BSBI News* no. 95, January 2004 pp 36-43).

Records for the subdivisions of vice-counties will not be treated separately; they must therefore be records for the vice-county as a whole. However, records will be accepted for the major islands in v.cc. 102-104, 110 and 113.

In the following list, records are arranged in the order given in the *List of Vascular Plants of the British Isles* and its supplements by D. H. Kent (1992), from which the species' numbers, taxonomy and nomenclature are taken. The Ordnance Survey national grid reference follows the habitat and locality. With the exception of collectors' initials, herbarium abbreviations are those used in *British and Irish Herbaria* by D. H. Kent & D. E. Allen (1984). Records are field records if no other source is stated. For all records 'det.' or 'conf.' appear after the herbarium if the determination was based on material already in an institutional herbarium, otherwise before the herbarium.

The following signs are used:

* before the vice-county number: to indicate a new vice-county record.

† before the species number: to indicate that the plant is an archaeophyte.

‡ before the species number: to indicate that the plant is a neophyte.

© before the species number: to indicate that the plant is a casual.

The above 3 signs may also be used before the vice-county number to indicate the status of the plant in that vice-county.

® before the vice-county number: to indicate that this is an additional hectad for a Rare or Scarce plant.

Ø at end of entry: established taxon not in Vice-County Census Catalogue. Name of authority follows plant name.

[] enclosing a previously published record: to indicate that that record should be deleted or changed.

The following list contains the second set of records up to and including the year 2006. Records including the year 2007 will be published in the next issue of *Watsonia*.

[*Isoetes* × *hickeyi* (*I. lacustris* × *I. echinospora*) 3/1.1×2. **70**, Cumberland: delete as unconfirmed, *fide* A. C. Jermy.]

Equisetum × *rothmaleri* (*E. arvense* × *E. palustre*) 4/1.5×8. ***49**, Caerns.: edge of cycle track, Pant Glas, SH4647, S. J. Thomas, 2006, conf. C. N. Page.

Equisetum × *bowmanii* (*E. sylvaticum* × *E. telmateia*) 4/1.7×9 ***106**, East Ross: marshy meadow near dense swamp woodland, south side of Loch Ussie, NH55, D. J. Tennant, 2006, det. C. N. Page, **E**.

‡**Pteris multifida** Poir. 8/1.mul. *29, Cambs.: one good-sized plant under grating on the Trinity Street side of Michaelhouse church, Cambridge, TL448585, P. H. Oswald, 2006, CGE, conf. F. J. Rumsey. Ø See *BSBI News* 104 for details of this species found in Bath.

‡**Pilularia globulifera** 9/1.1. ®69, Westmorland: bed of ephemeral pool, near Pewet Tarn, Subberthwaite, SD252870, C. Cornish, 2006. 3 sites in same monad.

‡**Ceterach officinarum** 15/3.1. ‡91, Kincardines.: south-facing dike, Stonehaven, NO862851, D. Welch, 2006. 1st record since 1970 at the location previously recorded.

‡**Matteuccia struthiopteris** 16/1.1. *62, N. E. Yorks.: several plants of varying age in damp woodland, originally Victorian planting, by Hodge Beck, Cockayne, Bransdale, SE622985, V. Jones, 2003.

Dryopteris × **complexa** nothosubsp. **complexa** (**D. filix-mas** × **D. affinis** subsp. **affinis**) 17/3.2×3. *46, Cards.: shaded roadside bank, 200m NW of Caer-Cadwgan, Cellan, SN614480, K. Trewren, S. J. Thomas & A. O. Chater, 2005. 1st Welsh record of nothosubspecies.

Dryopteris × **deweveri** (**D. carthusiana** × **D. dilatata**) 17/3.8×9. 49, Caerns.: wet heathy field, Mynydd Cennin, Bryncir, SH4444, W. McCarthy, 2006, conf. S. J. Thomas. 1st record since 1970.

‡**Abies alba** 20/1.1. *H12, Co. Wexford: many trees self-sown along ride of conifer plantation, Carrig Hill, S9434, P. R. Green, 2006.

‡**Cedrus deodara** 20/6.1. *29, Cambs.: one self-sown tree (c.20ft tall in 2006), wedged between two graves, Mill Road cemetery, Cambridge, TL461582, A. C. Leslie, 2002, CGE. Specimen collected 2006. 1st v.c. record for a clearly self-sown Deodar Cedar.

‡**Pinus radiata** 20/7.5. 44, Carms.: mixed mature groups of conifers and single trees mixed with native broad-leaves on open south-facing hillside generally dominated by bracken, West Mead Farm, Pendine, SN263094, R. D. & K. A. Pryce, 2006. 1st record as a neophyte.

‡**Cupressus macrocarpa** 21/1.1. *29, Cambs.: one self-sown young plant at base of St Andrews churchyard wall, Coldham's Lane, Cherry Hinton, TL489570, A. C. Leslie, 2002, det. K. W. Page. 1st record for clearly self-sown Monterey Cypress.

‡**Chamaecyparis lawsoniana** 21/2.1. *H12, Co. Wexford: several self-sown trees of various sizes on waste ground, New Ross, S725289, P. R. Green, 2006.

‡**Juniperus chinensis** L. 21/4.chi. *41, Glam.: one well-established shrub in sandy grassland, on Pennard Burrows, Gower, SS553886, A. S. Lewis, 2006. *44, Carms.: field hedge, Broad Oak, SN579226, V. & A. S. Lewis, 2006, NMW. 1st Welsh record. One mature tree 3m-4m tall, c.40cm in girth, cultivar with white leaf sprays at end of each branch, no cones visible, cut by hedge cutting. Known here for at least 40 years by landowner but girth would indicate that it is considerably older. Ø

‡**Helleborus orientalis** 28/3.3. *62, N. E. Yorks.: long-established at edge of copse, by ford in village, Battersby, NZ596076, V. Jones, 1993. May have originated from thrown-out garden rubbish.

‡**Helleborus argutifolius** 28/3.arg. *62, N. E. Yorks.: self-sown on wall, Sandsend, NZ859128, V. Jones, 2001.

‡**Anemone blanda** 28/9.bla. *42, Brecknock: gravelly area on river bank, Sennybridge, SN 920287, R. G. Woods, 2006.

‡**Anemone** × **hybrida** (**A. hupehensis** × **A. vitifolia**) 28/9.hup×vit. *H12, Co. Wexford: patch on bank of River Barrow, New Ross, S71552722, P. R. Green, 2006.

‡**Clematis tangutica** 28/12.3. *91, Kincardines.: path in woodland, Banchory, NO704965, D. Welch, 2006.

‡**Ranunculus ficaria** subsp. **ficariiformis** 28/13.17c. *67, S. Northumb.: north bank of R. Tyne, NZ118646, C. Metherell, 2006, hortol origin.

Thalictrum minus 28/17.4. *46, Cards.: one small plant in rock crevice in cliff in ancient woodland, bottom of Allt Boeth, Cwm Rheidol, SN737773, C. M. Forster Brown, 2006. Certainly native and 1st record as such.

‡**Berberis thunbergii** 29/1.2. *69, Westmorland: old quarry, Levens, SD499870, R. E. Groom, 2006, LANC. This plant is var. *atropurpurea*. *91, Kincardines.: streamside, Banchory, NO715965, I. P. Green & M. Duncan, 2006.

‡**Berberis julianae** 29/1.7. *©57, Derbys.: one bush in waste ground by disused canal, near Springfield Park, SK475349, R. D. Martin, 2006, conf. A. Willmot. Appears bird-sown.

‡**Berberis darwinii** 29/1.9. *91, Kincardines.: woodland near housing, Banchory, NO704965, D. Welch, 2006.

‡**Berberis verruculosa** Hemsl. & Wils. 29/1.ver. *77, Lanarks.: rough grassland, south-west of Milnwood, NS7459, P. Macpherson, 2006, det. E. J. Clement, **herb. P. M.** Probably originally planted in the area but now established. Ø

‡**Epimedium alpinum** L. 29/EPIalp. *46, Cards.: estate woodland, Castle Hill, Llanilar, SN6274, J. H. Salter, 1935-1942. Annotated by J. H. Salter as 'naturalised' in his copy of *Flowering Plants and Ferns of Cardiganshire* in NMW. Ø Apparently new as naturalised in the British Isles.

©**Eschscholzia californica** 30/6.1. 44, Carms.: many plants in lay-by on SE side of road, Glynhir Road, Llandybie, SN635148, BSBI Meeting, 2006. 1st record as neophyte (see *BSBI News* 105 for photo). *62, N. E. Yorks.: one self-sown plant in field edge, near industrial estate, Whitby, NZ907095, V. Jones & W. A. Thompson, 2005. *H12, Co. Wexford: single plant on newly sown road bank, Blackwater, T1234, P. R. Green, 2006.

‡**Pseudofumaria lutea** 31/3.1. *H12, Co. Wexford: several clumps on garden wall in Mill Park Road, Enniscorthy, S9739, P. R. Green, 2006.

‡**Pseudofumaria alba** 31/3.2. *62, N. E. Yorks.: a few plants in cracks in wall, Thirsk, SE427824, V. Jones & W. A. Thompson, 2006, **herb. V. Jones.**

Ceratocapnos calviculata 31/4.1. *29, Cambs.: weed amongst bedding plants, Notcutts garden centre, Horningsea, TL493622, A. C. Leslie, 2006.

Fumaria capreolata subsp. **babingtonii** 31/5.1b. ‡48, Merioneth: one or two fine plants at car park of the Royal St David's Golf Club, Harlech, SH53, P. M. Benoit & J. M. Maynard, 2000 & 2006. 1st record since 1970.

‡**Soleirolia soleirolii** 36/3/1. *110, Outer Hebrides: walls, Kyles Lodge, South Harris, NG997878, J. S. Faulkner, 2006, **E.**

‡**Pterocarya fraxinifolia** 37/2.1. *62, N. E. Yorks.: showing prolific natural regeneration in woodland, Mill Bank Wood, Kildale, NZ603098, V. Jones, 2004.

‡**Quercus rubra** 39/4.7. 46, Cards.: by Forestry Commission track, Coed Maenarthur, Pontrhyd-y-groes, SN722721, S. P. Chambers, 2006. 1st record of a self-sown sapling.

Betula nana 40/1.3 *78, Peebles.: Lee Pen, Innerleithen, NT3238, J. N. Brown, 1855, **E**, conf. D. J. McCosh from herbarium specimen. 1st localised record. Noted in Hudson's *Flora Anglica* (1778).

Chenopodium rubrum 43/1.6. *‡91, Kincardines.: road verge, Crathes, NO726964, I. P. Green, 2006.

Stellaria neglecta 46/5.4. 67, S. Northumb.: fen carr to north of lake, Minsteracres, NZ205561, A. J. Richards, 2006, conf. P. M. Benoit, **herb. G. A. Swan.** 1st record since 1970.

Cerastium arvense 46/7.2. *52, Anglesey: dune grassland, Valley, SH3074, I. R. Bonner & R. Birch, 2006, **herb. I. R. B.** Presumed native – link to eastern Ireland (or from an air base in E Anglia?).

‡**Petrorhagia prolifera** 46/24.2. *62, N. E. Yorks.: stony ground in hollow of long-deposited industrial slag, South Gare N of Redcar, NZ557272, C. I. Pogson, 2000, det. E. J. Clement, **herb. E. J. Clement.**

©**Persicaria capitata** 47/1.cap. *62, N. E. Yorks.: prolific over several metres at base of wall, Pickering, SE801837, V. Jones & W. A. Thompson, 2005.

©**Fagopyrum tataricum** (L.) Gaertn. 47/3.tat. *62, N. E. Yorks.: several plants appearing to be a grain contaminant in arable field, near Ingleby Greenhow, NZ572069, V. Jones, 2004, conf. E. J. Clement, **herb. V. Jones.** Ø

‡**Fallopia ×bohemica** (F. **japonica** × F. **sachalinensis**) 47/5.1×2. *70, Cumberland: riverbank, N side of A66 east of Scales, NY358268, D. Broughton, 2005, det. J. Bailey, **LANC, LTR.** Herbarium and determination based on R. E. Groom's 2006 material. *91, Kincardines.: streamside, Banchory, NO715965, I. P. Green & M. Duncan, 2006. *H12, Co. Wexford: large patch on road bank, Crooked Bridge, S826390, P. R. Green, 2006.

‡**Rheum palmatum** 47/7.pal. *69, Westmorland: copse with garden throwouts, Ninezergh Lane, Levens Hall, SD494849, G. Halliday, 2006, **LANC.**

Rumex ×schulzei (R. **crispus** × R. **conglomeratus**) 47/8.13×14. *44, Carms.: cattle-trampled rough pasture, East of Pont Cellyn, near Twyn Farm, SN535217, G. Kitchener, 2006.

***H12**, Co. Wexford: in field with both parents, Wexford, T024201, P. R. Green, 2006.

Rumex × **sagorskii** (**R. crispus** × **R. sanguineus**) 47/8.13×15. ***44**, Carms.: a vigorous plant, with both parents, Dryslwyn castle mound, SN552203, G. Kitchener, 2006. ***H12**, Co. Wexford: single plant in field with both parents, Coolmela, S946608, P. R. Green, 2006.

Rumex × **abortivus** (**R. conglomeratus** × **R. obtusifolius**) 47/8.14×19. ***44**, Carms.: edge of saltmarsh (with both parents), Laugharne, SN303108, G. Kitchener, 2006.

Rumex × **dufftii** (**R. sanguineus** × **R. obtusifolius**) 47/8.15×19. ***44**, Carms.: one large multi-stemmed plant with *R. sanguineus* nearby, S side of A40 near Pont Dulas, SN551219, G. Kitchener, 2006. ***H12**, Co. Wexford: single large plant on road bank with both parents, Mackmine Bridge, S964312, P. R. Green, 2006.

‡**Paeonia officinalis** 49/1.off. ***51**, Flints.: well established from planted material on old industrial site, Rhydymwyn Valley Nature Reserve, SJ205665, J. Phillips, 2006.

Hypericum × **desetangsii** (**H. perforatum** × **H. maculatum**) 51/1.6×7. ***91**, Kincardines.: riverside, Crathes, NO722964, I. P. Green & M. Duncan, 2006.

Hypericum undulatum × **H. tetrapterum** 51/1.8×9 ***2**, E. Cornwall: on edge of arable field in rushy area, east of Leigh Farm, Pillaton, SX387628, I. J. Bennallick, 2006, conf. N. K. Robson, **BM**. Growing with both parents. Also seen by I. J. Bennallick on the edge of an aqueduct at the base of a bank in the Luxulyan Valley, SX058570. Ø 1st confirmed record for British Isles of this hybrid.

Hypericum humifusum × **H. linariifolium** 51/1.10×11. ***49**, Caerns.: grassy slope above the sea, Mynydd Cilan, SH22, I. Edgar, 2006.

‡**Tilia tomentosa** Moench 52/1.tom. ***70**, Cumberland: roadside pasture, Watermillock, NY446225, G. Lines, 2006, **LANC**. Ø

Lavatera arborea 53/2.1. ©**67**, S. Northumb.: South Beach, Blyth, NZ3179, G. & A. Young, 2005. 1st record since 1970.

©**Abutilon theophrasti** 53/6.1. ***44**, Carms.: in flower and fruit in disturbed ground on road construction site with *Echinochloa crus-galli* and *Lactuca serriola*, near Morfa Roundabout, SS517986, V. & A. Lewis, 2005.

©**Anoda cristata** (Reichb.) Hochr. 53/ANO.cri. ***29**, Cambs.: Thriplow tip, TL445445, G. M. S. Easy, 1976, **herb. G. M. S. Easy**, det. A. L. Grenfell. The record was of the var. *brachyantha*. Ø

Viola × **intersita** (**V. riviniana** × **V. canina**) 57/1.4×6 ***H12**, Co. Wexford: several clumps on sand dunes with both parents, Ballyteige Burrow, S948050, P. R. Green, 2006.

‡**Viola cornuta** 57/1.10. ***52**, Anglesey: corner of pony-grazed field, Bryn Castell, Llanddona, SH563787, Anglesey Flora Group, 2006, conf. N. Brown. ***69**, Westmorland: pathside, N of Sunbiggin Tarn, NY672079, G. Lines, 2006, **LANC**.

©**Viola** × **wittrockiana** (**V. lutea** × **V. tricolor** × **V. altaica**) 57/1.11×12×alt. ***H12**, Co. Wexford: self-sown at base of wall, Duncannon, S7208, P. R. Green & A. Stevenson, 2006.

Viola × **contempta** (**V. tricolor** × **V. arvensis**) 57/1.12×13. ***70**, Cumberland: set-aside by R. Eden, Lazonby, NY558397, G. Lines, 2004, **photo in LANC**.

©**Azara microphylla** Hook. f., FLA/AZA.mic. ***29**, Cambs.: one self-sown plant at base of street wall of Department of Earth Sciences, Downing Street, Cambridge, TL4558, A. C. Leslie, 2006. Ø Apparently 1st British Isles record outside gardens for this species.

Populus nigra subsp. **betulifolia** 61/1.3a. ***35**, Mons.: 13 maiden, many-stemmed male trees in hedge line, Great Manson Farm, SO499156, D. E. Green, 2006. 1st record updating the VCCC although known for some time from this and 12 other tetrads in the vice-county.

‡**Salix acutifolia** 61/2.7. ***52**, Anglesey: lakeside, Llyn Alaw, SH388871, I. R. Bonner & M. Stead, 2006, det. A. O. Chater, **herb. I. R. B.** 1st British record as established neophyte. Originally planted with other willows around the reservoir margin.

Salix × **stipularis** (**S. viminalis** × **S. caprea** × **S. aurita**) 61/2.9×10×12. *©**57**, Derbys.: marshy grassland, Tideswell Dale, SK154736, A. Willmot, 2006. Possibly planted for landscaping.

‡**Malcolmia maritima** 62/9.1. ©**46**, Cards.: pavement weed, Corporation Street, Aberystwyth, SN583818, A. O. Chater, 2006. 1st record since pre-1936.

©**Matthiola longipetala** 62/10.lon. ***62**, N. E. Yorks.: self-sown in recently disturbed cliff

grassland, Robin Hood's Bay, NZ952051, V. Jones, 2001.

Rorippa islandica 62/12.3. *52, Anglesey: bare, damp, stony area used as a car park, Penwerthyr, Llyn Alaw, SH406865, I. R. Bonner, 2006, det. A. O. Chater, **herb. I. R. B.**

*69, Westmorland: muddy margin of sike, Tarn Sike, Sunbiggin, NY667076, G. M. Kay, 2005, det. T. C. G. Rich, **LANC.** Herbarium and determination based on G. Halliday's 2006 material.

©69, Westmorland: ephemeral pond, Brough Hill, Warcop, NY763156, G. Halliday, 2006, det. T. C. G. Rich, **LANC.**

‡**Cardamine raphanifolia** 62/14.4. *48, Merioneth: damp woodland, near Pont y Wern Ddu, Dolgellau, SH71, G. Jones, 2006, conf. P. M. Benoit.

‡**Cardamine corymbosa** 62/14.cor. *41, Glam.: garden weed probably of nursery origin, Cannisland Park, Pennard, Swansea, SS565899, A. S. Lewis, 2006. *50, Denbs.: garden gravel, Conwy, SH87, I. R. Bonner, 2004. 6-fig. grid reference withheld.

‡**Aubrieta deltoidea** 62/16.1. *H12, Co. Wexford: single clump self-sown on wall by fire station, New Ross, S7227, P. R. Green, 2006.

Erophila majuscula 62/22.1. *29, Cambs.: disturbed gritty soil on edge of farmland, Nuts Grove Farm, east of Thorney, TF327058, D. Broughton, 2006, conf. T. T. Elkington.

‡**Iberis sempervirens** 62/29.1. *44, Carm.: well naturalised on south facing bank at road junction to west of spinney of *Ulmus procera*, The Graig, Burry Port, SN446016, Llanelli Naturalists, 2006. *©62, N. E. Yorks.: one plant in pavement crack, Ormesby, NZ530174, V. Jones & W. A. Thompson, 2006.

‡**Iberis umbellata** 62/29.umb. *91, Kincardines.: path in woodland, Banchory, NO709963, I. P. Green & M. Duncan, 2006.

Brassica oleracea 62/34.1. ©113(S), Channel Is. (Sark): cliff path, Little Sark, path to the Pot, WV458738, S. Synnott, 2006, **herb. Société Serquaise**. 1st record for Sark. Not near past or present site of crop. Appears native but presumably casual.

Crambe maritima 62/41.1. 110, Outer Hebrides: Grenitote, N. Uist, NF837796, I. Crawford, 1988. 1st record since 1970. In Crawford (1988) National Sand Dune Vegetation Survey Site Report no 68: Grenitote, N Uist.

‡**Rhododendron luteum** 65/2.2. *91, Kincardines.: trackside in policies, Maryculter, NO871988, D. Welch, 2006, **ABD**.

Vaccinium ×intermedium (*V. myrtillus* × *V. vitis-idaea*) 65/13.6×4. *50, Denbs.: heather moorland, Esclusham Mountain, Wrexham, SJ236497, P. L. Thomas, 2006, conf. J. Hawksford.

Primula ×polyantha (*P. vulgaris* × *P. veris*) 69/1.1×3. *48, Merioneth: Talsarnau, SH63, O. H. Black & H. Handley, 1970. Also seen by O. H. Black in 1973.

‡**Philadelphus inodorus** L. 71/1.ino. *80, Roxburghs.: one very large bush (to 6m) on bank of River Tweed upstream from The Holmes, St Boswells, NT588315, R. W. M. Corner, 2006, det. D. R. McKean, E, **herb. R. W. M. C.** Known for over 30 years. Origin unknown. Ø

‡**Ribes odoratum** 72/2.5. *41, Glam.: waste ground, suckering extensively, Gorseinon, SS595986, A. S. Lewis, 2005. *67, S. Northumb.: old ballast hill, Seaton Sluice, NZ336768, G. & A. Young, 2004.

‡**Ribes divaricatum** Douglas 72/2.div. *46, Cards.: hedges and scrub, Gilfach yr Halen, SN436612, A. O. Chater & P. A. Smith, 2006, **NMW, LTR**. Ø Apparently new as naturalised in British Isles; relic bushes in old orchard and self-sown in hedges nearby.

‡**Sedum praealtum** 73/5.2. *41, Glam.: self-sown in churchyard, Sketty, Swansea, SS628928, A. S. Lewis, 2005.

‡**Sedum confusum** 73/5.3. *H12, Co. Wexford: large patch on field bank, New Ross, S725288, P. R. Green, 2006.

‡**Sedum spectabile** 73/5.4. *49, Caerns.: in hedge bank, Chwillog, SH4338, Caerns. Recording Group, 2006.

Sedum forsterianum 73/5.11. *‡91, Kincardines.: dyke, Mill of Muchalls, NO900913, D. Welch, 2003.

[‡**Sedum sexangulare** 73/5.13. 29, Cambs.: TL4192. Delete. Now considered to be an error for *S. acre*.]

Sedum anglicum 73/5.16. *‡91, Kincardines.: road verge, Tilquhillie, NO729958, I. P. Green & M. Duncan, 2006.

‡**Sedum dasyphyllum** 73/5.17. *69, Westmorland: limestone wall opposite church,

Heversham, SD496833, J. H. Clarke, 2005, **LANC**. Herbarium specimen G. Halliday 2006.

‡**Sedum kamschaticum** var. **ellacombianum** 73/5.kam. *©45, Pembs.: 30+ plants including small seedlings on waste ground of disused scrap metal depot, Johnston, SM932110, S. Bosanquet, 2006, det. S. Bosanquet & A. O. Chater. 1st Welsh record.

‡**Saxifraga xpolita** (**S. spathularis** × **S. hirsuta**) 74/5.9×10. 106, E. Ross: mixed woodland, Craigton, NH666488, B. R. & C. B. Ballinger, 2006. 1st record since 1970. Recorded here in 1956.

‡**Saxifraga xarendsii** Engl.74/5.are. *44, Carms.: several plants naturalised on low stone boundary wall, Red Roses Memorial Garden, SN204117, R. D. Pryce, 2006. Ø

‡**Heuchera sanguinea** 74/6.1. *62, N. E. Yorks.: established plants in rough grassland, South Gare, N of Redcar, NZ573256, V. Jones, 2005, conf. E. J. Clement, **herb. V. Jones**. May have originated from thrown-out garden rubbish

‡**Physocarpus opulifolius** 75/2.1. *50, Denbs.: wet farm woodland, Wrexham, SJ349532, R. Hesketh, 2005. 1st Welsh record.

‡**Spiraea xbillardii** (**S. alba** × **S. douglasii**) 75/3.2×3. *52, Anglesey: established between pond and nearby gardens, Valley, SH286790, I. R. Bonner & R. Birch, 2006, conf. R. Birch. Originating from nearby gardens but established.

‡**Holodiscus discolor** 75/5.1. *91, Kincardines.: woodland edge, Banchory, NO6896, I. P. Green, 2006.

‡**Rubus phoenicolasius** 75/8.8. *49, Caerns.: probably bird-sown from kitchen garden of nearby hotel known for growing own produce, on path-side, Marl Wood, Llandudno Junction, SH8079, I. & L. Fraser, 2006.

‡**Rubus spectabilis** 75/8.9. *52, Anglesey: well established in woodland, Church Wood, Plas Newydd, SH5268, Anglesey Flora Group, 2006, conf. I. R. Bonner, **herb. I. R. B.**

‡**Rubus loganobaccus** 75/8.10. *©57, Derbys.: deciduous woodland, Pleasley Vale, SK514648, A. Willmot, 2006.

[**Rubus vestitus** 75/8.163. 77, Lanarks.: near Langlands House, East Kilbride, NS6451, B. Simpson, 2005. Delete - re-identified as another species.]

Rubus furvicolor 75/8.168. *91, Kincardines.: hedgerow, Cammachmore, NO900948, D. Welch, 2006, conf. A. Newton, **herb. D. Welch**.

Rubus moylei 75/8.195. *46, Cards.: heathy, felled conifer plantation, 700m NNW of Gwenlli church, SN389541, D. E. Allen & A. O. Chater, 1998, det. D. E. Allen, conf. A. Newton, NMW.

Rubus distractiformis 75/8.210. *‡69, Westmorland: among shrubs, ASDA car-park, Kendal, SD522906, A. M. Boucher, 2006, det. A. Newton, **LANC**. No doubt introduced with shrubs, extension of area from SW Pennines.

Potentilla crantzii 75/9.11. *91, Kincardines.: riverbank reinforced with rocks, Inchmarlo, NO644963, D. Welch, 2006, **herb. D. Welch**.

‡**Potentilla montana** Brot. 75/9.mon. *46, Cards.: bank at top of sea cliffs, Constitution Hill, Aberystwyth, SN584828, A. D. Hale, 2006, det. A. O. Chater, NMW, LTR. Ø Apparently new as naturalised in British Isles.

©**Potentilla nepalensis** Hook. 75/9.nep. *62, N. E. Yorks.: one plant self-sown in pavement crack, Easingwold, SE530695, V. Jones & W. A. Thompson, 2006, conf. E. J. Clement, **herb. V. Jones**. Ø

‡**Sanguisorba minor** subsp. **muricata** 75/17.3b. *51, Flints.: disturbed ground on old industrial site, Rhydymwyn Valley Nature Reserve, SJ205665, J. A. Green, 2004. 1st record for subspecies. Probably from wild-flower seed mixture.

‡**Acaena novae-zelandiae** 75/18.1. *52, Anglesey: well established in lawn and path edges, Plas Newydd, SH5269, I. R. Bonner, 2006, det. J. Poland.

Alchemilla wichurae 75/19.13. 106, E. Ross: base-rich slope with rock exposure, Breabag Tharsuinn, NC303190, G. P. Rothero, 1998. 1st record since 1970. Still present here 2005.

‡**Alchemilla mollis** 75/19.15. *H12, Co. Wexford: scattered plants in disused quarry, Bunclody, S91875668, P. R. Green, 2006.

‡**Rosa 'Dorothy Perkins'** 75/21. 113(S), Channel Is. (Sark): scrub above sea cliff, top of path to Eperquerie Landing, WV462775, M. H. Long, 2006. 1st record for Sark. Ø

‡**Rosa 'Félicité et Perpétue'** 75/21. 113(S), Channel Is. (Sark): spreading down bank from roadside towards sea, east of Le Vieux Port overlooking Port à la Jument Bay, WV458760, M. H.

Long, 2006, **herb. Société Serquaise**. 1st record for Sark. Probably planted originally but now spreading down bank. Ø

‡**Rosa ferruginea** 75/21.8. *62, N. E. Yorks.: wasteland near old station, Kettlenesss, NZ833156, V. Jones, 2004.

‡**Rosa virginiana** 75/21.9. *©44, Carms.: old refuse tip, S of Cencaeu, Llanelli, SS529999, I. K. Morgan, 2004, det. R. Maskew. Since destroyed by construction of new Morrisons store.

*52, Anglesey: field boundary, Dwyran, SH439664, I. R. Bonner, 2005, conf. R. Maskew.

Prunus × **fruticans** (**P. spinosa** × **P. domestica**) 75/22.4×5. *62, N. E. Yorks.: many bushes at edge of woodland, Bassleton Wood, Thornaby, NZ447158, V. Jones & I. C. Lawrence, 2002.

‡**Sorbus aria** 75/28.9. *H12, Co. Wexford: a number of trees self-sown on dunes, Raven Wood Nature Reserve, T113240, P. R. Green, 2006, det. T. C. G. Rich.

‡**Aronia melanocarpa** 75/29.2. *70, Cumberland: scrubby grassland, Old Side, Workington, NX994302, R. E. Groom, 2006, **LANC**.

‡**Amelanchier lamareckii** 75/30.1. *41, Glam.: bird-sown tree, c. 2 m high, in heather on Graig Trewyddfa, Morriston, SS665977, I. K. Morgan, 2006, **NMW**.

‡**Photinia davidiana** 75/31.1. *45, Pems.: small specimens, almost certainly bird-sown, under a 200+ year old *Fagus sylvatica*, one fruiting, alongside Forestry Commission tree nursery, Minwear Wood, SN058137, S. B. Evans & J. Hudson, 2006. *91, Kincardines.: woodland near housing, Banchory, NO713965, I. P. Green & M. Duncan, 2006.

‡**Cotoneaster** × **suecicus** (**C. dammeri** × **C. conspicuus**) 75/32.11×18. *H12, Co. Wexford: single bush self-sown on wall above River Barrow, New Ross, S718277, P. R. Green, 2006.

‡**Cotoneaster congestus** 75/32.15. *41, Glam.: cliff top, with other *Cotoneaster* species, Mumbles Hill, Swansea, SS625875, A. S. Lewis, 2005, det. J. Fryer.

‡**Cotoneaster thymifolius** 75/32.17. *42, Brecknock: rock crevice below disused limestone quarry, Cefn Cil Sanws, Cefn Coed, SO 025091, J. N. Davies, 2005, det. G. Hutchinson, conf. J. Fryer, **NMW**.

‡**Cotoneaster divaricatus** 75/32.26. *50, Denbs.: Bryn Eurn, SH88, W. McCarthy, 2003.

‡**Cotoneaster bullatus** 75/32.34. *H12, Co. Wexford: single bush self-sown on dunes, Raven Wood Nature Reserve, T113249, P. R. Green, 2006.

‡**Cotoneaster rehderi** 75/32.35. *91, Kincardines.: woodland near housing, Banchory, NO706966, D. Welch, 2006.

‡**Cotoneaster dielsianus** 75/32.37. *44, Carms.: self sown on wall, St Anthony's Well, Llanstephan, SN346098, I. K. Morgan, 1993, det. G. Hutchinson, **NMW**.

‡**Vicia tenuifolia** 77/14.3. *29, Cambs.: about 40 plants in grassland, just east of old sand pit, above Ley Rectory Farm, Little Abington, TL539500, A. C. Leslie, 2006, **CGE**. Ø

Vicia lutea 77/14.13. *©57, Derbys.: waste grassland, Avenue Coking Works, SK399666, A. Willmot, 2006.

©**Vicia faba** 77/14.fab. *H12, Co. Wexford: waste ground, Silverspring Crossroads, T0209, P. R. Green, 2006.

‡**Lathyrus grandiflorus** 77/15.7. *62, N. E. Yorks.: railway ash, Battersby Junction, NZ558073, V. Jones, 1998.

©**Lathyrus odoratus** 77/15.odo. *62, N. E. Yorks.: wasteland, Thornaby, NZ463158, V. Jones, 1997.

‡**Melilotus officinalis** 77/17.3. *91, Kincardines.: arable edge, Tilquhillie, NO725956, I. P. Green & M. Duncan, 2006.

‡**Melilotus indicus** 77/17.4. *H12, Co. Wexford: hundreds of plants on waste ground, Wexford, T05412236, G. E. King-Salter, 2005, det. P. R. Green in 2006.

‡**Cytisus striatus** 77/23.3. *91, Kincardines.: steep bank of improved road, Durris, NO775915, D. Welch, 2006, **ABD**. Seen at this location in 1973 by L. Bisset, determined C. W. Muirhead.

‡**Genista lydia** Boiss. 77/25.lyd. *77, Lanarks.: The Gorbals, Glasgow, NS589634, P. Macpherson, 2006, det. E. J. Clement, **herb. P. M.** Still present 2007. Will probably survive until area is redeveloped. Ø

‡**Dorycnium hirsutum** (L.) Ser. 77/DOR.hir. *H12, Co. Wexford: single clump on verge of N11, Hollyfort, T225705, P. R. Green, 2006, **DBN**. Ø

- ©**Pisum sativum** 77/PIS.sat. *62, N. E. Yorks.: pavement cracks by church, Whip-Ma-Whop-Ma-Gate, York, SE605518, V. Jones & W. A. Thompson, 2006.
- ‡**Elaeagnus umbellata** 78/2.1. *©57, Derbys.: scrub on disused coal mine, between West Hallam and Ilkeston, SK449422, C. Smith, 2006, conf. C. S. Cook. Possibly a relic of ornamental planting.
- ‡**Elaeagnus multiflora** Thunb. 78/2.mul. *41, Glam.: single bush, presumably bird-sown, on rough ground by disused railway, Port Tennant, Swansea, SS681932, A. S. Lewis, 2005, conf. RHS Wisley. 1st Welsh record. Ø
- ‡**Myriophyllum aquaticum** 79/2.2. *48, Merioneth: ditch, near Penowern, Brynchrug, SH60, R. H. Gritten, 2006. *49, Caerns.: pond at Methlem farm, SH1730, independently noted by R. Dawes & T. Pearson and by W. McCarthy & M. Stead, 2006.
- Lythrum salicaria** 81/1.1. *‡91, Kincardines.: verge of lay-by, Banchory, NO726972, D. Welch, 2005. Possible accidental introduction by constructors of nearby pond.
- Epilobium** ×**subhirsutum** (**E. hirsutum** × **E. parviflorum**) 84/1.1×2. *44, Carms.: Old Station Yard, Carmarthen, SN416200, R. D. Pryce & P. Selby, 2002, det. G. D. Kitchener, NMW.
- *46, Cards.: pathside near Science Park, Llanbadarn Fawr, SN597813, S. P. Chambers, 2006, conf. T. D. Pennington, herb. S. P. Chambers.
- Epilobium** ×**limosum** (**E. parviflorum** × **E. montanum**) 84/1.2×3. *44, Carms.: Llandeilo Station, SN633225, BSBI Meeting, 2006, det. G. D. Kitchener.
- Epilobium** ×**dacicum** (**E. parviflorum** × **E. obscurum**) 84/1.2×6. *44, Carms.: Pantyffynnon Station, SN622107, BSBI Meeting, 2006, det. G. D. Kitchener.
- Epilobium** ×**floridulum** (**E. parviflorum** × **E. ciliatum**) 84/1.2×8. *52, Anglesey: lakeside, Llyn Alaw, SH385865, I. R. Bonner, 2006, det. G. D. Kitchener.
- Epilobium** ×**rivulare** (**E. parviflorum** × **E. palustre**) 84/1.2×9. *44, Carms.: Cwrtbrynbeirdd, Trapp, SN665179, BSBI Meeting, 2005, det. A. O. Chater, NMW.
- Epilobium** ×**interjectum** (**E. montanum** × **E. ciliatum**) 84/1.3×8. *44, Carms.: Llandeilo Station, SN6322, BSBI Meeting, 2006, det. G. D. Kitchener.
- Epilobium lanceolatum** 84/1.4. 50, Denbs.: coal tip waste, Bersham, SJ312481, A. K. Thorne, 2005, conf. T. D. Pennington, NMW. 2nd record and 1st since 1970.
- Epilobium** ×**vicinum** (**E. obscurum** × **E. ciliatum**) 84/1.6×8. *91, Kincardines.: woodland by old railway, Crathes, NO726963, I. P. Green & M. Duncan, 2006.
- ‡**Fuchsia magellanica** 84/5.1. *62, N. E. Yorks.: self-sown in rough grassland, by old mine workings, Brotton, NZ686188, V. Jones, 2005.
- ‡**Griselinia littoralis** 85/3.1. *H12, Co. Wexford: several bushes self-sown on top of wall of County Hall, Spawell Road, Wexford, T044222, P. R. Green, 2006.
- ‡**Euphorbia maculata** 91/2.2. *29, Cambs.: nursery weed, Westfield Nurseries, Whittlesey, TL278960, A. C. Leslie, 2006.
- ‡**Euphorbia** ×**pseudovirgata** (**E. waldsteinii** × **E. esula**) 91/2.14×wal. 51, Flints.: waste ground behind coastal dunes, Ffrith, Prestatyn, SJ043827, G. Wynne, 2002, conf. B. Ing. 2nd record and 1st as a neophyte. There was an unconfirmed record of this taxon from the same site in 1997.
- ‡**Euphorbia amygdaloides** subsp. **robbiae** 91/2.16b. *67, S.: Northumb.: where garden refuse is thrown over fence, growing with several other naturalised plants, north bank of R. Tyne, NZ118645, C. Metherell, 2006. Seen in similar site nearby (NZ119646).
- ‡**Euphorbia characias** subsp. **characias** 91/2.17a. *41, Glam.: self-seeding freely by riverside walk, St. Thomas, Swansea, SS662930, A. S. Lewis, 2006.
- ‡**Euphorbia mellifera** Aiton 91/2.mel. *41, Glam.: one bushy plant, self-sown from nearby garden on roadside, Penmaen, Gower, SS531886, A. S. Lewis, 2005. Ø
- ‡**Euphorbia myrsinites** L. 91/2.myr. *©62, N. E. Yorks.: one self-sown plant in crack in wall, Sowerby, SE433811, V. Jones & W. A. Thompson, 2006. Ø
- ‡**Euphorbia oblongata** 91/2.obl. *41, Glam.: self-sown on roadside, Horton, Gower, SS473859, A. S. Lewis, 2006. *©57, Derbys.: hedgerow, Hazelbarrow Farm, SK368811, K. Balkow, 2006. Near farm but not obviously a garden throwout.
- ‡**Euphorbia palustris** L. 91/2.pal. *69, Westmorland: a few well-established colonies in copse with garden throwouts, Ninezergh Lane, Levens Hall, SD494849, G. Halliday, 2006, det. E. J. Clement, LANC. Ø
- ‡**Vitis coignetiae** Pull. ex Planchon 93/1.coi. *42, Brecknock: bank of disused railway, Taf fechan, 1.5 km NE Cefn Coed, SO 043093, P. A. Smith & M. Teneva, 2006, det. T. G. C. Rich, NMW. 1st Welsh record. Ø

‡*Parthenocissus inserta* 93/2.2. *46, Cards.: willow carr by road, Llancynfelyn Common, SN642923, A. O. Chater, 2006. NMW. 1st record as neophyte.

©*Linum usitatissimum* 94/1.2. 51, Flints.: grassland on old industrial site, Rhydymwyn Valley Nature Reserve, SJ205665, J. Phillips, 2006. 1st recent record for v.c. (other than as a cultivated crop)

‡*Aesculus carnea* 98/1.2. *69, Westmorland: by roadside wall, S side of King's Meaburn, NY623208, G. Lines, 2004, photo in LANC.

[‡*Aesculus indica* 98/1.ind. *69, Westmorland: S side of King's Meaburn, NY623208. Delete. Record published erroneously in *Watsonia* 26: 83 (2006).]

‡*Ruta graveolens* L. 101A/RUT.gra. *©62, N. E. Yorks.: pavement crack, York, SE593527, V. Jones & W. A. Thompson, 2006. Ø

‡*Oxalis articulata* 102/1.8. ©44, Carms.: garden throwout in area of disturbed ground with tipped rubble and garden waste, vegetated with tall herb species, Ystrad Mine, Glanamman, SN658129, R. D. Pryce, 2006. 1st record since 1970.

‡*Oxalis debilis* 102/1.10. *69, Westmorland: garden weed, Whinlatter Drive, Kendal, SD525906, A. M. Boucher, 2004, LANC.

‡*Geranium versicolor* 103/1.2. *H12, Co. Wexford: three large clumps on side of the R739, Silverspring Crossroads, T024096, P. R. Green, 2006.

‡*Geranium oxonianum* (G. *endressii* × G. *versicolor*) 103/1.1×2. *62, N. E. Yorks.: road verge, Hutton Rudby, NZ472061, V. Jones, 2002.

‡*Geranium macrorrhizum* 103/1.17. *62, N. E. Yorks.: several plants self-sown in pavement crack, Cawton, SE643767, V. Jones, 2006.

‡*Geranium cantabrigiense* (G. *dalmaticum* × G. *macrorrhizum*) 103/1.dal×17. *46, Cards.: grassy slope by quarry, bottom of Bryn-y-mor Road, Aberystwyth, SN584825, A. O. Chater, 2005, NMW, LTR. Apparently new as naturalised in British Isles. Ø

©*Pelargonium hortorum* L. Bailey 103/PEL.hor. *62, N. E. Yorks.: one plant on pavement edge, Stokesley, NZ525086, V. Jones, 2001. Ø

©*Limnanthes douglasii* 103A/LIM.dou. *62, N. E. Yorks.: several self-sown plants at base of wall, Great Ayton, NZ562103, V. Jones, 2006.

©*Impatiens sultanii* Hook. f. 105/1.sul. *44, Carms.: several plants in flower in hedge-bottom by roadside field boundary near houses, Red Roses, SN204117, R. D. Pryce, 2006. 1st Welsh record. *H12, Co. Wexford: single plant self-sown at base of wall, New Ross, S720276, P. R. Green, 2006. Ø

‡*Hedera colchica* 106/1.1. *62, N. E. Yorks.: covering a wide area of wasteland by footpath, Stokesley, NZ525090, V. Jones, 2003.

‡*Hedera algeriensis* 106/1.alg. *46, Cards.: roadside bank just E of Llys-y-graig, Cwmerfyn, SN689831, A. O. Chater, 2006. 1st record & only extant Welsh record.

‡*Hydrocotyle ranunculoides* 107/1.ran. *52, Anglesey: borrowpit by A55, 2 × 2m. patch, Bryngwran, SH348771, O. Mountford, 2006, herb. I. R. B. *62, N. E. Yorks.: developing colony, wet area in woodland, Throxenby Mere, near Scarborough, TA008889, V. Jones, 2001.

‡*Scandix pecten-veneris* 107/7.1. 51, Flints.: ploughed-up footpath, Glol, 1.5 miles S of Trelogan, SJ118778, P. Day, 2007. 1st recent record for v.c. and for Wales.

Oenanthe pimpinelloides 107/19.3. *29, Cambs.: a number of plants scattered in herbaceous vegetation around fishermen's platforms dug into the bank of lake, Waterbeach airfield, TL489672, J. D. Shanklin, 2006, CGE. *H12, Co. Wexford: plentiful in small pasture by Duncannon Fort, growing with *Rumex pulcher*, Duncannon, S727082, P. R. Green, 2006, DBN.

Oenanthe crocata 107/19.5. *29, Cambs.: one fruiting plant at water level, at base of R. Ouse embankment, Middle Fen, Swavesey, TL359706, A. C. Leslie, N. P. Millar & J. D. Shanklin, 2006, CGE.

Oenanthe fluviatilis 107/19.6. 57, Derbys.: submerged in river in the middle of the channel, River Mease, Haunton, SK238113, D. Broughton, 2006. 1st record since 1970.

‡*Ammi majus* 107/32.1. *©H12, Co. Wexford: waste ground, Mullaunnasmear, S88935215, P. R. Green, 2006, DBN.

©*Nolana paradoxa* Lindley 109.2/NOL.par. *29, Cambs.: one flowering plant on recently disturbed verge, north side of Brooklands Avenue, Cambridge, TL455569, A. C. Leslie & A. Stevenson, 2006, CGE. Ø

‡**Physalis alkekengi** 110/6.1 *62, N. E. Yorks.: a large colony in rough grassland by farm buildings, Mill Farm, near Nunnington, SE674794, V. Jones, 2001. *69, Westmorland: large established patch in woodland, Hincaster, SD508850, A. M. Boucher, 2005, **LANC**.

‡**Lycopersicon esculentum** 110/7.1. *©70, Cumberland: forest ride, Coombs Wood, Armathwaite, NY512443, G. Lines, 2006.

©**Nicotiana alata** 110/NIC.ala. *62, N. E. Yorks.: one plant in wasteland, Sleights, NZ875072, V. Jones, 2003, conf. E. J. Clement, **herb. V. Jones**.

©**Petunia ×hybrida** (**P. axillaris** × **P. integrifolia**) 110/PET.axixint. *44, Carms.: Burry Port Railway Station, SN447007, G. Hutchinson, 2006, **NMW**. *62, N. E. Yorks.: one plant in wasteland, Stokesley, NZ523085, V. Jones, 2003.

Calystegia ×lucana (**C. sepium** × **C. sylvatica**) 111/3.2×4. *H12, Co. Wexford: growing on waste ground, New Ross, S717271, P. R. Green, 2006.

Polemonium caeruleum 114/1.1. ‡41, Glam.: one flowering clump by bridleway, Mill Lane, Mayals, Swansea, SS612907, P. V. & A. S. Lewis, 2005. 1st record as neophyte.

‡**Phacelia tanacetifolia** 115/1.1. *©51, Flints.: bare ground on old industrial site, Rhydymwyn Valley Nature Reserve, SJ205665, J. Phillips, 2006. *©62, N. E. Yorks.: grassland by road, South Gare, N of Redcar, NZ561262, V. Jones, 2001.

Symphytum tuberosum 116/4.3. *‡H12, Co. Wexford: patch on bank of the Owenavorrach River and several patches amongst scrub by ruin, Courtown, T203573, P. R. Green, 2006.

‡**Brunnera macrophylla** 116/5.1. *©57, Derbys.: laneside, Hazelbarrow Farm, SK365815, K. Balkow, 2006. Garden throwout.

‡**Trachystemon orientalis** 116/10.1. *44, Carms.: neglected Churchyard, Llandyfeisant Church, Dinefwr Park, Llandeilo, SN621222, V. & A. Lewis, 2005.

‡**Amsinckia micrantha** 116/12.2. *©44, Carms.: two plants in flower in angle between wall and tarmac-surfaced car park, Provisions Market, Carmarthen town centre, SN410201, R. D. Pryce, 2006, **NMW**. See *BSBI Welsh Bull.* 78 for photo.

©**Nonea lutea** 116/NON.lut *62, N. E. Yorks.: five plants in railway ash, near station, Kirkham, SE732658, V. Jones, 2002, det. E. J. Clement, **herb. V. Jones**. *69, Westmorland: one large plant, pavement weed, in front of Holly House, Pooley Bridge, NY474244, D. Dupree, 2006, det. E. J. Clement, **LANC**.

©**Verbena tenuisecta** Briq. 117/1.ten. *29, Cambs.: one self-sown flowering plant in paving crack, junction of Leys Road and Highworth Avenue, Cambridge, TL455602, A. C. Leslie, 2006. Ø

‡**Lamiastrum galeobdolon** subsp. **argentatum** 118/4.1c. 51, Flints.: possible garden escape in woodland at edge of old industrial site, Rhydymwyn Valley Nature Reserve, SJ205665, J. Phillips, 2006. 1st record as neophyte

Ajuga ×pseudopyramidalis (**A. reptans** × **A. pyramidalis**) 118/12.1×2. 106, E. Ross: beside track near rock exposure, Torr Achilty, NH447545, T. D. Dines & C. D. Preston, 1999. 1st record since 1970. Still present 2007 with 10 flowering spikes.

©**Nepeta racemosa** Lam. 118/13.rac. *62, N. E. Yorks.: nine self-sown plants on roadside stone wall, Kirbymoorside, SE694867, W. A. Thompson, 2005, det. V. Jones and W. A. Thompson, conf. E. J. Clement, **herb. V. Jones**. Ø

‡**Lavandula angustifolia** 118/LAV.ang. *©62, N. E. Yorks.: several plants among street cobbles, Easingwold, SE530698, V. Jones & W. A. Thompson, 2006.

Callitriche truncata 120/1.2. *52, Anglesey: pond and inflow stream, Hen Felin Ddwr, Llangeifni, SH456753, I. R. Bonner, 2006, conf. R. V. Lansdown, **herb. I. R. B.** 1st published Welsh record but known from 6 other sites in v.c. 52.

Plantago media 121/1.4. ‡48, Merioneth: a large patch on the disused railway track, now a long distance footpath, between Arthog and Penmaenpool, SH61, P. M. Benoit, 2006.

‡**Forsythia suspensa** (Thunb.) Vahl 123/1.sus. *29, Cambs.: one plant established on old dumped soil, waste ground south-west of Royston station, TL347411, A. C. Leslie, 2001. Ø

‡**Ligustrum vulgare** 123/4/1. 110, Outer Hebrides: Northton, S. Harris, NF99V, R. J. Pankhurst, A. P. Wilson, M. Scholten, M. Fraser, E. Stewart & S. Murray, 2006. 1st record since 1970.

Verbascum pulverulentum 124/1.11. *‡69, Westmorland: S side of main access track, 2 large flowering plants plus 2 rosettes in an area of dumped limestone, Roudsea Wood NNR, SD332830, K. Walker *et al.*, 2006, det. A. Lesley, **ABRN**.

‡**Mimulus ×hybridus** (*M. cupreus* × *M. × smithii*) cv. 'Malibu Ivory' 124/4.cup×smi. *44, Carm's.: boundary wall of school, Mynydd y Garreg Hall, car park wall, SN428079, BSBI Meeting, 2006, det. A. J. Silverside, NMW. 1st Welsh record (see *BSBI News* 105 for photo). Ø

‡**Hebe salicifolia** 124/17.1. *62, N. E. Yorks.: wasteland, York, SE598525, V. Jones & W. A. Thompson, 2006.

‡**Hebe brachysiphon** 124/17.2. *62, N. E. Yorks.: self-sown in cracks in wall, North Bay, Scarborough, TA042892, V. Jones & W. A. Thompson, 2005.

‡**Hebe ×franciscana** (*H. elliptica* × *H. speciosa*) 124/17.ell×spec. *62, N. E. Yorks.: abundantly self-sown in cracks in wall, North Bay, Scarborough, TA042892, V. Jones & W. A. Thompson, 2005.

Euphrasia arctica subsp. *arctica* 124/20.5a. *70, Cumberland: at 400m on damp bank near Hole House Farm, Garrigill, NY758387, F. J. Roberts *et al.*, 2005, det. A. J. Silverside, LANC. 1st definite record.

Euphrasia nemorosa × *E. confusa* × *E. micrantha* 124/20.7×9×18. *62, N. E. Yorks.: several plants by forest track near Ingleby Greenhow, NZ 598065, V. Jones, 1996, det. A. J. Silverside, herb. V. Jones. Ø

Euphrasia confusa × *E. micrantha* 124/20.9×18. *69, Westmorland: rough acid grassland, S of Tarn Sike, Sunbiggin, NY666075, G. Halliday, 2006, det. A. J. Silverside, LANC.

Euphrasia ostenfeldii 124/20.14. @110, Outer Hebrides: peaty coastal turf, Paible, Taransay, NG029991, A. J. Silverside, 2006.

Nemesia denticulata Benth. 124/NEM.den. *29, Cambs.: several plants in clinker at edge of old railway track north-west of former station, Histon, TL435631, A. C. Leslie, 2006, CGE. Ø

‡**Lathraea clandestina** 125/1.2. *46, Cards.: wooded dingle, Penglais, Aberystwyth, SN593820, R. Griffiths, 2006. Known here for at least 30 years.

Utricularia australis 128.2.2. *79, Selkirk's.: at 290m on shallow loch edge, Clearburn Loch, NT342154, J. Waddell, 2006. Several flowering plants and therefore determined as this species as a first record.

‡**Campanula portenschlagiana** 129/1.9. *H12, Co. Wexford: on several walls about the town, Enniscorthy, S9739, P. R. Green, 2006.

©**Campanula carpatica** Jacq. 129/1.car. *29, Cambs.: several flowering plants, presumably self-sown, in crevice running round top of chest tomb, St Benet's churchyard, Cambridge, TL4458, A. A. Butcher, 2006. Ø

©**Lobelia erinus** 129/7.2. *H12, Co. Wexford: self-sown at base of wall, New Ross, S7227, P. R. Green, 2006.

‡**Viburnum rhytidophyllum** 131/2.4. *41, Glam.: probably bird-sown on road verge, Bishwell, Gowerton, SS594956, A. S. Lewis, 2006.

Linnaea borealis 131/4.1. 106, E. Ross: pine plantation, Wester Culbo Wood, NH6359, B. R. & C. B. Ballinger, 2007. 1st record since 1970.

‡**Lonicera pileata** 131/6.1. *41, Glam.: bird-sown at edge of wall, Mayhill, Swansea, SS643943, I. K. Morgan, 2006, NMW. 1st Welsh record. *44, Carm's.: well established on laneside bank, The Graig, Burry Port, SN448017, Llanelli Naturalists, 2006.

‡**Lonicera xylosteum** 131/6.4. 29, Cambs.: one multi-stemmed shrub, bird-sown on the track of the old railway, by the Science Park, Milton, TL465613, A. C. Leslie, 2006, CGE. 1st record since 1900.

‡**Lonicera ×italica** (*L. caprifolium* × *L. etrusca*) 131/6.8 ×etr. *69, Westmorland: waste land E of Cavendish Dock, Barrow-in-Furness, SD218687, A. M. Boucher *et al.*, 2006, LANC.

‡**Lonicera tatarica** 131/6.tat. *69, Westmorland: one large bush in derelict factory area, Barrow-in-Furness, SD216686, A. M. Boucher *et al.*, 2006, LANC. *70, Cumberland: roadside by woodland, S of Unthank End, NY460345, G. Lines, 2006, LANC.

‡**Centranthus ruber** 133/3.1. *91, Kincardines.: old stone wall, Johnshaven, NO795670, D. Welch, 2006.

‡**Dipsacus laciniatus** 134/1.lac. *29, Cambs.: at least 50 flowering plants and more vegetative rosettes, waste ground on either side of railway, just south-west of level crossing, Shepreth, TL388476, A. C. Leslie, 2006, CGE. *67, S. Northumb.: lots of plants all along paths, Hauxley Nature Reserve car park, NU283024, D. Nelson, 2006. Also seen by F. Augier.

Carduus tenuiflorus 135/5.1. 29, Cambs.: one large plant on south-west verge of A14, Bar Hill, TL379641, A. C. Leslie, 2006, CGE. 1st record since 1955.

- Cirsium xcelakovskianum** (*C. palustre* × *C. arvense*) 135/6.9×10. *49, Caerns.: near Coedty reservoir, Dolgarrog, SH7566, W. McCarthy, 2006.
- ‡**Onopordum acanthium** 135/7.1. ‡41, Glam.: several plants on sandy waste, Port Eynon, SS471855, A. S. Lewis, 2006. 1st record since 1970. (A single plant was recorded by A. S. Lewis on a stony verge at Horton, SS470858, in September 2001).
- ‡**Lactuca serriola** 135/22.1. *H12, Co. Wexford: frequent on waste ground on west of the R733, New Ross, S711257, P. R. Green, 2006.
- Taraxacum stictophyllum** 135/25.45. *77, Lanarks.: by track beyond steading, Highfield, Coulter, NT014338, D. J. McCosh, 2006, det. A. J. Richards, **herb. D. J. M.**
- ‡**Taraxacum kernianum** 135/25.91. *69, Westmorland: footpath margin near Valley Drive, Kendal, SD528918, A. M. Boucher, 2006, det. A. J. Richards, **herb. A. M. B.**
- Taraxacum marklundii** 135/25.94. *77, Lanarks.: bottom lake, Highfield, Coulter, NT016342, D. J. McCosh, 2006, det. A. J. Richards, **herb. D. J. M.**
- ‡**Taraxacum latissimum** 135/25.152. *69, Westmorland: by St Mark's Church, Natland, SD521891, A. M. Boucher, 2006, det. A. J. Richards, **herb. A. M. B.**
- ‡**Taraxacum tumetillobum** 135/25.215. *69, Westmorland: waste ground, Windermere, SD411982, A. M. Boucher, 2006, det. A. J. Richards, **herb. A. M. B.**
- ‡**Taraxacum adiantifrons** 135/25.adi. *69, Westmorland: by St Mark's Church, Natland, SD521891, A. M. Boucher, 2006, det. A. J. Richards, **herb. A. M. B.**
- Hieracium subcrocatum** 135/28.14. 47, Monts.: many plants midstream on riverside rocks with a few on bank on S side of Afon Rhaeadr just above Pistyll Rhaeadr falls, SJ072295, A. K. Thorne, 2006, det. D. J. McCosh, **NMW**. 1st record since 1970.
- Hieracium diaphanum** 135/28.72. *47, Monts.: one flowering stem and a few small plants on large riverside rock, on S side of Afon Rhaeadr upstream of falls, SJ071296, A. K. Thorne, 2006, det. D. J. McCosh, **NMW**. 1st Welsh record.
- Hieracium uisticola** 135/28.89. 110, Outer Hebrides: Cladach Cuiashader, NB551585, P. A. Smith, 1999, det. D. J. McCosh, **E**. 1st record since 1970.
- ‡**Hieracium cardiophyllum** 135/28.139. *29, Cambs.: under trees by Royston road to Newmarket Road, north side of cutting, just out of Royston, TL370409, P. D. Sell, 1999, **CGE**.
- ‡**Hieracium exotericum** 135/28.140. *29, Cambs.: railway bank by Devil's Ditch, Dullingham, TL6360, R. J. Pankhurst, 1968, **CGE**, det. P. D. Sell. Originally determined by P. D. Sell as *H. sublepidoides* but redetermined by him in 1999.
- Hieracium britannicum** 135/28.179. *50, Denbs.: limestone cliffs, Bryn Euryn, SH832797, W. McCarthy, 2004, det. D. J. McCosh, **NMW**. 1st Welsh record.
- Hieracium eustoma** 135/28.185. *110, Outer Hebrides: Teinnasval, Sgoran Dubh, Uig, NB0425, E. B. Bangerter, 1938, **BM**, det. D. J. McCosh.
- ‡**Hieracium argillaceum** 135/28.arg. *45, Pembs.: old railway yard/disused railway track, Letterston, SM927305, S. B. Evans, 1999, **NMW**, det. D. J. McCosh. Determined in 2006. Ø
- *47, Monts.: inland cliffs, on S side of Afon Rhaeadr, SJ073294, A. K. Thorne, 2006, det. D. J. McCosh, **NMW**. *50, Denbs.: coal tip waste, Bersham, SJ310464, A. K. Thorne, 2005, det. D. J. McCosh, **NMW**.
- ‡**Hieracium aterrimum** 135/28.ate. *29, Cambs.: Royston to Newmarket road, just out of Royston, TL3740, P. D. Sell, 1956, **CGE**. Determined in 1999. Ø
- Hieracium consociatum** 135/28.con. *50, Denbs.: coal tip waste, Bersham, SJ314464, A. K. Thorne, 2005, det. D. J. McCosh, **NMW**. 1st v.c. & 2nd Welsh record. Ø
- ‡**Hieracium firmirum** 135/28.fir. *29, Cambs.: under trees by Royston road to Newmarket Road, just out of Royston, TL370409, P. D. Sell, 1999, **CGE**. Ø
- ‡**Hieracium gentile** 135/28.gen. *29, Cambs.: bank of cutting of A505, just east of Royston, TL373409, P. D. Sell, 1956. Grown from here in Cambridge University Botanic Garden and a specimen from cultivation collected 1967 (**CGE**) and det. P. D. Sell 1999. Ø
- ‡**Hieracium koehleri** 135/28.koe. *29, Cambs.: cutting just out of Royston on the Newmarket road, TL373409, P. D. Sell, 1953, **CGE**. Determined in 1999. Ø
- ‡**Hieracium neosparsum** 135/28.neo. *29, Cambs.: Royston to Newmarket road, just out of Royston, TL3740, P. D. Sell, 1956, **CGE**, det. P. D. Sell. Determined in 1999. Ø
- ‡**Hieracium onychodontum** 135/28.ony. *29, Cambs.: under trees by the Royston to Newmarket road, north side of cutting, just east of Royston, TL373409, P. D. Sell, 1999, **CGE**. Ø

‡*Hieracium quadridentatum* 135/28.qua. *29, Cambs.: chalk side of cutting on east side of junction of Royston to Newmarket road and the Royston bypass, TL373409, P. D. Sell, 1999, CGE. Ø

‡*Hieracium seriflorum* 135/28.ser. *29, Cambs.: under trees by Royston to Newmarket road, north side of cutting, just out of Royston, TL370409, P. D. Sell, 1999, CGE. Ø

‡*Hieracium sylvularum* 135/28.syl. *29, Cambs.: under trees by Royston to Newmarket road, north side of cutting, just out of Royston, TL370409, P. D. Sell, 1999, CGE. Ø

©*Helichrysum bracteatum* (Vent.) Andrews 135/34.bra. *46, Cards.: waste ground, boatbuilding yard, Ynys-las, SN616933, J. P. Woodman & A. O. Chater, 2006. Ø

‡*Aster novi-belgii* 135/41.4. *H12, Co. Wexford: patch on bank of River Barrow, New Ross, S71552722, P. R. Green, 2006.

‡*Erigeron glaucus* 135/43.1. *H12, Co. Wexford: one plant on sandy road verge, Coolrainey, T105275, P. R. Green, 2006.

‡*Erigeron speciosus* (Lindl.) DC. 135/43.spe. *62, N. E. Yorks.: large colony on road verge, by coast road, Sandsend, NZ865124, V. Jones, 2001. Ø

‡*Conyza canadensis* 35/44.1. *91, Kincardines.: flower bed in garden centre, Banchory, NO701967, I. P. Green, 2006.

‡*Conyza sumatrensis* × *Erigeron acer* 135/44.2×43.6. *29, Cambs.: sixteen plants, with both parents, on south-west facing, steep chalk bank on north side of Royston bypass, TL363421, A. C. Leslie, 2006, CGE. Ø Apparently first record for British Isles.

©*Conyza floribunda* Humb. Bonpl. & Kunth 135/44.flo. *29, Cambs.: between pavement slabs, Free School Lane, Cambridge, TL4458, P. D. Sell, 1999, CGE. This record was of the var. *linearifolia*. Ø

‡*Olearia macrodonta* 135/45.2. *70, Cumberland: roadside by harbour SSSI, Maryport, NY033362, G. Lines, 2006.

‡*Olearia solandri* Hook. f. 135/45.sol. *41, Glam.: self-sown on east-facing limestone cliff, Mumbles Head, SS630874, A. S. Lewis, 2006. 1st Welsh record. Ø

‡*Achillea nobilis* L. 135/53.nob. *©29, Cambs.: one plant established on waste ground, lay-by along the Oakington Road, Cottenham, TL442668, A. C. Leslie, 1990, CGE. Ø

‡*Leucanthemella serotina* 135/57.1. *62, N. E. Yorks.: large colony in rough grassland, railway embankment N of station, Pickering, SE797845, V. Jones & W. A. Thompson, 2005.

©*Leucanthemum paludosum* (Poiret) Bonnet & Barratte 135/58.pal. *62, N. E. Yorks.: one self-sown plant at base of wall, Thirsk, SE435824, V. Jones & W. A. Thompson, 2006, det. E. J. Clement, herb. V. Jones. Ø

‡*Senecio inaequidens* 135/62.3 *29, Cambs.: one large plant on margin of old runway, Waterbeach airfield, TL486664, J. D. Shanklin, 2006, CGE. *67, S. Northumb.: several plants on cinder heap, Hauxley Nature Reserve, NU283024, D. Nelson, 2006, conf. F. Augier & A. J. Richards.

‡*Senecio smithii* 135/62.9. *91, Kincardines.: ditch, Drumlithie, NO783810, D. Welch, 2006. Observed in a ditch by the same track by A. Craib (Glasgow) in 1973.

‡*Delairea odorata* 135/65.1. *44, Carms.: Llanybri, SN336125, I. K. Morgan & R. N. Stringer, 2005. 1st Welsh record. Overflowing over garden wall onto roadside vegetation, where there were young plants from seed or rooting of rampant stems. Also across road.

‡*Calendula officinalis* 135/73.1 ©48, Merioneth: two plants c. 20m apart at foot of soil mound in small field beside the Tallylyn railway, Hen-dy near Tywyn, SH50, S. P. Chambers, 2006. 1st record since 1970. (A single plant was recorded by A. S. Lewis on a stony verge at Horton, SS470858 in September 2001).

‡*Calendula arvensis* 135/73.2. *48, Merioneth: numerous plants (possibly from bird seed) at supermarket car park and base of hotel wall, Park Road, Barmouth, SH61, P. M. Benoit, 2006. Flowered continuously through the mild winter of 2006-7.

‡*Ambrosia artemisiifolia* 135/74.1. *©45, Pembs.: disturbed ground, Rhoscrowther, SM904021, S. B. Evans, 1999, det. T. C. G. Rich. Specimen collected and provisionally identified by S. B. E. - confirmed by T. C. G. Rich 21/9/2006. Found in village demolished by Texaco/Chevron on site of old aviary. *91, Kincardines.: earth heap near farm, Banchory, NO717912, I. P. Green, 2006.

- ‡**Helianthus ×laetiflorus** (**H. tuberosus** × **H. pauciflorus**) 135/79.2×pav. *52, Anglesey: waste ground, Carnau, SH276806, W. McCarthy, 2006, det. E. J. Clement.
- ‡**Galinsoga parviflora** 135/80.1. *52, Anglesey: hen run on former arable field, Penlon, Newborough, SH430650, B. Wrightson, 2006, det. E. J. Clement.
- ‡**Cassinia leptopylla** R. Br. 135/CAS.lep. *H12, Co. Wexford: single plant self-sown in crack of concrete, Kilmore Quay, S966033, P. R. Green, 2006. Perhaps conspecific with *C. fulvida*. Ø
- ©**Melampodium montanum** Benth. 135/MEL.mon. *H12, Co. Wexford: single plant self-sown at base of wall, New Ross, S720276, P. R. Green, 2006, DBN. Ø
- ©**Tagetes patula** 135/TAG.pat. *H12, Co. Wexford: single plant self-sown at base of wall, New Ross, S720276, P. R. Green, 2006.
- Butomus umbellatus** 136/1.1. *‡44, Carms.: well established in eutrophic pond inside sea wall constructed within the last decade as part of the Machynys Golf Course development, SS516978, I. K. Morgan, 2006, NMW.
- Sagittaria sagittifolia** 137/1.1. *‡44, Carms.: vegetated attenuation pond, Traveller's Rest, Carmarthen, SN386191, R. D. Pryce, 2006.
- [‡**Egeria densa** 138/3.1 *80, Roxburghs.: pond, Smailholm village, NT646372, L.W.Gaskell, 2002. Delete. Incorrect determination.]
- ‡**Lagarosiphon major** 138/6.1. *80, Roxburghs.: pond, Smailholm village, NT646372, L. W. Gaskell, 2002, det. R. W. M. Corner, **herb. R. W. M. C.** Wrongly determined as *Egeria densa*. See *Watsonia* 26: 93 (2006) *H12, Co. Wexford: plentiful in stream along roadside by Wexford Blocks Ltd, Castlebridge, T056269, P. R. Green, 2006.
- Potamogeton ×gessnacensis** (**P. natans** × **P. polygonifolius**) 142/1.1×2. *46, Cards.: backwater outflow by Forestry Commission car park, Tynbedw, Llnafan, SN694716, R. V. Lansdown & A. O. Chater, 2006, conf. C. D. Preston, NMW.
- Potamogeton obtusifolius** 142/1.14. *62, N. E. Yorks.: The Mere, Scarborough, TA0286, H. Moseley, 1840, det. Dandy and Taylor. Overlooked for the VCCC.
- Potamogeton compressus** 142/1.17. ®57, Derbys.: submerged in canal, Langley Mill, SK454471, P. Precey, 2006. Unboated part of Erewash Canal above the locks.
- Arum maculatum** 147/5/1. ‡110, Outer Hebrides: Newton Lodge, SW corner of walled garden, NF892773, R. J. Pankhurst, 2006. 1st record since 1970.
- ‡**Arum italicum** subsp. **italicum** 147/5.2b. ©57, Derbys.: roadside verge, Middle Moor, Ashover, SK319634, N. Law & K. Huston, 2006, conf. A. Willmot. 1st record since 1970.
- ©**Pistia stratiotes** L. 147/PIS.str. *57, Derbys.: floating on stream, Old Hay Brook between Totley & Dore, SK3080, K. Balkow, 2006. No houses nearby. Ø
- ‡**Lemna minuta** 148/2.4. *70, Cumberland: pond in Nichol Hill W.T. Reserve, Penrith, NY511305, R. W. M. Corner, 2006, LANC. *H12, Co. Wexford: frequent in ditch, Ardcanan, T0624, P. R. Green & J. Monaghan, 2006.
- ‡**Luzula nivea** (L.) DC. 151/2.niv. *©62, N. E. Yorks.: several self-sown plants at base of river wall, behind the supermarket, by R. Derwent, Malton, SE785719, V. Jones, 2004, **herb. V. Jones**. Ø
- Eleogeton fluitans** 152/9.1. 29, Cambs.: abundant in drain along north side of Benwick Road, Whittlesey, TL291961, A. C. Leslie, 2006, CGE. 1st record since 1975, although marked in VCCC as not recorded post 1969. 91, Kincardines.: curling pond, Banchory, NO683963, I. P. Green, 2006. 1st record since 1970.
- ‡**Cyperus congestus** Vahl 152/11.con. *44, Carms.: locally frequent on limestone-aggregate-surfaced factory development plateau at site where gipsies had periodically camped over the previous few years, 'Delta Lakes' site, Machynys, Llanelli, SS509985, G. Hutchinson, I. K. Morgan & R. D. Pryce, 2003, det. D. A. Simpson, NMW. 1st Welsh record. Originally determined as *C. rotundus* but subsequently redetermined as *C. congestus* by D. A. Simpson at Kew. Ø
- ‡**Cyperus involucratus** Rottb. 152/11.inv. *69, Westmorland: ditch, recreation ground, Milnthorpe, SD493814, J. H. Clarke, 2006, LANC. Ø
- Carex maritima** 152/16.14. ®110, Outer Hebrides: damp sandy areas, Corran Ra, Taransay, NB040004, J. W. McIntosh, L. Laxton, E. Stewart, M. Hall, 2006. The first of four new sites in this hectad on the same day. ®110, Outer Hebrides: sandy shore, Port nan Long, North Uist, NF897781, R. J. Pankhurst, 2006.

Carex xsooi (*C. acutiformis* × *C. riparia*) 152/16.25×26. *29, Cambs.: second field east of River Cam, Cambridge Washes, Dimmock's Cote, TL539721-2, G. Crompton & P. Stebbings, 1992, CGE, conf. A. C. Jermy, M. J. Y. Foley & M. S. Porter. This parentage suggested by R. W. David.

Carex xcsomadensis (*C. riparia* × *C. vesicaria*) 152/16.26×29. *29, Cambs.: north bank of R. Ouse near Aldreth, TL408735, A. O. Chater, 1955, BM, det. A. C. Jermy & A. O. Chater.

Carex xlateola (*C. distans* × *C. viridula* subsp. *viridula*) 152/16.41×46. *44, Cambs.: damp hollow in saltmarsh/dune interface between helipad and firebreak, RAF Range, Tywyn Burrows, SN369050, BSBI Meeting, 2006, det. M. S. Porter. 1st Welsh record. (See *BSBI News* 105 for photo.)

Carex digitata 152/16.48. @57, Derbys.: shaded Magnesian limestone outcrop, Pleasley Park, SK516650, A. Willmot, 2006, det. D. A. Simpson. 1st Derbyshire record for the Magnesian Limestone.

Carex recta 152/16.63. @106, E. Ross: tidal estuary by Newton of Ochtow, Kyle of Sutherland, NC485001, M. Dean, B. R. and C. B. Ballinger, 2006.

Carex xdecolorans (*C. nigra* × *C. bigelowii*) 152/16.67×69. *46, Cards.: upland sheepwalk, Sian Groca, Pumlumon, SN80388773, A. O. Chater, 2001, NMW.

‡**Carex buchananii** 152/16.buc. *29, Cambs.: one self-sown plant at base of brick wall, Back Lane, Ely, TL545800, A. C. Leslie, 2005, CGE. Site revisited in 2006 when flowering material confirmed the identification.

‡**Sasa palmata** 153/3.1. *67, S. Northumb.: site of old estate garden, Bothal, R. Wansbeck, NZ236861, G. & A. Young, 2004. *H12, Co. Wexford: several patches under trees, Ballinlug, S844443, P. R. Green, 2006.

‡**Lolium xboucheanum** (*L. perenne* × *L. multiflorum*) 153/13.1×2 *H12, Co. Wexford: road verge, Templeludigan, S793356, P. R. Green, 2006.

‡**Briza maxima** 153/17.3. 41, Glam.: roadside weed, Capel y Gopa, Pontarddulais, SN602035, I. K. Morgan & R. N. Stringer, 2005. 1st record as neophyte.

Poa annua forma **purpurea** 153/18.2pur. *46, Cards.: flowerbeds and paths, Archibalds' garden centre, Ffostrasol, SN363477, J. P. Poland & A. O. Chater, 2006, NMW. This almost invisible form was described by M. L. Grant in *Watsonia* 24: 525-526 (2003) and seems to be known only from gardens.

‡**Poa chaixii** 153/18.7. *62, N. E. Yorks.: several long-established plants at edge of wood, Crow Wood, Danby, NZ717084, V. Jones, 1990.

Melica nutans 153/25.1 *46, Cards.: rocky slope in ancient woodland, bottom of Allt Boeth, Cwm Rheidol, SN73707733, C. M. Forster Brown, 2006, NMW.

Deschampsia cespitosa subsp. **parviflora** 153/32.1b. *67, S. Northumb.: dry woodland with mature trees, Minsteracres, NZ022554, A. J. Richards, 2006, herb. G. A. Swan. 1st localised record. Also seen at NU922612 West Dipton Dene and NU935613 Hole House Wood.

‡**Phalaris canariensis** 153/38.3. 91, Kincardines.: pathside, Banchory, NO709963, I. P. Green & M. Duncan, 2006. 1st record since 1970.

Agrostis xmurbeckii (*A. capillaris* × *A. stolonifera*) 153/39.1×4. 48, Merioneth: roadside, near Bron Meirion, Arthog, SH61, P. M. Benoit, 2006. 1st record since 1970. With both parents but no other *Agrostis* present. Characters intermediate and at just the right stage for the yellow indehiscent anthers to be obvious.

Agrostis curtisii 153/39.6. *45, Pembs.: a few plants present in major heathland creation project on former arable coastal fields, Runwayskiln, Trehill Farm, Marloes, SM774078, M. Sutton, 2006, det. A. O. Chater. Not recorded on any of the adjacent coastal heath.

Calamagrostis epigejos 153/40.1 *106, East Ross.: in birch woodland, Torrachilty Wood, NH441556, M. Eagleson, 1988, conf. D. R. McKean, E. Still present October 2007.

‡**Polypogon viridis** 153/46.2. *62, N. E. Yorks.: several plants in grassland at edge of conifer plantation near Newby, NZ517127, V. Jones, 2005, conf. A. Copping, herb. V. Jones.

*H12, Co. Wexford: frequent at base of walls about Duncannon, S7208, P. R. Green, 2006, DBN.

Bromus racemosus 153/50.3. 45, Pembs.: rush-pasture, Moor Farm, Jeffreyston, SN068077, S. Bosanquet, 2001. 1st record since 1970.

[‡**Cortaderia selloana** 153/62.1. 110, Outer Hebrides: roadside, Tarbert, NB142008, R. J. Pankhurst, 2003. Delete. Redetermined in 2006 as *C. richardii*.]

‡*Cortaderia richardii* 153/62.ric. *77, Lanarks.: roadside, Hazelbank, NS8345, P. Macpherson, 2004, det. E. J. Clement, **herb. P. M.** Flowering specimen. *91, Kincardines.: small plantation, Tilquhillie, NO728950, I. P. Green, 2006. *110, Outer Hebrides: roadside, Tarbert, NB142008, R. J. Pankhurst, 2003.

©*Eragrostis minor* 153/65.2. *29, Cambs.: dozens of small plants in amongst cobbles bordering a path across Great Court, Trinity College, Cambridge, TL447586, A. C. Leslie, 2006, **CGE**, conf. E. J. Clement.

©*Echinochloa colona* 153/68.col. *46, Cards.: bird-seed casual by bus station, Aberystwyth, SN586816, A. O. Chater, 2006, **NMW**. 1st v.c. & only recent Welsh record.

©*Echinochloa frumentacea* 153/68.fru. *44, Carms.: on waste ground near Pembrey Parish Church, SN427013, I. K. Morgan, 2006, det. G. Hutchinson, **NMW**.

©*Setaria italica* 153/70.ita. *45, Pembs.: disturbed ground in village demolished by Texaco/Chevron on site of old aviary, Rhoscrowther, SM904021, S. B. Evans, 1999, det. G. Hutchinson.

‡*Setaria pumila* 153/70.pum. *©47, Monts.: one handsome little clump at garden edge near birdtable, Foel, SH992106, M. Wainwright, 2006, det. J. Mason. *Ambrosia artemisiifolia* nearby.

©*Digitaria ciliaris* 153/71.cil. *46, Cards.: pavement weed, Aberystwyth marina, SN581812, A. O. Chater, 2006, **NMW**. 1st v.c. & 2nd Welsh record.

‡*Anemanthele lessoniana* (Steud.) Veldkamp 153/ANE.les. *91, Kincardines.: path in woodland, Banchory, NO709963, I. P. Green, 2006. *H12, Co. Wexford: single clump self-sown at base of hedge on roadside, Buncloody, S90715599, P. R. Green, 2006. Ø

Sparganium natans 154/1.4. 91, Kincardines.: curling pond, Banchory, NO683963, I. P. Green, 2006, **herb. D. Welch**. 1st record since 1957.

©*Eichhornia crassipes* (Mart.) Solms 157/Eic.cra. *57, Derbys.: floating on stream, Old Hay Brook between Totley & Dore, SK3080, K. Balkow, 2006. No houses nearby. Ø

‡*Kniphofia uvaria* 158/6.1. *41, Glam.: several flowering plants in disused quarry, Rhoose, ST056661, A. S. Lewis, 2006.

Colchicum autumnale 158/7.1. *51, Flints.: three flowers in a clump on rough pasture with bracken and *Cirsium arvense*, W of Cefn Mawr Quarry, S of Cefn Bychan, Pant-y-mwyn, SJ1963, J. Skates & G. Wynne, 2006. 1st record since 1970. Status uncertain.

‡*Tulipa gesneriana* 158/10.3. 113(S), Channel Is. (Sark): garden outcast growing in a hollow in waste ground, between Saut à Juan quarry and Le Port, WV454760, R. M. Veall, 2005, photograph with *Société Serquaise*. 1st record outside garden for Sark.

Convallaria majalis 158/13.1. *‡106, E. Ross: beside track, Brahan, NH517548, B. R. & C. B. Ballinger, 2006, **herb B. R. B.**

‡*Scilla siberica* 158/19.3. *62, N. E. Yorks.: completely covering an old grave and spreading into neighbouring grassland, churchyard, Carlton, NZ507045, V. Jones, 2000.

‡*Hyacinthus orientalis* 158/21.1. *©62, N. E. Yorks.: one plant on road verge, Battersby, NZ592081, V. Jones, 1998. May be a discarded bulb. *H12, Co. Wexford: single plant, with pink flowers, on rough ground, Clonmore, S945316, P. R. Green, 2006.

‡*Allium subhirsutum* 158/24.5. *41, Glam.: increasing in sandy grassland and scrub, Horton, Gower, SS476855, A. S. Lewis, 2005.

‡*Allium paradoxum* 158/24.9. *35, Mons.: a few plants making spontaneous appearance in 2005 in overgrown bed in lawn, La Cuesta, Chepstow, ST5293, T. G. Evans, 2006. *H12, Co. Wexford: wooded east bank of Owenavorrigh River, Courtown, T20295724, P. R. Green, 2006.

†*Allium ampeloprasum* var. *ampeloprasum* 158/24.13. *H12, Co. Wexford: large patch on road bank, Houseland, S75740116, P. R. Green, 2006, **DBN**.

‡*Nectaroscordum siculum* 158/25.1. *57, Derbys.: under trees and bushes on river bank, Wye Dale, SK104725, P. Llewellyn, 2006, conf. A. Willmot. Apparently well naturalised.

‡*Leucojum aestivum* subsp. *pulchellum* 158/31.1b. *46, Cards.: wooded slope, Llanbadarn Fawr, SN607805, A. O. Chater & S. P Chambers, 2006, **NMW**. 1st record of subspecies.

‡*Galanthus nivalis* × *G. elwesii* 158/32.1×2. *62, N. E. Yorks.: several well-established plants in grassland under trees, Eston cemetery, NZ547187, V. Jones, 2006, conf. J. Armitage.

‡*Narcissus tazetta* 158/33.1. *H12, Co. Wexford: large patch under a tree in field, Ballinesker, T118289, P. R. Green, 2006.

‡*Narcissus cyclamineus* 158/33.6. *41, Glam.: in rubbly waste, Langdon Road, Swansea Docks, SS670930, A. S. Lewis, 2005. 1st Welsh record.

‡*Sisyrinchium californicum* 159/2.3. *46, Cards.: abundant in area 30 x 10m on gravelly scrub slope, Maes-y-pwll, New Quay, SN391595, A. O. Chater, 2006, conf. E. J. Clement, NMW.

‡*Sisyrinchium striatum* 159/2.5. *H12, Co. Wexford: clump on waste ground, New Ross, S711257, P. R. Green, 2007.

‡*Iris germanica* 159/5.1 *67, S. Northumb.: Seaton Sluice, NZ337768, J. L. Durkin, 2005.

‡*Iris orientalis* 159/5.7. *41, Glam.: about 20 flowering spikes (perhaps planted?), on verge of B4265, near Llantwit Major, SS975694, P. V. & A. S. Lewis, 2006. 1st Welsh record.

‡*Crocus tommasianus* 159/8.2. *H12, Co. Wexford: clump on rough road verge, where soil had been dumped, Polumaloe, S697190, P. R. Green, 2006.

‡*Gladiolus communis* subsp. *byzantinus* 159/9.2b. *H12, Co. Wexford: single plant on road verge, Gallagher, T0007, P. R. Green, 2006.

‡*Crocsmia paniculata* 159/13.1. *H12, Co. Wexford: large patch on waste ground, Templeludigan, S793356, P. R. Green, 2006.

‡*Cordyline australis* 160/3.1. 44, Carms.: seeding at junction of sandstone wall and unmetalled backlane, Sandy Road, Iscoed, Llanelli, SN494007, I. K. Morgan, 2006. 1st Welsh record as a neophyte.

Epipactis × *schmalhauseni* (*E. atrorubens* × *E. helleborine*) 162/3.2×4. *69, Westmorland: grikes of limestone pavement, Hutton Roof, SD555781, A. Gendle, 2005, det. A. J. Richards, photo LANC.

Gymnadenia conopsea subsp. *borealis* 162/16.1c. *79, Selkirks.: at 200m on flushed hillside, Williamshope, Glenkinnon Burn, NT418334, C. Morrison, 1978, det. R. W. M. Corner. First record of subspecies. Photograph retained by R. W. M. Corner.

Dactylorhiza × *hallii* (*D. maculata* × *D. praetermissa*) 162/18.2×4. *70, Cumberland: scrub on roadside bank, A66 E of Threlkeld, NY348270, A. Gendle, 2006, det. R. M. Bateman.

Dactylorhiza praetermissa 162/18.4. *69, Westmorland: 80+ plants in roadside/woodland margin, Prizet, S of Kendal, SD506902, A. Gendle, 2006, det. R. M. Bateman, *70, Cumberland: scrub on roadside bank, A66 E of Threlkeld, NY348270, A. Gendle, 2006, det. R. M. Bateman.

Obituaries

FLORENCE EVA CRACKLES

1918–2007

Eva once told me that her father taking her for walks in the countryside first introduced her to the wonders of nature. Eva's father was unemployed for many years and despite a tough domestic economy and wartime in her native Kingston upon Hull, she managed to achieve a Bachelor of Science (General) Degree (External, London) in mathematics and chemistry at age 22 years. Her mathematics tutor was Dr Jacob 'Bruno' Bronowski, and it was clear that this great man influenced Eva's intellectual and philosophical development, and that her father sowed the first seed of a flourishing career in the study of natural history.

In 1941 Eva started teaching in Hull then, briefly in Cambridge, before spending the remainder of her active teaching career at home. Her first venture into organised study of natural history came by joining the Hull Scientific and Field Naturalists Club in 1941 and thereafter she was introduced to the Yorkshire Naturalists Union (Y.N.U.) in 1943. At that time Eva divided her interest between birds and botany. In the field of ornithology she became seemingly physically attached to the Spurn peninsula, at first for its birds. In the early 1950's Eva's interest in birds waned as greater interest in plants took hold. The wartime bombing of Hull had produced oases of wildflowers on derelict sites and Eva's early accounts of these, her project writing '*Crackles Country*' for the Hull Daily Mail and her work on the evening class lecture circuit for the Workers' Educational Association launched Eva into recognition by both the public and academia. Bob Lewis introduced her to the B.S.B.I. and she soon took the reins as recorder for vice county 61 (S.E. Yorkshire), both for the B.S.B.I. and for the Y.N.U. In 1956 Eva replaced her bicycle with motorcycle and her botanising thereafter became less parochial and more rewarding. Her studies and participation in B.S.B.I. events took her to East Anglia, the Northern Isles and Scandinavia where she made lifelong friends. In her capacity as recorder for the B.S.B.I., she was now able to contribute to the Atlas of the British Flora and coordinated the recording activity of local botanists.



Eva Crackles (photograph taken in 1990).

Eva was elected to Fellowship of the Linnean Society of London in 1966. Research on *Calamagrostis stricta*, *C. canescens* and their hybrids found at Leven Canal led to a Masters Degree from the University of Hull in 1978. In the 1980's, following the Wildlife and Countryside Act, Eva was engaged in assessing the botanical importance of various sites identified as potential Sites of Special Scientific Interest. Then, in 1990, after an enormous amount of research involving many local botanists, Eva published, "The Flora of the East Riding of Yorkshire". It was shortly after this that Eva's mobility declined and she became wheelchair-bound in the field. I got to know Eva at this time and soon became her chauffeur and honorary wheelchair-pusher on some botanical excursions. I soon learned to ignore Eva complaining, "I wish you would find smoother terrain, I'm trying to make notes", for the learning experience of accompanying Eva in the field was the best available and free of charge.

In 1991, Hull University conferred upon Eva the Degree of Doctor of Science *honoris causa* and then, in 1992, Her Majesty the Queen graciously granted Membership of the Most Excellent Order of the British Empire (MBE) for her work in conservation. In 1998 the B.S.B.I. launched the Atlas 2000 project, but with failing health Eva realised that she could no longer cope with such a massive undertaking, and she retired as B.S.B.I. recorder and from the Linnean Society. Eva was elected Honorary Life member of the B.S.B.I. in 2000, by which time she had become incapable of caring for herself. Eva was also a supporter of the Yorkshire Wildlife Trust, the South

Holderness Country-side Society and the East Yorkshire Local History Society. The range of subjects covered in Eva's published works (q.v.) is broad but can be summarised as, "a study of plant distribution with analysis of why".

Eva's training in mathematics and chemistry made her very intense and scientifically exacting in all that she did and she had a formidable memory for detail. However, many will have witnessed occasions of a dry sense of humour and warmth when engaged in the subject of cricket or her fascinating family history.

PETER J. COOK

Selected List of Publications of Eva Crackles (1918–2007)

The following list is from the B.S.B.I. Literature database supplemented with local articles published since 1966.

- Crackles, E. (1966). Three Umbellifers at the northern edge of their range. *Naturalist (Hull)*, Ser. 3, **1966**: 49–51.
- Crackles, E. (1966). Plant Records: East Riding. *Naturalist (Hull)*, **1966**: 22–23.
- Crackles, E. (1967). Plant records: East Riding. *Naturalist (Hull)*, Ser. 3, **1967**: 22–23.
- Crackles, E. (1967). Some plant records by Robert Teesdale with special reference to the East Yorkshire flora. *Naturalist (Hull)*, Ser. 3, **1967**: 34–47.
- Crackles, E. (1968). Plant records: East Riding. *Naturalist (Hull)*, Ser. 3, **1968**: 20–21.
- Crackles, E. (1968). Some plant associations of the river Hull valley. *E. Yorkshire Field Stud.* **1**: 13–24.
- Crackles, E. (1969). Plant records: East Riding. *Naturalist (Hull)*, Ser. 3, **1969**: 21–22.
- Crackles, E. (1970). Plant records: East Riding. *Naturalist (Hull)*, Ser. 3, **1970**: 29–30.
- Crackles, E. (1971). Plant records: East Riding. *Naturalist (Hull)*, Ser. 3, **1971**: 25–26.
- Crackles, E. (1971). Arable weeds in East Yorkshire. *E. Yorkshire Field Stud.* **3**: 1–14.
- Crackles, E. (1972). Plants records: East Riding. *Naturalist (Hull)*, Ser. 3, **1972**: 38–40.
- Crackles, E. (1974). Seeking to understand the flora of the East Riding of Yorkshire. *Naturalist (Hull)*, Ser. 3, **1974**: 1–17.
- Crackles, E. (1974). A rush called the dumble. *Local Historian*, **11**: 63–67.
- Crackles, E. (1975). The Monkey Orchid in Yorkshire. *Naturalist (Hull)*, Ser. 3, **1975**: 25–26.
- Crackles, E. (1975). The flowering plants of Spurn Point. *Naturalist (Hull)*, Ser. 3, **1975**: 59–65.
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- Crackles, E. (1976). Botanical report for 1974: East Riding. *Naturalist (Hull)*, Ser. 3, **1976**: 110–111.
- Crackles, F. (1977). Botanical reports for 1975 and 1976: flowering plants and ferns: East Yorkshire (v.c. 61). *Naturalist (Hull)*, Ser. 3, **1977**: 147–148 + 152.
- Crackles, F. E. (1979). Botanical report for 1977: East Yorkshire (v-c61). *Naturalist (Hull)*, Ser. 3, **1979**: 67–68.
- Crackles, F. E. (1981). Reports of field meetings 1979: Spurn Point, S. E. Yorkshire. 11th August. *Watsonia*, **13**: 254.
- Crackles, E. (1981). Botanical report for 1978 – Flowering plants and ferns, East Yorkshire (v.c. 61). *Naturalist (Hull)*, Ser. 3, **1981**: 31–32.
- Crackles, E. (1981). Botanical report for 1979 – Flowering plants and ferns, East Yorkshire (v.c. 61). *Naturalist (Hull)*, Ser. 3, **1981**: 35–36.
- Crackles, E. (1981). Botanical report for 1980 – Flowering plants and ferns, East Yorkshire (v.c. 61). *Naturalist (Hull)*, Ser. 3, **1981**: 149–150.
- Crackles, F. E. (1982). *Stratiotes aloides* L. in the East Riding of Yorkshire. *Naturalist (Hull)*, Ser. 3, **1982**: 99–101.

- Crackles, F. E. (1983). *Stratiotes aloides* L. in S. E. Yorks. – A fruitful search or a hoodwink? *Watsonia*, **14**: 451.
- Crackles, F. E. (1983). Botanical report for 1981: flowering plants and ferns, East Yorkshire (v.c. 61). *Naturalist (Hull)*, *Ser. 3*, **1983**: 29–30.
- Crackles, F. E. (1983). *Ruppia spiralis* L. ex Dumort. and *R. maritima* L. in S. E. Yorkshire. *Watsonia*, **14**: 274–275.
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- Crackles, E. (1983). The Flora of the East Riding of Yorkshire: Progress report. *Naturalist (Hull)*, *Ser. 3*, **1983**: 121.
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- Crackles, F. E. (1986). *Dactylorhiza majalis* (Reichb.): F. Hunt and Summerhayes subsp. *cambrensis* (R. H. Roberts) R. H. Roberts in S. E. Yorkshire. *Watsonia*, **16**: 79–80.
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- Crackles, E. (1986). In Praise of Hybrids. *BSBI News*, **42**: 12.
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DAVID PAUL STEVENS
(1958–2007)

With the premature death of David Stevens on 24 April 2007, Wales lost its foremost authority on the floristic composition, distribution and ecology of species-rich pastures and hay meadows. We and many other of his close working friends and colleagues have also lost a mentor and a highly talented conservation scientist.

David was born and brought up in Redditch in the west Midlands, and whilst at school in his mid teens developed a strong interest in field botany and natural history that was to last for the rest of his life. He was drawn at an early age to applying a scientific approach to understanding the natural world. He joined the Worcestershire Wildlife Trust at the age of 17, and began to appreciate the floristic interest of remnant unimproved grasslands, such as Eades Meadow, in that county.

But it was as an undergraduate at the University of Leicester that his future career began to take shape, particularly under the influence of Clive Stace; he joined the B.S.B.I. in 1980 and became fascinated by field studies in ecology and evolution, gaining a first class honours degree in Biological Sciences in 1979. He subsequently became a research student of John Richards at the University of Newcastle, working on genetic adaptation in the Meadow Saxifrage *Saxifraga granulata* and completing his PhD in 1985. His discovery that this species is gynodioecious, with populations having both hermaphrodite and male-sterile individuals (Stevens & Richards 1985; Stevens 1988), was later supplemented by a modelling approach to evolutionary aspects of gynodioecy (Stevens & van Damme 1988). David then worked in a busy teaching post in the Genetics Department at the University of Wales, Swansea, between 1984–1987, where he and Quentin Kay undertook a review of British dioecious flowering plant species (Kay & Stevens 1986). In his subsequent career in conservation, David continued to take an active, if sideline, interest in plant reproductive biology and sexual systems, including a wide-ranging study of gynodioecy in British populations of the Hare's-tail Cottongrass *Eriophorum vaginatum* (Stevens & Blackstock 1997).

David's working life undertook a major change of direction in 1988 when he joined the Nature Conservancy Council in Bangor (later in 1991 to become the Countryside Council for



Wales) as its leading specialist in grassland conservation. His initial work concentrated on directing an intensive floristic and plant community survey of different forms of remnant species-rich grasslands across the lowland landscapes of Wales. Although now well characterised, it is important to realise that at that time the Welsh grassland resource was poorly known, with many key sites unprotected and no real concept of the character or variation of the resource across Wales. Execution of this survey meant coming to grips with the new “neo-phytosociological” approach to community recognition and mapping that came to life in the British conservation scene through the development and publication of the *National Vegetation Classification* (Rodwell 1991–2000). He encouraged his survey team to adopt a critical approach to all aspects of their work, including plant identification, and many new and interesting records, such as those for *Carex montana* in *Molinia* vegetation (Stevens *et al.* 1994), were distributed to B.S.B.I. recorders. By 2004, when the survey was completed, over 1000 sites had been recorded and mapped (digitally), supported by some 10,000 relevés. The findings have transformed the conservation prospects for this habitat in Wales, with the best surviving unimproved neutral, acid, calcareous and marshy grasslands put clearly on the map, and as a result many now notified as S.S.S.I.

Through the 1990s, David's role as a conservation scientist with C.C.W. became increasingly influential. He became leader of a team of ecological specialists, commissioning, publishing and interpreting new research to benefit habitat protection programmes and new countryside conservation initiatives, and more generally providing science advice for all aspects of terrestrial habitat conservation in Wales. Much of this work takes place behind the scenes in government-sponsored conservation agencies, but a rigorous and often original approach is fundamental to providing the evidence-base for those engaged in policy development and conservation applications at field level. David was highly skilled and well-suited to this work, typically with a keen and influential sense of the direction we should take. He was especially influential in the development of the first all-Wales agri-environment scheme, and also contributed hugely to the development and subsequent implementation of the UK Biodiversity Action Plan in Wales. One outcome of the latter concerned his work to disaggregate our *Habitat Survey of Wales* data-set (run in conjunction with the grassland survey by Liz Howe) for use by the new Local BAP partnerships (Jones *et al.* 2003). He also used his understanding of genetics to review the policy position in this field of conservation (Stevens & Blackstock 1997b). Before his illness struck in late 2005, he was developing an interest in the current landscape-scale perspective for habitat conservation in response to environmental change.

David was endearingly modest, thoughtful and helpful to others and he was a key formative influence in the career development of many conservation scientists. There is little

doubt that David would have excelled in academia, being both a gifted teacher and researcher, but his career path was ultimately to the immense gain of nature conservation; his conviction that it could only be pursued effectively when firmly under-pinned by scientific evidence remains as a continuing influence among his many colleagues in the conservation world. Perhaps less widely appreciated was David's humanity and compassion. Many of those close to him in C.C.W. had direct experience of this over the years, and this quality combined with his rare intellect made him one of those people that one is truly blessed to have known.

When David was diagnosed with an incurable brain tumour in January 2006, a strong and remarkable aspect of his character emerged. He confronted the diagnosis directly and courageously, accepted that he had to undergo difficult and harrowing treatment, and determined to live as fully as possible with his family and at work through his final months. His very open and honest approach, set out in widely distributed newsletters, was truly inspiring for all of us in close connection. He worked hard through this period on a book-length account of Welsh grasslands, as well as a synopsis of the survey he oversaw (Stevens *et al.* 2007). Throughout this time, he and his wife Jane kept a happy and active home life with their sons Clive and Glyn. In his personal memoir, written in hospital during 2006, David hoped that he 'will be remembered fondly and with a sense of celebration' rather than sadness. Of course, those close to David have been profoundly moved by his passing, but he did indeed give us considerable cause for celebration.

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T. H. BLACKSTOCK & P. S. JONES

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The cover illustration of *Meconopsis cambrica* (L.) Viguier (Welsh Poppy) was drawn by Rosemary Wise.

Genetic variation in Irish Whitebeam, *Sorbus hibernica* E. F. Warb. (Rosaceae) and its relationship to a *Sorbus* from the Menai Strait, North Wales

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ABSTRACT

Genetic variation within the Irish endemic *Sorbus hibernica*, Irish Whitebeam, and its relationships to *S. aria*, *S. eminens*, *S. porrigentiformis* and a taxon from the Menai Strait have been assessed using AFLPs and morphology. *Sorbus hibernica* is genetically distinct from *S. aria*, *S. eminens* and *S. porrigentiformis* but is close to the Menai Strait taxon. *Sorbus hibernica* cannot be separated from the Menai Strait taxon using leaf or fruit characters, but they differ in ploidy.

KEYWORDS: AFLP, Ireland, *Sorbus aria*, *Sorbus eminens*, *Sorbus porrigentiformis*.

INTRODUCTION

Sorbus hibernica E. F. Warb., Irish Whitebeam, is one of the few vascular plants endemic to Ireland. It was first collected in 1885 but remained unrecognised until 1933 (Pugsley 1934), and was first described by Warburg (1952). Rich *et al.* (2005) reviewed its history, distribution and ecology, and reported that it had been recorded from at least 150 localities in 76 hectads in 29 vice-counties in Ireland. It is triploid (Bailey *et al.* 2008), and like the other polyploid members of the genus in Britain and Ireland is usually regarded as apomictic, although this has not been investigated experimentally.

Proctor & Groenhof (1992), whilst investigating *Sorbus* populations using isozymes, found similarities between *S. hibernica* and the English endemic *S. eminens* E. F. Warb., and with an unnamed taxon previously ascribed to *S. porrigentiformis* E. F. Warb. from the Menai Strait, North Wales, and suggested that this relationship should be investigated further.

Parnell & Needham (1998) found that *S. hibernica* was morphologically variable, and noted that further work was needed to confirm its apomictic nature and also to look more closely at its relationships to other taxa. In this paper, we present a DNA analysis using amplified fragment length polymorphisms (AFLP; as previously used in *Sorbus* by Fay *et al.* 2002) with some comparative morphology to follow up these suggestions.

Morphologically *S. hibernica* looks similar to *S. porrigentiformis* E. F. Warb., but it is distinct from it, and differs in having leaves with finer, unserrate tooting and elliptic to obovate leaves (Fig. 1). Studies of plastid DNA by Chester *et al.* (2007) showed that *S. porrigentiformis* has plastid types C, D, H1, R and T, differing from *S. eminens*, *S. hibernica*, and the Menai Strait *Sorbus* which all had the plastid type A, which is also common in *S. aria* (L.) Crantz. We have therefore only included a few *S. porrigentiformis* DNA samples in the comparisons, and one sample of the related *S. 'Bristol porrigentiformis'* sensu Proctor & Groenhof (1992). Morphologically, *S. hibernica* is also easily separated from both northern and southern forms of *S. eminens* (cf. Proctor & Groenhof 1992) which have large, nearly orbicular leaves; again we have therefore only included a few DNA samples in the comparison. As *S. hibernica* is very similar in leaf shape and tooting to the Menai Strait *Sorbus*, we have both included DNA samples and carried out a more detailed morphological analysis. Some DNA samples of the diploid *S. aria* from France and England, where it is native, and from Ireland, where it is introduced (Praeger 1934), were also included for comparison.

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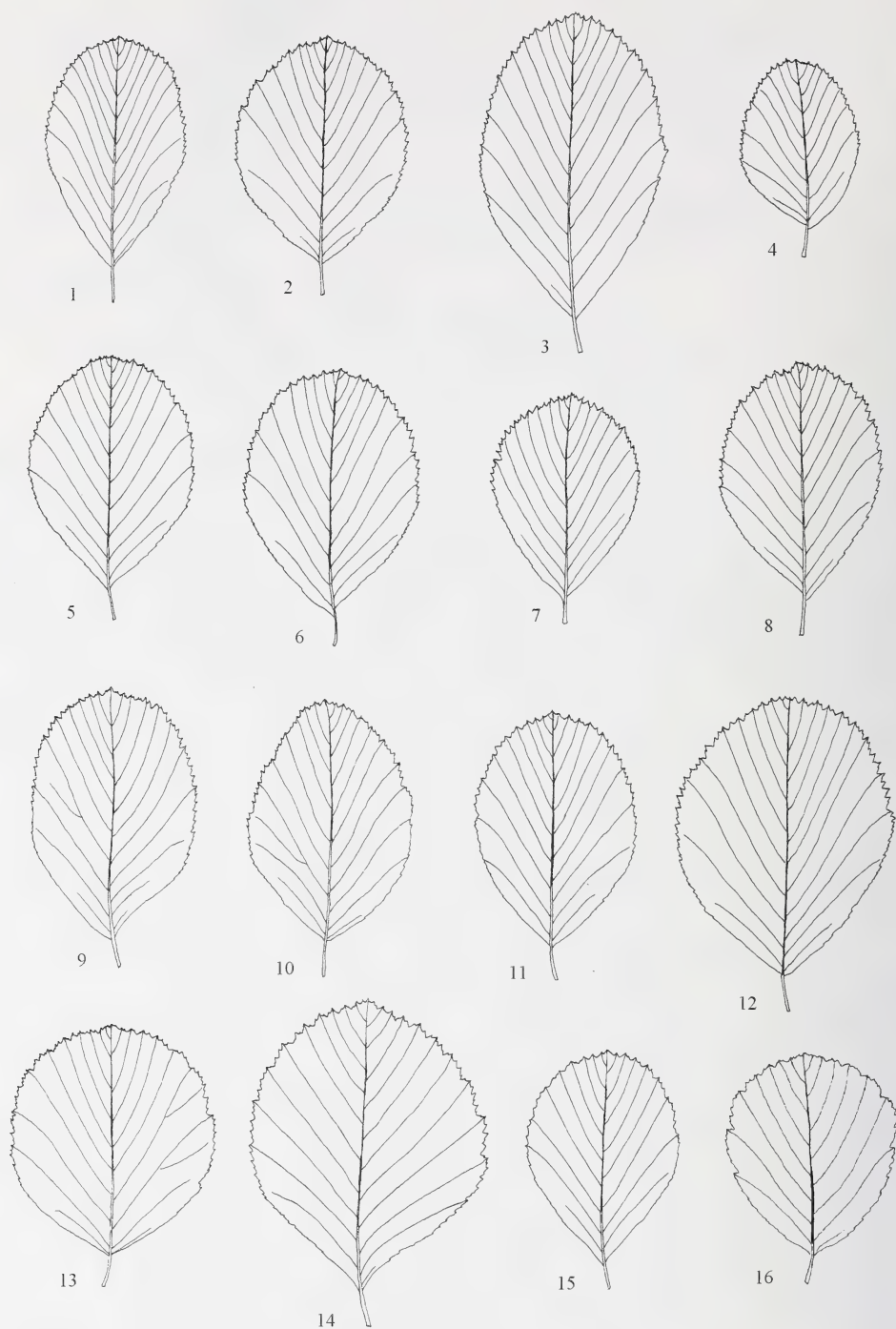


FIGURE 1. Leaves of *Sorbus* species from the short, sterile shoots. *Sorbus hibernica*: 1, Killowen. 2, Kilbeggan. 3, Clifden. 4, Cong. 5, Lough Derg. 6, Kilkenny. 7, Clonbur. 8, Cappagh. Menai Strait *Sorbus*: 9–12, Bangor. *Sorbus eminens*: 13, southern form, Shirehampton. 14, northern form, Coldwell. *Sorbus porrigentiformis*: 15, Stokeleigh. *Sorbus* 'Bristol porrigentiformis': 16, Leigh Woods. Not to scale.

METHODS

DNA ANALYSIS

DNA samples were collected from 21 *S. hibernica* trees across Ireland, and compared with samples of *S. aria* (seven samples), *S. eminens* (both forms, seven samples), *S. porrigentifomis* (3 samples), *S. 'Bristol porrigentifomis'* (one sample) and the *Sorbus* from the Menai Strait (3 samples). Two leaves from each tree were torn into narrow strips and put into desiccant silica gel in which they were kept until processed (Chase & Hills 1991). Voucher specimens were collected at the same time for NMW, though in some cases leaves from the typical broad, short shoots were not available due to hedge cutting or were out of reach. The samples included in the DNA analysis are listed in Table 1 with their origin, cross-referenced with the NMW accession numbers and the Kew extraction numbers. Duplicate aliquots of the DNA samples have been deposited in the Irish DNA Bank at Trinity College, Dublin.

DNA was extracted from approximately 0.2 g of dried material using a modified 2× CTAB (cetyltrimethyl-ammonium bromide) procedure (Doyle & Doyle 1987), purified and quantified using a spectrophotometer.

AFLPs were performed according to the AFLP Plant Mapping Protocol of PE Applied Biosystems Inc. (ABI). For each specimen, 0.5 µg of DNA were digested using the restriction enzymes MseI and EcoRI. Standard adaptors (PE Applied Biosystems) were ligated to the genomic digests. Twenty four unique primer combinations were screened for their ability to amplify scoreable bands, from which two were selected for this study. Amplification fragments were separated on an ABI 3100 DNA analyser. Genescan 3.7 and Genotyper 2.0 were used to analyse the fragments which were scored as either present (1) or absent (0) for all individuals. The resulting binary matrix was analysed using the UPGMA (Unweighted Pair-Group Method using Arithmetic Averages) algorithm in the software package PAUP version 4.0d64 for Macintosh (Swofford 1998) and by Principal Co-ordinates Analysis (PCOA) in the R Package for Multivariate Analysis version 4.0 (Casgrain & Legendre 1999) using Jaccard's coefficient.

MORPHOLOGY

Broad leaves from the short vegetative shoots, excluding the oldest and youngest leaf (Aas *et al.* 1994), were measured on 88 leaves of

S. hibernica, 50 leaves of *S. aria* from Ireland and 56 leaves of the Menai Strait *Sorbus* on herbarium material in the Welsh National Herbarium (NMW), Trinity College Dublin (TCD) and Belfast (BEL). As many as possible of the trees sampled during the DNA analysis were included, but some lacked the short shoots or were poor specimens. The samples used additional to the DNA analysis samples are given in Appendix 1.

The leaf length (excluding petiole), width, distance along the mid-vein of the widest point, the angle of veins to the midrib at the middle of the leaf, and the total number of veins were measured. From these, the leaf length:width ratio and the position of the widest point along the leaf (expressed as a percentage) were derived. The seven characters were then analysed using Principal Components Analysis (PCA) with a correlation matrix in PAST version 1.72 (Hammer *et al.* 2001).

RESULTS

DNA ANALYSIS

A total of 187 size fragments were scored of which 95% were polymorphic (10 invariable). In the UPGMA analysis (Fig. 2), the *Sorbus hibernica* samples, Group A, all cluster together and separately from all other taxa. This is a relatively genetically uniform group which represents the main *S. hibernica* taxon with elliptic-obovate leaves and fine, uniserrate toothings. The relatively tight grouping suggests it is probably (predominantly at least) apomictic but that cannot be confirmed from these data.

The three Menai Strait samples, Group B, form a group distinct from, but obviously close to, *S. hibernica*. Group C contains the group of apomictic polyploid taxa from south-west England, the two forms of *S. eminens* and the form of *S. porrigentifomis* from Bristol; these are clearly closely related to each other and are approximately genetically equidistant from the *S. hibernica* group and the Menai Strait samples. The three British *S. porrigentifomis* samples, Group E, form a distinct group that is genetically more distant from these groups than *S. aria* from France and Ireland.

The samples of the genetically diverse sexual diploid *S. aria* group by geographic origin. One Group D *S. aria* specimen was collected at Ballynahinch, Galway (vc. H16), the type locality of *S. hibernica* (Warburg 1957), where we failed to refind *S. hibernica*.

TABLE 1. *SORBUS* SAMPLES ANALYSED DURING DNA ANALYSIS.
SOME *S. HIBERNICA*, *S. ARIA* AND *S. 'MENAI STRAIT'* SAMPLES WERE
ALSO USED FOR THE LEAF MORPHOLOGICAL ANALYSIS

Taxon	Locality	Vice-county/Region	Country	Voucher	Kew DNA bank no.
<i>S. 'Bristol porrigentiformis'</i>	Leigh Woods	6 North Somerset	England	2001.25.273	36.80
<i>S. 'Menai Strait'</i>	Menai Strait	49 Caernarfonshire	Wales	2002.17.68	42.12
<i>S. 'Menai Strait'</i>	Menai Strait	49 Caernarfonshire	Wales	2002.17.66	42.13
<i>S. 'Menai Strait'</i>	Menai Strait	49 Caernarfonshire	Wales	2002.17.67	42.15
<i>S. aria</i>	Above Senanque	Provence	France	Civeyrel <i>et al.</i> 492, K	46.30
<i>S. aria</i>	Ballynahinch	H16 West Galway	Ireland	2003.20.26	51.01
<i>S. aria</i>	Burnham Beeches	24 Buckinghamshire	England	2001.48.10	24.10
<i>S. aria</i>	Burnham Beeches	24 Buckinghamshire	England	2001.49.11	27.20
<i>S. aria</i>	Lecarrow	H25 Roscommon	Ireland	2003.4.1042	49.03
<i>S. aria</i>	Roundstone	W16 West Galway	Ireland	2003.20.24	50.05
<i>S. aria</i>	Tallyho	H23 Westmeath	Ireland	2003.20.30	49.06
<i>S. eminens</i> , southern form	Cheddar Gorge	6 North Somerset	England	2001.25.141	36.05
<i>S. eminens</i> , southern form	Cheddar Gorge	6 North Somerset	England	2001.25.145	36.12
<i>S. eminens</i> , southern form	Cheddar Gorge	6 North Somerset	England	2001.25.142	36.16
<i>S. eminens</i> , southern form	Cheddar Gorge	6 North Somerset	England	2001.25.144	38.05
<i>S. eminens</i> , southern form	Leigh Woods	6 North Somerset	England	2001.25.274	36.15
<i>S. eminens</i> , northern form	Seven Sisters	36 Herefordshire	England	2001.25.51	38.20
<i>S. eminens</i> , northern form	Symonds Yat	34 West Gloucestershire	England	2001.25.219	38.10
<i>S. hibernica</i>	Ballybetagh	H21 Dublin	Ireland	2001.25.289	41.12
<i>S. hibernica</i>	Ballybetagh	H21 Dublin	Ireland	2003.4.1048	51.02
<i>S. hibernica</i>	Ballybetagh	H21 Dublin	Ireland	2003.4.1045	51.03
<i>S. hibernica</i>	Ballybetagh	H21 Dublin	Ireland	2003.4.1046	51.08
<i>S. hibernica</i>	Ballybetagh	H21 Dublin	Ireland	2003.4.1049	52.01
<i>S. hibernica</i>	Ballybetagh	H21 Dublin	Ireland	2003.4.1047	52.02
<i>S. hibernica</i>	Cappagh	H8 Limerick	Ireland	2003.4.1055	52.03
<i>S. hibernica</i>	Clifden	W16 West Galway	Ireland	2003.20.25	50.06
<i>S. hibernica</i>	Dalkey Hill	H21 Dublin	Ireland	2003.4.1050	51.04
<i>S. hibernica</i>	Dalkey Hill	H21 Dublin	Ireland	2003.4.1051	51.06
<i>S. hibernica</i>	Dalkey Hill	H21 Dublin	Ireland	2003.4.1052	51.07
<i>S. hibernica</i>	Dalkey Quarry	H21 Dublin	Ireland	2003.4.1054	51.05
<i>S. hibernica</i>	Drumnasole	H39 Antrim	Ireland	2002.27.46	42.03
<i>S. hibernica</i>	Kilbeggan	H23 Westmeath	Ireland	2003.20.29b	49.04
<i>S. hibernica</i>	Kilbeggan	H23 Westmeath	Ireland	2003.20.29c	49.05
<i>S. hibernica</i>	Kilbeggan	H23 Westmeath	Ireland	2003.20.29	50.08
<i>S. hibernica</i>	Kilcullen Upper	H6 Waterford	Ireland	2003.20.9	49.07
<i>S. hibernica</i>	Lecarrow	H25 Roscommon	Ireland	2003.4.1043	49.02
<i>S. hibernica</i>	Lough Derg	H10 North Tipperary	Ireland	2003.20.12	50.03
<i>S. hibernica</i>	Lough Derg	H10 North Tipperary	Ireland	2003.20.13	50.04
<i>S. hibernica</i>	Priesthaggard	H12 Wexford	Ireland	2003.20.5	49.08
<i>S. hibernica</i>	Seagull Bog	H18 Offaly	Ireland	2003.20.32	50.07
<i>S. porrigentiformis</i>	Ban-y-Gor	34 West Gloucestershire	England	2002.17.105	27.90
<i>S. porrigentiformis</i>	Craig-y-cilau	42 Brecknockshire	Wales	2002.17.42	25.60
<i>S. porrigentiformis</i>	Cwm Clydagh	42 Brecknockshire	Wales	2001.25.74	21.80

¹All NMW except one sample of *S. aria* from France for which the voucher is held at K

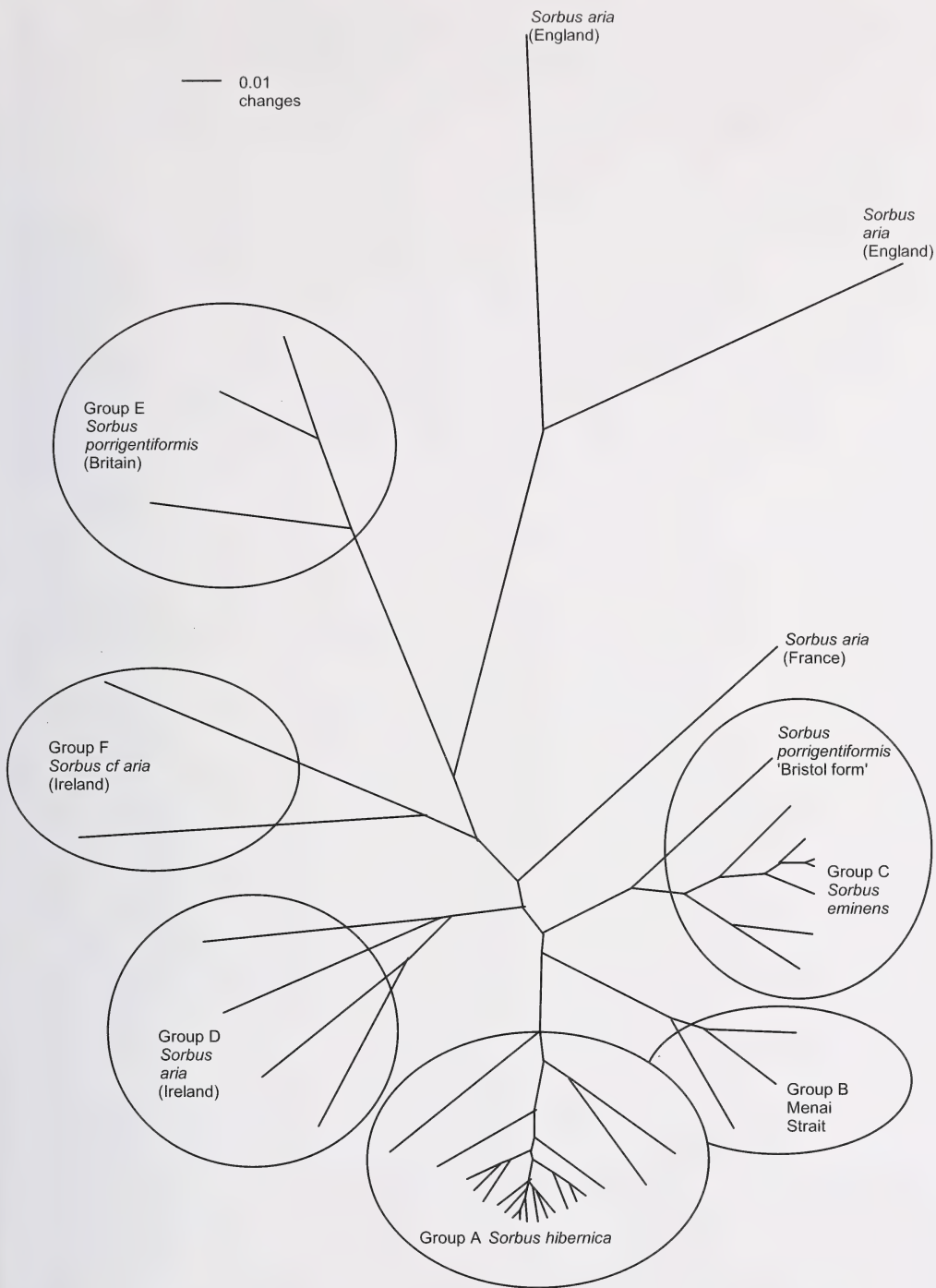


FIGURE 2. Unrooted UPGMA dendrogram showing relationship between the *Sorbus* DNA samples studied using amplified fragment length polymorphisms. The origins of the samples are listed in Table 1.

Two samples labelled *S. cf aria*, Group F, look intermediate between *S. hibernica* and *S. aria* and require further study. Tree 49.02 from Lecarrow, Roscommon (v.c. H25) is from a mixed population with clear *S. aria* (tree 49.03) and also *S. hibernica* (fruit sample NMW; no DNA sample). Tree 49.08 is from Priesthaggard, Wexford (v.c. H12), an area where some *S. hibernica* is certainly present but *S. aria* is unknown.

In the DNA Principal Co-ordinates Analysis (Fig. 3) based on the same data as Figure 2, axis one accounts for 24% of the variance and axis two for 15%. The clustering shows a very similar pattern to that found in the UPGMA analysis. There is clear separation of *S. porrigentiformis* and both forms of *S. eminens* from the other taxa and each other, the *S. 'Bristol*

porrigentiformis' clustering with *S. eminens*. The Menai Strait taxon (Group B of Fig. 2) is close to but separated from *S. hibernica*. *Sorbus aria* is separated from *S. hibernica*, and the two *S. cf aria* samples (Group F of Fig. 2) are outliers near *S. aria* and *S. hibernica*.

MORPHOLOGY

In the morphological Principal Components Analysis (Fig. 4), axis one accounts for 40% of the variance and axis two for 22%. There is reasonable separation between *S. aria*, which is mostly confined to the upper right corner of the graph (a few more widely scattered samples elsewhere), and *S. hibernica* and the Menai Strait *Sorbus* in the lower, left hand corner of the graph. There is complete overlap between *S. hibernica* and the Menai Strait *Sorbus* and they cannot be distinguished morphologically

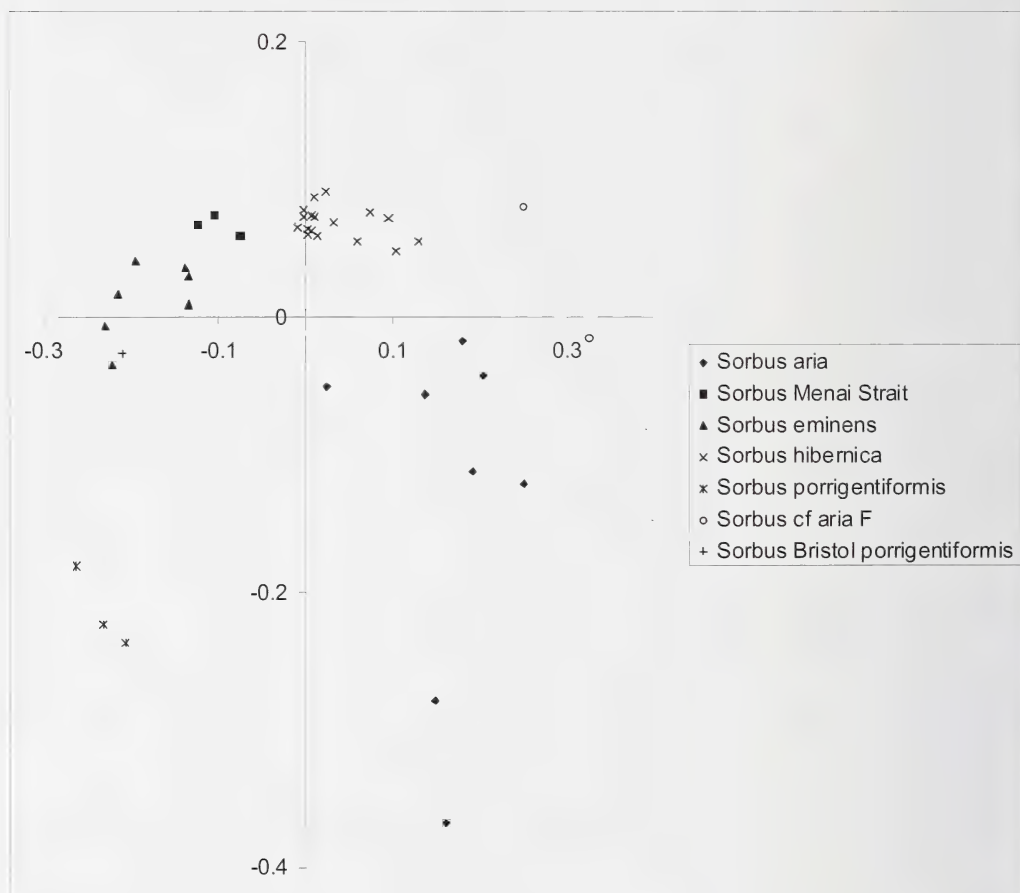


FIGURE 3. Principal Co-ordinates Analysis plot of *Sorbus* taxa based on amplified fragment length polymorphisms. The origins of the samples are listed in Table 1, and are the same as in Figure 2.

(see also Fig. 1). The *S. hibernica* plants of Groups B, C and D, and the proposed intermediate plants of Group F (cf. Fig. 2) mostly fall near the centre of the plot clustering within *S. hibernica* and do not form discrete groups.

DISCUSSION

The DNA analysis shows that *S. hibernica* is distinct from *S. aria*, *S. eminens* and *S. porrigentiformis* but is close to the Menai Strait taxon. In agreement with Proctor & Groenhof (1992), the Menai Strait taxon is also confirmed to be genetically distinct from *S. porrigentiformis* in which it was formerly included. The morphological data confirm that *S. hibernica* is distinct from *S. aria* (as also found by Parnell & Needham 1998), but not from the Menai Strait *Sorbus*.

The limited genetic variation found in *S. hibernica* suggests it is probably apomictic, like most *Sorbus* microspecies. To judge from the AFLP data here, *S. hibernica* is less genetically variable than the sexual diploid *S. aria*. Nonetheless, there is some genetic variation in *S. hibernica*, as has been observed for other apomictic polyploids in other groups (e.g. *Hieracium*, Chapman *et al.* 2003; Rich *et al.* 2008). There is no geographic pattern to the genetic variation observed. This variation in *S. hibernica* is probably caused by random mutations; Bengtsson (2003) showed that mutations can slowly accumulate in species with asexual breeding systems leading to variable populations which show little genetic structure. The variation could also be caused by hybridisation, sub-sexual reproduction, or repeated derivation from its parents. Although

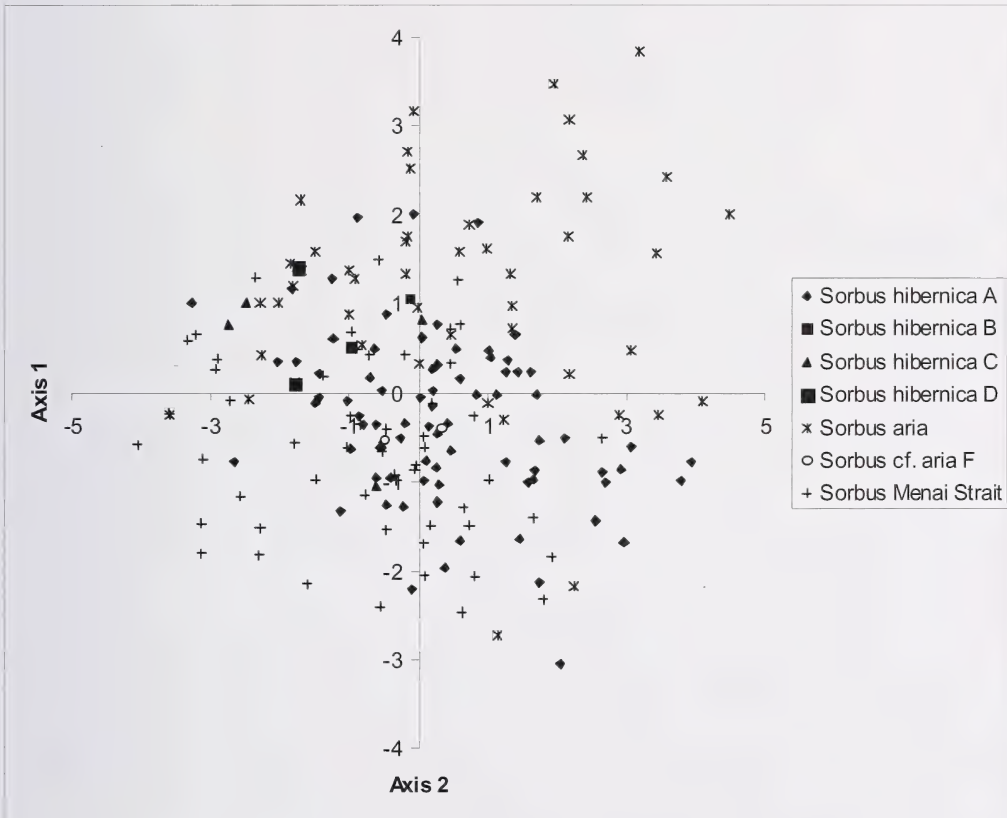


FIGURE 4. Principal Components Analysis plot of leaf characters in *Sorbus*. The group labels relate to the same groups shown in Figure 2, although not all samples are represented as some voucher specimens were inadequate for morphological analysis; other samples used are listed in Appendix 1.

the possibility of hybrids between *S. aria* and *S. hibernica* has been proposed here, there is no clear evidence to demonstrate that this occurs, and such plants might be expected to be morphologically significantly different from *S. hibernica*. Significant sub-sexual reproduction is also unlikely in a triploid. The origin of *S. hibernica* is currently unknown, but it is likely to result from *S. aria* crossing with a tetraploid such as *S. eminens*, *S. porrigentiformis* or *S. rupicola* (Syme) Hedl. in Britain where all the taxa occur, with subsequent dispersal by birds migrating to Ireland (Wernham *et al.* 2002). *Sorbus hibernica* is also not as uniform morphologically as some of the other apomictic taxa we have studied (e.g. *S. bristoliensis*; Houston *et al.* 2008); Parnell & Needham (1998) also found that it was variable.

Although the Menai Strait plants form a distinct genetic group, they are clearly closely related to *S. hibernica*. Their minor genetic separation could result from long-term isolation across the Irish Sea, or could reflect a similar origin. They differ in chromosome number as the Menai Strait plants are reported

as tetraploid and *S. hibernica* as triploid (Bailey *et al.* 2008), suggesting they have different origins. Morphologically, the two taxa cannot be distinguished from the leaves (Figs 1 and 4), and the limited data on fruit size, shape and colouration available show strong overlap between *S. hibernica* and the Menai Strait *Sorbus* (Proctor & Groenhof 1992; pers. obs. T. Rich). Further morphological characters will need to be sought to separate the Menai Strait *Sorbus* from *S. hibernica*.

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APPENDIX 1. *SORBUS* SAMPLES USED IN MORPHOLOGICAL ANALYSIS*SORBUS ARIA*

Loch Bunny, H9 Clare, 19 July 1978, D. A. Webb (**TCD**). Ardrahey, H15 SE Galway, 21 August 1952, D. A. Webb (**TCD**). Ballinadareen, H15 SE Galway, 19 July 1978, D. A. Webb (**TCD**). Gort, H15 SE Galway, 20 August 1952, T. G. Tutin (**TCD**). Oranmore, H15 SE Galway, 19 July 1978, D. A. Webb (**TCD**). Oughterrard, H15 SE Galway, 1978, D. A. Webb (**TCD**). Ballynahinch, H16 W Galway, 21 September 2003, L. Houston (**NMW**). Clontarf golf course, H21 Dublin, 29 September 1978, P. H. Pitkin & D. A. Webb (**TCD**). Portlick Castle, H23 Westmeath, 16 August 1982, D. L. Kelly (**TCD**). Tallyho, H23 Westmeath, 23 September 2003, L. Houston (**NMW**). Whitehill, Castlepollard H23 Westmeath, 8 June 1983, D. A. Webb & F. H. Perring (**TCD**). Slish Wood, H28 Co Sligo, 1962, D. E. de Vasian (**BEL**). Lower Kilycolpy, H36 Tyrone, 29 July 1927 and 10 September 1937, F. H. W. Kerr (**BEL**). Carnagaver, 8 August 1986, J. Harron (**BEL**).

SORBUS HIBERNICA (ADDITIONAL TO SPECIMENS LISTED IN TABLE 1)

Boolabrien Upper, H6 Co Waterford, 18 September 2003, L. Houston (**NMW**). Coolbunnia, H6 Co Waterford, 10 June 2003, P. R. Green (**NMW**). Ballyallia Lough, H9 Clare, C. M. Brady, 22 June 2002 (**NMW**). Lough Derg, H10 North Tipperary, 18 September 2003, L. Houston (**NMW**). Loughmerans, H11 Co Kilkenny, 29 September 2006, T. C. G. Rich, R. N. Goodwillie & D. A. Cann (**NMW**). Pilltown, H12 Co Wexford, 11 August 1958, D. A. Webb (**TCD**). Priesthaggard, H12 Co Wexford, 17 September 2003, L. Houston (**NMW**). Gort, west of, H15 SE Galway, 20 August 1952, T. G. Tutin (**TCD**). Clifden, H16 West Galway, 10 June 1990, T. G. Evans (**NMW**). Errislanann Peninsula, H16 West Galway, 5 September 1979, D. A. Webb (**TCD**). Cong, H17 NE Galway, 30 August 2005, D. T. Price (**NMW**). Tullamore, H18 Offaly, 1978, D. A. Webb (**TCD**). Between Greenane and Rathdrum, H20 Co Wicklow, 11 September 1978, D. A. Webb (**TCD**). Ballybetagh, H21 Co. Dublin, 25 September 2004, P. H. Carvill (**NMW**). Killowen, 25 September 2006, T. C. G. Rich & D. A. Cann (**NMW**). Loch Fea, H36 Tyrone, 28 September 2006, T. C. G. Rich & D. A. Cann (**NMW**). Inishmaine, H26 East Mayo, 30 August 2005, D. T. Price (**NMW**). Clonbur, H26 East Mayo, 30 August 2005, D. T. Price (**NMW**).

SORBUS 'MENAI STRAIT'

Menai Strait, 19 September 1985, T. C. G. Rich (**NMW**). Menai Strait, 21 August 1989, G. Hutchinson (**NMW**). Nant Porth, 12 June 1990, M. C. F. Proctor (**NMW**). Menai Strait, 9 July 2002, T. C. G. Rich & R. A. Jones (**NMW**). Upper Bangor, 19 September 2003, T. Dines & W. McCarthy (**NMW**).

Conservation of Britain's biodiversity: status of the two Wye Valley endemics *Hieracium pachyphylloides*, Carboniferous Hawkweed and *H. vagicola*, Tutshill Hawkweed (Asteraceae)

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ABSTRACT

Reviews of historical data combined with field surveys have been carried out to assess the status of two hawkweeds endemic to the Wye Valley, *Hieracium pachyphylloides* and *H. vagicola*. *H. pachyphylloides* has declined from six sites to one site, and *H. vagicola* from two sites to one site. Both species are 'Critically Endangered' under the I.U.C.N. threat criteria. The main threats are rock climbing, closure of woodland canopies and spread of alien plants. Conservation action is urgently required.

KEYWORDS: endemic, England, I.U.C.N. Threat Criteria, rock climbing, Wales.

INTRODUCTION

There are two *Hieracium* species endemic to the lower Wye Valley on the border between England and Wales, *H. pachyphylloides* (Zahn) Roffey, Carboniferous Hawkweed, and *H. vagicola* P. D. Sell, Tutshill Hawkweed (Sell & Murrell 2006). Both are rare plants about which very little is known, so a review of the historical data has been combined with field surveys to determine their current statuses and needs for conservation, as required under the Global Plant Conservation Strategy (Secretariat for the Conservation of Biodiversity 2002). The data are summarised here; full details can be found in Sawtschuk (2006).

The glaucous-leaved hawkweed in the Wye Valley gorge between Ross and Monmouth now known as *H. pachyphylloides* was known to W. H. Purchas and A. Ley for many years under the name *H. caesium* Fries (Purchas &

Ley 1889). Following the clarification that *H. caesium* was a Scandinavian plant which did not occur in Britain, and that the Wye Valley plants differed from other plants also once referred to *H. caesium*, Purchas described it as *H. murorum* L. var. *pachyphyllum* (Purchas 1895). Williams (1902) raised this variety to species rank as *H. pachyphyllum* but the combination was invalid as that name was already in use for a different European species described by Brenner in 1892. Zahn (1921) treated it as a subspecies of *H. murorum*, selecting the new epithet *pachyphylloides* as the combination *H. murorum* L. subsp. *pachyphyllum* Brenner also already existed. Roffey (1925) then raised it to its current status as a species using Zahn's epithet. It is a member of Section *Hieracium*.

Hieracium vagicola has only recently been described (Sell & Murrell 2006). Plants were formerly included under *H. subbritannicum* (Ley) P. D. Sell & C. West, another endemic of the Wye Valley and South Wales, but differ mainly in the dense stellate hairs on the involucre bracts. It is a member of Section *Stelligera*.

The species are illustrated in Figures 1 and 2, and are described in detail in Sell & Murrell (2006). Key identification features to help separate them from the other glaucous-leaved species recorded in the Wye Valley (*H. schmidtii* Tausch, *H. subplanifolium* Pugsley and *H. subbritannicum*) are for *H. pachyphylloides*, the weakly toothed, truncate-based leaves with numerous pale, simple eglandular hairs abaxially and the greyish-green involucre bracts with many, black-based

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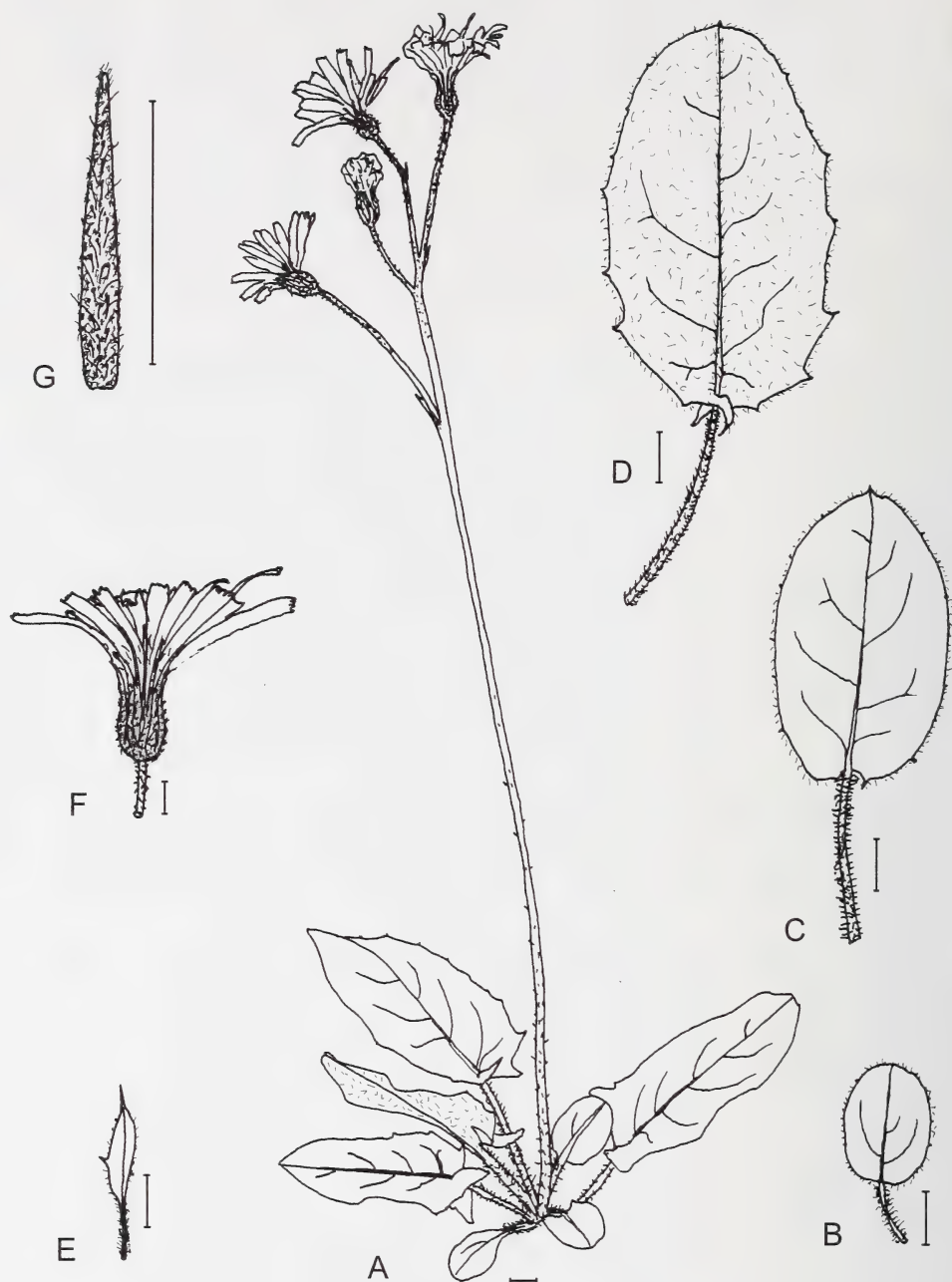


FIGURE 1. *Hieracium pachyphyloides*. A, Whole plant. B-C, Outer rosette leaves, upper surfaces. D, Inner rosette leaf, lower surface. E, Stem leaf. F, Capitulum. G, Involucral bract. Scale bars 1 cm. Del. T. Rich.

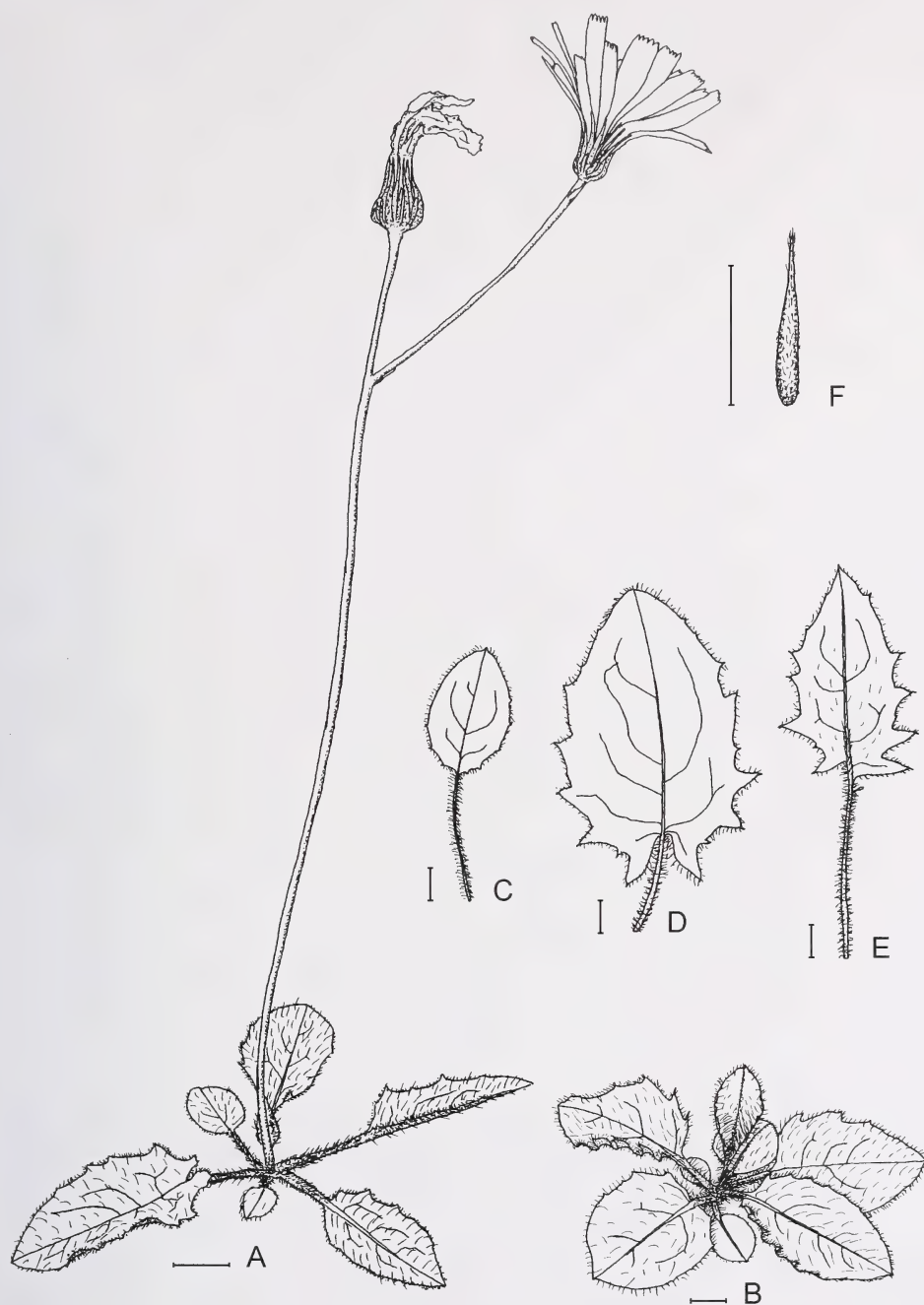


FIGURE 2. *Hieracium vagicola*. A, Whole plant. B, Vegetative rosette. C, Outer rosette leaf, upper surface. D, Inner rosette leaf, lower surface. E, Inner rosette leaf, upper surface. F, Involucral bract. Scale bars 1 cm. Del. T. Rich.

simple eglandular hairs, few glandular hairs and dense stellate hairs, and for *H. vagicola* the slender stems and strongly toothed basal leaves with the lowest teeth on either side somewhat reflexed at the truncate base with few to numerous simple eglandular hairs abaxially, and involucre bracts blackish-green with a long-drawn out filamentous apex and few to numerous simple eglandular hairs and glandular hairs, and dense stellate hairs.

METHODS

Historical data were compiled from herbaria (**BEL**, **BIRM**, **BM**, **CGE**, **E**, **LIV**, **MANCH**, **NMW**), the literature and correspondence with local botanists. The records traced are given in Appendices 1 and 2.

Field surveys were carried out between 2003 and 2007 using the historical records to target areas to search. As both species occur in Carboniferous Limestone cliffs and quarries, they were searched for by walking along the tops and bottoms of the cliffs, and by using binoculars. Some limited climbing with roped access was carried out at Symonds Yat. Access to rocks in one place at Symonds Yat was restricted due to nesting peregrines. Reasons for possible loss of populations and threats to extant populations were assessed in the field. Voucher specimens and photographs have been deposited in **NMW**.

Associated species were recorded in estimated 2 m × 2 m quadrats around the species. Soil pH was measured with a pHep2 Hanna pocket-sized pH meter in a 50:50 mixture with distilled water on soil samples collected from around the roots.

RESULTS

HISTORICAL RECORDS

About 12 populations of *H. pachyphylloides* have been recorded in six localities in three vice-counties (Appendix 1). In three localities it has only been collected once about 100 years ago and all are imprecise or ambiguous. The limestone cliffs near Chepstow on the Gloucestershire side of the Wye could refer to any of the cliffs and quarries from Tutshill to Ban-y-gor rocks. Brockweir Common is disused name for the general area around St Briavels and the Hudnals, an area of hilly pastures (Peterken

2005), and it is not clear exactly where the hawkweed might have occurred as there are no obvious cliffs. The third record 'Bigswear opposite Tintern' is ambiguous as Bigswear is c. 5 km north of Tintern, and cannot be described as 'opposite'; it is possible that the record refers to the Shorn Cliff, opposite Tintern Abbey. The fourth *H. pachyphylloides* locality around Symonds Yat and Coldwell Rocks includes cliffs, quarries and the railway line, where it was frequently collected in several places in this area until the 1960s. It was collected four times at Piercefield Park but has not been seen for over 100 years. It has occurred in several places on the Great Doward, where it was last collected in 1910.

The *H. pachyphylloides* literature record for Stroud in Riddelsdell *et al.* (1948) is best not accepted without a voucher. There is a correctly identified specimen from Pwll Byffre in **BM** which is likely to either be a confused label/specimen or a misidentification (no glaucous-leaved plants were present there in 2004 or 2005 and there are no other collections for this well known site). Records for Ireland refer to *H. basalticola* Pugsley.

Hieracium vagicola has been recorded in two areas in the Tutshill to Ban-y-gor rocks area (Appendix 2). Shoolbred (1920) cited it from Beaucliffe, an old name for Cockshoot, but we have traced no voucher material (a possible specimen in **NMW** is labelled Bannagher [=Ban-y-gor?] cliffs but is not *H. vagicola*). The cliffs and quarries from Pen Moel to Lancaut form one large locality where it has occurred scattered in various subpopulations, and was last recorded in 1984. A record for the Symonds Yat area, whilst plausible, is based on a rather confusingly labelled specimen, and is best rejected.

FIELD SURVEYS 2003–2007

Both hawkweeds grow on cliffs and rocky places which are difficult to search thoroughly, and consequently we made several visits to sites to try to refind the plants in their historic sites (Kéry *et al.* (2006) found between two and four visits were usually required to be fairly certain of refinding rare species). The quality of the historical information does not always make refinding sites simple and we often had to use our intuition about *Hieracium* ecology to find suitable places to search.

Both hawkweeds lost much of their distinctive glaucous leaf coloration later in the season, and we recommend future surveys are carried out in May–June when the glaucous coloration on the early leaves is strong and the plants are flowering.

Hieracium pachyphyllodes was refound in three subpopulations of 22, 32 and 19 plants in the Symonds Yat and Coldwell Rocks area, where they had not been recorded for nearly 50

years. It was not refound in the Tutshill to Ban-y-gor rocks area (3 visits), Brockweir Common (3 visits), Bigsweir (2 visits, including Shorn Cliff from below only), Piercefield Park (3 visits) or the Great Doward (7 visits).

Hieracium vagicola was refound in one population of 126 plants at Woodcroft Quarry. It was not be refound at Pen Moel (1 visit), Lancaut (2 visits) or Cockshoot, Ban-y-gor (1 visit).

The records are mapped in Figure 3.

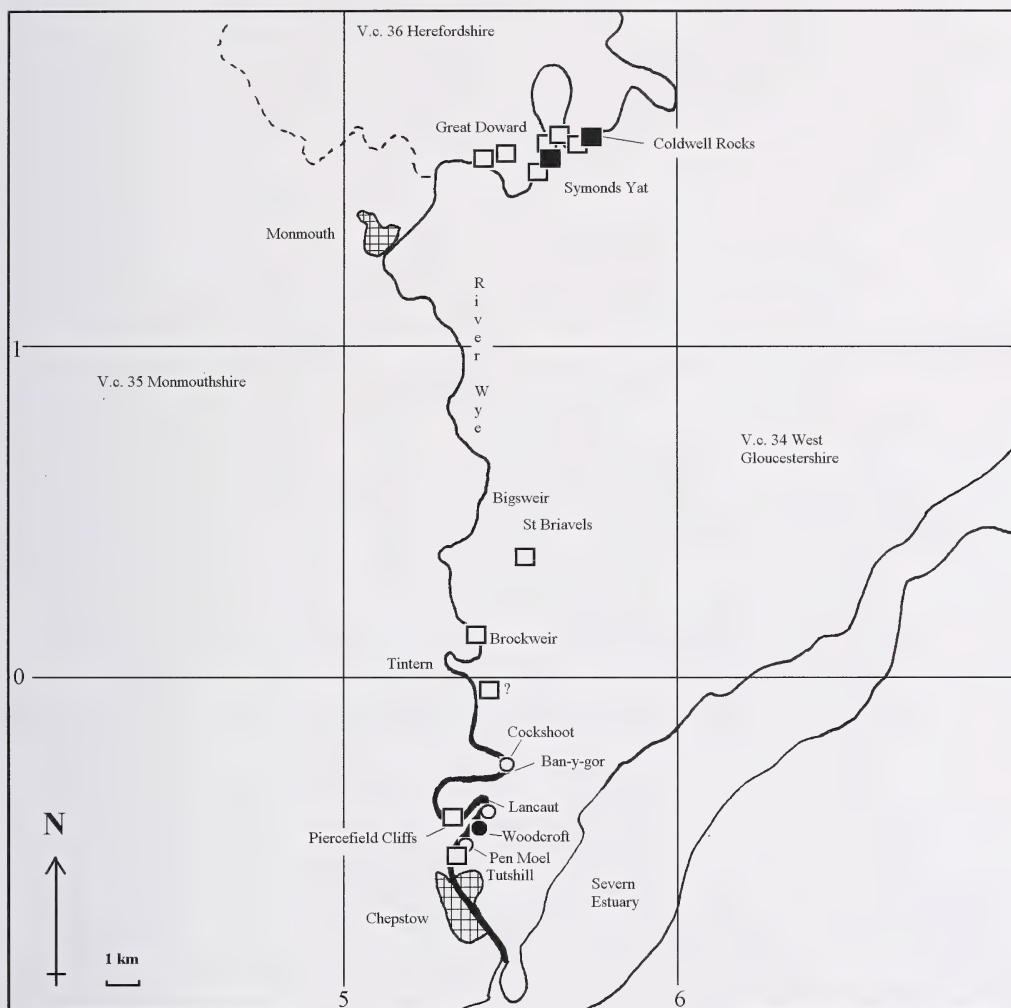


FIGURE 3. Distribution of *Hieracium pachyphyllodes* and *H. vagicola* in the Wye Valley. *H. pachyphyllodes*: □, old records; ■, 2006. *H. vagicola*: ○, old records; ●, 2006.

HABITATS

Hieracium pachyphylloides occurred in crevices and ledges on vertical Carboniferous Limestone rock faces and on the flatter tops of rocky bluffs. Typical associated herbs included *Asplenium trichomanes* L., *A. ruta-muraria* L., *Geranium robertianum* L., *Melica uniflora* Retz., *Scabiosa columbaria* L. and other *Hieracium* species in scrappy, open, herbaceous vegetation in open woodland. Overall the vegetation is probably best attributed to the W8g *Fraxinus excelsior* – *Acer campestre* – *Mercurialis perennis* woodland *Teucrium scorodonia* subcommunity of Rodwell (1991). Although this is a woodland community, the hawkweed is a light-demanding species which does not tolerate shade and is only found in the more open areas. Two soil pHs measured were pH 6.5 and 7.2.

Hieracium vagicola occurred in crevices and ledges on vertical Carboniferous Limestone rocks and on quarry spoil heaps. Associated species included *Bromopsis erecta* (Huds.) Fourr., *Festuca ovina* L. and *Scabiosa columbaria* L. The more natural crevice vegetation is probably best referred to the OV39 *Asplenium trichomanes* – *A. ruta-muraria* community of Rodwell (2000) but we have been unable to access it safely to record it in detail. On the quarry spoils heaps *H. vagicola* occurs in a disturbed, open, scrappy scrub community of *Fraxinus excelsior* L., *Ligustrum vulgare* L., *Rosa* spp. and *Buddleja davidii* Franch., probably best included in the W21d *Crataegus monogyna*-*Hedera helix* scrub, *Viburnum lantana* subcommunity of Rodwell (1991). The soil from a spoil heap was pH 7.1.

DISCUSSION

The field survey showed that *Hieracium pachyphylloides* has declined from six sites to one site, and *H. vagicola* from two sites to one site. Both species could occur elsewhere on the vast areas of cliff in the Wye Valley which we have not surveyed as there are no historical records.

Both species can be classified under the I.U.C.N. (2001) threat criteria as 'Critically Endangered' due to their small, declining populations and clear, continuing threats to their survival. Although much of the Wye Valley has numerous nature conservation designations at national (S.S.S.I.) and international (S.A.C.) level and large-scale

conservation projects such as the Ravine WoodLIFE project, the designations will do nothing to protect either species; specific conservation action is urgently required for both.

The probable major reason for loss or decline of both *Hieracium* species from many of the wooded cliffs, quarries and railway lines is shading due to closure of canopy by trees or by scrub invasion. Historically the woodlands in the Wye Valley would have been managed, with the coppicing and clearance regularly creating suitable open habitat for many light-demanding species such as *H. pachyphylloides* and *H. vagicola*. Old photographs of the Wye valley (Helme 1989; Rainsbury 1989) show some of the rocks and cliffs, especially around Symonds Yat and at Pen Moel, to have been much more open in the past when the areas were quarried or managed. Some scenic pathways giving access to areas such as Piercefield or Coldwell Rocks are no longer maintained for the views and have shaded over. To what extent both hawkweeds have been lost directly due to quarrying of their limestone rock habitat is unclear, but both have benefited at least temporarily from the open conditions created by quarrying. The cessation of quarrying has allowed scrub and woodland to reinvade and has resulted in loss. *Hieracium pachyphylloides* was also lost from the Great Doward quarry by infilling after quarrying had ceased. The closure of the Wye Valley railway has allowed scrub invasion of the cuttings (previously kept open to minimise fire risk) where *H. pachyphylloides* once occurred. The reason for loss from the Brockweir Common area is not known but it could have been a transient population.

There are two immediate threats to survival of *H. pachyphylloides*. First, the continuing closure of the canopy which will cause further loss by shading at Coldwell Rocks. Second, two subpopulations at Symonds Yat are seriously endangered by, yet partly maintained by, rock climbing. Climbing is very popular at Symonds Yat (Willson 1999) and during the good weather there are regularly large groups of school children on adventure activities during the week, and literally hundreds of recreational climbers may be present at the weekends. On the one hand the climbers trample the vegetation (including *H. pachyphylloides*) underfoot and sometimes very locally remove plants from the cliff faces (McMillan & Larson 2002; Müller *et al.* 2004;

Kuntz & Larson 2006), but on the other hand they help to maintain the cliff bases and tops open by their access paths. The balance between damage and benefit is very fine. Stopping the climbing activities completely would probably result in the plants being shaded out within a few years. The best way to protect *H. pachyphylloides* in this area is to regularly monitor the populations and work with the rock climbing community to control access to specific climbs when threats are perceived.

There are three main threats to *H. vagicola*. First, climbing, which is not as popular at Woodcroft Quarry as at Symonds Yat, and does not include school groups. At this quarry, the forth-coming fourth edition of Willson's (1997) climber's guide will specifically mention *H. vagicola* with a request for its conservation and advise climbers of its occurrence including re-routing of some climbs. Second, further development of the quarry, which still has extant extraction permissions, could result in further loss. The quarry is excluded from the Lower Wye Gorge S.S.S.I. and thus *H. vagicola* is very

vulnerable. Third, spread of alien plants such as *Buddleja* or *Cotoneaster microphyllus* Wallr. which are both already well-established in the quarry.

Further work is required to ensure ex-situ conservation of both these hawkweeds. A small batch of seed material of *H. pachyphylloides* has been deposited in the Millennium Seed Bank. One plant of *H. vagicola* is currently held in cultivation.

ACKNOWLEDGMENTS

Collation of the historical data for *H. pachyphylloides* was funded by the Countryside Council for Wales. We would like to David McCosh and Peter Sell for their considerable help and advice, Trevor Evans, Mark and Clare Kitchen, George Peterken and Stephanie Thompson for information, Claire Jusseau for help with field work, Deborah Spillards, Gina Murrell and the Keepers of the herbaria for access to libraries and specimens, and Libby Houston, John Willson and Paul Wood for discussions on climbing.

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(Accepted May 2008)

APPENDIX 1. HISTORICAL RECORDS OF *HIERACIUM PACHYPHYLLOIDES*

V.C. 34 WEST GLOUCESTERSHIRE

Near Chepstow (ST59). Limestone cliffs and quarry base, Gloucestershire side of Wye, near Chepstow, 18 September 1893, W. A. Shoolbred (NMW).

Brockweir (SO50). Brockweir Common, wood, 20 June 1894, W. A. Shoolbred (NMW).

Bigswear (SO50). Bigswear, opposite Tintern, July 1911, H. J. Riddelsdell (BM).

Symonds Yat (SO51). Symonds Yat, 7 June 1889, A. Ley (BM, CGE). Symonds Yat, 26 May 1896, A. Ley (BM, Set of British *Hieracia* no. 64). Symonds Yat, limestone rocks above the station, 12 May 1894, A. Ley (BM, NMW, CGE). Symonds Yat, May 1894, Captain Steuart (NMW). Symonds Yat, May 1894, A. Ley (BM). Symonds Yat, 12 June 1901, E. S. Marshall (CGE). Symonds Yat, 30 May 1904, A. Ley (LIV, NMW). Symonds Yat, railway bank, 30 May 1904, S. H. Bickham & A. Ley (BM, CGE). Symonds Yat, 17 June 1904, E. F. Linton (Set of British *Hieracia* no. 64, LIV, NMW). Symonds Yat, railway bank, 22 May 1905, S. H. Bickham (BM, LIV). Symonds Yat, bank the station, 22 June 1908, A. Ley (BM). Symonds Yat, 28 May 1913, H. J. Riddelsdell (BM, NMW, CGE, Riddelsdell *et al.* 1948). Symonds Yat, railway bank, August 1922, H. S. Redgrove (BM). Symonds Yat, near station, 2 June 1953, J. E. Raven (CGE, herb. McCosh). Symonds Yat, railway bank near station, 14 June 1953, C. A. E. Andrews (BIRM). Symonds Yat, north side of railway, east end of tunnel, May 1956, C. A. E. Andrews (BIRM). Symonds Yat, 2 June 1956, F. R. Browning (E). Symonds Yat, 17 June 1962, cutting at E. end of Symonds Yat Railway tunnel, B. A. Miles (CGE). Symonds Yat, bank of disused railway (cultivated), 5 July 1964, J. N. Mills (MANCH).

Coldwell Rocks (SO5616). Coldwell Rocks, 1847, W. H. Purchas (Purchas & Ley 1889). Coldwell Rocks, 23 June 1868, on the Wye, W. H. Purchas (CGE). Coldwell, near Lydbrook, 9 June 1886, A. Ley (CGE). Coldwell, limestone rocks, 5 June 1890, A. Ley (BM). Coldwell, quarry, 13 June 1899, A. Ley (BM).

V.C. 35 MONMOUTHSIRE

Piercefield (ST59). Piercefield, limestone cliffs above the Wye, 5 May and 3 September 1893, W. A. Shoolbred (NMW; Wade 1970). Piercefield Cliffs, June 1894, W. A. Shoolbred (NMW). Piercefield, limestone cliff, 4 June 1897, W. A. Shoolbred (BM).

V.C. 36 HEREFORDSHIRE

Great Doward (S051). Great Doward, limestone debris, B. Watkins, 1868 (Purchas & Ley 1889). Great Doward Quarries, on the limestone debris in the Great Quarry, 20 June 1881, 28 June 1881, and lime point near the Quarry Limestone, 8 June 1886 A. Ley (CGE). Great Doward Hill, 2 June 1882, A. Ley (BM). Great Doward Quarries, 2 June 1882, A. Ley (BIRM). Great Doward Hill, 10 June 1889, F. J. Hanbury (BM). Great Doward Quarries, 9 June 1886, A. Ley (CGE). Great Doward Hill, rocks about the caves, 7 June 1889, A. Ley (CGE). Great Doward Hill, limestone, 12 July 1889, F. J. Hanbury (BM). Great Doward, rocks near the King Arthur's cave, 9 October 1893, A. Ley (CGE). Great Doward, in the quarry, 12 May 1894, A. Ley (CGE, BM, LIV, NMW; Purchas & Ley 1889). Great Doward, 31 May 1897, E. F. & W. R. Linton (CGE, LIV). Great Doward, limestone quarries, 31 May 1897, A. Ley (BM, LIV, NMW; Set of British *Hieracia* no. 64). Great Doward, May 1889, E. Armitage (NMW). Great Doward Hill, 21 May 1902, A. Ley (BM, LIV). Great Doward Hill, 10 June 1902, A. Ley (NMW). Great Doward Hill, August 1903, H. J. Riddelsdell (BM). Doward, May 1904, E. Armitage (NMW). Great Doward, 22 May 1905, A. Ley (LIV). Great Doward, 1 June 1910, H. J. Riddelsdell (BEL, BM, CGE, NMW).

DOUBTFUL RECORDS:

Stroud, banks near, v.c. 34 West Gloucester (Riddelsdell *et al.* 1948).

Pwll Byffre, v.c. 42 Breconshire, 10 July 1929, H. J. Riddelsdell (BM); possibly a confused label.

APPENDIX 2. HISTORICAL RECORDS OF *HIERACIUM VAGICOLA*

V.C. 34 WEST GLOUCESTERSHIRE

Cockshoot, Ban-y-gor (ST59). Beaucliffe (Shoolbred 1920).

Lancaut (ST59). Lancaut cliffs (Shoolbred 1886, 1920). One plant (as *H. subbritannicum*), 10 June 1984, *Hieracia* Study Group (*Hieracia* Study Group 1985).

Pen Moel (ST59). Pen Moel, limestone cliffs and debris under quarry, 25 June 1891, 8 July 1891, 5 May 1893, 16 May 1894 and 27 August 1895, W. A. Shoolbred (**BM**, **CGE**, **NMW**; Shoolbred 1886, 1920). Pen Moel cliffs, 26 June 1895, E. S. Marshall (**CGE**). Pen Moel rocks, 6 September 1900, A. Ley (**BM**, **CGE**, **NMW**; Set of British *Hieracia* no. 136). Pen Moel, 12 June 1913, W. C. Barton (**BM**). Pen Moel, rocky bank by road, 31 July 1916, L. B. Hall (**BM**). Pen Moel, rocks by roadside, 30 July 1920, C. E. Salmon (**BM**). Pen Moel cliffs, below, 24 June 1932, H. W. Pugsley (**BM**). Pen Moel, 1958, C. West (cultivated as *H.105*, **CGE**).

Woodcroft (ST59). Woodcroft (Shoolbred 1920). Woodcroft, August 1922, H. S. Redgrove (**BM**). Woodcroft, bank at, 24 June 1932, H. W. Pugsley (**BM**). Woodcroft, ST540960, 1958, P. D. Sell (**CGE**).

DOUBTFUL RECORDS:

Symonds Yat, date 'forgotten' with 1 June 1895 added later, A. Ley (**BM**; sheet has a series of mixed and confusing labels).

The status of *Hieracium arranense* and *H. sannoxense* (Asteraceae), two endemic hawkweeds from the Isle of Arran, Scotland

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ABSTRACT

Hieracium arranense and *H. sannoxense* are very rare Scottish endemics confined to the Isle of Arran. A review of the records and field work was carried out in 2007. There are about 225 plants of *H. arranense* in six sites; it was not refound in two sites. About 27 plants of *H. sannoxense* were found in two sites. Under the I.U.C.N. Threat Criteria, *H. arranense* is 'Endangered' and *H. sannoxense* is 'Critically Endangered'.

KEYWORDS: Arran Hawkweed, I.U.C.N. Threat Criteria, Sannox Hawkweed.

INTRODUCTION

Sell & Murrell (2006) described two new hawkweeds endemic to the Isle of Arran (v.c. 100 Clyde Islands), Scotland: *Hieracium arranense* P. D. Sell, Arran Hawkweed and *H. sannoxense* P. D. Sell, Sannox Hawkweed (Asteraceae). The only information known about them was that cited by Sell & Murrell (2006), namely that *H. arranense* occurred in several places on the west coast of Arran and that *H. sannoxense* was only known at Sannox Bridge. To assess their needs for conservation, and to provide an I.U.C.N. Threat Category as required under the Global Plant Conservation Strategy (Secretariat for the Conservation of Biodiversity 2002), field surveys of the known sites were carried out in June 2007 and are reported in summary herein. Full details are given by Rich & McCosh (2008) and have been deposited with Scottish Natural Heritage, Scottish Wildlife Trust, the B.S.B.I. V.C. Recorder and the B.S.B.I. Threatened Plants Database.

Both species belong to *Hieracium* section *Subalpina* Pugsley, whose members typically have dark heads, often few, on long, straight peduncles, ligules often pilose-tipped and leaves often with some microglands (Sell & Murrell 2006). *Hieracium arranense* (Fig. 1) has mostly ovate, spotted or blotched or unmarked, weakly glaucous to green, entire to acuminate-toothed rosette leaves with numerous simple eglandular hairs abaxially, 0–2 reduced stem leaves with stellate hairs abaxially, involucre bracts with numerous stellate hairs (especially on margins), frequent simple eglandular hairs and sparse glandular hairs, glabrous-tipped ligules, discoloured styles (discoloration more apparent in dried material), and reddish-black achenes (Sell & Murrell 2006). Our observation of plants in the field show it also has sparse stellate hairs on the midrib, yellow rather than discoloured styles in fresh plants, and blackish rather than reddish achenes. It varies in size and leaf toothiness and coloration, possibly depending on habitat.

Hieracium sannoxense (Fig. 2) has ovate to elliptic, finely denticulate, unspotted, green leaves in a basal rosette, with no or with 1–2 small, reduced stem leaves; involucre bracts acute with many, long simple eglandular hairs, some glandular hairs and a few stellate hairs; and yellow styles when fresh (discoloured with age). *Hieracium sannoxense* looks like some species of *Hieracium* section *Cerinthoidea*, and could well have originated through hybridization of a member of section *Cerinthoidea* with a species from section *Subalpina* or section *Alpina* (Sell & Murrell 2006).

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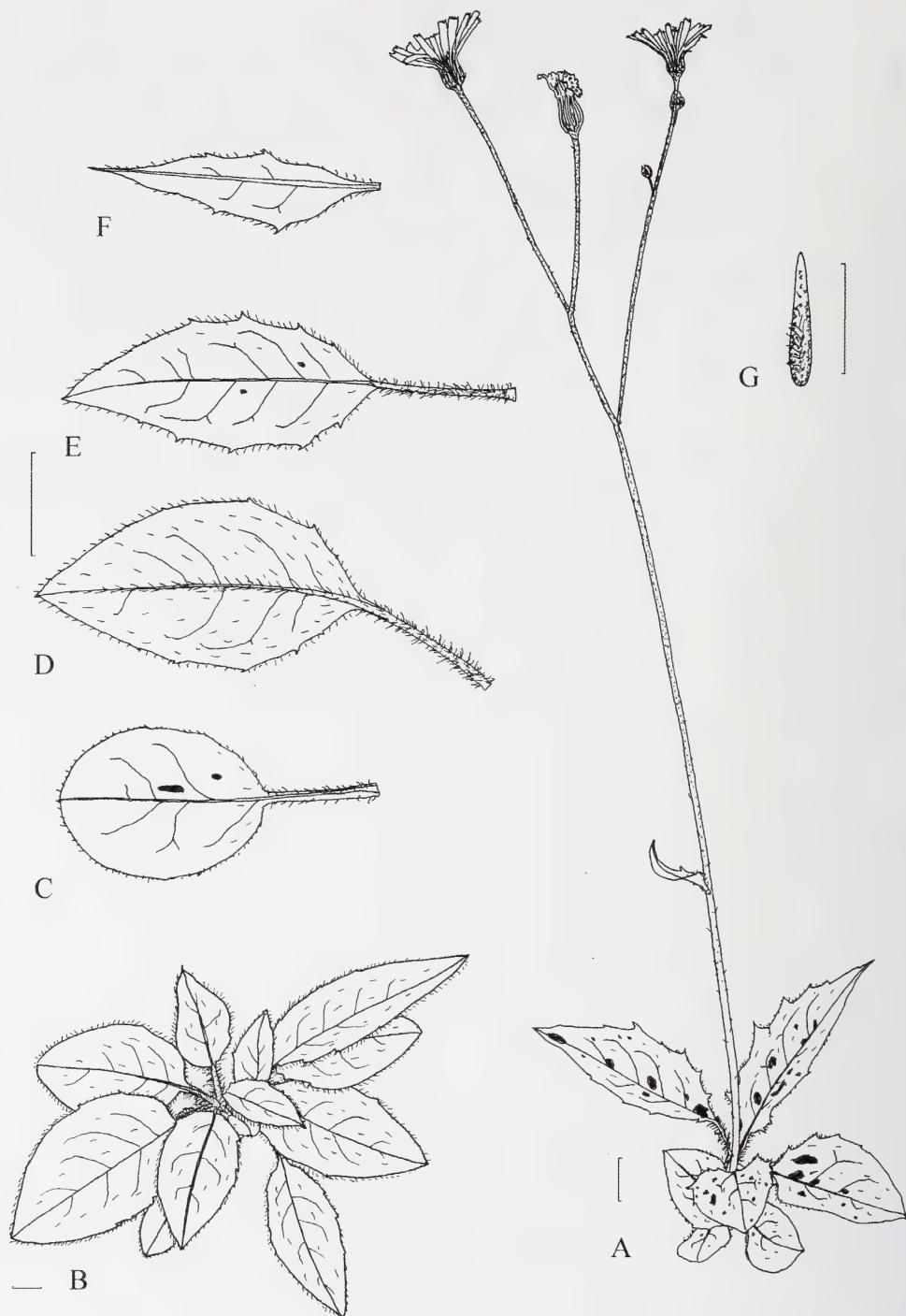


FIGURE 1. *Hieracium arranense*. A, whole plant. B, vegetative rosette. C-E, rosette leaves (upper sides C, E; lower side D). F, stem leaf, upper side. G, involucral bract. Scale bars 1 cm.

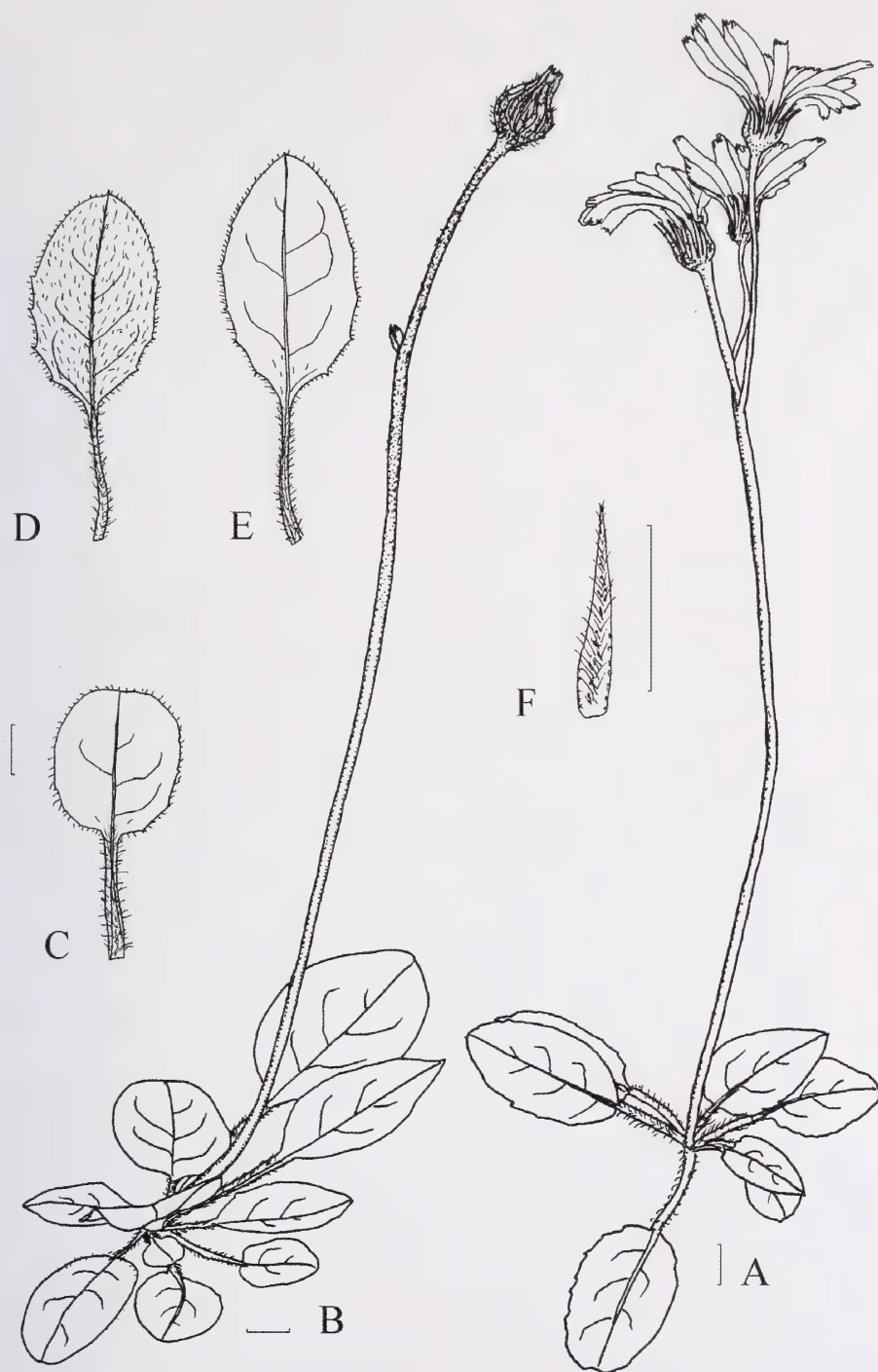


FIGURE 2. *Hieracium sannoxense*. A, flowering plant. B, plant after flowering. C-E, rosette leaves (upper sides C, E; lower side D). F, involucral bract. Scale bars 1 cm.

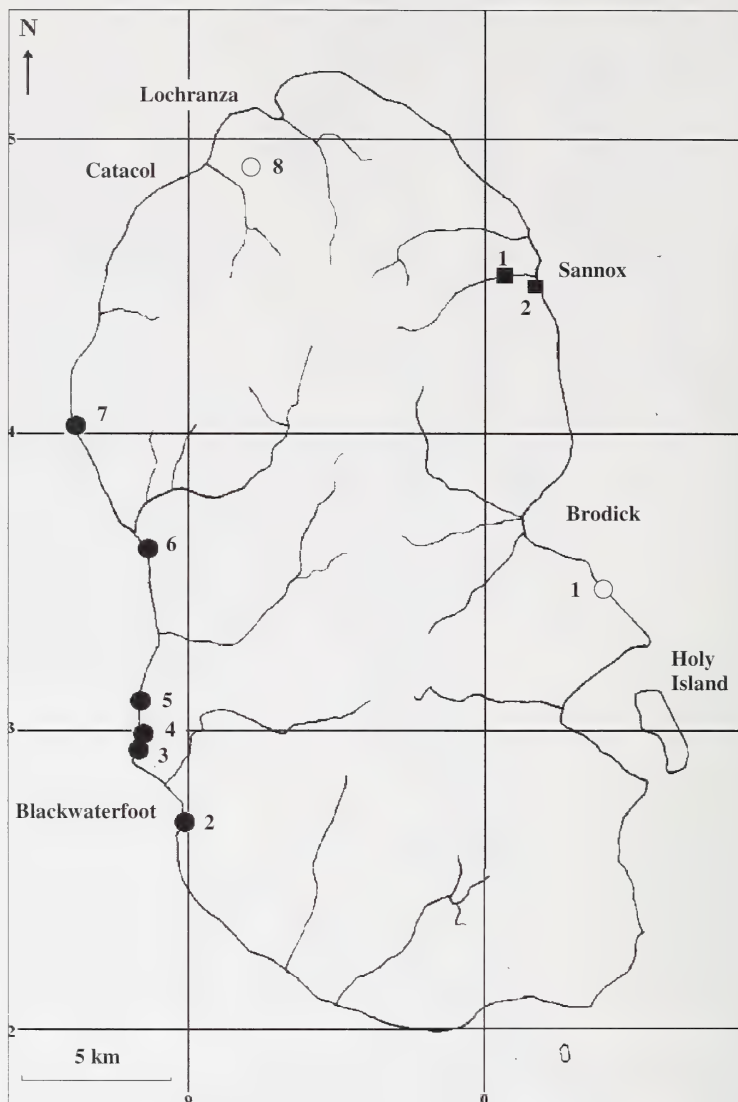


FIGURE 3. Distribution of *Hieracium arranense* (●, 2007; ○, pre-2000) and *H. sannoxense* (■, 2007) on Arran, Scotland. Sites are numbered in clockwise order around the island separately for each species.

The Isle of Arran is situated in the Firth of Clyde in South-west Scotland. It is about 32 km long by 7 km wide and has a varied geology (Geological Survey 1928). The core of the northern half of the island is dominated by mountains formed from Tertiary igneous rocks, and rises to 874 m (Goat Fell). The southern half of the island is lowland, and is formed from Devonian and Carboniferous sedimentary rocks cut by igneous intrusions. The rocks and soils in the north are generally acidic, whilst those in the south are locally more calcareous. Igneous intrusions in the form of sills and

dykes are widespread in the south and around the coast in the north, and locally may be base-rich. The climate is relatively mild due to the North Atlantic Drift, with mild, wet winters and cool, wet summers.

METHODS

Existing information was compiled from herbaria and D. McCosh's *Hieracium* database; this database contains about 29000 records compiled over the last 20 years from numerous British and Irish herbaria (BEL, BIRM, BM,

CGE, DBN, E, GL, HTN, LANC, LCN, LTN, MANCH, NMW and PTH) and other determinations. The only material traced in public herbaria was 5 sheets of *H. arranense* and 3 sheets of *H. sannoxense* in Cambridge (CGE), on which the original descriptions were based, and one specimen in E.

Sites were surveyed on four days between 19–26 June 2007. Plants were counted as far as practical within the time available, and binoculars were used to count plants on cliffs. Voucher specimens from selected sites have been deposited in BM, E and NMW. Soil pH was measured with a calibrated pHep2 Hanna pocket-sized pH meter in a 50:50 mixture with distilled water of dried soil samples collected from around the roots.

I.U.C.N. Threat Categories were derived using the criteria in I.U.C.N. (2001).

RESULTS

Figure 3 shows the sites for both *Hieracium* species on the Isle of Arran.

HIERACIUM ARRANENSE

1. DUN FIONN, SOUTH CORRIEGILLS

Hieracium arranense was first recorded at this site by A. R. Church on 17 June 1988 (**herb. D. McCosh**).

The site was visited on 25 June 2007. *Hieracium caesiomurorum* Lindeb. (one plant) and *H. cyclicum* P. D. Sell (frequent) were scattered on the north-facing, basalt cliffs of the hill fort at NS046336, but *H. arranense* was not found. *Hieracium caledonicum sensu lato* has been recorded on the cliffs c. 1 km to the south.

2. RUBHA GARBHARD, BROWN HEAD

This site was first recorded by A. G. Kenneth on 24 May 1974 (CGE).

One plant occurred in a rock cleft in low quartz-porphry sea cliffs at the back of a raised beach at NR/899261 on 21 June 2007, with *Festuca rubra* L., *Holcus lanatus* L., *Hypochaeris radicata* L., *Succisa pratensis* Moench and *Teucrium scorodonia* L. No other hawkweeds were seen on the cliffs, which generally appear too acid and dry for *Hieracium*.

Two populations occur at the top of the raised beach on flat, vegetated shingle. Four

plants occurred in a sward of *Pilosella officinarum* F. W. Schultz & Sch. Bip. with *Agrostis stolonifera* L., *Anthoxanthum odoratum* L., *Deschampsia flexuosa* (L.) Trin., *Galium saxatile* L. and *Sedum anglicum* Huds. at NR900263 (soil pH 6.0), and 16 plants in a more grassy sward of *Anthoxanthum odoratum* and *Festuca rubra* with *Digitalis purpurea* L. and *Senecio jacobaea* L. at NR899264. Seeds from eight plants were collected for the Millennium Seed Bank.

3. THE DOON, BLACKWATERFOOT

The Doon is an impressive hill above Kilbrannan Sound capped by massive quartz-feldspar porphyry columns. The underlying horizontal beds of sandstone are exposed at the north end. This site was first recorded in 1987 by A. McG. Stirling as 'Drumadoon' (**herb. D. McCosh**).

Twenty seven *H. arranense* plants occurred scattered over the sandstone rocks in a small area at NR886294 with *Dactylis glomerata* L., *Festuca rubra*, *Koeleria macrantha* (Lebed.) Schult., *Plantago maritima* L., *Primula vulgaris* Huds. and *Pteridium aquilinum* (L.) Kuhn. Two probable plants of *H. arranense* occurred out of reach nearby on the otherwise very species-poor, quartz-feldspar porphyry cliffs at the north end of the hill.

4. BOULDER NORTH OF THE DOON, BLACKWATERFOOT

An isolated erratic boulder of igneous origin in the middle of the broad raised beach at NR886296 was covered with 62 plants of *H. arranense*, mostly as very small rosettes rooted in the rock crevices, associated with *Armeria maritima* Willd., *Festuca ovina* L., *Hypochaeris radicata*, *Rumex acetosa* L. and *Sedum anglicum*. The soil was a blackish, organic rendzina of pH 4.4. Plants were only flowering on the sheltered eastern side. Seed from two plants was collected for the Millennium Seed Bank.

5. KING'S CAVE, TORR RIGH MOR, BLACKWATERFOOT

This site was first recorded by A. Somerville on 10 July 1895 (E), and again by A. G. Kenneth and P. D. Sell on 2 June 1974 (CGE). It is the type locality.

Hieracium arranense was frequent on the sandstone cliffs and basalt about King's Cave on 21 June 2007. About 50 plants occurred out of reach on the sandstone cliffs from c. 200 m south of (c. NR885307), to 30 m north of (NR884309), King's Cave, but only a few accessible plants could be checked. 35 plants

occurred on the basalt dyke where the footpath cuts up the cliff at NR884312, associated with *Brachypodium sylvaticum* (Huds.) P. Beauv., *Calluna vulgaris* (L.) Hull, *Erica cinerea* L., *Festuca rubra*, *Luzula sylvatica* (Huds.) Gaudin, *Polypodium* sp., *Sedum anglicum* and *Teucrium scorodonia* on a blackish organic soil of pH 5-8. Plants flowered freely on the sheltered eastern side of the dyke away from the sea, where seed was collected from one plant for the Millennium Seed Bank. A small population of c. 5 plants occurred on sandstone rocks which differed from typical *H. arranense* with its weakly glaucous leaves with yellowish styles in having green foliage and discolored styles; in all other respects they are similar to *H. arranense* and are assumed to be local variants.

One large *H. arranense* plant occurred on the newly made bank of a ditch by the new footpath to the car park behind and above King's Cave at NR885307; this plant is unlikely to survive in the long term as the ditch sides colonize with vegetation.

6. CNOCAN CUALLAICH CLIFFS. DOUGARIE

This site was first recorded on 24 May 1974 by A. G. Kenneth and again a week later on 1 June 1974 by A. G. Kenneth and A. McG. Stirling (CGE).

A small population of *H. arranense* occurred scattered on west-facing Devonian sandstone and conglomerate cliff outcrops above bracken behind improved pasture, though most plants were inaccessible on the cliffs. 14 plants occurred in crevices at NR890353 with *Asplenium marinum* L., *Festuca rubra*, *Plantago maritima* and *Rosa* sp. One plant occurred on a south-west-facing rock at NR891354, and six plants occurred on wet cliffs immediately south-east of the tiny graveyard, with *Agrostis stolonifera*, *Carex flacca* Schreb., *Eupatorium cannabinum* L., *Succisa pratensis* and sheets of bryophytes dripping with calcareous water; this is an unusual habitat.

7. IMACHAR

Three plants were found on a basalt dyke in a field below the road, with *H. deganwyense* Pugsley (3 plants) and *H. vulgatum* Fr. (5 plants) at NR864402 on 22 June 2007.

8. ABHAINN BHEAG. CATACOL

This site was first recorded on 24 May 1974 by A. G. Kenneth at NR919490 (CGE).

The ravine was searched on 22 June 2007 in rain without success, though there were a number of vegetative rosettes which could have been *H. arranense* in the area indicated by the grid reference at the bottom of the gorge, but none with spotted leaves. *Hieracium coniops* Norrl. occurred on the slate on the northern side, and *H. cyclicum* and *H. rubicundiforme* (Zahn) Roffey on the basalt dyke on the south side, and one plant of *H. eucallum* P.D. Sell & C. West was found by the lower dam. *Hieracium boswellii* E. F. Linton, *H. glandulidens* P. D. Sell & C. West and *H. argenteum* Fr. have also been recorded previously but were not refound. Above the main lower waterfall, only *H. vulgatum* agg. was seen on the shaded north bank near *Sorbus pseudofennica* E. F. Warb. Above the second main waterfall the ravine opens out and no *Hieracium* plants could be seen with binoculars.

HIERACIUM SANNOXENSE

1. GLEN SANNOX

Hieracium sannoxense was first collected at Sannox Bridge by A. G. Kenneth and A. McG. Stirling on 1 June 1974 (CGE, the grid reference cited on the specimen is erroneous). It was collected again on 14 June 1976 by A. G. Kenneth (CGE).

A small population totalling 17 plants was found in Glen Sannox scattered up and down the stream on sandstone rocks around the footbridge at NS010453 on 19 June 2007 (it appears that the type locality is this footbridge and not the A841 bridge at NS016455). At NS011453, two flowering plants, one vegetative plant and two seedlings were found on low, stream-washed rocks in the river, associated with *Campanula rotundifolia* L., *Hieracium argenteum*, *Nardus stricta* L., *Solidago virgaurea* L. and *Viola riviniana* Rchb., in very open, sparse vegetation. Four flowering and four vegetative plants occurred at NS010453 on the southern river bank on bryophyte-rich rocks with *Blechnum spicant* (L.) Roth., *Sanicula europaea* L. and *Solidago virgaurea*, shaded under *Betula pubescens* Ehrh. and *Rosa canina* L. Four vegetative plants occurred in rocks in the stream at NS009450. *Hieracium argenteum* and *H. vulgatum* were both more frequent and more widely scattered along the river. The sandstone

has some mildly basic characteristics, and barytes used to be mined in this area. Downstream the burn becomes heavily shaded in the area managed by Corrie Golf Club. Upstream the woodland ceases at about the small weir at NS008452, where the glen opens out and the river only has small boulders.

2. SANNOX

A new population of c. 10 *H. sannoxense* plants was found on 19 June 2007 on a large, conglomerate, erratic boulder beside the A841 road at the southern end of Sannox (NS019448), associated with *Deschampsia flexuosa*, *Festuca rubra* and *Rubus* sp. Seeds from one plant were collected for the Millennium Seed Bank.

OTHER SITES SEARCHED AROUND SANNOX

The A841 bridge at NS016455 had no *Hieracium* and looked unsuitable. The North Sannox Burn had *H. argenteum* and *H. vulgatum* c. 100 m below the bridge at Lag nan Sasunnach (NS013465) and *H. vulgatum/H. coniops* at North Sannox Bridge (NR993468). No *Hieracium* was seen on waterfalls for c. 1.5 km above North Sannox Bridge.

DISCUSSION

Our survey indicates that both Arran endemic hawkweeds are very rare. *Hieracium arranense* has about 225 plants in six sites and was not refound in two sites; it is I.U.C.N. (2001) Threat Category 'Endangered'. Further searches of the two sites where it was not refound would be worthwhile. *Hieracium sannoxense* has about 27 plants in two sites,

and is I.U.C.N. (2001) Threat Category 'Critically Endangered'. It is possible that there are other sites for both species as we could not search the whole island.

Hieracium sannoxense is the rarest and most threatened, and is a priority for *in situ* conservation action. The margins of the burn in Glen Sannox are heavily shaded by *Alnus glutinosa* (L.) Gaertn., *Betula pubescens*, *Fagus sylvatica* L., *Quercus petraea* (Matt.) Liebl., *Salix aurita* L. and *S. cinerea* L., and the hawkweeds would clearly benefit from opening up the canopy, and reduction of the sheep and deer grazing. The conglomerate boulder at Sannox is under threat of scrub encroachment and spread of *Rubus*. *Hieracium arranense* is less threatened, mainly occurring on open rocks kept open by their exposed situation, and probably does not require active conservation at this stage. Both species should be monitored every five years.

To judge from the records in the *Hieracium* database and our field work, in general Arran is not rich in *Hieracium* species. 23 *Hieracium* species have been recorded, though most are infrequent and very local, and include two other species of interest. *Hieracium cyclicum* is a very locally distributed species of the west coast of Scotland and a few isolated sites in Ireland; it is scattered around Arran on conglomerate and basalt rocks. *Hieracium coniops*, another uncommon species in SW Scotland (Sell & Murrell 2006), seems to be as frequent on Arran as its close relative *H. vulgatum*.

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Red Duckweed (*Lemna turionifera* Landolt) new to Britain

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ABSTRACT

In May 2007, red duckweed (*Lemna turionifera*) was found in a ditch at Stoborough in Dorset. In July 2007, a second population was found in the South Forty-Foot Drain in Lincolnshire. *L. turionifera* is native in North America and northern Asia. It has also been recorded from Austria, Belgium, the Czech Republic, France, Germany, the Netherlands, Norway, Poland and Sweden where it has usually been considered to be an alien. Its occurrence in two very widely separated sites suggests that it may have been in Britain for some time but has been overlooked. Notes are provided to aid identification of *L. turionifera*, particularly in relation to *L. minor* and *L. gibba* and some information is provided on the habitats and species associated with it at its two British sites.

KEYWORDS: Lemnaceae, distribution.

INTRODUCTION

In May 2007, John Bruinsma, Klaus van de Weyer and I visited a number of sites in southern England to enable Klaus to prepare guidance on the identification of some aquatic plant taxa which occur or have occurred in Germany with which he was not familiar. One of these was *Potamogeton* × *sudermanicus* Hagstr. at its only British location near Stoborough in Dorset (vc. 9). Whilst searching for the pondweed, *L. turionifera* Landolt was found growing with *L. gibba* L. in populations embayed by a plank bridge and among marginal vegetation. On 19 July 2007 another population of *L. turionifera* was found in the course of a survey of aquatic vegetation in the South Forty-Foot Drain, between Billingborough Fen and Quadring Low Fen, Lincolnshire (vc. 53).

Material from both populations was sent for determination by Professor Dr. E. Landolt at the Institut für Integrative Biologie, Zürich. The material from Stoborough was too degraded for determination by the time it arrived but Prof. Landolt has been able to confirm that the material from the South Forty-Foot Drain was

L. turionifera. The two populations were sufficiently similar that I am convinced that they are both of the same species and therefore the collection from Stoborough represents the first record of this species in Britain. Material from this collection has been deposited at BM.

DISTRIBUTION

L. turionifera is native in North America and northern Asia. In North America it occurs from Mexico north to Alaska and through much of Canada and the United States east to Nova Scotia, it is largely absent from the south-eastern United States. In Asia it occurs in a broad band from Turkey, north and east across Russia to Kamchatka and Sakhalin Island (Landolt 1986). In Eurasia, the western limits of its distribution have been obscured by apparently non-native populations (Muller 2004), where it has been recorded from Austria, Belgium (Hoste & Bruinsma 2007; van Landuyt 2007), the Czech Republic, France (Muller 2004), Germany (Landolt 1986, Wolff and Ortschiedt 1993), Poland (Muller 2004), the Netherlands (Wolff & Bruinsma 2005), Sweden and Norway (GBIF 2007). Its occurrence in Britain may be part of a westward range expansion.

IDENTIFICATION

A total of seven species of Lemnaceae are known to occur in the wild in Britain. In addition to species of *Lemna*, these include *Spirodela polyrrhiza* (L.) Schleiden and *Wolffia arrhiza* (L.) Horkel & Wimmer. Another species *Landoltia* (formerly *Spirodela*) *punctata* (G. Mey) Les & D. J. Crawford has been recorded as a contaminant in garden centres (Rumsey 2006), but not yet in the wild. The species of *Lemna* known to occur in the wild in Britain fall into three sections: Section *Hydrophylla* most clearly distinguished by submerged growth and the fronds tapering to a stalk at the base, represented by *L. trisulca* L.;

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Section *Uninerves*, best distinguished by having only one nerve, represented by *L. minuta* Kunth.; and Section *Lemna* best distinguished by having floating growth and more than one nerve, represented by *L. gibba*, *L. minor* and *L. turionifera* (Landolt 1986). *L. gibba* can sometimes be identified by its growth form, where the cells of the aerenchyma expand so that the whole frond becomes swollen and can be up to 4 mm thick. However, not only can *L. gibba* occur in populations where no fronds are swollen, but *L. minor* can show some expansion, although never as much as *L. gibba* (Landolt 1986). When not expanded, *L. gibba* and *L. minor* can usually be separated by the shape of fronds, although this is not always clear and some populations may need to be grown in cultivation until characteristic features are

sufficiently well developed (E. Landolt, pers. comm. 2007).

L. turionifera can usually be identified by the presence of papules along the median line, of which the apical is not significantly larger than the others and by reddish coloration commencing around the point at which the root is attached on the underside and developing as brownish-red discoloration of the bases of fronds on the upper side, making fronds look "dirty". This latter feature is the best method of recognising plants of *L. turionifera* among mixed floating *Lemna* populations. Papules are small raised bumps which occur on the upper surface of fronds and are the same colour as the surrounding tissue. The following key provides guidance on identification of those species of *Lemna* known to occur in the wild in Britain.

KEY

1. Fronds denticulate at the apex; narrowed to a stalk-like portion at the base..... *L. trisulca*
Fronds entire and with at most only a minute stalk-like portion.....2
- 2(1) At least some fronds greatly swollen to more than 2 mm, with a firm, whitish or translucent swelling below the green upper cells*L. gibba*
Fronds $\pm$ flat, clearly bifacial and not or at most only slightly swollen3
- 3(2) Fronds with reddish coloration4
Fronds lacking reddish coloration, entirely green or glaucous6
- 4(3) Reddish coloration developing initially at the margins then spreading inwards on both surfaces or as scattered dots over the upper surface.....*L. gibba*
Reddish coloration either mainly on the upper surface or developing initially at point of root attachment (node) underneath and spreading outward5
- 5(4) Reddish coloration $\pm$ restricted to the upper side of fronds or markedly less intense on the underside; papules near the tip and at the node larger than the ones in between*L. minor*
Reddish coloration either restricted to or more intense on the underside; papules of uniform size *L. turionifera*
- 6(5) Fronds evidently glaucous (although this is very difficult to confirm in small or sparse populations); fronds small (<4 mm $\times$ 2.5 mm); vein solitary and indistinct.....*L. minuta*
Fronds green, not glaucous; fronds small to large (<10 $\times$ 7 mm); veins usually more than one and usually evident as ridges along the frond7
- 7(6) Fronds with distinct papules along the median line of the upper surface, the papule at the tip not distinctly larger than the proximal papules..... *L. turionifera*
Fronds without distinct papules or with papules near the tip distinctly larger than proximal ones.....8
- 8(7) Fronds widest toward the often broad apex; largest fronds with five veins all arising from the same point.....*L. gibba*
Fronds widest at the middle or toward the base, apex usually fairly narrow; largest fronds with 4-5 veins with the outer veins arising from the inner *L. minor*

DISTRIBUTION AND HABITAT IN BRITAIN

DORSET (V.C. 9)

The population at Stoborough was found in a broad ditch, approximately 10 m wide, with a width of about 7 m of open water. The margins were densely vegetated mainly with *Glyceria maxima* (Hartmann) O. Holumb. *L. turionifera* was mainly found in a mixed population with *L. gibba* embayed by railway sleeper crossing the ditch near its mid-point. Scattered plants were also found in areas of open water on the landward side of stands of *G. maxima*. Other plants recorded in the ditch included, *Potamogeton* × *sudermanicus* Hagst., *P. acutifolius* Link and *Lemna gibba*; *Lemna minuta* occurs in a very well-developed population in a nearby ditch. The ditch where the *L. turionifera* was found is shown running just north of due west of Redcliffe Farm on a map published by Preston & Pearman (1998).

LINCOLNSHIRE (V.C. 53)

At the point where *L. turionifera* was found, the South Forty-Foot Drain is a wide, deep channel with very slow-flowing or still water running between high, steep embankments through fenland. The population in the South Forty-Foot Drain occurred with a very rich fenland aquatic plant community including *Ceratophyllum demersum* L., *Chara vulgaris* L., *C. virgata* Kütz., *Hottonia palustris* L., *Lemna gibba*, *L. minor*, *L. trisulca*, *Myriophyllum verticillatum* L., *Nymphoides peltata* Kuntze, *Potamogeton lucens* L., *P. natans* L., *P. pectinatus* L., *P. trichoides* Cham. & Schldtl., *Ranunculus circinatus* Sibth., *Riccia fluitans* L., *Sagittaria sagittifolia* L. and *Tolypella prolifera* (Desv.) Leonh.

Landolt (1986) recognises only five phytosociological associations characterised by

L. turionifera. One of these, referred to as "Association of *L. turionifera* and *Riccia fluitans*" is reported to include *L. turionifera*, *L. trisulca*, *Spirodella polyrrhiza* and *Wolffia columbiana* Karsten with occasional *Lemna valdiviana* Phil., *Wolffia borealis* (Engelm.) Landolt and *Ceratophyllum demersum*. Clearly many of these species are unlikely to occur in Britain however it would seem reasonable to attribute the population in the South Forty-Foot Drain to this association, because it shares *Riccia fluitans*, *Lemna trisulca* and *Ceratophyllum demersum*. Muller (2004) suggests that in Europe *L. turionifera* is associated with still, eutrophic water with a pH of 7–9 and this is likely to agree with the conditions in both the British sites.

The discovery of this species at two widely separated sites in Britain suggests that it may well be widely established and has simply been overlooked. *Lemna* species are not necessarily well recorded in Britain and it is hoped that information presented here will help to improve recording.

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John Fitz-Roberts: A little-known seventeenth century botanist

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ABSTRACT

Information is provided relating to the work and collections of the little-known botanist, John Fitz-Roberts of Kendal, who was active around the end of the seventeenth-century. Records, traceable from the literature of the day, preserved specimens, and letters sent to him by James Petiver, are discussed. Some of his records are cited as obscure polynomials and where possible these have been identified through reference to the early literature. Where localised, the current status of the recorded plant is briefly commented upon. Fitz-Roberts appears to have been one of the first, if not the first, to record *Sesleria caerulea* in Britain.

KEYWORDS: John Robinson, Kendal, Nicolson, Petiver, Plukenet, Ray, *Sesleria caerulea*, Wilson.

INTRODUCTION

Details of the life of the late seventeenth century Kendal botanist John Robinson alias Fitz-Roberts are largely shrouded in mystery. He appears to have been active well before the 1690s and also later but published nothing himself. One of his contemporaries was the well-known Cumbrian botanist and Quaker Thomas Lawson (1630–1691) who mentioned Fitz-Roberts in his correspondence. What little is known of Fitz-Roberts originates mainly from those who knew him or with whom he corresponded directly. These included the Cumbrian botanist, William Nicolson (1655–1727) who was Archdeacon (later Bishop) of Carlisle, John Ray (1627–1705), James Petiver (1633/4–1718), and the Queen's Botanist, Leonard Plukenet (1642–1706). Nevertheless, James Newton (1639–1718) and Richard Richardson (1663–1741), both of whom sometimes botanised in Westmorland, appear not to have been known to him. In more recent times there have been cursory references to him by Martindale (1888–1889), Dandy (1958),

Desmond (1977) and Whittaker (1981, 1986). However, he is not mentioned by Raven (1947) in his review of the naturalists of around that period and has been completely overlooked by Flora writers covering the Kendal area, such as Baker (1885), Wilson (1938) and Halliday (1997).

No reason has yet been found for his change of name. Although Nicolson, in his diary entry for June 1690, refers to him as "Joh [John] Robinson", later he attributes two of his records to "J.F.R" (an abbreviation for John Fitz-Roberts). However, his name as Fitz-Roberts seems to have been established by the mid-1690s as evidenced by letters written to him around then by Petiver and records quoted by Ray (1696 *passim*). Petiver, in *Philosophical Transactions* (1710–1712), confirms his name change when describing him as "Mr John Robinson, alias Fitz-Roberts, a Curious Naturalist, sent up several of these Plants [*Osmunda Westmorlandica* = *Cryptogramma crispa*] from Kendal". Similarly, the relatively few surviving herbarium specimens he sent to Petiver (now in the Sloane herbarium, **BM**) are, except for one (a lichen), labelled in Petiver's hand in the name of Fitz-Roberts, not Robinson; similarly, Lawson (prior to his death in 1691) in a letter to Ray had already referred to him as Fitz-Roberts. All this contrasts with some of Nicolson's 1690 diary entries and it is possible he may have used both names for a while before Fitz-Roberts became finally accepted. His reason for the change may have been an attempt to avoid confusion with another contemporary Cumbrian naturalist, also a correspondent of Ray, Thomas Robinson, who was Rector of Ousby from 1672–1719 and author of *Natural History of Westmorland and Cumberland* published in 1709.

So far, the dates of Fitz-Roberts' birth and death are unsubstantiated, the Parish register for the Kendal area being lost around the time of his birth whilst that covering later years is

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still un-transcribed. However, a parish record confirms a marriage to have taken place in Kendal on 2 January 1682 between a Mr John Robinson and Anne King of Strickland Roger [Kendal Parish Register transcripts] which could refer to him. Prior to his death in 1691 Thomas Lawson had sent to Ray a drawing made by Fitz-Roberts of *Andromeda polifolia* (see below) which appears to place Fitz-Roberts as an experienced botanist by the 1680s, if not earlier. Nicolson in his diary for 1690 referred to him flatteringly as "Joh. Robinson (sutoris ultra crepidam docti)" again suggesting that he was well-established and well-known by that date. The botanist John Wilson (1696–1751), author of *A Synopsis of British Plants, in Mr Ray's Method* (Wilson 1744), also knew Fitz-Roberts and probably gained much of his early botanical experience from him (see *Gentianella amarella* below). Known as "Black Jack", Wilson was originally a Kendal shoe-maker, later becoming a baker and finally, a lecturing botanist and author as well as something of a local character (Nicholson 1832). The connection with Wilson suggests that Fitz-Roberts was botanising until at least the 1720s and probably later. If the recorded Kendal wedding of 1682 was indeed that of Fitz-Roberts, it would seem that his life span approximated to the years c.1655–c.1730. He was known to live at the Ghyll (Nicholson 1832) [SD50.92] which is just to the west of Kendal close to the Brigsteer and Levens roads and is ideally placed for access to the botanically-rich limestone countryside nearby. Although possibly not his actual home, Gill Cottage is shown at this location on a map published in 1859, with Gill Well only a field's distance away.

THE TOPOGRAPHY OF THE AREA AROUND FITZ-ROBERTS' HOME

John Fitz-Roberts appears to have been active mainly in the south of the old county of Westmorland (v.c. 69) and occasionally in "Lake Lancashire". Both areas are now within administrative Cumbria and lie to the north of the estuary of the River Kent. Even today, the area within a 10 km radius of his home is botanically-rich and it would have been even richer at the end of the seventeenth century. This is especially the case to the west and south, since much of the substrate is limestone, the major features being the long, steep outcrops of Cunswick and Scout Scars and

their associated open grassland. Lying below the scars is limestone woodland and the small Cunswick Tarn with its surrounding fen margin. Drained mossland separates this area from another major feature lying to the west, the limestone scar of Whitbarrow, whilst still further away to the west and south are the outcrops at Meathop, Kirkhead and Humphrey Head. By contrast, to the north and east of his home the substrate is largely acidic and so has a different, more restricted flora.

Fitz-Roberts is known to have botanised especially on the nearby escarpments as well as on the lower, wetter mossland, much of it nowadays given over to agriculture. Other records of his for more montane plants suggest visits to nearby acidic Silurian areas such as the valleys of Kentmere and Sleddale to the north-west of Kendal. So far there is nothing to indicate that he travelled much further afield and, surprisingly, there are no localised records of his for the Whitbarrow area. Even today the latter is still botanically-rich and it is possible that access over the intervening, now-drained, moss land would have been difficult and involved a long detour round higher ground (the so-called "landway"). However, he did visit Humphrey Head at least once, so he probably used this route on that occasion.

FITZ-ROBERTS' BOTANICAL RECORDS

A note in Nicolson's diary states that on 10 June 1690, he received a specimen of *Ophrys insectifera* from Fitz-Roberts "missa est mihi a Do. Robinson de Kendal, planta nostras perelegans Orchis myodes". In the following week Nicolson paid a visit to Kendal, perhaps to preach, and on 18 June visited Fitz-Roberts, noting in his garden a range of plants "horto Joh. Robinson (sutoris ultra crepidam docti) planta occurrebant sequentes Britannicae". These were described under their contemporary names, some of which are identifiable: *Acetosa Rotundifolia* West[morland] (*Oxyria digyna*), *Acorus verus*, *Betonica aquatica* (*Scrophularia aquatica*), *Conyza major* (*Inula conyza*), *Conyza media*, *Cotyledon Hirsuta*, *Geranium nodosum*, *Geranium fuscum*, *Geranium longius radicatii*, *Marrubium Aquaticum*, *Pentaphylla erectii* fol. *Argenteo* (*Potentilla argentea*), *Polygonatum* (*Polygonatum multiflorum* or *P. odoratum*, both scarce locally), *Parmica vulgaris* (*Achillea ptarmica*), *Serratula foliis o dissectis* (*Serratula tinctoria*) and *Tapsus Barbatus* (*Verbascum thapsus*).

On the following day (19 June) Nicholson and Fitz-Roberts together with two others made a small local botanical expedition. They went through the woods by the River Kent to the waterfall at Levens (i.e. downstream from Kendal) noting fossils in the dam on the river and found the scarce *Meum athamanticum* in fields near Kendal Castle and *Euonymus Theophrasti* (*Euonymus europaeus*) plentiful in hedgerows around the villages of Natland and Sedgwick. ["Do. Sutch M.B. medicus Kendaliensis, A Farrington Affinis meus peerdilectis, Joh. Robinson antedictus, et W.N. Inter sylvas et fl. Cantij cataractus, aestivo calare obrutio? Occurrebant Lapides Entrochi in una massam concreti. In ye mill-damm, above ye Force near Levens.....Meum. In ye fields near Kendal-Castle.... and Euonymus Theophrasti. Exceedingly plentiful in ye Hedges about Natland and Sedgwick"].

Working largely within the Kendal area, Fitz-Roberts was the first to report the presence of a number of interesting plants, specimens of some of which he had collected are now preserved in the Sloane herbarium (BM). Several of his records are also acknowledged in the works of Petiver and Ray. One, *Sesleria caerulea*, which, although classified as a nationally scarce plant (Halliday 1994), is exceptionally abundant on the northern limestones. It was first recorded by Fitz-Roberts (Ray 1696) as: "Gramen parvum montanum spica crassiore purpuro-coerulea brevi.....Ab amico optimo D. Fitz-Roberts accepi, qui alicubi in Cumberlandia collegit". This was a well-documented find since there is an excellent specimen (HS 150 f.118) in the Sloane herbarium (BM) collected by Fitz-Roberts (Fig. 1), Petiver's label stating "Mr Fitz-Roberts gathered this elegant grass at Hols-Fell Nabb ½ a mile from Kendall". Accompanying it is also the description taken from Leonard Plukenet's *Almagestum Botanicum* (1696).

Hols-Fell Nabb (Helsfell Nab) [SD5093] is only 1 km to the north of where Fitz-Roberts lived at the Ghyll and a little to the east of the long west-facing limestone escarpment of Cunswick Scar [SD4993-94] where *Sesleria caerulea* is still exceptionally abundant and where other much scarcer plants are found today, such as *Carex ericetorum* and *Helianthemum oelandicum*.

RECORDS IN CONTEMPORARY LITERATURE AND DIARIES

ACTAEA SPICATA L.:

This was recorded by William Nicolson in his manuscript as having been seen on the outskirts of present-day Kendal on 9 August 1691. The locality was Shaw Wood, Stainbank Green (SD5091) where it was described as abundant at that date and presumably in fruit. Whilst there is only circumstantial evidence that the record was originally Fitz-Roberts', this wood, nowadays no longer present, was only a few hundred metres from his home at The Ghyll and the *Actaea* was recorded at a period when Nicolson was known to be visiting him (see above). It seems inconceivable that such an interesting plant had not first been found there by Fitz-Roberts who then later showed it to Nicolson. *A. spicata* has not been recorded for this general area of south Westmorland for some considerable time, the closest being at two sites near Arnside where it was last seen in 2002. At Shaw Wood, Nicolson (cf. manuscript) also recorded *Filipendula vulgaris* which again would surely have been previously known to Fitz-Roberts and again, presumably shown to Nicolson at the same time as the *Actaea*. No Fitz-Roberts specimen of either plant has been traced.

ANDROMEDA POLIFOLIA L.:

Quoted by Ray (1696: 202) as "Ledum palustre nostras Arbuti flore. Rosmarinus sylvestre minus nostras Park.....Marsh Cistus, or wild Rosemary Flos, ut ex icone ejus ad vivum depicta à D. Joanne Fitz-Roberts; & à D. Tho. Lawson à me transmissa apparet.....". This illustration referred to as drawn by Fitz-Roberts will have been of a plant collected from either Brigsteer Moss (near to Fitz-Roberts' home) or one of the others close by which nowadays are mostly drained and "improved". However, the plant is still present on some of the mosses within the area.

CRYPTOGRAMMA CRISPA (L.) R. BR. EX HOOK.:

Petiver (1710–1712: 376) stated "Osmunda Westmorlandica, foliis tenuissimè dissectis, Mus. Petiver. "Mr John Robinson, alias Fitz Roberts, a Curious Naturalist, sent up several of these plants from Kendal, which were set in Chelsea Garden and elsewhere, but after a

winter or two, they often go off". From the polynomial and illustrations quoted by Petiver: i.e. Plukenet (1691, t.3, ic.2) and Morison [=Bobart] (1699, sect 14, t.4), the plant can be identified as *C. crispa*. This is still frequent on acidic scree and stone walls in the Kendal area, especially off the limestone to the north.

GENTIANELLA AMARELLA (L.) BOERNER:

Ray (1696: 156) recorded "*Gentianella fugax verna seu praecox*. Vernal dwarf Gentian. Found by Mr Fitz-Roberts on the Backside of Halse-fellnab [SD5093] near Kendal; as also in the Parks on the other side of Kendal, on the back of Birk-hag [SD5391]. Aprili mense floret ad Junium usque". The first site is where Fitz-Roberts also collected *Sesleria caerulea* (see above), that at Birk Hagg, nowadays farmland, is a little way to the east of Kendal. Both populations appear to have been flowering much earlier than normal. At the time, Ray considered it to be a new species but Wilson, who also knew the plant from where Fitz-Roberts had seen it, stated "Mr Fitz-Roberts told me he never gave any intelligence about it, only that he informed Mr Petever [sic], he had seen the Autumnal Gentian (which grows very plentifully in those places) flower sooner than common; and this probably caused the mistake" (Wilson 1744: 135). *G. amarella* still occurs on grazed limestone grassland around Kendal.

HELIANTHEMUM OELANDICUM (L.) DC. SUBSP. *CANUM* (L.) BONNIER:

Again, given by Ray (1696: 203) as: "*Chamaecistus seu Helianthemum alpinum folio Pilosellae minoris Fuchsij J.B.....* Hoary dwarf Mountain-Cistus with Coltsfoot Leaves..... At Buck-Barrow Bank Scar, betwixt Brigsteer and Conswick; also on the Rocks about Cartmel-Wells in Lancashire plentifully. Observed by Mr Fitz Roberts". A sheet in the Sloane herbarium (HS 152 f.277) on which an unidentified specimen bears Fitz-Roberts' name also contains specimens of what appears to be this plant which are very likely to have originated from him. The first locality mentioned is the southern part of the cliff now known as Scout Scar (SD4890–SD4892), the long limestone outcrop lying just to the south of Cunswick Scar, where both *Helianthemum oelandicum* (*H. canum*) and *H. nummularium* are frequent to this day. The second locality is the coastal limestone ridge of Humphrey Head (SD3973–SD3974) where the plant also survives together with other rarities.

MELICA NUTANS L.:

Ray (1696: 262) stated: "Gramen Aven. locustis rubris montanum C.B. locustis rubra J.B. Park. Mountain Oat-Grass with red husks. This was sent [to] Mr Petiver out of the north, and by him communicated to me". Later in the same publication he (Ray 1696: 325) specifically mentioned that it was sent to him by Fitz-Roberts from near Kendal. Also that he had also received what he described as 'most elegant' specimens of the same plant from Jacob Breyne (1637–1697, the well-known Polish botanist): "Hoc à D. Fitz-Roberts circa Kendalium Westmorlandiae oppidum primarium collectum & ad me transmissum est, cujus etiam elegantissima specimina accepi à celebratissimo Jacobo Breynio". Fitz-Roberts' plant is identified through the reference to John Parkinson (Park.) given above. In his *Theatrum Botanicum*, Parkinson (1640) provided an illustration of this plant, the central example clearly depicting the rather one-sided inflorescence of *M. nutans*. In his edited and posthumously published "*Concordia*" of grasses etc. Petiver (1767) re-confirms Fitz-Roberts as the original collector: "Mr Fitz-Roberts first observed this, about Kendale in Westmoreland". The plant is still quite frequent in light woodland over limestone on both sides of the Kent estuary.

OXYRIA DIGYNA (L.) HILL:

Petiver (1710–1712: 377) stated that Welsh Sorrell "*Acetosa Cambrobritannica Montana*" had been seen "by Mr Tho. Lawson and Mr John Fitz-Roberts, two other expert Botanists, in Westmorland...". Amongst various synonyms given by Petiver, it can be identified from the illustrations in Parkinson (1640: 745, fig 12) and Morison (1680: vol.2 sect.5, t.28, fig.10), both clearly of *Oxyria digyna*. A plant of damp mountain rocks and gullies, it still occurs in the central Lake District area from where they most likely saw it.

PULMONARIA OFFICINALIS L.:

Nicolson, in his manuscript, recorded "*Pulmonaria folis Echij, flore rubro*. Bugloss-Cowslips; or long-leav'd Sage of Jerusalem. Nigh Burnishead-Chapple [= Burneside, SD 50.95]. J.F.R. [Fitz-Roberts]"; this is also noted in Whittaker (1981). The plant had been grown in British gardens for centuries and became widely naturalised in scrub and woodland. Thomas Johnson (Gerard 1633) described and illustrated it, stating that it was first found by John Goodyer in the New Forest in 1620.

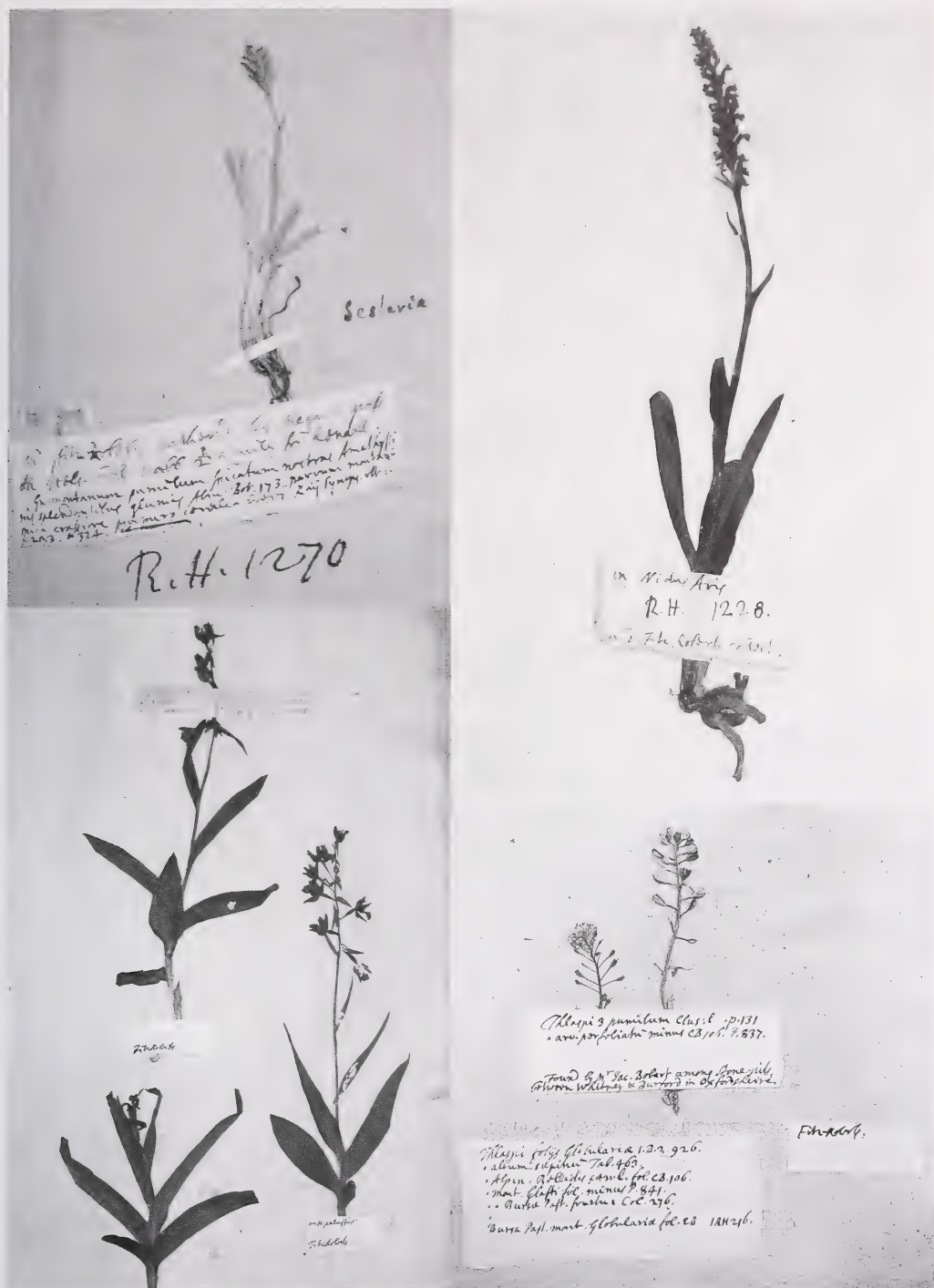


FIGURE 1. Fitz-Roberts' specimens: *Sesleria caerulea* (top left); *Pseudorchis albida* (top right); *Epipactis palustris* (bottom left); the Fitz-Roberts-Bobart specimen of *Thlaspi perfoliatum* (bottom right).

TRAGOPOGON PORRIFOLIUS L.:

A reference to the vegetable known as salsify is given by Ray (1696: 77): "Tragopogon purpureum in Anglia sponte provenire nobis affirmavit D. Fitz-Roberts" and had been introduced and become naturalised in Britain by this time. It seems that Fitz-Roberts considered it to be native contrary to Ray's earlier opinion that it was naturalised; however, Ray was correct. No precise locality was recorded by Fitz-Roberts although there is a much earlier (pre-1597) record from near Whalley (v.c. 59) probably originally assignable to Thomas Hesketh (1560–1613) (or his mother, Lady Hesketh) which is given in Gerard's "*Herball*" (Gerard 1597). From Nicolson's manuscript it is clear that he also knew the plant "in the fields about Carlisle [Carlisle]".

VERONICA SPICATA L.:

Nicolson, in his manuscript, also quoted a record for *V. spicata* at Humphrey Head which he attributed to Fitz-Roberts: "Veronica spicata. Quae vel – Major. On the rock above Cartmell-Well. J.F.R. [Fitz-Roberts]". This is also noted in Whittaker (1981). Even in those days Cartmel Well (or Holy Well) was a well-known spring under the west-facing limestone cliff of Humphrey Head and was reputed to have medicinal healing qualities. The spring and *V. spicata* are still there, the latter surviving as a small scattered population at several points along the cliff along with other local rarities. Fitz-Roberts appears to have been the first to record *V. spicata* in northern England. It can also be found a little to the east near Arncliffe (v.c. 69) in two very small populations.

FITZ-ROBERTS' HERBARIUM SPECIMENS

Further contributions made by Fitz-Roberts to the flora of his local area are represented by the small series of specimens which he sent to Petiver. These are usually mounted amongst others of different provenance on mixed sheets, randomly distributed in three folio volumes in Petiver's herbarium (Sloane, **BM**). Due partly to their age, several are poorly preserved and often difficult to identify. Petiver signified the Fitz-Roberts origin by placing small handwritten labels over, or adjacent to them, variously worded "Fitz-Roberts", "Fitz-

Roberts", "Fitz-R", etc. Unfortunately, not all the labels and specimens are directly attached to each other so that in some instances there is doubt about a genuine Fitz-Roberts connection and most of these have been excluded here. Altogether, seventeen specimens attributable to Fitz-Roberts are briefly described below. They are amongst some of the oldest surviving within the British Flora and in some cases may represent the earliest for Westmorland since, despite Lawson sending material to Bobart at Oxford and to Ray about this time, not all of these will have survived. On some of the sheets, Petiver has written "R.H." followed by a number, this a reference to what he considered to be that particular plant on that page in Ray's *Historia* (Ray 1686–1688). The specimen references given below (as HS) are those of the volume and page number in Sloane (**BM**).

CYPRIPEDIUM CALCEOLUS L.:

This is represented by specimen(s) at HS 152 f. 171. Long since extinct in the wild in the Kendal area and virtually so in Britain, the most recent records for this area are from the nineteenth century. These are Whitbarrow, where it was recorded by F. Clowes (Martineau (1855), "The Lyth" (which may be the same locality, since Whitbarrow lies immediately to the west of the Lyth valley) known from a fir plantation in the 1860s (*Anon*, **BM**!)), and Barrowfield [Wood], Scout Scar, a specimen from there having been transplanted into the garden at Levens Hall (1875, *herb. E. F. Linton*, **BM**!). This last locality, close to Fitz-Roberts' home is the most likely source for his specimens. Unfortunately, one of them (lower left on the sheet) lacks a flower. Plants from the Kendal area were also transplanted into the grounds of nearby Sizergh Castle.

EPIPACTIS PALUSTRIS (L.) CRANTZ:

This sheet (HS 152 f.174) comprises three specimens (Fig. 1) with the lower left having the inflorescence broken off. The others (both labelled "Fitz-Roberts" by Petiver) have been referred to *E. palustris* and would appear to comply. It was described by Wilson (1744) as being "In several marshy places about Kendal" but the locality from where Fitz-Roberts collected it would probably be the fen margins of Cunswick Tarn (SD4893) where it was later seen by Gough (Nicholson 1832) and thought to be last recorded there in 1952 (Halliday

1997). There are also records at two other nearby sites where Fitz-Roberts may have collected it: on Whitbarrow, known to W. Foggitt (Wilson 1938), and in Barrowfield wood [SD4891–SD4892] in 1908 (about 2 km to the south of Cunswick Tarn) (*Martindale*, **KDL**!). Today, the plant appears to be extinct in this general area (Halliday 1997). Two other species of *Epipactis*: *E. helleborine* and *E. atrorubens* occur on the wooded limestones of Cunswick and Scout Scars, and may well have been known to Fitz-Roberts.

ERIPHORUM VAGINATUM L.:

A plant of boggy ground on moorland and mountains, frequent in areas to the north of Kendal. However, it is also known from coastal mosses around the Kent from where Fitz-Roberts may have collected it (HS 150 f.183).

LOBELIA DORTMANNA L.:

Frequent at the shallow stony borders of the more acidic lakes and tarns away from the limestone areas and still fairly common to this day. Fitz-Roberts' closest site would probably have been to the west of Kendal towards Windermere. This specimen is on sheet HS 152 f.183.

PERSICARIA VIVIPARA (L.) RONSE:

Fitz-Roberts' specimen is at HS 151 f.28. This plant is currently found in hill pastures and mountain areas of Cumbria where it can be locally frequent. His closest locality was probably to the north on the limestone near Orton, a distance of c. 25 km from his home and somewhat outside his normal ambit.

PSEUDORCHIS ALBIDA (L.) A. & D. LOEVE:

Now very scarce in northern England this occurs only in upland pastures, usually off the limestone. However, there is an old record by Gough (Nicholson 1832) for Barrowfield Wood near Kendal. Although limestone woodland is a most unusual locality for *P. albida*, the site is only 2 km from Fitz-Roberts' home and is a place he would certainly have visited and from where he would surely have collected a specimen if he had found it. His specimen (Fig. 1) is on sheet HS 152 f.170. Whilst it is clearly *P. albida* (Fig. 1) there is further confusion in that Petiver had labelled it "An Nidus Avis...a D. Fitz Roberts collecta". The area close to Barrowfield Wood is where *Neottia nidus-avis* is still present to this day but *P. albida* is unknown. Nowadays not present in the Kendal area, *P. albida* was collected at

nearby Spy Crag, Staveley (*Martindale & Martindale*, **KDL**!) towards the end of the nineteenth century and also at Bannerrigg, Windermere (1886, *Martindale* (**KDL**!).

SAXIFRAGA AIZOIDES L.:

The specimen is on sheet HS 152 f.101 and labelled "Kendall Fitz-R-" and "Sedum montanū luteū minus nostras. R.C: An Sedū illecebra folijs oblongis. Mer. Pin. [Merrett's "Pinax" (Merrett 1666)]". Nowadays, the plant is frequent on wet rocks and flushes in the Lake District hills. The likeliest locality for Fitz-Roberts to have collected it would have been either to the north of Staveley or in Longsleddale, both places near Kendal and where it still occurs. At the latter site it was described as being "in the greatest plenty" by William Curtis in 1782 (Curtis 1855–1856: 111). As indicated on Fitz-Roberts' label (see above) it had been recorded some years earlier by both Ray and by Merrett from Ingleborough, both these records almost certainly attributable to Thomas Willisell. Lawson also sent a Westmorland specimen to Bobart at Oxford (Morison 1699) probably predating that of Fitz-Roberts. [Another plant of a similar habitat is *Sedum villosum*. This also has extant localities in the area north of Staveley, and it was from nearby Sleddale that Thomas Lawson recorded it in the late seventeenth century. Surprisingly, Fitz-Roberts doesn't appear to have known it].

SESLERIA CAERULEA (L.) ARD.:

This well-preserved specimen (Fig. 1) (HS 150 f.118) has already been discussed in some detail above. It is one of the few for which a precise locality is given.

THLASPI PERFOLIATUM L.:

The significance of this specimen (Fig. 1) in relation to Fitz-Roberts is uncertain but a label on the sheet suggests that it might at one time have come into his possession. A directly attached label states it to have been found by Jacob Bobart among stone pits between Whitney and Burford in Oxfordshire, an area towards the centre of its very restricted British range. Fitz-Roberts seems unlikely to have visited there himself but may have received the specimen from Jacob Bobart (the younger) who by then would have been in charge of the Oxford Botanic Garden. How it came into Petiver's possession is uncertain but the reference to Fitz-Roberts must have some significance.

Other specimens in Petiver's herbarium were sent to him by Fitz-Roberts but, because of their inadequacy or poor quality, they are almost impossible to identify with certainty. These are:

ALCHEMILLA SP.:

A poor fragmentary specimen (HS152 f.255), again difficult to identify, may be the ubiquitous *A. xanthochlora*. On the other hand Fitz-Roberts would have had easy access to other members of the genus and so by sending the specimen to Petiver, he may have regarded it as something more unusual.

COCHLEARIA SP.:

Well-labelled but poorly preserved, this specimen (HS 152 f.27) appears to represent the upper part of an inflorescence of a *Cochlearia* but, in the absence of the lower leaves, it is not possible to identify it further. Nowadays, the mainly coastal *C. anglica*, *C. danica* and *C. officinalis* are all known fairly close to Fitz-Roberts' home area whilst *C. pyrenaica* occurs inland on the nearby hills.

GERANIUM SP.:

Fitz-Roberts' specimen (HS 32 f.75) is towards the bottom left side of the sheet and is poorly preserved. It may be *G. pratense* or *G. sylvaticum*, both frequent in the meadows and woods of his local area. Alternatively, it may have been a non-native *Geranium* from his well-stocked garden.

NYMPHAEA L. CF. *ALBA*:

This is represented (HS152 f.182) by only a single leaf and fruit of what is probably *N. alba*, frequent in lakes, ponds and backwaters thereabouts. It was recorded at Cunswick Tarn, close to Fitz-Roberts' home by Gough in the early 1800s (Nicholson 1832) and is probably still there.

SAXIFRAGA OPPOSITIFOLIA L.:

A specimen of this is on the same mixed sheet (HS 152 f.101) as the clearly labelled Fitz-Roberts' specimen of *Saxifraga aizoides*. However, another label, "Kendal FitzR", is so placed as to make it uncertain whether it refers to another nearby undetermined specimen or to that of *S. oppositifolia* (or even is a second label for the *S. aizoides*). If *S. oppositifolia* was intended, the closest localities for Fitz-Roberts would have been in mountains of the central Lake District or on the Craven limestones.

VACCINIUM VITIS-IDAEA L.:

This specimen (HS 152 f.233) is merely a small fragment but is probably of this plant. Nowadays it is largely upland but in the past was frequent on the lowland mosses around the Kent estuary and still survives at Meathop Moss (Halliday 1997).

There is also a specimen of another ericaceous plant on the same sheet as the *Helianthemum oelandicum* (discussed above, HS 152 f.277). Unfortunately, it comprises only a small twiglet with few leaves and no flowers and is very difficult to identify. *V. oxycoccos* would have been frequent in the damp heathy ground west of Kendal and *Arctostaphylos uva-ursi* present further into the central Lake District hills. It is possible that one of these is represented.

Finally, there is a specimen (HS 150 f.66) of a poorly-preserved lichen. The label, difficult to transcribe, appears to state "Lichen cinereus [indecipher] subterus/subtius nigricans Nob. Kendall. J. Robinson". It is allotted the reference number R.H. 117 relating to the "*Lichen terrestris cinereus*. Ash-coloured ground Liverwort" of Ray (1686–1688). This is the only specimen traced where Petiver uses the name Robinson rather than Fitz-Roberts. The lichen appears to be a species of *Parmotrema*, possibly the fairly widespread *P. perlatum* (Huds.) Choisy (*Parmelia perlata* (Huds.) Ach.). One other Fitz-Roberts specimen, so far untraced, is in OXF.

LETTERS FROM JAMES PETIVER TO FITZ-ROBERTS

Other than the records shown above, there is little else to throw light onto Fitz-Roberts as either a person or as a botanist. Fortunately however, there are two surviving copies of letters to him written by Petiver which provide at least a modest insight. These are preserved in the Sloane manuscripts section of the British Library in a bound volume (ms. 3332) and are randomly distributed amongst a large number of other miscellaneous correspondence between Petiver and contemporary naturalists. Both letters are difficult to transcribe in places but Petiver's admiration for Fitz-Roberts expertise is clear to see.

In one, undated but written in the Spring of the early 1690s (Appendix 1), he refers to Fitz-Roberts' "moss cropping" [plant collecting] ability. (This term seems to have had local

origins since, Thomas Lawson, in a letter to John Ray, stated: "After it [*Eriophorum vaginatum*] turns white sheep are greedy after it; so it is called Moss-crops about... [Westmorland]" (Lankester 1848). Petiver's letter suggests that Fitz-Roberts was well-known to members of Petiver's botanical circle. This was especially so to Petiver's friend, the eminent Samuel Doody (1656–1706), curator of the Chelsea Physic Garden, who wanted Fitz-Roberts to collect for him. Although, Fitz-Roberts appears to rarely have travelled far outside his native Westmorland, Petiver's comment "I should be glad to hear that we might suddenly expect to see you in London...." suggests he might have visited the capital on at least one occasion.

The second letter is dated 17 September 1695 (Appendix 2) and opens rather quaintly with Petiver saying that he had sent (via a relation of a friend) a 12 penny token, and that this person would visit him and drink with him. A comment about the imminent publication of the second edition of Ray's "Synopsis" follows and then a further request is made for Fitz-Roberts to collect plant specimens. Petiver also asks for those of insects and suggests how they should be collected and preserved; he also encourages him to recruit others for the same purpose. In the postscript he reminds him of the shells and insects which he had sent "as a pattern for you to instruct others by, not doubting but you will very much add to them having far more opportunities than we have" (i.e. Petiver living in London). This is the only instance traced which suggests that Fitz-Roberts was in any way an entomologist but in those day anyone interested in botany would often be an all-round naturalist as well. Petiver also states that his "first century of Plants Insects Shells is not yet quite published" but nevertheless sends him uncorrected proofs. This is the first pamphlet in a series of ten "centuries", the first of which he published towards the end of that year (1695) in his *Musei Petiveriana* (Petiver 1695–1703). In the letter, Petiver indicates that a second one is to follow shortly and that he is willing to acknowledge any specimens Fitz-Roberts might send. However, an examination of these which were also posthumously re-published in *Opera Historiam naturalem spectantia* (Petiver 1767) provide nothing of further significance in relation to Fitz-Roberts. The reason why he didn't take up Petiver's offer is strange since they were apparently in close contact at this time.

There is no doubt more to be learnt about John Fitz-Roberts (alias Robinson) of Kendal but unless relevant, so-far undiscovered,

manuscripts or letters are found, a further search of the old herbaria may provide the only opportunity to gain additional information about him. Unfortunately though, in the late seventeenth century, herbarium specimens were rarely accurately labelled as to collector and locality so that whilst Petiver, Plukenet and Ray were quite ready in their published works to acknowledge Fitz-Roberts' contributions, they were less meticulous (Petiver being the exception) in noting the same in their private herbaria. It is quite likely that additional Fitz-Roberts' specimens are hidden anonymously in the herbaria of Doody, Ray and others. This situation also arose with Thomas Willisell, probably the most prolific plant collector of the early period, who provided a vast number of records and specimens for Christopher Merrett's "*Pinax*" (Merrett 1666; 1667). Merrett merely gave Willisell a cursory mention in his Introduction and abjectly failed to acknowledge any of the records for the many plants he had provided. Again, Willisell's specimens similarly lie unattributed and dispersed amidst Merrett's large personal collection (BM).

John Fitz-Roberts emerges as a highly respected and competent field botanist, held in high esteem by his colleagues. Mainly specialising in his local area of south Westmorland, it is very likely that he showed many interesting plants to Thomas Lawson, and that some of these, as well as others recorded by William Nicolson, were his original finds.

Herbarium acronyms given are as indicated by Holmgren *et al.* (1990); all the specimens originating from Fitz-Roberts (Sloane, BM) have been seen; the symbol (!) indicates that herbarium specimens from other sources have also been examined.

ACKNOWLEDGMENTS

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APPENDIX 1

LETTER PETIVER TO FITZ-ROBERTS (UNDATED) (SLOANE MS 3332, F.27)

"Mr Fitz-Roberts, Being now entered upon the New year and find the verdant spring trying to show its early product, this is therefore to put you in mind of moss cropping as also to collect fair quantity to supply....Moss cropper you have formerly hinted to me ye have observed near ye in prime abt [about] this time I mean ye Schonoglaurus. Dear Friend Our Botanical Society have you in frequent remembrance but especially my own singular friend Mr Doody who particularly desires to have hishundred to ye and he begs ye would be mindfull of him in relation to wt roots ye could procure of ye choicest plants you have in ye Parts. I should be glad to hear that we might suddenly expect to see you in London if we cannot be so happy in ye interim let me enjoy a letter. All correspondence met will be very acceptable to him who is sincerely your Friend. J Petiver".

APPENDIX 2

LETTER PETIVER TO FITZ-ROBERTS (LOND., SEPT 17, 1695) (SLOANE MS 3332, F.171V/F.172)

"Mr Fitz-Roberts, My good ffriend. I take this opportunity of letting you know that I have you, which let this 12 penny token to follow, which I have sent by a relation of a friend of mine to drink with you, as also that I have taken care to ye new Edition of Mr Ray's Synopsis which will now be very suddenly published. I hope this you have got plenty of specimens of ye Adiantum floridum prolongans ye Polium and some other plants that I formerly gave you a catalogue of, which are rare with us. As also a collection of Insects formed glorious etc. Pray what plants you have by you as ye first return or if you prefer to give ye to this Gent he will send them to me or his Bro: which is all and I will gladly defray ye charges. I am very zealous in ye discovery of Insects which I desire yr assistance in and begg that will gather or collect so most of them shall come in your way or you can from others procure, I would have you in the Spring oblige some therefore to collect all ye Butterflies, Moths, Beetles and Boogs etc that he can catch, which he may stick through the back with a Pin having always a Pincushion in his pocket, for that purpose and those when caught he may stick within ye crown of his hat till he comes home, or into a small Pill box which he may carry in his Pocket. My first century of Plants Insects Shells is not yet quite published, but too let you see it is a doing I have inclosed sent you an uncorrected part of it. I do design to print another century before Christmas and would gladly have some communications from you insert therein and therefore pray fail not of something though never so small, which shall be justly acknowledged by kind friend...Yr most humble servant James Petiver.

P.S. I have sent you of Shells and Insects 3 or 4 of each as a pattern for you to instruct others by, not doubting but you will very much add to them having far more opportunities than we have... vale.

N.B. The Shells and Insects are Numbred according to my Century to wch I sd for you".

The status of Coral-necklace *Illecebrum verticillatum* L. (Caryophyllaceae) in Great Britain

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ABSTRACT

The native range of *Illecebrum verticillatum* in England is re-considered in the light of newly available historical records and nineteenth and twentieth century forestry and recreational activities. It is concluded that is probably a nineteenth century arrival outside of Cornwall, but that it is now a benign and intimate part of the flora that conservationists want to preserve. Milder winters seem to aiding the spread and survival of new populations. Nonetheless if only the Cornish populations were to be taken into account, then it would have a much higher Threat Status and thus attract more funding.

KEYWORDS Native and alien ranges; conservation criteria; forestry and recreation; climate.

DESCRIPTION, HABITATS, ECOLOGY AND PHYTOGEOGRAPHY

Illecebrum verticillatum is a small glabrous annual with reddish stems which elongates to form a many-stranded plant over summer. It is often scarcely visible before late July, flowers late in the season and is usually killed by frosts. However, well-grown plants, presumably belonging to the previous year, have been noticed in West Cornwall and the New Forest as late as January; C. Chatters (pers. comm.) on a visit in late January 2008, noticed much material including plants in active growth in a New Forest pond kept open by mechanical cutting, arson and mountain bikes. He found. The submerged material, in about 20 cm of water, had infrequent green growing points from the apical tip of the last season's 'branches'. The terrestrial material, on a slight slope above the pond's current water-level, in a zone that might be inundated in extreme circumstances, was much greener with well developed leaves and fresh growth, with the base of stems and the central root quite woody. The plants had weathered the hard frosts of

early winter with the terrestrial plants in stronger growth than those buffered from the hardest frosts by being submerged. None had the appearance of recently germinated plants over-wintering to bloom the following year. Another West Cornwall site visited by DAP in mid-February 2008, revealed good growth with green, not red, stalks.

It grows in or by pools or on seasonally wet sandy, or gravelly, tracks (including rides in forestry plantations) and heathy lawns on acid soils. It also occurs on railway clinker, possibly spreading from nearby forestry rides, and as a casual elsewhere. It spreads by seed though it has been known to root from stem fragments. In West Cornwall associates in 2005 included *Hydrocotyle vulgaris*, *Hypericum elodes*, *Isolepis setacea*, *Juncus bulbosus*, *Lythrum portula*, *Myosotis secunda*, *Potamogeton polygonifolius*, and *Ranunculus flammula*. On Bodmin Moor associates in 2007 included *Hypericum elodes*, *Juncus articulatus*, *J. bulbosus*, *Lythrum portula*, *Myosotis secunda*, *Potamogeton polygonifolius*, and *Ranunculus flammula*. Murphy (1994) gives track associates as *Cicendia filiformis*, *Gnaphalium uliginosum* and *Radiola linoides* whilst for the New Forest pools she lists *Galium constrictum*, *Hydrocotyle vulgaris* and *Littorella uniflora*, with rarer *Anagallis minima* and *Cicendia filiformis*.

Illecebrum verticillatum is a suboceanic southern-temperate species which appears to be widespread in N.W. Europe, from Poland to southern Spain, with very isolated scattered outliers in Italy, Greece and the Azores (Jalas & Suominen 1976). Hulten & Fries (1986) show many additional outliers, together with a large part of N.W. Africa. Little is known as to its current status in Europe; the Atlas for West Germany (Haupler & Schonfelder 1988) shows it to have declined severely in that area.

The first record in the British Isles was made by John Ray on a trip to Cornwall in 1662,

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possibly near to St Columb near Newquay; there have been many other records from that county during the next two centuries. It was not until 1846 that it was found elsewhere (in Kent), with later records from Berkshire (1891), Hampshire (c. 1920) and Dorset (1981).

In the British Isles most recent floras and atlases have treated it as a native plant in Cornwall, Hants and Berkshire and as an alien elsewhere, though with no rationale for those decisions.

HISTORY IN BRITAIN

CORNWALL (V.CC 1 & 2)

Rose Murphy (pers. comm.) writes that "old and recent records of *Illecebrum verticillatum* appear to be concentrated on the granite areas of Cornwall, or on the metamorphic aureoles that surround the granite where most of the mining and tin-streaming (and disturbance) took place".

Davey (1909) gives about 40 sites, dating back to the Ray's first record of 1662, describing it as widely distributed but rather rare; Thurston & Vigurs (1922) add another six sites. There are currently records from 63 tetrads, past and present (Colin French pers. comm.) Not until the flora of Margetts & David (1981) is there any mention of a decline, where the caption merely states that 'this very local plant has declined in the last fifty years for reasons that are not easy to find, as there are still plenty of suitable habitats'. Whatever their reservations, it is clear that lack of management, with no grazing and no disturbance, led to a massive decline in both *Illecebrum verticillatum* and in its associated rare species such as *Anagallis minima* and *Radiola linoides*. Stewart *et al.* (1994) gave recent records from seven 10 km squares in Cornwall. The latest Cornish Flora, French *et al.* (1999) correctly attributed the serious decline to loss or change of habitat, but still showed recent records from five 10 km squares.

The situation in 2008 is that is known in West Cornwall (v.c. 1) from three small sites in one 10 km square (perhaps around twenty plants in all) and in East Cornwall (v.c. 2) as less than five plants in one site and good populations on Bodmin Moor – a total of three 10 km squares and five tetrads for the county. Further details of the decline there will be covered in a forthcoming article (Pearman, in press).

OTHER COUNTIES

SOUTH HAMPSHIRE (V.C. 11)

Illecebrum verticillatum was first recorded in v.c. 11 at Titchfield Haven in 1920 (Rayner 1929), across the Solent Estuary from its current stronghold in the New Forest. There are no further details of this record. Rayner gives the first record from the New Forest 'young spruce plantation, Wilverley Inclosure, in great abundance, 1925' and describes its gradual disappearance there over the next three years as it was displaced by native grasses. He relates the experience of a Mr Hall, who grew it in cultivation, and noted its ability to very quickly cover cleared ground, but that it was unable to maintain its hold in competition with other plants. Rayner also reports that a specimen, labelled as from this locality (presumably he meant Wilverley) was brought anonymously to the Southampton Wild Flower Exhibition in 1920.

Brewis *et al.* (1996) noted that it had steadily spread over some 50 years, with records there from some 30 tetrads. There was no comment in this work on its likely origin, other than a comment on the original Wilverley record, where it was noted as 'perhaps introduced with imported conifers'.

It is not clear if the increase in records is the result of genuine spread or due to better recording. Factors leading to a rapid spread might include heavy grazing pressures (though precise figures are hard to interpret, cattle numbers are higher than in the past), recreation (lots of riders), together with the disturbances associated with gravel extraction; there has also been much forestry work. The newly-established Forestry Commission took over responsibility for the management of the New Forest in 1923. Much conversion of broad-leaved woodland to conifers took place from that date, though some had already occurred following the New Forest Deer Removal Act of 1851 (Tubbs 1986). Work on forestry is still ongoing, including removal of trees planted as late as the 1970s. All these activities could have physically spread the plant from site to site and created suitable, often seasonally flooded, open ground. Warmer winters and different rainfall patterns may also have aided its spread. Clive Chatters (conservation officer for the Hampshire Wildlife Trust and the new chairman of the New Forest National Park) and the current V.C. Recorder, Martin Rand (pers.

comm.) have pointed out that many of the older and the currently known sites for *Illecebrum* are at well-known botanising locations. It is therefore unlikely that it was overlooked although under-recording in the past certainly accounts for the difficulty in tracking the history of its spread and the dynamics of individual populations. Furthermore, they feel it is still spreading, though not just within the core of the Forest itself. Rand adds that it behaves as a coloniser and he cannot think of an instance where it occurs in a well documented and localised site that has not been recently disturbed. He also drew attention to a comment on a herbarium specimen in **BM**, collected at Shave Green Enclosure, Cadnam, 1930, Mrs E. Rothwell, "so abundant that a cartload was taken away and destroyed".

Illecebrum verticillatum is so often associated with other native flora characteristic of these temporary, disturbed sites that it would be difficult for a stranger to the New Forest to judge that it was other than native there. It grows around ponds with a suite of plants including *Pulicaria vulgaris* (first recorded 1835), *Mentha pulegium* (1839), *Galium constrictum* (1924), *Ludwigia palustris* (1645), *Gnaphalium uliginosum*, and *Lythrum portula* (Tubbs 1986). Note that these dates are for the first records for the whole of Hampshire, rather than from the New Forest – all, with the exception of *Galium constrictum*, were first recorded from v.c. 12, North Hampshire. It seems that botanical exploration for the New Forest was quite late compared to many parts of Britain (see Rand (2005) for pertinent comments on *Gladiolus illyricus* – another late discovery). There are also many more records and sites known for *Galium constrictum* and *Ludwigia palustris* over the last 40 years, though Chatters (1999) suggests that this may be due to greater recording effort starting in the 1950s and 1960s rather than any general increase in the numbers of sites or populations.

Galium constrictum, though it is a critical plant, was also not discovered in Hampshire until the 1920s when it was recorded (as *G. debile*) from Lyndhurst and Hatchet Pond (Druce 1924). There was a similar increase in records over the next half-century. Druce makes rather a meal of its native status, concluding 'the European distribution is not antagonistic to *debile* being a native of the Channel Isles and south-western England.' The map in Meusel & Jäger (1992) only tenuously supports this view, showing a core distribution

around the Mediterranean with a narrow extension north through France. In Britain it is almost confined to the New Forest. There was a relatively short-lived occurrence in Devon, at a site subsequently lost to ball-clay extraction and two unusual records from South Wiltshire (v.c. 8), where it was recorded in 1984 in water-meadows at North Charlton (SU12), and with imported scalplings lining a new pond at the Shire Horse Centre, Teffont (ST93) – this latter site was wrongly mapped as native in Preston *et al.* (2002).

Elsewhere in South Hampshire there are records from the Avon Valley at Somerley (SU10) (1980s), and Southleigh Forest (SU70), where it was recorded in 1957 and destroyed in 1982. Recently it has been found at Ringwood Forest, west of the R. Avon, on the borders of Hampshire and Dorset, found by Neil Sanderson in 2006.

WEST KENT (V.C. 16)

All Kent records come from the area now known as Bedgebury Forest. It is the site of the National Pinetum, developed on an area of acid soils over gravels and clay which is surrounded by a larger forested area.

Bedgebury was owned by Viscount Lord Beresford, who was a General (later Field Marshal) under the Duke of Wellington in the Spanish Peninsula wars. He bought the estate in 1836, and planted many trees in the earlier years of his ownership. The main estate was purchased from his heirs by the Crown in 1919 for forestry purposes and was developed jointly by the Forestry Commission and the Royal Botanic Gardens, Kew from 1923 until 1965, when the Pinetum reverted solely to the Forestry Commission. The first trees for the Pinetum were raised at Kew in 1921.

There is an mysterious record in the *Flora of Kent* (Hanbury & Marshall 1899), referring to herbarium specimens that were found by a Mr Duthie (presumably Mr J. F. Duthie, who was born in Kent, botanising there until the 1870s, but then spent 30 years in India and Ceylon before returning to Kew in 1903) at Edinburgh University (now at E) labelled 'boggy places four miles SW from Dover'. He noted that there was no likely station in the Dover neighbourhood. Hanbury & Marshall wondered whether there is a village of that name in the south-western counties. But Druce (1920) includes a record from near Doves, Kent (indeed, his correspondent pointed out that her site was about four miles away), and on the

current OS map there is a Doves Farm at TQ7834, four miles east of the Bedgebury site.

The Edinburgh specimen was examined by DAP in October 2007. There are two sheets, both from the Kent site: one from the herbarium of W. G. McIvor, collected by him in 1846, and another from the herbarium of a Mr Murchison, though this second sheet lacks a date and source. McIvor's specimen has been annotated by David McClintock as referring to Doves rather than Dover.

Druce's 1920 record seems to have become well-known, as Miss Vachell and her friends visited Sophia Wood, near Hawkhurst, in October 1923 (Rich & Forty 2005). George Hutchinson located Vachell's herbarium specimen at Cardiff Museum (NMW), and plausibly suggested that Sophia Wood was the estate name for what is now known as Frith Wood (TQ7332).

In 1944 Francis Rose reported it from rides in Bedgebury Forest (Anon 1946), where it still occurs, at c. TQ7232. There are other specimens at NMW from the same area collected by J. E. Lousley (1944) and R.A. Boniface (1947). It is very likely that all of these records relate to the same site, which extends the history of the plant in the Bedgebury area back to 1846.

BERKSHIRE (V.C. 22)

First discovered in the county by A. W. S. Fisher, a scholar at Winchester College, in 1891 (Druce 1891) and described by Druce (1897) as 'found by a pool; it grows on the damp sandy margin with *Hydrocotyle*, *Ranunculus*, *Millegrana* (*Radiola linoides*), *Drosera*, *Veronica scutellata*, *Juncus bulbosus* and others. No other introduced vegetation is near, except that it is in a district in which Pines and Rhododendrons are planted... Subsequently I found it in considerable abundance, and it appeared as if the *Illecebrum* had been covered with sand brought from the neighbourhood in order to raise the road...'. Druce did not give details of the location, but it was at the western end of Nine Mile Ride near Wellington College (SU86) (Crawley 2005). Though it was last seen there in 1956, it has been found in at least seven nearby sites, in a strip about 8 km in length from west to east. It still persists at Heath Lake (SU8265), and possibly on private land that is inaccessible nearby (Crawley 2005).

Wellington College was opened as a monument to the great Duke in 1859, on a site described at the time as 'a wild and cheerless spot on a bleak, inhospitable-looking

moor' (Wellington College website). It lies about five miles to the east of the Stratfield Saye, the house presented to the Duke of Wellington by the nation in 1817.

The Kent and Berkshire sites are both on estates in which forestry plantings were started in the 19th century by military aristocrats. The possibility that they introduced *Illecebrum* from a common source needs investigation.

DORSET (V.C. 9)

The first definite, and for many years the only, record was from the Royal Army Ordnance Corps base at West Moors (SU00), where it was found on the edges of a pool in 1981 and later spread on the cinder base of nearby disused railway sidings. In 2002 Jonathan Spencer, Senior Ecologist for England with the Forestry Commission, reported that he had seen it, some years before, in the rides of a Commission nursery just to the north. This was probably the origin of the plants at West Moors Army site. It still survives in small quantity there. Odd plants have also been found on Army land at Barnsfield Heath (SU10) (political Dorset, but actually in v.c. 11) and at Woolbridge, on army training ranges (SY88).

There is an intriguing earlier record, from the beach at Ferrybridge, Weymouth, in 1792, from a recorder, William Sole, who apparently knew the plant from Cornwall (Barrett 1912), which is assumed to be only a casual (see the records from Branton and Anglesey, below).

NORTH HANTS (V.C. 12)

Plants were first recorded in 2005, growing in profusion along some of the wet sandy tracks used for military training near Aldershot (SU82) (Mundell 2006). Since then there have been records from at least six sites within five 10 km squares, all within the same type of habitat and use.

OTHER SITES

It is likely that other British records are casual occurrences, though there are a few of interest.

NORTH DEVON (V.C. 4)

There is a specimen in **BM** collected at Branton Burrows, 1862.

ANGLESEY (V.C. 52)

There is a specimen in **BM** annotated "rocks by the sea, Anglesea", 1921.

SOUTH NORTHUMBERLAND (V.C. 67)

J. P. M. Brenan (Anon 1947) reported records from a nursery near Falstone, noting that it was

suggested that the *Illecebrum* was introduced with bundles of trees obtained from various nurseries. He reports that it was said to be plentiful in certain tree nurseries in the New Forest.

MID LOTHIAN (V.C. 83)

Another specimen in the herbarium at Edinburgh (E), labelled 'Dickson's garden in Edinburgh', 19 August, 1796.

OUTER HEBRIDES (V.C. 100)

Specimens in E from the Isle of Barra collected by J. W. Heslop Harrison and his colleague W. A. Clark. Details are given by Clark in a cover letter to the director of the Royal Botanic Garden in Edinburgh (dated 19 July 1939) 'thinly scattered around the margin of a loch near Borge'). He also enclosed a specimen of *Juncus capitatus*, gathered the same day, noting that this latter was only found in one spot. Pankhurst & Mullin (1991) remarked that the *Illecebrum* record required confirmation and it was widely dismissed, along with the *Juncus*, as another Heslop Harrison fraud. However, there is an earlier record from Eriksay (Goodrich-Freer 1902), and Whittington & Edwards (2000) report the finding of subfossil pollen of *Illecebrum* there.

STATUS AND CONCLUSIONS

There is little reason to doubt the nativeness of the records from Cornwall. It has been known continuously for nearly 350 years and, whilst it is almost totally dependant on heavy stock-grazing and disturbance by animals or humans, this is the case for many other annuals of open habitats.

As far as the rest of England is concerned there would be little doubt of its nativeness from a phytogeographical view if we did not know its recent history here. On the criteria used to judge other potential neophytes (see Pearman 2007) the situation would be evenly poised, with spatial coherence, trends in frequency and to some extent first recorded date everywhere other than Cornwall, being balanced by occurrence in semi-natural habitats, persistence and European range. On balance it is unlikely that it was overlooked for nearly 200 years after its discovery in Cornwall in the well-botanised south-east of England and

it was probably introduced with various forestry operations there.

In the New Forest the evidence is more equivocal; it is an intimate part of the flora of the wet lawns and pool edges and associated with a suite of native species and is a valued part of a community that conservationists wish to preserve (*vide* Pearman 2007). But it is still increasing its range (there has been a veritable surge in records recently); the *Illecebrum* population appears to have fluctuated with changing stocking practices, leisure pursuits, the amount of tree-planting and gravel extraction. The source of trees planted in the early and mid-nineteenth century in Kent and Berkshire, and that of those planted in the New Forest in the twentieth century is unknown. The reasons for the delayed spread from the Forest need investigating; it is possible that the increase there coincided with the collapse of grazing elsewhere in the south of England, which thus limited the opportunities to spread. Furthermore, as *Illecebrum* is frost-sensitive, recent warmer winters may have helped it spread into areas where it was previously checked by hard frosts.

In the latest Red List (Cheffings & Farrell 2005) *Illecebrum* is categorised as Vulnerable. The heavy losses in Cornwall have, to some extent, been offset by consolidation and new sites in central-southern England. If those latter sites were not treated as native, then it would probably be in the most threatened category, Critically Endangered. It is now on the new BAP list which should stimulate considerable conservation effort in Cornwall, where currently there is none.

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Corynephorus canescens (L.) P. Beauv. (Grey Hair-grass) on the Sefton Coast, Merseyside (v.c. 59)

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ABSTRACT

This paper describes the history, current status and habitat of the nationally rare *Corynephorus canescens* on the Sefton Coast, some 250 km north-west of its nearest native localities in East Anglia. The grass is now largely confined to acidic fixed-dunes on the Southport & Ainsdale Golf Course where it has apparently increased over the past decade to a population comprising nearly 10,000 plants occupying c. 0.86 ha.

KEYWORDS: Climate, conservation, fixed-dunes, golf course, habitat, population.

INTRODUCTION

Corynephorus canescens (L.) P. Beauv. (Grey Hair-grass) is a nationally rare, perennial grass which occurs on consolidated sand-dunes, on sandy shingle and on open sand either in coastal locations or inland. The *New Atlas of the British & Irish Flora* (Leach 2002) shows its recent occurrence in 14 hectads as a British native and states that the plant's distribution has probably stabilised following losses in the 1930s.

C. canescens occurs mainly on or near the coasts of East Anglia, specifically East Suffolk (v.c. 25) and East and West Norfolk (v.c. 27, 28). It is also rare inland in West Suffolk (v.c. 26) and is present in two hectads in Jersey (v.c. S(113)). Its only other "native" populations are on the Sefton Coast, Merseyside, South Lancashire (v.c. 59), some 250 km north-west of the nearest East Anglian sites. There has been some debate about the origin of *C. canescens* on the Sefton Coast, far from its main centre of distribution in East Anglia. Savidge *et al.* (1963) regard it as native, as does Leach (2002), but Hubbard (1954) and Sell & Murrell (1996) treat it as probably introduced.

Occurrences in Glamorgan (v.c. 41), Worcestershire (v.c. 37), Staffordshire (v.c. 39), Moray (v.c. 95), Westernness (v.c. 97), and

Co. Antrim (v.c. H39) are shown as "non-native" in the *New Atlas* (Leach 2002). However, Ryves *et al.* (1996) suggest that the plant's recent arrival in Scotland may be an expansion of its natural range, while Trist (1998) also argues that the Staffordshire and Worcestershire sites could be relicts of ancient heathlands and therefore also native localities. As it is known from only 27 localities, the plant's conservation status is described as "near threatened" by Cheffings & Farrell (2005) whilst, on the Sefton coast, concern for its correct management has resulted in the preparation of a "Species Action Plan" (Merseyside Biodiversity Group 2001).

According to Stace (1991) the main habitats of *C. canescens* are leached fixed-dunes and inland sandy heathlands on acid soils. Marshall (1967) reports that the plant can also grow in calcareous dunes but the substrate must be very low in mineral nutrients. Ellenberg Indicator Values for this species in Hill *et al.* (2004) are listed below:

- Light: 9 Full light.
- Moisture: 1 Extreme dryness; restricted to soils that often dry out for some time.
- Reaction: 3 Mainly on acid soils but exceptionally also on near-neutral ones.
- Nutrients: 1 Extremely infertile sites.
- Salinity: 0 Absent from saline sites.

Marshall (1965, 1967, 1968) states that individual plants are relatively short-lived (2–6 years), so the grass relies on high reproductive capacity and seed viability to maintain its populations, seed successfully re-sowing itself in stable sand for several years. *C. canescens* grows most vigorously where there is up to 10 cm of sand accumulation per year, and it is a potentially long-lived perennial providing sand accretion is taking place. This seems to be due, in part, to the fact that the efficiency of the root

system decreases with age, good growth being dependent on the production of new roots positioned higher on the morphological axis and which is stimulated by sand accumulation.

This is a particularly distinctive and attractive grass, densely-tufted with stiff, bristle-like blue-grey blades and purplish-pink sheaths. Trist (1998) describes how, in early July, plants can be seen at a distance of 30–40 metres when the panicles are spreading at anthesis and the colony is a mass of silver and pale pink. In autumn, the bleached inflorescences also stand out when seen from a considerable distance (personal observations).

OCCURRENCE ON THE SEFTON COAST

As earlier recorders did not have access to modern satellite positioning technology, details of localities are often imprecise. Travis (1928) states that the plant was thought to have been discovered in 1928 by Sir G. Talbot but was actually first recorded, though not identified, by F. W. Holder on 4 May 1919 “among the rough and high dunes west of the pine woods near the Formby golf links”. This record is also included in Savidge *et al.* (1963) who state that it apparently became extinct at one of its two known sites in 1937. Roberts & Smith (2007) include a photograph taken on 1 August 1937 by Holder, showing J. N. Frankland and J. E. Lousley with *C. canescens* “on dunes near Ainsdale”. This seems likely to have been Holder’s original locality.

There are herbarium specimens of *C. canescens* in **LIV** collected by Holder, Frankland and J. D. Massey between 1929 and 1931 but, frustratingly, the localities given are extremely vague: “sandy slopes Formby dunes”; “Freshfield sandhills”; “dry dunes Formby”; “near Southport.” Similarly, a specimen collected by V. Gordon on 16 September 1986 is simply labelled “Ainsdale”.

The database of the *New Flora of South Lancashire Project* lists records made in 1982 by P. Doody, P. Field and T. C. G. Rich “on the edge of the golf links” (G.R. SD318128), while P. Lockwood recorded the plant at G.R. SD318127 on 22 August 1987. This location appears to lie in a transitional zone between an Ainsdale recreation ground and the Southport & Ainsdale Golf Course and is presumably the site described by Trist (1998) as “a recent find” (i.e. about 1980) at G.R. SD318127. He states that “...at Ainsdale, accretion is now

active and rabbits are contributing to the sand accretion requirements of *Corynephorus canescens*. Here the site is c. 100 × 4 m where our grass is dominant on two fixed dunes and has only *Hypochaeris radicata* and *Ornithopus perpusillus* as constant species.” However, Trist’s description does not accord with the playing area of the golf course, where bare sand lying outside bunkers and rabbit (*Oryctolagus cuniculus*) activity are not tolerated by course managers.

The first National Vegetation Classification (NVC) survey of the Sefton Coast (Edmondson *et al.* 1988–1989) records extensive stands of *C. canescens* on Southport & Ainsdale Golf Course. It occurred in “a possible variant of SD13b”, later reclassified as SD11a (*Carex arenaria* – *Cornicularia aculeata* dune, *Ammophila arenaria* sub-community), with much *Agrostis capillaris* and mosses, or as a co-dominant with *Festuca ovina*. Other associates included *Ammophila arenaria*, *Anthyllis vulneraria*, *Carex arenaria*, *Hypochaeris radicata*, *Sedum acre*, the hair-moss *Polytrichum juniperinum*, and lichens (*Cladonia*). This site is at least 2 km from its earliest known locations, being in an area of low dunes, rather than the high dune landscape where the grass was first reported. The plant was also found by D. A. Nissenbaum growing abundantly on railway track ballast near Ainsdale (Atkinson & Houston 1993).

In his survey of Sefton Coast dune-heath in 1993–1994, Gateley (1995) records *C. canescens* in two quadrats on Southport & Ainsdale Golf Course. He states that the *Polytrichum juniperinum*-dominated low dunes, with frequent *C. canescens*, found here are unique locally. Soils are generally acidic with pH 3.43–4.44 at the surface and 3.82–4.62 at 10 cm depth.

The Sefton Coast Life Project (co-financed by the European Commission through the community LIFE-Nature fund) mapped eight large and seven small colonies on Southport & Ainsdale Golf Course in 1996–1998. The surveyors also located two patches of the grass on the eastern edge of Hillside Golf Course, across the railway line from one of the Southport & Ainsdale sites. A second NVC survey of the dune system in the years 2003 and 2004 (Gateley & Michell 2004) again found large populations of *C. canescens* at Southport & Ainsdale Golf Course, on the low eastern dunes with a very short acid sward, rich in the moss *Polytrichum juniperinum*. The

TABLE 1. SUMMARY OF *CORYNEPHORUS CANESCENS* DATA FOR 23 GOLF COURSE, RAILWAY TRACK AND RECREATION GROUND SITES

Site no.	Grid References	Dimensions (m)	Area(m ²)	Aspect	Estimated no. of plants
1L	SD3164412837–SD318612849	187 × 21	3927	S	5000
2L*	SD3161912825–SD3164412780	45 × 15	675	-	600
3L	Not found				
4L	Not found				
5L	SD3155312758–SD3153512828	70 × 22	1540	W	500
6L	SD3156812798	15 × 6	90	-	60
7L	SD3168513255	9 × 3	47	W	80
	SD3170413247	10 × 2			
8L	SD3195613100–SD3199113130	60 × 22	1320	SE	1500
9L	Not found				
10L*	SD3177612970–SD3179312970	24 × 20	480	-	250
11L*	Not recorded	22 × 3	66	-	100
12L*	SD3182112848–SD3185412855	40 × 2	80	-	230
13L*	SD3187312855	15 × 9	135	W	300
14S	SD3177613411	5 × 3	15	S	20
15S	Not found				
16S	Not found				
17S	Not found				
18S*	SD3187212950	2 × 2	4	-	40
19S*	SD3180312914	5 × 5	25	W	15
20S	SD3183512883	5 × 3	15	W	10
21S	SD3170012787	-	-	-	1
22S	SD3162012745	18 × 5	90	W	200
23S*	SD3150012782	3 × 3	9	-	15
R	SD317132			-	20
Rec.	SD31911276–SD31931278	31 × 3	93	-	110
Total			8611		9951

* = new site not mapped in 1997; L = large; S = small; R = Railway track; Rec. = Ainsdale recreation ground

authors attribute the vegetation to U1 (*Festuca ovina* – *Agrostis capillaris* – *Rumex acetosella* grassland) which is characteristic of grazed swards on acid substrates in the pastoral upland fringe. The U1 community has similarities to SD12 (*Carex arenaria* – *Festuca ovina* – *Agrostis capillaris* dune grassland), and grades into it, but generally lacks typical coastal dune plants.

THE 2007 SURVEY – RATIONALE

The Species Action Plan for *C. canescens* recommends surveys of the golf course colonies at five-year intervals (Merseyside Biodiversity Group 2001). Therefore, ten years on from the Sefton Coast Life Project survey, it was thought desirable to revisit the main sites

for the plant on Southport & Ainsdale Golf Course. Accordingly, permission for a survey was obtained in mid-September 2007, a time of year when the plants are particularly noticeable.

METHODS

All colonies mapped by the Sefton Coast Life Project and other sites recommended by the golf course manager were visited on 18 and 20 September 2007. The positions of the colonies were determined using a hand-held Garmin Etrex Global Positioning System and the areas occupied by *C. canescens* were estimated by pacing. The associated vascular plant taxa were also listed and an indication of their relative frequency was estimated using the DAFOR



FIGURE 1. Location of *Corynephorus canescens* colonies 1996–1998, Southport and Ainsdale golf course

scale. Notes were made on habitat characteristics, including aspect. In addition, visits were made to the Liverpool Road Cemetery, Ainsdale, the nearby Ainsdale recreation ground and the trackside for a distance of 1 km north of Ainsdale Station.

Hillside Golf Course was not surveyed. Distribution maps were prepared by staff of the Technical Services Department of Sefton Metropolitan Borough Council, using the Sefton Coast Geographic Information System (Figs 1 & 2).



FIGURE 2. Locations of *Corynephorus canescens* colonies 2007, Southport and Ainsdale golf course and Ainsdale recreation ground

RESULTS

Although a large area of ostensibly suitable acidic fixed-dune habitat is present in Liverpool Road Cemetery, Ainsdale, no *C. canescens* was found, neither was a search of the railway north

of Ainsdale Station successful. However, a population of 110 plants was discovered on a low ridge 31 m long $\times$ 3 m and c. 0.5 m high near the western boundary of the Ainsdale recreation ground at G.R. SD319128 (Table 1, Fig. 2). Vascular plant associates were *Agrostis*

capillaris, *Ammophila arenaria*, *Bellis perennis*, *Carex arenaria*, *Festuca ovina*, *Hypochaeris radicata*, *Plantago coronopus* and *Senecio jacobaea* which suggests a moderately acidic substrate. There is also a high frequency of mosses and some patchy bare ground caused by regular mowing. No evidence of rabbit-grazing could be seen.

Six of the golf course sites mapped by the Sefton Coast Life Project (three large and three small) could not be refound but eight new sites (five large and three small) were located and mapped (Figs 1 & 2). In all cases, the habitat of extant sites was described as a short, open, sparse community of grasses (mainly *Agrostis capillaris* and *Festuca ovina*) and mosses with frequent rosette-forming composites (especially *Hypochaeris radicata*) and often some *Rumex acetosella*. Many sites are on fixed-dune crests or on steep slopes, usually west- or south-facing, although some were found on relatively level or slightly undulating terrain; none occur on north-facing slopes. There was no sign of rabbit-grazing but many sites are affected by human activity, most of it light to moderate trampling by golfers. Some populations of *C. canescens* are situated on grassy footpaths and one turf-stripped area (site 18) has been recently colonised by the plant. A seven-metre diameter bunker at site 1, filled in three years ago, was planted up with *C. canescens* by course managers (M. Mercer pers. comm. 2007) and now supports a vigorous sward of the grass. Adjacent to site 7, c. 20 plants of *C. canescens* could be seen (through binoculars) within the railway fence on a disturbed, sandy strip next to track ballast. A small site mapped on the edge of Hillside Golf Course, opposite site 7, appears now to be too heavily vegetated to be suitable for *C. canescens*. The largest population (c. 5000 plants) was found at site 1, where densities of c. 20 tussocks per square metre occur on a south-facing fixed-dune ridge.

A list of associates of *C. canescens* is given in Table 2; only 35 vascular taxa (three non-native) were noted, most being characteristic of fixed-dunes with a somewhat acidic substrate. In nearly all cases, the vegetation of extinct sites (e.g. 3, 4, 7 and 9) was deemed to be now unsuitable for *C. canescens*, due to coarsening of the sward.

The total golf course population of *C. canescens* is estimated at nearly 10,000 plants, occupying an area of c. 8600 m² (0.86ha) (Table 1).

DISCUSSION

On the Sefton Coast, *C. canescens* was first recorded on high dunes near the sea between Formby and Freshfield. Although the exact localities were not specified, it is clear that the plant has been long extinct in this area, its recent distribution being confined to an area on, and adjacent to, the Southport & Ainsdale Golf Course, which is 2 km inland. While the 1996–1998 Sefton Coast Life Project survey did not estimate the area of the sites or the population sizes, it is reasonable to infer that *C. canescens* has consolidated its status on the golf course. It has disappeared from six sites, but eight new ones were found; these supported c. 1500 additional plants (Table 1). Also, two of the largest sites (1 and 8) now cover considerably larger areas than in 1997 (Figs 1 & 2). Losses are probably attributable to habitat change, specifically the development of taller and denser grass swards.

The recreation ground population is evidently a relict of that recorded by Doody, Field and Rich in 1982 and Lockwood in 1987, subsequently described by Trist (1998), although it seems now to be much smaller in area.

The vegetation of the golf course sites accords well with the Gateley (1995) and Gateley & Michell (2004) descriptions, though the latter's determination of the U1 grassland community may be unsatisfactory in view of the many fixed-dune plants recorded as associates of *C. canescens* (Table 2). Although no NVC samples were taken for analysis, the species composition seems closer to the rather similar SD12 *Carex arenaria* – *Festuca ovina* – *Agrostis capillaris* dune grassland than to U1. SD12 is characteristic of fixed, acidic sands around the coasts of Britain, especially towards the north and west, where calcareous wind-blown material has been leached over time (Rodwell 2000). However, in places, the vegetation may be closer to the SD11 (*Carex arenaria* – *Cornicularia aculeata* dune community), a lichen-rich type associated with *Corynephorus canescens* on the East Anglian coast (Rodwell 2000) and which Edmondson *et al.* (1988/89) considered best to represent the golf-course vegetation. Gateley & Michell (2004) mapped only 3.3 ha of SD11 on the Sefton Coast, mostly associated with pine plantations and the oldest, most leached, eastern soil of the dune system. However, the fixed-dune communities on Southport & Ainsdale Golf Course were poor statistical fits

TABLE 2. VASCULAR ASSOCIATES OF *CORYNEPHORUS CANESCENS* AT SOUTHPORT & AINSDALE GOLF COURSE

Taxon	English name	Frequency
<i>Agrostis capillaris</i>	Common Bent	f
<i>Aira praecox</i>	Early Hair-grass	o
<i>Ammophila arenaria</i>	Marram	o
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	o
<i>Anthyllis vulneraria</i>	Kidney-vetch	r
<i>Arenaria serpyllifolia</i>	Thyme-leaved Sandwort	o
<i>Asparagus officinalis</i> *	Garden Asparagus	r
<i>Calluna vulgaris</i>	Heather	r
<i>Campanula rotundifolia</i>	Hare-bell	o
<i>Carex arenaria</i>	Sand Sedge	o
<i>Centaureum erythraea</i>	Common Centaury	r
<i>Conyza canadensis</i> *	Canadian Fleabane	r
<i>Cytisus scoparius</i>	Broom	r
<i>Deschampsia flexuosa</i>	Wavy Hair-grass	vlf
<i>Equisetum arvense</i>	Field Horsetail	lo
<i>Festuca ovina</i>	Sheep's-fescue	a
<i>Festuca rubra</i>	Red Fescue	o
<i>Galium verum</i>	Lady's Bedstraw	o
<i>Hypochaeris radicata</i>	Cat's-ear	f
<i>Leontodon saxatilis</i>	Lesser Hawkbit	f
<i>Lotus corniculatus</i>	Bird's-foot-trefoil	r
<i>Oenothera xfallax</i> *	Intermediate Evening-primrose	r
<i>Ononis repens</i>	Common Restharrow	r
<i>Ornithopus perpusillus</i>	Bird's-foot	r
<i>Pilosella officinarum</i>	Mouse-ear Hawkweed	r
<i>Plantago coronopus</i>	Buck's-horn Plantain	lo
<i>Plantago lanceolata</i>	Ribwort Plantain	o
<i>Polypodium vulgare</i>	Common Polypody	lo
<i>Rubus caesius</i>	Dewberry	lf
<i>Rumex acetosa</i>	Sheep's-sorrel	f
<i>Salix repens</i>	Creeping Willow	lo
<i>Sedum acre</i>	Biting Stonecrop	lo
<i>Senecio jacobaea</i>	Common Ragwort	r
<i>Trifolium arvense</i>	Hare's-foot Clover	o
<i>Viola canina</i>	Heath Dog-violet	r
Total 35 taxa (3 alien)		

* = non-native or introduced native taxon; a = abundant; f = frequent; o = occasional; r = rare; v = very; l = locally.

to known NVC communities (P.S. Gateley, pers. comm. 2007).

C. canescens was often found on fixed-dune crests as well as on quite steep south- or west-facing slopes. Such sites will be well-drained and susceptible to summer dryness, which presumably gives a competitive advantage to this relatively drought-tolerant species. Marshall's (1967) findings that the plant requires sand accretion for vigorous growth and a long life-span do not explain the plant's

success at the golf course where there appears to be little sand movement. Although the grass has colonized a turf-stripped site and has grown well on an infilled bunker at site 1, management to create greater instability seems unnecessary at the golf course.

At the Ainsdale recreation ground, the *C. canescens* colony has persisted for at least 25 years, apparently assisted by regular mowing which creates bare ground for seedling establishment. Although small, this population

is of particular interest, being the only one readily accessible without special permission.

In Merseyside, *C. canescens* is near the northern limit of its European distribution, which closely matches the 15°C July isotherm. The climate in northern Britain is cold enough to have a cumulative effect on flowering date and seed germination, sufficient to postpone the emergence date of seedlings beyond the critical time for survival (Marshall 1968). Therefore, recent increases in summer temperatures may well have benefited reproduction and survival of the Sefton Coast populations.

Most of the existing populations on the golf course appear healthy with plenty of young plants. There also seem to be extensive areas of potentially suitable habitat in the golfers' roughs to allow for further spread. Although no evidence of rabbit-grazing was found and the grassy roughs are not mown (M. Mercer pers. comm. 2007), the extreme infertility of the old, heavily leached dune soils here, coupled with small-scale disturbance from course activity, seem capable of maintaining *C. canescens* populations at present. However, the long-term future of the plant may be threatened by nitrogen deposition from air pollution which is reaching critical levels in northwest England, perhaps sufficient to cause vegetation change (Gateley & Michell 2004). The Sefton Coast Life Project included objectives for *C. canescens* conservation in a Site Management

Plan for Southport & Ainsdale Golf Course (1998). Since about 1999, the Southport & Ainsdale Club, with the support of Countryside Stewardship funding, has pursued a programme of "rough" management designed to restore and conserve the dune and dune heath character of the course (Gill 2004).

As this is a nationally rare plant, the abundance of *C. canescens* at Southport & Ainsdale Golf Course has great conservation significance. Indeed, based on Trist's (1998) data, this may be the largest population in Britain outside North Norfolk and the Channel Isles. The presence of this species is also listed as a reason for the notification of the Sefton Coast Site of Special Scientific Interest, which was extended in 2000 to include the Southport & Ainsdale Golf Course.

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Population explosion of *Hypochaeris glabra* L. on the Sefton Coast, Merseyside in 2007

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ABSTRACT

Hypochaeris glabra has been historically scarce and recently rare in South Lancashire (v.c. 59) and is poorly represented in North-west England. In 2007, 28 populations supporting over 5200 plants and occupying about 2.4 ha were found on the Sefton Coast sand-dunes. The typical habitat is rabbit-grazed fixed-dune with a short, open sward, often with a substantial cover of mosses and lichens. The composition of associates suggests a neutral to somewhat acidic substrate at most sites. It is surmised that unusual weather conditions contributed to this apparent population explosion.

KEYWORDS: Climate, grazing, habitat, *Hypochaeris glabra*, population, sand-dunes, Sefton Coast, v.c. 59.

INTRODUCTION

Hypochaeris glabra L. (Smooth Cat's-ear) is a native annual of open, summer-parched grasslands and heathy pastures, on usually acidic, nutrient-poor, sandy or gravelly soils, also occurring in dune grassland or on sandy shingle. It was formerly widespread as a weed of arable fields and as a wool-shoddy alien (Preston *et al.* 2002). Rodwell (2000) includes *H. glabra* as a component of the SD19 *Phleum arenarium* – *Arenaria serpyllifolia* dune annual community.

This plant is of European southern temperate origin but is widely naturalised outside its native range (Preston *et al.* 2002). Thus, in parts of North America and Australia it is classed as a “problem weed” on sandy soils.

STATUS IN THE BRITISH ISLES

H. glabra is scattered throughout Britain from the Channel Islands to Scotland where, however, there are only four recent records. It is mainly concentrated in the East Anglian Breckland and Sandlings, the Surrey heaths and the Welsh Borders (Wilson & King 2003). The plant is declining in semi-natural habitats, having disappeared in many areas as a result of agricultural improvement or loss of grazing.

However, it is easily overlooked, particularly as the flowers close in the afternoon (Preston *et al.* 2002). The species has a Change Index (1930–1999) of -1.01, its conservation status is given as “vulnerable” and it is a U.K. Species of Conservation Concern (Cheffings & Farrell 2005). Confined to Ulster in Ireland, *H. glabra* is Red Listed and protected under the Wildlife (N.I.) Order, 1985.

In North-west England, the plant is notified as a Species of Conservation Importance (Regional Biodiversity Steering Group 1999). It is poorly represented in most vice-counties in this region. There are no modern records for Cheshire (v.c. 58). Thus, Lord de Tabley (1899) states that *H. glabra* has been found in three stations in fields and on banks on a sandy soil but Newton (1971) lists the plant as apparently extinct in the county. It has never been found in West Lancashire (v.c. 60), perhaps because the only likely habitat on the coastal golf courses is difficult of access (E. F. Greenwood pers. com.). *H. glabra* has been recorded from 13 tetrads in Cumbria (v.c. 69, v.c. 69b, v.c. 70), where it is rare on acid, sandy ground and sand-dunes from South Walney to Ravenglass (Halliday 1997). The plant is also known from the Ayres' dunes (three hectads) in the north of the Isle of Man (v.c. 71).

HISTORY IN SOUTH LANCASHIRE (V.C. 59)

The earliest relevant floras (Hall 1839; Dickinson 1851) do not mention *H. glabra*. Twenty-six records for South Lancashire before 2007 are listed in Table 1. The first for the vice-county is given in Savidge *et al.* (1963) as “Moseley Common” (undated, pre-1900). For this record, the *New Flora of South Lancashire Project* cites the Grid Reference SD7201 and the date 1859. Moseley Common still exists, situated between Tyldesley and Worsley in Greater Manchester. There are only two other records away from the Sefton Coast, both in 1975 for Gorse Wood, Westthroughton (SD6506) (*New Flora Project*).

TABLE 1. PRE-2007 RECORDS OF *H. GLABRA* IN SOUTH LANCASHIRE

Year	Locality	Recorder	Herbarium sheet
1859	Moseley Common	Anon.	
1866	Half-a-mile north of Crosby	Lord de Tabley	
1869	Freshfield	G. E. Hunt	
1870	Formby	H. S. Fisher	MANCH
1873	Formby	H. S. Fisher	
1875	Hightown	R. Brown	LIV
1876	Hightown	J. H. Lewis	
1878	Ainsdale	J. C. Melvill	Melvill
1879	Ainsdale	J. H. Lewis	
1879	Southport, Ainsdale	J. H. Lewis	MANCH
1880	Birkdale	C. T. Green	
1881	Southport	C. T. Green	
1907	Freshfield	W. G. Travis	LIV
1909	Freshfield	W. G. Travis	LIV
1926	Ainsdale	J. N. Frankland	LIV
1933	Birkdale Cemetery	F. W. Holder	LIV
1950	SD31	Anon.	
1950	SD20	Anon.	
1953	Ainsdale	F. W. Holder	LIV
1953	Freshfield	F. W. Holder	LIV
1953	Freshfield	V. Gordon	LIV
1956	Formby	M. H. Bigwood	
1975	Gorse Wood, Westhoughton	M. E. Martin	
1975	Gorse Wood, Westhoughton	E. H. Hancock, E. G. & M. E. Martin	
2000	Ainsdale Sand Dunes N.N.R.	P. H. Smith	
2003	Ainsdale Sand Dunes N.N.R.	S. Taylor	

Sources: *New Flora of South Lancashire* Project, Liverpool Museum Herbarium (**LIV**), Manchester Museum Herbarium (**MANCH**)

The first record of *H. glabra* on the Sefton Coast was by Hon. J. L. Warren (Lord de Tabley) who found the plant in 1866 on sandhills half-a-mile north of Crosby (Brown 1875). The next sighting was by G. E. Hunt: "Sandy ground, Freshfield in 1869" (Brown 1873; Wheldon 1909). There are also records for Formby in 1870 and 1873, Hightown in 1876, Ainsdale in 1878 and 1879 and Birkdale in 1880 (Table 1). Melvill (1909) had a sheet of *H. glabra* in his herbarium labelled "Very scarce on sandhills at Ainsdale, S.W. Lancashire August 24th 1878". Some of these early records are represented by sheets in **LIV** and **MANCH** (Table 1).

Green (1933) summarises the status of *H. glabra* in the Liverpool district as: "Sand dunes. Rare. Hightown to Birkdale." Travis's *Flora of South Lancashire* (Savidge *et al.* 1963) describes the occurrence of the plant as: "Occasional on sand-dunes, rare elsewhere",

and cites records thus: "Sand-dunes from Freshfield to Ainsdale; by Birkdale Cemetery; sand-dunes, Crosby to Hightown."

Prior to the present study, the only Sefton Coast records in the last 50 years are for Ainsdale Sand Dunes National Nature Reserve in 2000 and 2003. The Ainsdale records were from Phase 1 of the Dune Restoration Area where pine plantations were felled in 1992, followed by winter sheep-grazing. However, a *Wildflower Society* meeting on 9 July 1994, led by Mrs Shirley Brown, reports finding *H. glabra* near the National Trust carpark at Victoria Road, Formby Point, some 2 km to the south.

The above observations strongly suggest that *H. glabra* has historically been a scarce plant in the vice-county, but particularly rare over the last half-century and largely confined to the sand-dunes of the Sefton Coast. Before 2007, I had only seen it once (Ainsdale N.N.R., 2000) in nearly 40 years of recording.

TABLE 2. SUMMARY OF *H. GLABRA* POPULATION DATA

Site	Locality	Grid reference	Area (m ²)	No. of plants	No. of vascular associates
1	Blundell Avenue, Formby Point	SD2809707780	1	2	14
2	Blundell Avenue, Formby Point	SD2799707925	1300	c.500	35
3	Blundell Avenue, Formby Point	SD2794507920	4500	c.100	25
4	Blundell Avenue, Formby Point	SD2780408094	5	c.50	17
5	Blundell Avenue, Formby Point	SD277076	700	c.500	40
6	Victoria Road Formby Point	SD2791408565	50	30–50	10
7	Victoria Road, Formby Point	SD2785608830	350	c.500	19
8	Victoria Road, Formby Point	SD2786408544	120	c.500	20
9	Victoria Road, Formby Point	SD2785408603	375	100+	21
10	Victoria Road, Formby Point	SD2778108576	64	100+	16
11	Victoria Road, Formby Point	SD2789208522	26	c.20	12
12	Lifeboat Road, Formby Point	SD2782706883	200	c.500	24
13	Lifeboat Road, Formby Point	SD2778406844	32	c.30	15
14	Lifeboat Road, Formby Point	SD2779806811	4	c.10	10
15	Lifeboat Road, Formby Point	SD2763706878	10,000	c.100	17
16	Formby Golf Course	SD2765309013	850	1000+	22
17	Formby Golf Course	SD2780009020	2850	c.500	22
18	Formby Golf Course	SD2778909247	1100	c.20	20
19	Formby Golf Course	SD2776009242	300	100+	22
20	Ainsdale Sand Dunes N.N.R.	SD2914610822	116	c.20	13
21	Ainsdale Sand Dunes N.N.R.	SD2915510820	36	c.50	13
22	Ainsdale Sand Dunes N.N.R.	SD2916910817	30	c.20	19
23	Ainsdale Sand Dunes N.N.R.	SD2917110769	104	c.50	20
24	Ainsdale Sand Dunes N.N.R.	SD2916510752	227	200+	16
25	Ainsdale Sand Dunes N.N.R.	SD2917510702	18	c.50	16
26	Ainsdale Sand Dunes N.N.R.	SD2913410720	12	c.30	21
27	Ainsdale Sand Dunes N.N.R.	SD2913810702	288	c.100	18
28	Ainsdale Sand Dunes N.N.R.	SD2905610691	175	c.50	21
Total			23,833	5242+	

THE 2007 SURVEY – METHODS

On 19 June 2007, while surveying a colony of *Pyrola minor* on National Trust land north of Victoria Road, Formby Point, with Pat Lockwood, I came across two colonies of *H. glabra* on heavily Rabbit-grazed, acid grassland (National Grid Reference SD2708). Then, on 5 July 2007, we found more populations on similar habitat near Blundell Avenue, Formby about 500 m south of the first discovery (SD2807, SD2707, SD2708). These initial sightings led to a more systematic search of the dune system during July, August and early September, with the result that additional colonies were found on the National Trust property and also at Sefton Council's Lifeboat Road site (SD2606, SD2706), at Natural England's Ainsdale Sand Dunes National Nature Reserve (SD2910) and on Formby Golf Course (SD2709). Visits were also made to potentially suitable habitat at Ravenmeols dunes (SD2705, SD2706), Birkdale Common

(SD3114), Liverpool Road Cemetery, Ainsdale (SD3213) and the southern half of Southport & Ainsdale Golf Course (SD3112, SD3113) but no *H. glabra* was found.

For each site with *H. glabra*, associated vascular plants were listed, their relative abundance being assessed using the DAFOR scale. Locations were determined using a hand-held Garmin Etrex GPS, the approximate areas of colonies were measured by pacing and an estimate made of the number of *H. glabra* plants in each. Notes were also made on habitat characteristics.

RESULTS

A total of 28 populations of *H. glabra* was recorded, five at Blundell Avenue and six at Victoria Road on National Trust property, four at Lifeboat Road, four at Formby Golf Course and nine at Ainsdale Sand Dunes National Nature Reserve. These cover an area of about 23,800 m² (2.4 ha) and are estimated to contain



Figure 1. Locations of Smooth Cat's-ear *Hypochaeris glabra* on the Sefton Coast

over 5200 plants (Table 2, Map 1). The largest single colony is at site 16 on the western edge of Formby Golf Course, and supports over 1000 plants. This is a large (850 m²) site which

has been recently turf-stripped, providing an open habitat that has been colonised by ruderal vegetation, including *H. glabra*. Other large populations were found at sites 2 and 5 near

Blundell Avenue, Formby Point. Site 2 is a transitional zone between a former *Asparagus* field and a conifer plantation, while site 5 is part of a disused *Asparagus* field next to the National Trust site office. In recent years, the latter site has been mowed annually but, like site 2, has recently been planted up with young conifers. Both localities support hundreds of *H. glabra* plants at relatively high density in a plant community dominated by *Carex arenaria* and *Agrostis capillaris*. The largest number of colonies (nine) was found on Ainsdale N.N.R. in Phase 1 of the Dune Restoration Area. Plants were largely confined to an eastern zone of open, more consolidated, dune within about 200 m of the existing conifer woodland. These populations have a relatively low density of *H. glabra* plants. A scattering of isolated individuals was noted between the main colonies and also on the adjacent access track which is used by Land Rovers.

Species-richness of sites is generally low, ranging from a mean of 16.3 at Victoria Road to 26.2 at Blundell Avenue, the overall average being 19.2 vascular taxa per site (Table 2).

A total of 83 vascular taxa was recorded as associates of *H. glabra* (Table 3). *Agrostis capillaris* and *Carex arenaria* are each absent from only two sites, while *Senecio jacobaea*, *Erodium lebelii*, *Crepis capillaris*, *Sedum acre*, *Centaureum erythraea*, *Arenaria serpyllifolia* and *Lotus corniculatus* also have high rates of occurrence. The species composition suggests a neutral to somewhat acidic substrate at most sites.

The habitat at almost all sites was described as fixed-dune with a short, open sward, often with a substantial cover of mosses and lichens. Except on Formby Golf Course, there is invariably evidence of heavy rabbit-grazing. The Ainsdale N.N.R. sites are also winter-grazed by sheep. Moderate human trampling is a factor at some localities, but heavy recreational pressure seems to result in an absence of *H. glabra*.

DISCUSSION

It is apparent that, on the Sefton Coast, *H. glabra* is associated with a rather specific habitat type; sparsely vegetated, short open turf, usually rabbit grazed, with a high frequency of mosses and lichens and a low species-richness of vascular plants, many of which are indicative of neutral to moderately acidic soil conditions. The plant seems to be

absent from areas heavily disturbed by trampling, or sand-blow, preferring a more consolidated substrate. Few individuals were found in more luxuriant, grassy swards or where fresh sand was being deposited.

As Sefton Coast dune sand is initially high in calcium, the plant tends to be found in older parts of the dune system where prolonged leaching has washed out much of the calcium carbonate (Smith 1999). Several colonies are on the edges of pine plantations or in areas cleared of pines, where the presence of needle litter may have increased levels of acidity. The Formby Golf Course colonies are nearer the sea than the others, the substrate appearing less acid than elsewhere. However, these dunes are actually quite old, their proximity to the shore being due to over 400 m of marine erosion since the early twentieth century (Smith 1999). All these golf course sites have recently been turf-stripped, *H. glabra* being part of ruderal vegetation recolonising the disturbed areas which, in this case, shows no evidence of rabbit grazing.

These observations accord with habitat characteristics described in the literature, namely impoverished sandy grasslands and abandoned arable fields on non-calcareous soils (Wilson & King 2003).

Although samples were not taken to determine N.V.C. communities, the associated species list (Table 3) suggest that most of the sites accord with the SD12 *Carex arenaria*-*Festuca ovina*-*Agrostis capillaris* dune grassland, though some stands may be closer to, or include patches of, SD19 *Phleum arenarium*-*Arenaria serpyllifolia* dune annual community (Rodwell 2000). Of the commoner associates, *Agrostis capillaris* and *Carex arenaria* are listed by Rodwell (2000) as major components of SD12, while *Arenaria serpyllifolia*, *Carex arenaria*, *Centaureum erythraea*, *Crepis capillaris*, *Sedum acre* and *Senecio jacobaea* are similarly listed for SD19.

In view of the paucity of previous records for the Sefton Coast and the nationally declining status of the species, the abundance of *H. glabra* on the Sefton Coast sand-dunes in 2007 is extraordinary. It should also be noted that extensive areas of potentially suitable habitat on parts of Ainsdale N.N.R. and several golf courses were not visited. As the plant is small and rather shy of flowering, it could have been overlooked in the past. However, the intensity of botanical recording over many years in this area, and the large size of the populations found, make this unlikely.

TABLE 3. OCCURRENCE AND FREQUENCY OF *H. GLABRA* AND VASCULAR ASSOCIATES ON 28 SITES

Taxon	English name	No. of occurrences	Modal frequency
<i>Acer pseudoplatanus</i>	Sycamore	2	r
<i>Achillea millefolium</i>	Yarrow	2	r
<i>Aesculus hippocastaneum</i>	Horse-chestnut	1	r
<i>Agrostis capillaris</i>	Common Bent	26	a
<i>Aira caryophyllea</i>	Silver Hair-grass	2	o
<i>Aira praecox</i>	Early Hair-grass	2	o
<i>Ammophila arenaria</i>	Marram	8	o
<i>Anagallis arvensis</i>	Scarlet Pimpernel	1	o
<i>Anchusa vulgaris</i>	Bugle	5	r
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	2	r
<i>Anthyllis vulneraria</i>	Kidney Vetch	1	r
<i>Arenaria serpyllifolia</i>	Thyme-leaved Sandwort	16	o
<i>Arrhenatherum elatius</i>	False Oat-grass	1	r
<i>Asparagus officinalis</i>	Garden Asparagus	2	r
<i>Betula pendula</i>	Silver Birch	2	r
<i>Bromus hordeaceus</i>	Soft Brome	3	o
<i>Carex arenaria</i>	Sand Sedge	26	a
<i>Centaurea nigra</i>	Common Knapweed	1	r
<i>Centaureum erythraea</i>	Common Centaury	17	r
<i>Cerastium fontanum</i>	Common Mouse-ear	7	o
<i>Chamerion angustifolium</i>	Rosebay Willowherb	15	o
<i>Cirsium arvense</i>	Creeping Thistle	5	o
<i>Conyza canadensis</i>	Canadian Fleabane	5	r
<i>Crataegus monogyna</i>	Hawthorn	1	r
<i>Crepis capillaris</i>	Smooth Hawk's-beard	19	o
<i>Cynoglossum officinale</i>	Hound's-tongue	10	o
<i>Echium vulgare</i>	Viper's-bugloss	1	f
<i>Epipactis dunensis</i>	Dune Helleborine	2	r
<i>Equisetum arvense</i>	Field Horsetail	1	o
<i>Erigeron acer</i>	Blue Fleabane	1	r
<i>Erodium cicutarium</i>	Common Stork's-bill	11	o
<i>Erodium lebelii</i>	Sticky Stork's-bill	21	o
<i>Erodium xanaristatum</i>	Hybrid Stork's-bill	2	o
<i>Euphorbia portlandica</i>	Portland Spurge	3	o
<i>Festuca ovina</i>	Sheep's Fescue	6	f
<i>Festuca rubra</i>	Red Fescue	11	f
<i>Fragaria vesca</i>	Wild Strawberry	4	f
<i>Galium verum</i>	Lady's Bedstraw	4	o
<i>Geranium molle</i>	Dove's-foot Crane's-bill	7	o
<i>Holcus lanatus</i>	Yorkshire-fog	14	o
<i>Hypochaeris glabra</i>	Smooth Cat's-ear	28	o
<i>Hypochaeris radicata</i>	Cat's-ear	9	o
<i>Leontodon saxatilis</i>	Lesser Hawkbit	15	o
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	16	o
<i>Luzula campestris</i>	Field Wood-rush	7	f
<i>Oenothera glazioviana</i>	Large-flowered Evening-primrose	1	o
<i>Oenothera ×fallax</i>	Intermediate Evening-primrose	2	o
<i>Ononis repens</i>	Common Restharrow	9	f
<i>Ornithopus perpusillus</i>	Bird's-foot	1	r
<i>Phleum arenarium</i>	Sand Cat's-tail	1	r
<i>Pilosella officinarum</i>	Mouse-ear-hawkweed	3	o

TABLE 3 continued

Taxon	English name	No. of occurrences	Modal frequency
<i>Pinus nigra</i>	Austrian Pine	1	o
<i>Plantago coronopus</i>	Buck's-horn Plantain	4	f
<i>Plantago lanceolata</i>	Ribwort Plantain	5	f
<i>Poa annua</i>	Annual Meadow-grass	4	o
<i>Poa humilis</i>	Spreading Meadow-grass	1	o
<i>Polygala vulgaris</i>	Common Milkwort	1	r
<i>Populus alba</i>	White Poplar	2	r
<i>Prunella vulgaris</i>	Selfheal	4	o
<i>Quercus</i> sp.	Oak	1	r
<i>Ranunculus bulbosus</i>	Bulbous Buttercup	1	r
<i>Rosa canina</i> agg.	Dog-rose	2	r
<i>Rubus caesius</i>	Dewberry	15	o
<i>Rumex acetosella</i>	Sheep's-sorrel	7	f
<i>Sagina apetala</i>	Annual Pearlwort	6	o
<i>Salix repens</i>	Creeping Willow	2	a
<i>Sedum acre</i>	Biting Stonecrop	19	o
<i>Senecio jacobaea</i>	Common Ragwort	23	o
<i>Senecio vulgaris</i>	Groundsel	1	r
<i>Solanum dulcamara</i>	Bittersweet	1	r
<i>Sonchus asper</i>	Prickly Sow-thistle	9	r
<i>Sonchus oleraceus</i>	Smooth Sow-thistle	1	r
<i>Spergula arvensis</i>	Corn Spurrey	1	r
<i>Taraxacum officinale</i> agg.	Dandelion	6	r
<i>Trifolium arvense</i>	Hare's-foot Clover	12	f
<i>Trifolium campestre</i>	Hop Trefoil	1	r
<i>Trifolium dubium</i>	Lesser Trefoil	5	o
<i>Trifolium repens</i>	White Clover	5	o
<i>Veronica officinalis</i>	Heath Speedwell	4	o
<i>Vicia lathyroides</i>	Spring Vetch	1	r
<i>Viola canina</i>	Heath Dog-violet	6	r
<i>Vulpia bromoides</i>	Squirreltail Fescue	2	r
<i>Vulpia fasciculata</i>	Dune Fescue	1	r
84 taxa			

Being an annual, this species may be susceptible to adverse environmental conditions, especially at time of germination and establishment of seedlings. Spring and summer 2007 were characterised by wholly exceptional weather conditions, specifically a warm, dry April followed by the wettest early summer (May to July inclusive) since records began. The habitat occupied by *H. glabra* is particularly susceptible to spring and summer drought and it is possible that 2007 provided ideal conditions for a population explosion. Thus, Rodwell (2000) points out that, in a number of annual species, both viability and germination rate have been shown to decline markedly with decreasing soil moisture, desiccation often arresting establishment.

However, Wilson & King (2003) state that germination of *H. glabra* occurs mainly in the autumn and that seed is relatively short-lived. The inference is that, despite the paucity of recent records, there must have been sufficient plants on the dunes to provide a seed-bank and that the weather conditions of autumn 2006 were important, as well those of spring and summer 2007.

Contrary to statements in the literature (e.g. Wilson & King 2003) that *H. glabra* closes its flowers in the afternoon, it was noted that fully open flowers were usually to be found from about 11.00 to 15.00 hrs BST in sunny or partly cloudy conditions. At these times, the plants were easy to find but, even when closed, inflorescences could readily be recognised by

the tapering shape and characteristic pattern of purple-edged involucre bracts. There was, however, a remarkable variation in the height of mature plants, from about 2 cm to 30 cm. The spiky pappus-heads were identifiable from a few metres away and often led to the discovery of a colony, which was also assisted by the characteristic appearance of the preferred habitat.

Although two of the largest sites contain recently planted pine trees, most of the habitat of *H. glabra* on the Sefton Coast dunes appears to be self-sustaining, requiring little active management. At most sites, present levels of rabbit-grazing and human trampling seem sufficient to maintain the open, sparsely vegetated communities favoured by the plant. However, the recently noted trend towards denser swards, perhaps influenced by aerial nitrogen deposition (Gateley & Michell 2004), could represent a long-term threat to this

species. Thus, Wilson & King (2003) specify increases in nitrogen applied to nutrient-poor soils and agricultural improvement of sandy arable and pasture land as among the reasons for a national decline of *H. glabra*.

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Notes

VIPER'S-GRASS *SCORZONERA HUMILIS* L. AT WAREHAM MEADOWS, DORSET

VIPER'S-GRASS IN BRITAIN

Viper's-grass *Scorzonera humilis* is restricted to four sites in Britain, in two Dorset and two in South Wales, and is classified as Vulnerable in the Vascular Plant Red List for Great Britain (Cheffings & Farrell 2005). Historically, another three populations were known from England, one in Warwickshire, and two in Dorset.

In Warwickshire, five plants were found in 'a damp, old meadow on a sandy clay soil' in the 1950s (Hawkes & Phipps 1954). The meadow was an unimproved, but not particularly species-rich, grassland, a habitat that 'is not apparently specialised and must be mirrored in thousands of places in the British Isles.' This small population persisted for less than fifteen years after its discovery and it was extinct by 1965 (Perring & Farrell 1983).

The two extinct Dorset sites were on a roadside 1 km to the east of Wareham Meadows, and in a wet, grassy field over 11 km away (Hall 1928). The roadside site contained 'a single fine plant' according to John Raven in 1972 (record card in Biological Records Centre, Monks Wood), but this plant has since died.

Viper's-grass is still present at Corfe Common in Dorset, where there were four flowers in 2006 (B. Edwards pers. comm.)

Two Welsh sites were discovered in 1996 and 1997 (Preston *et al.* 2002), and at least one of them contains many thousands of plants in 'several hectares of marshy pasture' (Woodman & Walls 1999).

The remaining English site is at the Royal Society for the Protection of Birds' Wareham Meadows nature reserve. The earliest record certainly from this locality is from 1950, but it is assumed that this is the same location where the plant was first discovered in Britain in 1914 (Druce 1915). The '*Scorzonera* field' is a 1 ha plot surrounded by ditches on three sides, with a rushy pasture to the west into which the Viper's-grass is spreading into. It has been found in some of the adjacent fields in the past (Druce 1916).

CONDITION OF THE WAREHAM MEADOWS SITE

If this field is the same one that Noel Sandwith found over 90 years ago, it appears to have become more overgrown and enriched. On his visit in 1916, G. C. Druce found Viper's-grass 'in great plenty growing in a very wet pasture among *Hydrocotyle*, *Ranunculus flammula*, *Carex panicea*, *Carex echinata*, *Carex flava* var. *oedocarpa*, *Carex [nigra]*, *Molinia*, *Cirsium [dissectum]*, *Potentilla palustris*, *Juncus articulatus*, *Juncus acutiflorus*, *Festuca rubra*, *Agrostis [stolonifera]*, and [*Danthonia decumbens*]'.

In his note from 1929 he adds Bulbous Foxtail *Alopecurus bulbosus* (Druce 1929). Purple Moor-grass *Molinia caerulea* is still frequent, but Soft Rush *Juncus effusus* is spreading, there are two stands of Common Reed *Phragmites australis*, and the northern part is dominated by a stand of Greater Pond-sedge *Carex riparia*. The reed and pond-sedge both spread after changes were made to the water levels on the rest of Wareham Meadows in 1997–1998. Viper's-grass is now most frequent in the drier, western half of the field, in the more open grassland.

In the late 1990s, although there were still thousands of plants in the field, RSPB staff were concerned that the vegetation was becoming too rank for the Viper's-grass; this concern was also expressed by the authors of the account in the *Red Data Book* (Woodman & Walls 1999). A small part of the south-western corner of the field, covering approximately 15 m × 20 m, was cut with a hay mower in mid-August 1999, to see if this would benefit the Viper's-grass by reducing the growth of the surrounding vegetation. The following year, a larger area, covering most of the western half of the field, was hay cut, and the reed and sedge beds were flailed. Prior to these cuts, the field had been fenced off (by the previous tenant) to protect the plants, and it had not been managed for at least five years. In subsequent years, encroaching reed and sedge were cut and removed, and in August 2006, after the Viper's-grass had finished flowering, cattle were brought in to the field to graze it.

These measures do seem to have created a more open structure, but more information was needed about how the plants were responding.

POPULATION STRUCTURE AT WAREHAM MEADOWS

In Belgium, many Viper's-grass populations contain a large number of old plants with very few young ones, and seedling establishment is rare (Colling *et al.* 2002). This age structure is particularly prevalent in drier sites with taller vegetation and more nutrients. These aged populations may be in danger of extinction if they are unable to replace dying plants with new seedlings. In contrast, there are other populations, in wetter and more nutrient-poor sites, with a much higher proportion of young plants. These regenerating populations may be more viable than the older ones.

In July 2002 attempts were made to assess the condition of the population using similar methods to the Belgian study: the number of plants in each of four size classes was recorded in ten randomly sited 1 m × 1 m quadrats. Size is probably closely correlated with age in Viper's-grass, and it was measured by the number of basal leaf rosettes on each plant (the four classes were: one rosette; 2–5 rosettes; 6–25 rosettes; and more than 25 rosettes). The results suggested that the structure of the Wareham Meadows population was somewhere between that of the regenerating and aged populations found in Belgium, but this was a small sample with only 33 plants in the quadrats and very few young seedlings. This indicated that the conditions in the field could be improved by creating a more open structure to the sward. In August 2002, the bridge across the ditch into the *Scorzonera* field was repaired and cattle were allowed in to graze the site and open up the vegetation.

In April 2003 a larger sample was taken using 50 randomly sited quadrats to assess the age structure and map the distribution of the plants.

The results (from 195 plants) were very similar to those from 2002 (Fig. 1), with 86% of the plants in the 2–5 and 6–25 rosettes classes. There were few presumed young plants (those with a single rosette), but there were even fewer very old ones (those with more than 25 rosettes) (Table 1).

In 2005, the reed and sedge beds were cut again, and cattle grazed the field in 2006. In April 2007 the 2003 survey was repeated using another 50 random quadrats. This time the results (from 178 plants) showed 87% of plants were in the 2–5 and 6–25 rosette classes with more (56% of all plants) in the 2–5 class (Table 1). This could suggest that there were more younger plants in 2007, in response to the habitat management work. Difficulties in distinguishing individual plants may have led to overestimates of the number of smaller plants. For example, one plant had three single rosettes at least 10 cm apart from each other, but they were all connected by one rhizome.

VIPER'S-GRASS DISTRIBUTION AND THE VEGETATION AT WAREHAM MEADOWS

The map (Fig. 2) shows the number of Viper's-grass plants found in each quadrat, the position of each quadrat, and the vegetation in the field in April 2007. In both 2003 and 2007, most of the plants were amongst the more open Red Fescue *Festuca rubra* and Purple Moor-grass *Molinia caerulea* on the western side of the field. There were also many plants in the stand of other grasses in the south-west corner of the field, but this was largely excluded from the quadrat survey, which used a north-south and east-west grid and so cut off the north-west and south-west corners of the field. This open grassland was the favoured habitat: there were a few plants in the more tussocky grassland, in the open rush beds, and in the edge of the sedge bed along the northern side, but there were none in the middle of the dense rush,

TABLE 1. THE NUMBER OF VIPER'S-GRASS *SCORZONERA HUMILIS* PLANTS IN DIFFERENT SIZE CLASSES IN SAMPLES FROM 2002, 2003, AND 2007

Year	Number of rosettes per plant					N quadrats
	1	2–5	6–25	25+	N plants	
2002	4	12	16	1	33	10
	12%	36%	48%	3%		
2003	17	22	96	10	195	50
	9%	37%	49%	5%		
2007	19	100	56	3	178	50
	11%	56%	31%	2%		

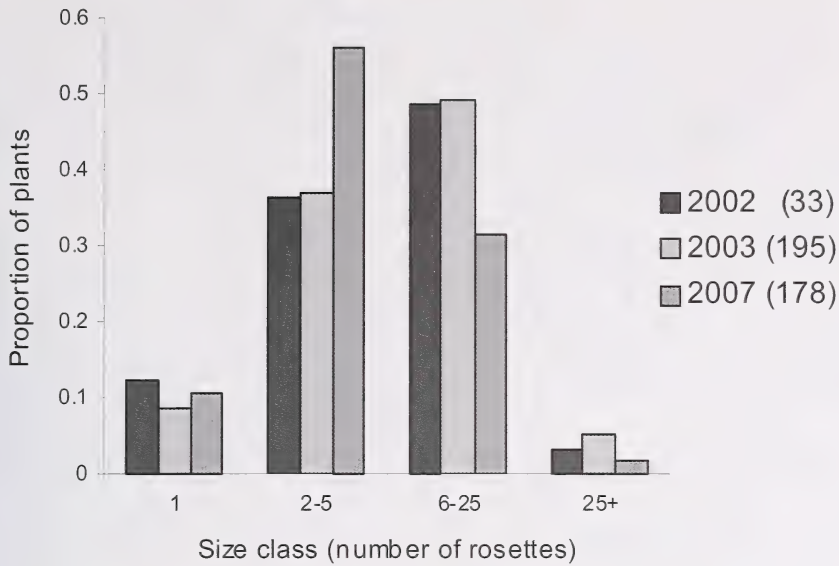


FIGURE 1. The proportion of Viper's-grass *Scorzonera humilis* plants in each of the four size classes in 2002 and 2003. Sample sizes were 33 plants in 2002 and 195 plants in 2003. The number of plants surveyed in each year is shown in brackets.

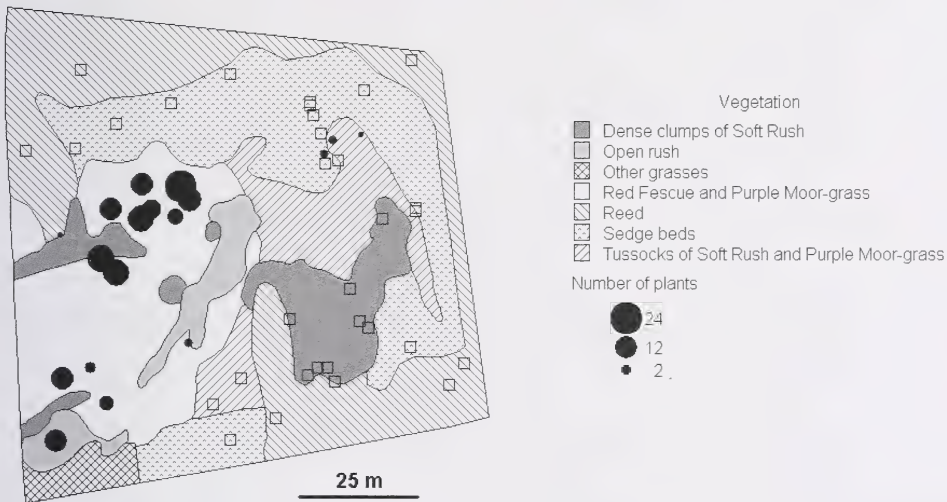


FIGURE 2. Vegetation and the number of Viper's-grass *Scorzonera humilis* plants in fifty 1 m x 1 m quadrats in the field at Wareham Meadows in April 2007. Squares show the position of quadrats where no plants were found.

reed, or sedge beds. A survey in 1997 produced similar results (Clowes 1998). In 2007, when the vegetation was mapped using GPS equipment, the favoured habitat covered just under a quarter (0.21 ha, 24%) of the field, the unsuitable area of rushes, reeds, and sedge beds covered two-thirds (65%, 0.57 ha), and the remaining 10% (0.09 ha) was tussocky Purple Moor-grass and rushes.

Extrapolating the mean number of plants per quadrat (12.3) in the Red Fescue and Purple Moor-grass area over the whole area covered by this favoured habitat, gives a population estimate of about 23,000 plants (bootstrap analysis places confidence limits of 15,000–29,000 on this estimate).

HABITAT MANAGEMENT FOR VIPER'S-GRASS

After a gap of many years, the *Scorzonera* field is being grazed again. It is expected that cattle grazing will open up the tussocky grassland, create more suitable areas for seedlings to

establish, and improve conditions for the Viper's-grass. Open conditions in the adjacent western field are maintained by cutting or grazing, which should aid the spread of the plant and increase its distribution. Viper's-grass has already spread at least 27 m into this field. The population will be monitored to make sure that grazing is having the desired effect.

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Plant Records

Records for publication must be submitted to the appropriate Vice-county Recorder (see *BSBI Year Book 2008*), and not to the Editors. Following publication of the *New Atlas of the British & Irish Flora* and the *Vice-county Census Catalogue*, new criteria have been drawn up for the inclusion of records in *Plant Records*. (See *BSBI News* no. 95, January 2004 pp. 10 & 11). These are outlined below:

First records of **all** taxa (species, subspecies and hybrids) included in the VCCC, designated as native, archaeophyte, neophyte or casual.

First record since 1970 of the taxa above, except in the case of *Rubus*, *Hieracium* and *Taraxacum*.

Records demonstrating the rediscovery of all taxa published as extinct in the VCCC or subsequently.

Newly reported definite extinctions.

Deletions from the VCCC (e.g. through the discovery of errors, the redetermination of specimens etc.) **NB** – only those errors affecting VCCC entry.

New 10km square records for Rare and Scarce plants, defined as those species in the *New Atlas* mapped in the British Isles in 100 10km squares or fewer. (See *BSBI News* no. 95, January 2004 pp. 36–43).

Records for the subdivisions of vice-counties will not be treated separately; they must therefore be records for the vice-county as a whole. However, records will be accepted for the major islands in v.cc. 102–104, 110 and 113.

In the following list, records are arranged in the order given in the *List of Vascular Plants of the British Isles* and its supplements by D. H. Kent (1992), from which the species' numbers, taxonomy and nomenclature are taken. The Ordnance Survey national grid reference follows the habitat and locality. With the exception of collectors' initials, herbarium abbreviations are those used in *British and Irish Herbaria* by D. H. Kent & D. E. Allen (1984). Records are field records if no other source is stated. For all records 'det.' or 'conf.' appear after the herbarium if the determination was based on material already in an institutional herbarium, otherwise before the herbarium.

The following signs are used:

* before the vice-county number: to indicate a new vice-county record.

† before the species number: to indicate that the plant is an archaeophyte.

‡ before the species number: to indicate that the plant is a neophyte.

© before the species number: to indicate that the plant is a casual.

The above 3 signs may also be used before the vice-county number to indicate the status of the plant in that vice-county.

® before the vice-county number: to indicate that this is an additional hectad for a Rare or Scarce plant.

Ø at end of entry: established taxon not in Vice-County Census Catalogue. Name of authority provided.

[] enclosing a previously published record: to indicate that that record should be deleted or changed.

The following list contains the first set of records up to and including the year 2007. The second set of records for this period will be published in the next issue of *Watsonia*.

Huperzia selago subsp. **arctica** 1/1.1b. ***110**, Outer Hebrides: moorland, Grianan, Barra, NF694016, R. J. Pankhurst, 2007, det. F. J. Rumsey, E.

‡**Selaginella kraussiana** 2/1.2. ***38**, Warks.: one metre square patches in rock gardens and palm house, Birmingham City Botanic Garden, SP0485, J. W. Partridge, 2007, conf. M. W. Poulton, **WARMS**. Well naturalised. Birmingham & Black Country County Flora Project. ***100** (Great Cumbrae), Clyde Is.: lawn behind former Garrison House, Millport Garrison, NS164551, BSBI, 2007. Doubtless a long established escape.

Equisetum ×dycei (*E. fluviatile* × *E. palustre*) 4/1.4×8. *100 (Arran), Clyde Is.: shoreline south of King's Cave, NR8830, C. N. Page, 1988. 1st record for Arran and for v.c.100. 100 (Bute), Clyde Is.: raised beach flush, White Port, NS109543, A. C. Hannah, 2007. 1st record for Bute. 110, Outer Hebrides: roadside ditch, Seilebost, NG065968, R. J. Pankhurst, 1996, det. H. McHaffie, E. 1st record since 1970.

Equisetum ×rothmaleri (*E. arvense* × *E. palustre*) 4/1.5×8. *10, Wight: on slumped coastal cliffs, Brambles Chine, Colwell, SZ3388, P. D. Stanley, 2007, det. P. J. Acock, **herb. P. D. Stanley**.

Pilularia globulifera 9/1.1. 8, S. Wilts.: pool, Plaitford, SU274173, R. Veall, 2005. 1st record since 1892. Had been presumed extinct.

Ceterach officinarum 15/3.1. *67, S. Northumb.: on urban wall, North Shields, NZ348686, G. & A. Young, 2006.

‡**Cyrtomium falcatum** 17/2.1. *63, S. W. Yorks.: wall near R. Don, Sheffield, SK372885, J. Westfold, Sheffield City Ecology Unit, 2007.

Dryopteris affinis subsp. *affinis* 17/3.3a. *63, S. W. Yorks.: Glen Howe Woods, Stocksbridge, SK2994, Yorks. Fern Group, 2004.

Dryopteris affinis subsp. *cambrensis* 17/3.3b. *63, S. W. Yorks.: Bradfield Dale, Stocksbridge, SK2491, Yorks. Fern Group, 2007.

Dryopteris affinis subsp. *borreri* 17/3.3c. *63, S. W. Yorks.: Glen Howe Woods, Stocksbridge, SK2994, Yorks. Fern Group, 2004.

‡**Azolla filiculoides** 19/1.1. *©100 (Arran), Clyde Is.: pond at Merkland, NS020383, A. R. Church, 1993. Did not persist.

‡**Ginkgo biloba** L. 19A/GIN.bil. *63, S. W. Yorks.: one regenerating seedling, Hickleton Hall, Thurnscoe, SE4805, G. D. T. Wilmore, 2001. Ø

‡**Larix ×marschlinsii** (*L. decidua* × *L. kaempferi*) 20/5.1×2. *7, N. Wilts.: four seedlings in woodland, Savernake Forest, Marlborough, SU225655, J. Oliver, 2005.

‡**Nymphaea marliacea** Lat.-Marl. 26/1.mar. *110, Outer Hebrides, lochan opposite Loch an Duin, Northbay, Barra, NF699033, R. J. Pankhurst, 2007, **E. Ø**

‡**Helleborus argutifolius** 28/3.arg. *©39, Staffs.: four seedlings in pavement, parents other side of wall, Wombourne, SO872921, C. B. Westall, 2003. *©63, S. W. Yorks.: limestone exposure near High Melton College, SE5001, C. A. Howes, 2007.

©**Nigella damascena** 28/5.1. 113(S), Channel Is. (Sark): roadside verge at foot of bank, east of Port à la Jument House, WV460761, R. M. Veall, 2007, **herb. Société Sercquaise**. Self-seeded from nearby garden. 1st record for Sark.

‡**Consolida ajacis** 28/7.1. ©63, S. W. Yorks.: waste ground, Longley Park, SK3591, K. Balkow, 2007. 1st record since 1970.

‡**Clematis tangutica** 28/12.3. *59, S. Lancs.: 13 plants as pavement weeds originating from a nearby garden plant, Salthill Road, Clitheroe, SD7442, D. P. Earl, 2006.

‡**Clematis recta** L. 28/12.rec. *29, Cambs.: three self-sown plants in road gutters along Greenfields, Newmarket, TL650632, A. C. Leslie, 2007. Ø

Ranunculus parviflorus 28/13.7. *‡85, Fife: several clumps in waste ground, former harbour, Kirkcaldy, NT285921, G. H. Ballantyne, 2007. 1st record for Scotland since c. 1880.

Ranunculus baudotii 28/13.21. *100 (Bute), Clyde Is.: in brackish pond, Cradh ruadh, NS087528, A. C. Hannah, 2005.

Aquilegia vulgaris 28/16.1. *©110, Outer Hebrides: pavement weed, Stornoway, NB425332, P. A. Smith & M. Teneva, 2007.

‡**Berberis aggregata** 29/1.5. *110, Outer Hebrides: low sea cliff, north shore of Loch Boisdale, NF800193, P. A. Smith & M. Teneva, 2004, det. E. J. Clement, E. E. J. Clement describes this as nearest to *B. aggregata*. Three visits were needed to obtain sufficient material!

‡**Berberis julianae** 29/1.7. *38, Warks.: four or five seedlings on pavement edge, Corncrake Close, Wyld Green, Birmingham, SP126950, J. W. Partridge, 2007, conf. M.W. Poulton, **WARMS**. Birmingham & Black Country County Flora Project.

‡**Berberis darwinii** 29/1.9. *38, Warks.: roadside, Dunchurch, SP4871, M. D. G. Jones, 1960, **WARMS**. Original record unearthed by Computer Map Flora Team. Seen since. Bird-sown elsewhere.

†*Papaver rhoeas* 30/1.4. **100** (Great Cumbræ), Clyde Is.: NS15, NCC Freshwater Loch Survey, 1996. 1st record for v.c.100 but not localised. ©**100** (Bute), Clyde Is.: disturbed ground, John Street, Rothesay, NS086644, A. C. Hannah, 2006. 1st localised record for v.c.100 and 1st for Bute.

†*Chelidonium majus* 30/5.1. **100** (Arran), Clyde Is.: spreading on to road verges, Lamlash, Whitehouse Wood, NS025307, A. McBain, 2005, det. A. W. Smith.

‡*Dicentra spectabilis* (L.) Lemaire 31/1.spe. ***63**, S. W. Yorks.: wetland area, Chellow Dene Woods, Bradford, SE132338, B. A. Tregale & M. Wilcox, 2007. Ø

‡*Corydalis cheilanthifolia* 31/2.3. ***59**, S. Lancs.: bare ground, site of former garden centre, Cable Street, Formby, SD301078, P. H. Smith & M. P. Wilcox, 2006, det. M. P. Wilcox.

Fumaria officinalis subsp. *wirtgenii* 31/5.7b. ***7**, N. Wilts.: farmland, Bromham, ST968648, J. Newton, 2005. Occasional.

†*Fumaria densiflora* 31/5.8. ®**13**, W. Sussex: edge of arable, Goodwood, The Trundle, SU862108, M. M. Shaw, 2007.

Ulmus ×hollandica (*U. glabra* × *U. minor* × *U. plotii*) 33/1.1×3×4. ***62**, N. E. Yorks.: three trees in woodland, their provenance uncertain, Deepdale Wood, Loftus, NZ717183, V. Jones, 2004, conf. M. Coleman, **herb. V. Jones**.

Ulmus minor subsp. *angustifolia* 33/1.3b. *‡**63**, S. W. Yorks.: edge of North Beck, Canal Road, Bradford, SE153362, B. K. Byrne, 2007.

‡*Nothofagus obliqua* 39/2.1. *©**7**, N. Wilts.: one young sapling among hundreds of *Fraxinus excelsior* in woodland, Savernake Forest, Marlborough, SU203680, J. Oliver, 2005.

‡*Quercus ilex* 39/4.3. *©**100** (Bute), Clyde Is.: two small trees in woodland, not obviously planted, Kerrycroy, NS106615, A. C. Hannah, 2005.

Betula pubescens subsp. *tortuosa* 40/1.2b. ***38**, Warks.: woodland, Sutton Coldfield, SP0998, E. F. Warburg, 1960s, **WARMS**. Original record unearthed by Computer Map Flora Team. **110**, Outer Hebrides: top of sea cliff, Camas Aspaic near Cromor, NB403217, P. A. Smith & M. Teneva, 2007, det. A. O. Chater, **E**. 1st record since 1970.

Alnus ×hybrida (*Alnus glutinosa* × *A. incana*) 40/2.1×2. ***29**, Cambs.: one self-sown sapling on waste ground, Barnwell East LNR, Cambridge, TL479583, A. C. Leslie, 2007, **CGE**.

‡*Alnus cordata* × *A. incana* 40/2.3×2. ***29**, Cambs.: one coppiced sapling, apparently having arisen spontaneously on waste ground, Barnwell East LNR, Cambridge, TL479583, A. C. Leslie, 2007, **CGE**. Ø

‡*Alnus rubra* 40/2.rub. ***59**, S. Lancs.: disused railway line, Padiham old railway, SD8032, C. S. Crook, 2006.

‡*Carpobrotus edulis* 42/8.2. **113(S)**, Channel Is. (Sark): bank on east side of road, Rue du Fort, WV466765, R. M. Veall, 2007, **herb. Société Sercquaise**. Spread from plants in garden. 1st record for Sark.

†*Chenopodium glaucum* 43/1.5. *©**7**, N. Wilts: nursery weed, Atworth, ST851654, P. Green, 2005.

†*Chenopodium polyspermum* 43/1.8. *©**100** (Bute), Clyde Is.: demolition site, Mansefield Place, Rothesay, NS088642, A. C. Hannah, 2006, det. D. R. McKean, **E**.

©*Chenopodium quinoa* Willd. 43/1.qui. ***8**, S. Wilts.: in tree nursery, Landford, SU252201, P. Woodruffe, 2005. Introduced, naturalising. ***85**, Kinross, set-aside field, Burleigh, by Loch Leven, NO128037, L. Lavery, 2006, det. W. Hay. Now occasionally planted for wildlife and occurring as a casual. Ø

Atriplex ×gustafssoniana (*A. prostrata* × *A. longipes*) 43/3.2×4. ®**13**, W. Sussex, bank of River Adur, river side of flood bank, Beeding Brooks (South), TQ190114, A. Spiers, A. G. Knapp, M. M. Shaw & E. J. Clement, 2007, det. A. G. Knapp & A. Spiers.

‡*Atriplex halimus* 43/3.9. ***59**, S. Lancs.: sand-dunes, Hightown, SD298030, P. H. Smith, 2007, **herb. D. P. Earl**.

‡*Amaranthus hybridus* 44/1.2. *©**100** (Bute), Clyde Is.: demolition site, Mansefield Place, Rothesay, NS088642, A. C. Hannah, 2006, det. D. R. McKean, **E**.

©*Amaranthus caudatus* 44/1.cau. ***38**, Warks.: five plants on farm dump, Castle Hills, Elmdon, SP177822, A. Morris, 2007, det. J. W. Partridge, **WARMS**. Self-sown escape.

‡*Portulaca oleracea* 45/1.1. *13, W. Sussex: well established along edges of concrete roads in several places within military base, Thorney Island, SU7602, Sussex Botanical Recording Society, det. A. Spiers. Stace's *Flora* reports this as casual only but it is clearly fully established here.

Minuartia hybrida 46/4.5. ®8, S. Wilts.: several fine plants by tank track in chalk grassland, near Tilshead, SU018487, S. Pilkington, 2005.

Stellaria neglecta 46/5.4. 85, Fife: old railway line west of Balwearie Mill, Kirkcaldy, NT260900, G. H. Ballantyne, 2006. First found here in 1985 but not confirmed. 1st record since 1871/72.

‡*Cerastium tomentosum* 46/7.3. 113(S), Channel Is. (Sark): on heap of rubble from demolished building above Derrible Bay north of dew-pond, WV472754, R. M. Veall, 2007, **herb. Société Sercquaise**. 1st record for Sark since 1957.

Myosoton aquaticum 46/8.1. *67, S. Northumb.: Bolam Low House, NZ083815, C. M. Irvine, 2006, **herb. G. A. Swan**.

‡*Petrorhagia nanteuilli* 46/24.1. *38, Warks.: flower bed in garden, Haddon Road, Leamington Spa, SP328667, R. W. B. Dawson, 1966, det. J. G. Hawkes & R. C. Readett, **WARMS**. Herbarium specimen seen.

©*Gypsophila viscosa* Murray 46/GYP.vis. *85, Fife, waste ground, Springfield, NO340118, W. Hay & L. Lavery, 2006, det. R.B.G.E. One plant outside a garden but not in it. Ø

‡*Persicaria capitata* 47/1.cap. *©63, S. W. Yorks.: waste ground, Saltaire, SE1436, M. Wilcox, 2000.

‡*Polygonum rurivagum* 47/4.6. *110, Outer Hebrides: sandy waste ground near Baghasdail, NF732174, P. A. Smith & M. Teneva, 2007, conf. A. O. Chater. E.

Rumex ×*schulzei* (*R. crispus* × *R. conglomeratus*) 47/8.13×14. 29, Cambs.: one plant with both parents, north side of shallow pool by Ely North Junction, Ely, TL557810, A. C. Leslie & A. Stevenson, 2007. 1st record since 1951.

‡*Hypericum 'Hidcote'* 51/1.hid. *©63, S. W. Yorks.: waste ground near car park, Cusworth Hall, SE5403, G. D. T. Wilmore, 2004. Ø

‡*Hypericum olympicum* L. 51/1.oly. *38, Warks.: seedlings on pavement edge, Maney Hill Road, Wyld Green, Birmingham, SP126942, M. W. Poulton, 2007, conf. J. W. Partridge, **WARMS**. Birmingham & Black Country County Flora Project. Ø

‡*Tilia 'Petiolaris'* DC. 52/1.pet. *63, S. W. Yorks.: waste ground, Keresforth Hill, Barnsley, SE3305, P. Middleton, 2007. Ø

‡*Tilia tomentosa* Moench 52/1.tom. *63, S. W. Yorks.: roadside verge, Fenwick, SE5916, G. D. T. Wilmore, 2007. Ø

Malva moschata 53/1.1. ‡100 (Bute), Clyde Is.: Ardbeg shore, NS081671, A. C. Hannah, 2005.

©*Althaea cannabina* L. 53/3.can. *29, Cambs.: a single self-sown plant on abandoned allotments, Crane's Lane, Kingston, TL345549, P. J. Reynolds, 2004. Ø

Drosera ×*obovata* (*D. rotundifolia* × *D. anglica*) 55/1.1×2. *67, S. Northumb.: Hummell Knowe, NY704715, A. J. Richards *et al.*, 2007, **herb. G. A. Swan**. 1st localised record.

Viola ×*bavarica* (*V. riviniana* × *V. reichenbachiana*) 57/1.4×5. 38, Warks.: seven or eight plants with parents nearby in front garden path, Russell Terrace, Leamington Spa, SP324654, J. W. Partridge, 2007, conf. M. W. C. Hardman, **WARMS**. 1st record since 1970. See *BSBI News* no.106 p. 8.

‡*Viola* ×*wittrockiana* (*V. lutea* × *V. tricolor* × *V. altaica*) 57/1.11×12×alt. *38, Warks.: ten plants on soil dump by roadside, Castle Vale, Birmingham, SP142891, J. W. Partridge, 2007, conf. E. J. Clement, **WARMS**. Self-sown. *©62, N. E. Yorks.: one plant in wasteland, Battersby Junction, NZ588072, V. Jones, 1993.

‡*Populus trichocarpa* 61/1.4. *67, S. Northumb.: Scotch Gill, Morpeth, NZ1886, G. & A. Young, 2007. Determined from photos by G. Young and A. J. Richards.

‡*Populus balsamifera* 61/1.bal. *©7, N. Wilts.: suckering at field edges, Great Bedwyn, SU280643, J. Oliver, 2005.

Salix ×*fruticosa* (*S. viminalis* × *S. aurita*) 61/2.9×12. *85, Fife: field edge near old moss, north side of Star of Markinch, NO313035, L. Tucker, 2006. Grown on in 2007 to confirm identity.

Salix caprea subsp. *sphacelata* 61/2.10b. *67, S. Northumb.: Long Rack, NY909731, M. E. Braithwaite, 2007, det. R. D. Meikle. 2nd published record.

Salix xstrepida (*S. cinerea* × *S. myrsinifolia*) 61/2.11×14. *67, S. Northumb.: River Derwent, Blanchland, NY9650, Q. Groom, 2007, det. R. D. Meikle. 1st record since 1959.

‡*Sisymbrium strictissimum* 62/1.1. *38, Warks.: one plant in abandoned allotment, St. Mary's Allotments, Leamington Spa, SP332654, J. W. Partridge, 2006, conf. T. C. G. Rich, WARMS. Originally cultivated?

‡*Sisymbrium irio* 62/1.2. *©13, W. Sussex: cracks in concrete at car park & gutters, Churchill Square car park, Brighton, TQ305040, A. Spiers, 2007.

‡*Bunias orientalis* 62/6.1. *©63, S. W. Yorks.: edge of arable field adjacent to M1, SE2911, P. Middleton, 2007. 1st record since 1970.

‡*Cardamine corymbosa* 62/14.cor. *©7, N. Wilts.: nursery weed, Atworth, ST851654, P. Green, 2005. *©59, S. Lancs.: bare ground, Lydiate, SD3604, R. F. Goodchild, 2006. Garden escape from a nearby nursery.

Erophila glabrescens 62/22.3. *63, S. W. Yorks.: weed on waste ground, Jacobs Well, Bradford, SE1633, M. Wilcox, 2007. 1st record since 1970.

‡*Thlaspi arvense* 62/28.1. 100 (Bute), Clyde Is.: disturbed field edge at The Plan (turning circle), NS092531, A. C. Hannah, 2007. 1st record since 1970.

©*Lepidium bonariense* 62/30.bon. 29, Cambs.: about a dozen plants on gravelly ground used for parking farm machinery, north-east of Clayway Farm, Padnal Fen, Ely, TL575832, A. C. Leslie, 2007, conf. E. J. Clement, CGE. 2nd record and 1st since 1961.

‡*Hirschfeldia incana* 62/38.1. *67, S. Northumb.: Skinnerburn Road, Newcastle, NZ242634, G. & A. Young, 2002, herb. G. A. Swan. 1st published record.

Crambe maritima 62/41.1. *67, S. Northumb.: Whitley Bay, NZ37, B. W. Fox, 1948, Bolton Museum. 1st record. Not seen since.

Raphanus raphanistrum subsp. *maritimus* 62/42.1b. *©63, S. W. Yorks.: car park, waste ground, Vicar Lane, Bradford, SE166328, B. A. Tregale, 2007.

©*Biscutella auriculata* L. 62/BIS.aur. *38, Warks.: allotment, Leamington Spa, SP330657, J. W. Partridge, 1990, conf. T. C. G. Rich. Ø

©*Eruca vesicaria* subsp. *sativa* (L.) Cav. 62/ERC.ves.a. 59, S. Lancs.: pavement, King Street, Clitheroe, SD742419, M. P. Wilcox, 2006. 1st record since 1970. Ø

‡*Gaultheria shallon* 65/8.1. *©8, S. Wilts.: Black Lane, near Redlynch, SU224194, D. J. Wood, 2005. 1st record since 1970.

Pyrola minor 66/1.1. *©13, W. Sussex: large colony at edge of ride and in adjacent woodland, Graffham Common, SU932194, B. Middleton, 2006, conf. A. G. Knapp.

‡*Lysimachia ciliata* 69/4.4. *60, W. Lancs.: rough ground, Carleton, SD328401, M. Sutcliffe, 2007.

Lysimachia thyrsiflora 69/4.7. *‡13, W. Sussex: Woodcote Pond, Ifold, TQ024311, T. Greenaway, 2007, det. E. J. Clement, herb. E. J. Clement. Not deliberately introduced.

‡*Lysimachia verticillaris* Spreng. 69/4.ver. *©63, S. W. Yorks.: lay-by, north side of road near Rossington, SK643971, G. Coles, 2006. See *Watsonia* 22: 279-281 (1999). Ø

Anagallis minima 69/6.3. 85, Fife: forest track, Tentsmuir, NO4927, P. Gaff, 2007. 1st record since c.1890 (also at this site).

‡*Philadelphus xvirginalis* (*P. coronarius* × *P. microphyllus* × *P. pubescens*) 71/1.1×mic×pub. *38, Warks.: dump, Parkhall Wood, Minworth, SP163908, J. W. Partridge, 2006, conf. E. J. Clement, WARMS. Birmingham & Black Country Flora Project.

‡*Escallonia xlangleyensis* (*E. macrantha* × *E. virgata* (Ruiz & Pav.) Pers.) 72/1.1×vir. *38, Warks.: dump, Hook Drive, Sutton Coldfield, SP106994, J. W. Partridge, 2006, conf. E. J. Clement, WARMS. Birmingham & Black Country Flora Project.

‡*Ribes sanguineum* 72/2.4. *©100 (Bute), Clyde Is.: Cnocnicoll Wood, NS1060, A. C. Hannah, 2004. Probably bird-sown.

Crassula tillaea 73/1.1. 13, W. Sussex: disturbed sandy paths, Chapel Common, SU821285, M. Edwards, 2006, conf. A. G. Knapp. Had been considered extinct in county. *©13, W. Sussex: in reasonable quantity on car parking area, Littlehampton, TQ029015, M. Berry, 2007, conf. A. Spiers.

- ‡**Sedum praealtum** 73/5.2. *39, Staffs.: four or five plants in shade on footpath verge, Wordsley, SO884877, C. B. Westall, 2007.
- ‡**Sedum 'Herbstfreude'** (*S. spectabile* × *S. telephium*) 73/5.4×5. *©62, N. E. Yorks.: base of wall, Swainby, NZ475022, V. Jones & W. A. Thompson, 2006. *©63, S. W. Yorks.: Ainsbury Avenue Tip, Thackley, SE1738, B. A. Tregale & M. Wilcox, 2006.
- ‡**Sedum nicaeense** 73/5.9. *29, Cambs.: two plants on flat garage roof of Wychwood, Crane's Lane, Kingston, TL345549, P. J. Reynolds, 2007.
- ‡**Sedum sexangulare** 73/5.13. *13, W. Sussex: on graves, Midhurst Cemetery, SU876215, Sussex Botanical Recording Society, 2007, det. A. G. Knapp.
- ‡**Sedum kamtschaticum** 73/5.kam. *100 (Bute), Clyde Is.: on walls and shore rocks at old bathing station, Rothesay, NS084655, A. C. Hannah, 2007.
- ‡**Sedum spathulifolium** 73/5.spa. *©63, S. W. Yorks.: old quarry, Bolton Woods, Bradford, SE1636, M. Wilcox, 2002.
- ‡**Astilbe** × **arendsii** (*A. japonica* × *A. rosea* × *A. chinensis*) 74/1.1×ros×chi. *63, S. W. Yorks.: waste ground, old mill site, Bradford, SE133334, B. A. Tregale & M. Wilcox, 2007.
- ‡**Saxifraga cymbalaria** 74/5.2. *60, W. Lancs.: on path by side of and on top of limestone wall, Silverdale, SD459758, E. F. & B. D. Greenwood, 2007.
- ‡**Saxifraga umbrosa** 74/5.8. ©67, S. Northumb.: extensive patch by stream in remote wildwood, West Dipton Burn, NY917614, A. J. Richards, 2007. 1st record since 1970.
- ‡**Spiraea** × **rosalba** (*S. salicifolia* × *S. alba*) 75/3.1×2. *63, S. W. Yorks.: Deep Lane Quarry, Bradford, SE1232, B. A. Tregale & M. Wilcox, 2000.
- ‡**Spiraea alba** var. **latifolia** 75/3.2. *77, Lanarks.: scrub between road and Glenbuck Loch, NS7528, P. Macpherson & J. R. Hawell, 2007, det. A. J. Silverside, **herb. P.M.**
- ‡**Spiraea douglasii** subsp. **douglasii** 75/3.3a. *62, N. E. Yorks.: one bush in rough grassland, Whitby, NZ886107, V. Jones, 2003, conf. W. A. Thompson.
- ‡**Spiraea japonica** '**Anthony Waterer**' 75/3.5. *38, Warks.: ten seedlings in gutter and pavement, Pilkington Avenue, Wylde Green, Birmingham, SP122947, J. Hardwick, 2007, det. M. W. Poulton, **WARMS**. Birmingham & Black Country County Flora Project.
- ‡**Holodiscus discolor** 75/5.1. 29, Cambs.: one small, self-sown plant on brick wall, behind The Gallops, Old Station Road, Newmarket, TL649635, A. C. Leslie, 2007. 2nd record and 1st since 1940.
- ‡**Rubus tricolor** 75/8.2. *38, Warks.: brickwork on canal edge, Grand Union Canal, Birmingham, SP081868, M. W. Poulton, 2007, conf. J. W. Partridge, **WARMS**. Bird-sown?
- ‡**Rubus parviflorus** 75/8.6. *59, S. Lancs.: St. Luke's churchyard, Crosby, SD323000, P. H. Smith, 2007, **herb. D. P. Earl**.
- Rubus** × **pseudoidaeus** (*R. idaeus* × *R. caesius*) 75/8.7×321. *‡10, Wight: disused railway embankment adjoining gardens, Wroxall, SZ5580, P. D. Stanley, 2007, det. E. J. Clement.
- ‡**Rubus phoenicolasius** 75/8.8. *39, Staffs.: scrub at north end of football field, Wombourne, SO863925, C. B. Westall, 2007.
- ‡**Rubus spectabilis** 75/8.9. *38, Warks.: hedge, City Botanic Gardens, Birmingham, SP048852, J. W. Partridge, 2007, det. A. L. Newton, **WARMS**. Naturalised escape.
- ‡**Rubus cockburnianus** 75/8.11. *38, Warks.: canal wall, Grand Union Canal, Birmingham, SP12398, M. W. Poulton, 2007, conf. J. W. Partridge, **WARMS**. Bird-sown? None nearby.
- Rubus averyanus** 75/8.35. *12, N. Hants.: among Rhododendrons, Queen Elizabeth Park, Farnborough, SU867561, D. E. Allen, 2007, **BM, HCMS**.
- Rubus cambrensis** 75/8.38. *11, S. Hants.: roadside margin of open oakwood strip south-east of Marchwood, SU393095, D. E. Allen, 2007, conf. A. Newton, **BM, HCMS**. 2nd record of this British endemic away from South Wales/Welsh Border.
- Rubus septentrionalis** 75/8.123. *12, N. Hants.: locally abundant, Chawton Park Wood, Four Marks, SU6736, D. E. Allen, 2006, conf. A. Newton, **BM, HCMS**. Possibly introduced with Scottish conifers.
- Rubus armipotens** 75/8.135. *59, S. Lancs.: woodland, Mere Sands Wood, Rufford, SD4515, D. P. Earl, 2006, det. A. Newton, **herb. D. P. Earl**. Liverpool Botanical Society Excursion.
- Rubus bartonii** 75/8.146. *‡11, S. Hants.: at intervals in planted shrub belt round Lower Testwood Reservoir, near Totton, SU3515, D. E. Allen, 2007, **BM, HCMS**.

- Rubus criniger** 75/8.150. *10, Wight: weed in three adjacent gardens, West Cowes, SZ493965, D. E. Allen, 2004, **BM, HCMS**. Seen also in 2007.
- Rubus leucostachys** 75/8.156. *10, Wight: heathy scrub, roadside verge near Shorwell, SZ463822, D. E. Allen & M. J. Burnhill, 2007, **BM**.
- Rubus melanocladus** 75/8.170. *10, Wight: at intervals for at least 200 m along margin of scrub, Tennyson Down, Freshwater, SZ3285, D. E. Allen & M. J. Burnhill, 2007, conf. A. Newton, **BM, HCMS**. Hitherto believed endemic to south end of Welsh Border.
- Rubus leightonii** 75/8.190. *29, Cambs.: large patch on west side of disused railway, just north of Elm Road level crossing, north of March, TL420994, A. C. Leslie, 2006, det. A. L. Bull, conf. A. Newton, **CGE**.
- Rubus newbouldii** 75/8.196. *29, Cambs.: scrambling through shrubs on south side of Cambridge Road, Waterbeach, TL489651, A. C. Leslie, 2007, det. A. L. Bull, conf. A. Newton, **CGE**.
- Rubus raduloides** 75/8.199. *29, Cambs.: scattered along south-west margin of Thrift Covert, north of Cheveley, TL679636, A. C. Leslie, 2005, det. A. L. Bull, conf. A. Newton, **CGE**.
- Rubus ahenifolius** 75/8.204. *11, S. Hants.: one clump, Canterton Glen, New Forest, SU272126, D. E. Allen, 1989, conf. A. Newton, **BM, HCMS**. Since gone.
- Rubus babingtonii** 75/8.265. *10, Wight: abundant in many clay copses between Medina and Newtown Rivers, SZ49, D. E. Allen, 1982, conf. A. Newton, **BM, HCMS**. Found in many squares within this hectad. Identity in contention between 1982 and 2007.
- Rubus dasyphyllus** 75/8.268. *29, Cambs.: straggling over shrubs on the south side of the B1085 just east of entrance to Dane Hill Farm, Kennett, TL690682, A. C. Leslie, 2006, det. A. L. Bull, conf. A. Newton, **CGE**. 1st record since 19th century.
- Rubus proietus** 75/8.281. *12, N. Hants.: one bush, Woolmer Forest south margin, SU808315, D. E. Allen & A. Brewis, 1981, **BM**, conf. A. Newton.
- Rubus halsteadensis** 75/8.309. *29, Cambs.: several patches at north-east margin of Foxwarren Plantation, Newmarket, TL662638, A. C. Leslie, 2007, det. A. L. Bull, conf. A. Newton, **CGE**.
- Rubus aghadargensis** 75/8.agh. *100, Clyde Is.: hedges, north outskirts of Brodick, Arran, NS0136, D. E. Allen, 1997, **BM**.
- Rubus hindii** 75/8.hin. *9, Dorset: former railway, East Weare, Portland Isle, SY703719, D. E. Allen & B. Edwards, 2007, **BM**.
- Potentilla erecta** subsp. **strictissima** 75/9.13b. *63, S. W. Yorks.: Chellow Dene Quarry, Bradford, SE114347, M. Wilcox, 2002, conf. T. C. G. Rich.
- ‡**Potentilla atrosanguinea** Lodd. 75/9.atr. *©63, S. W. Yorks.: disused quarry, Bolton Woods, Bradford, SE1636, M. Wilcox, 2002. Ø
- ‡**Fragaria moschata** 75/11.2. ©10, Wight: pathside verge outside gardens, Carisbrooke, SZ4888, P. D. Stanley, 2007. 1st record since 1970.
- Sanguisorba minor** 75/17.3. *©100 (Bute), Clyde Is.: disturbed ground, Bogany Point, Rothesay, NS104654, A. C. Hannah, 2004. Possibly imported.
- ‡**Acaena ovalifolia** 75/18.3. *38, Warks.: short grass of golf course, Edgbaston Golf, Birmingham, SP056840, M. W. Poulton, 2007, conf. P. F. Yeo, **WARMS**.
- Alchemilla subcrenata** 75/19.6. *67, S. Northumb.: Wooley Park, NY832553, J. O'Reilly, 2007, conf. M. E. Bradshaw.
- ‡**Rosa 'Albertine'** 75/21. 113(S), Channel Is. (Sark): under hedge beside footpath, near La Vaurocque, footpath Rue de la Coupée to Grand Beauregard, WV461756, R. M. Veall, 2007, **herb. Société Sercquaise**. Garden relic. 1st record for Sark. Ø
- Rosa ×molletorum** (**R. canina** × **R. mollis**) 75/21.12×17. *63, S. W. Yorks.: hedge, Heaton Royds, Bradford, SE1336, B. A. Tregale, 2000, det. A. L. Primavesi.
- Prunus ×fruticans** (**P. spinosa** × **P. domestica**) 75/22.4×5. *63, S. W. Yorks.: near entrance of Anston Stones Wood, SK521840, E. Ellis, R. Beevers, G. T. D. Wilmore, 2007, conf. R. M. Burton.
- ‡**Prunus cerasus** 75/22.7. ‡63, S. W. Yorks.: waste ground, Nailer's Rough, Bradford, SE123359, B. A. Tregale, 2006. 1st record since 1970.
- ‡**Prunus serrula** Franch. 75/22.ser. *63, S. W. Yorks.: seedlings, self-seeded, Bingley Jubilee Gardens, SE107391, B. K. Byrne & B. A. Tregale, 2007. Ø

- ‡*Malus* × *purpurea* (*M. niedzwetskyana* × *M. atrosanguinea*) 75/27.niexatr. *63, S. W. Yorks.: Hagg Wood near Crookes, Sheffield, SK3187, Sheffield City Ecology Unit, 2000.
- ‡*Cotoneaster dammeri* 75/32.11. *85, Fife: ledge of sea wall, former harbour at Kirkcaldy, NT285921, G. H. Ballantyne, 2006.
- ‡*Cotoneaster lacteus* 75/32.13. *38, Warks.: industrial site near railway, Wood Street, Rugby, SP506760, J. W. Partridge, 2006, det. J. Fryer, **WARMS**. Site now redeveloped.
- ‡*Cotoneaster rehderi* 75/32.35. *38, Warks.: side of flooded pit, Castle Vale, Sutton Coldfield, SP143921, M. W. Poulton, 2006, det. J. Fryer, **WARMS**. Birmingham & Black Country Flora Project.
- ‡*Cotoneaster dielsianus* 75/32.37. *38, Warks.: wall of garden, Four Oaks Road, Birmingham, SP111986, J. W. Partridge, 2006, det. J. Fryer, **WARMS**. Birmingham & Black Country Flora Project.
- ‡*Cotoneaster henryanus* 75/32.hen. *38, Warks.: scrubby wood, Castle Vale, Sutton Coldfield, SP140921, M. W. Poulton, 2006, det. J. Fryer, **WARMS**. Birmingham & Black Country Flora Project.
- ‡*Cotoneaster hsingshangensis* 75/32.his. *77, Lanarks.: surviving in wood, Bystone, south-east of Busby, NS5855, P. Macpherson, 2007, det. J. Fryer, **herb. P.M.**
- ‡*Cotoneaster mairei* 75/32.mai. *38, Warks.: five or six self-sown plants on concrete canal margin, Grand Union Canal, Leamington Spa, SP335651, J. W. Partridge, 2006, det. J. Fryer, **WARMS**.
- ‡*Pyracantha rogersiana* 75/33.2. *C7, N. Wilts.: one plant in hedgerow, Murhill, ST791609, J. Presland, 2005. Probably bird-sown.
- Lotus subbiflorus* 77/8.4. *13, W. Sussex: many plants scattered along grassy headland of asparagus field, Durloughmarsh Farm, SU786244, Sussex Botanical Recording Society, 2007, det. A. G. Knapp.
- Lotus angustissimus* 77/8.5. @10, Wight: dry grassland taken out of arable, Knighton, SZ5786, G. N. Toone, 2007, **herb. G. N. Toone**. 2nd recent find, both in dry grassland taken out of cultivation. *13, W. Sussex: sandy field on private land, Coates, TQ000175, F. Abraham, 2007, conf. A. G. Knapp. Not in VCCC although there have been former v.c.13 records. @13, W. Sussex: small patch on headland at edge of asparagus field, one other plant nearby, Durloughmarsh Farm, SU787244, Sussex Botanical Recording Society, 2007, det. A. G. Knapp.
- Vicia tetrasperma* 77/14.8. 100 (Arran), Clyde Is.: Slidery shore, NR929222, A. W. Smith, 2006. 1st record for Arran. *100 (Bute), Clyde Is.: John Street, Rothesay, NS086644, A. C. Hannah, 2005. 1st record for Bute and for v.c.100.
- ‡*Lathyrus grandiflorus* 77/15.7. *C100 (Great Cumbrae), Clyde Is.: shore side of road, Fintray, NS155565, BSBI meeting, 2007.
- ‡*Lathyrus latifolius* 77/15.9. *100 (Arran), Clyde Is.: shoreline, Sannox, NS018453, A. W. Smith, 2001.
- Medicago arabica* 77/18.5. ‡85, Fife: shore bank and waste ground at Black Sands (former ballast bank), Aberdour, NT193850, G. H. Ballantyne, 2006. Abundant, having re-appeared following renovations. Known here previously from at least 1821.
- ‡*Trifolium incarnatum* subsp. *incarnatum* 77/19.19a. 59, S. Lancs.: fodder field, Graveyard Lane, SD422042, D. P. & J. Earl, 2007, det. D. P. Earl. 1st record since 1970.
- ‡*Lupinus arboreus* 77/21.1. *100 (Bute), Clyde Is.: edge of farm track, Upper Ettrick, NS037678, A. C. Hannah, 2007, BSBI meeting.
- Genista pilosa* 77/25.3. *C63, S. W. Yorks.: on waste ground, Wheatley, Doncaster, SE5904, L. A. Hill, 2007. Garden escape.
- Ulex minor* 77/26.3. *‡100 (Bute), Clyde Is.: at 150m beside forestry track, Shalunt, NS042713, A. C. Hannah, 2005. Perhaps imported with forestry materials.
- ‡*Cercis siliquastrum* L. 77/CER.sil. *29, Cambs.: self-sown in shrubbery, north end of Downing Street, Cambridge, TL650632, A. C. Leslie, 2006. Ø
- ©*Scorpiurus muricatus* 77/SCO.mur. *13, W. Sussex: three plants in shallow dip between asparagus crop and headland, Durloughmarsh Farm, SU787244, K. A. Knapp, 2007.
- Epilobium xerroneum* (*E. hirsutum* × *E. montanum*) 84/1.1×3. *10, Wight: at 200m in disturbed open ground in plantation, Brighstone Forest, SZ4385, P. D. Stanley, 2007, **herb. P. D. Stanley**.

Epilobium × **palatinum** (**E. parviflorum** × **E. tetragonum**) 84/1.2×5. *10, Wight: open disturbed ground, Kingston, SZ4881, P. D. Stanley, 2007, herb. P. D. Stanley.

Epilobium × **dacicum** (**E. parviflorum** × **E. obscurum**) 84/1.2×6. *52, Anglesey: lakeside, Llyn Alaw, SH385865, I. R. Bonner, 2006, det. G. D. Kitchener.

[**Epilobium** × **floridulum** (**E. parviflorum** × **E. ciliatum**) 84/1.2×8. *52, Anglesey: lakeside, Llyn Alaw, SH385865, I. R. Bonner, 2006, det. G. D. Kitchener. Delete this record; details incorrectly printed. See *Watsonia* 27:80 (2007)]

Epilobium × **haussknechtianum** (**E. montanum** × **E. tetragonum**) 84/1.3×5. *63, S. W. Yorks.: waste ground, Otley Road, Bradford, SE171339, B. A. Tregale & M. Wilcox, 2007.

Epilobium tetragonum subsp. **tournefortii** 84/1.5tou. *29, Cambs.: large population on dry, sunny, south-west facing bank on north-east side of Royston bypass, TL363421 - 365419, A. C. Leslie & A. Stevenson, 2007, det. G. Kitchener, CGE. Ø

Epilobium × **fossicola** (**E. ciliatum** × **E. palustre**) 84/1.8×9. *59, S. Lancs.: dune-slack, Birkdale Sandhills, SD305131, P. H. Smith & M. P. Wilcox, 2006, det. M. P. Wilcox.

‡**Ludwigia grandiflora** 84/3.gra. *10, Wight: aggressively colonising agricultural reservoir, Mottistone, SZ3983, M. J. Burnhill, 2007, det. E. J. Clement, herb. C. R. Pope. 1st county record for a highly invasive species. *60, W. Lancs.: plants covering pond, Carleton, SD336401, M. Sutcliffe, 2007.

Mercurialis perennis 91/1.1. *©110, Outer Hebrides: Stornoway, NB43, Mr Gibson, 1908, BM. Reported in Bennett (1909) *Annals of Scottish Natural History* 54-55. M. Spencer has recently located the specimen in Bennett's herbarium at BM.

Euphorbia serrulata 91/2.7. *©39, Staffs.: several plants on banks of pool in regraded landfill area, near Hednesford, SK006133, I. J. Hopkins, 2007.

‡**Euphorbia amygdaloides** subsp. **robbiae** 91/2.16b. *©7, N. Wilts.: roadside, Marlborough, SU192695, J. Oliver, 2005. Garden escape.

‡**Euphorbia oblongata** 91/2.obl. *7, N. Wilts.: wall-pavement angles, Malmesbury, ST936871, J. Newton & J. Oliver, 2004. Known here for a few years, but declining.

‡**Euphorbia waldensteinii** 91/2.wal. *©39, Staffs.: Roadside hedgebank on little-used section of former A449 NE of Wombourne, SO885945, C. B. Westall, 2003.

‡**Koeleruteria paniculata** 97/1.1. *29, Cambs.: one self-sown plant at field margin, east of The Leetes, Leetes Lane, Little Eversden, TL375534, P. J. Reynolds, 2006.

‡**Aesculus indica** 98/1.ind. *63, S. W. Yorks.: seedlings, self-seeded, Bingley Jubilee Gardens, SE107391, B. A. Tregale, 2007.

‡**Geranium versicolor** 103/1.2. *©7, N. Wilts.: naturalised in rough grassland, Broughton Gifford, ST874645, J. Presland, 2005. *29, Cambs.: three self-sown plants on the east side of Crane's Lane, Kingston, TL345549, P. J. Reynolds, 2002.

Geranium rotundifolium 103/1.4. ©59, S. Lancs.: mound of soil, Kirkby, SD430007, R. F. Goodchild, 2006. 1st record since 1970. ‡67, S. Northumb.: Moorbank, Newcastle, NZ233658, A. J. Richards, 2007, herb. G. A. Swan. 1st record since 1854.

‡**Geranium clarkei** 'Kashmir Purple' 103/1.kas. *85, Fife: more than 20 clumps in shady den, by burn, Lade Braes, St Andrews, NO500162, G. H. Ballantyne, 2005. A few plants introduced in 1990 have now spread and are naturalising fast. Ø

©**Tropaeolum majus** 104/1.maj. *38, Warks.: farm dump, Castle Hills, Elmdon, SP177822, A. Morris, 2007, det. J. W. Partridge, WARMS. Self-sown escape. *62, N. E. Yorks.: several plants in wasteland, Warrenby, NZ583251, V. Jones, 2000.

‡**Eryngium campestre** 107/4.4. *29, Cambs.: one flowering plant on grassy verge towards north-east end of central reservation of the Barton Road, just north-east of the Grantchester Road/Coton Road roundabout, Cambridge, TL423570, D. J. Barden, 2007, CGE.

‡**Foeniculum vulgare** 107/21.1. 67, S. Northumb.: Gosforth, Regent Centre, NZ242686, G. & A. Young, 2007. 1st record since 1970.

‡**Bupleurum longifolium** L. 107/26.lon. *38, Warks.: single plant appeared spontaneously in garden, Stratford on Avon, SP178554, J. M. Price, 2006, conf. M. J. Southam. Has since gone. Ø 1st British record?

‡**Angelica archangelica** 107/37.2. 13, W. Sussex: more than 30 plants on damp sides of track near farm, NE of Billingshurst, TQ108265, Sussex Botanical Recording Society, 2007, det. A. G. Knapp. 1st record since 1970.

Peucedanum palustre 107/39.2. *85, Fife: a well established colony in marshy ground, west end of Swan Pond, Lumphinnans, NT168931, B. Hogarth, 2006, conf. M. J. Southam. 1st record for Scotland. Status unknown.

©**Laser trilobum** (L.) Borkh.107/LAS.tri. *63, S. W. Yorks.: waste ground, Darnall, Sheffield, SK3687, A. Woodcock, Sorby NHS Plant Recorder, 2000. Ø

Gentianella germanica 108/5.3. 8, S. Wilts.: chalk grassland, Mere, ST826336, T. C. G. Rich, 2001. 1st record since 1891. Had been presumed extinct.

Gentianella x pamplinii (G. *germanica* x G. *amarella*) 108/5.3x4. 8, S. Wilts.: chalk grassland, Mere, ST826336, T. C. G. Rich, 2001. 1st record since 1891. Had been presumed extinct.

Gentianella anglica 108/5.5. ®8, S. Wilts.: thousands of plants in chalk grassland, Cley Hill near Warminster, ST840448, J. Ford, 2005.

‡**Nicandra physalodes** 110/1.1. 85, Fife: garden weed, McKane Park, Dumfermline, NT0886, C. Howard, 2006. 1st record since 1962.

©**Datura ferox** 110/9.fer. *38, Warks.: topsoil heap, building site, Castle Vale, Birmingham, SP142891, M. W. Poulton, 2007, conf. J. W. Partridge, WARMS. With other bird seed aliens. 59, S. Lancs.: disturbed ground amongst sand-dunes, Cabin Hill, Formby, SD284051, P. H. Smith, 2006, det. M. P. Wilcox. 1st record since 1970. *85, Fife: old garden (under renovation), Giffordtown near Ladybank, NO289111, J. Maillie, 2005, det. J. M. H. Shaw. 1st record for Scotland.

‡**Nicotiana xsanderae** (N. *alata* x N. *forgetiana*) 110/NIC.alaxfor. *38, Warks.: ten self-sown plants in abandoned garden, Four Oaks, Birmingham, SP114993, M. W. Poulton, 2006, conf. J. W. Partridge. Birmingham & Black Country County Flora Project.

‡**Calystegia silvatica** subsp. *disjuncta* Brummitt, 111/3.4b. *110, Outer Hebrides: roadside bank, Castlebay, Barra, NL664983, R. J. Pankhurst, 2007, det. R. Brummitt, E. Ø

‡**Pulmonaria rubra** 116/3.3. *59, S. Lancs.: streamside, Clitheroe Beck, Clitheroe, SD747416, M. P. Wilcox, 2007.

‡**Symphytum 'Hidcote Blue'** (S. *officinale* x S. *asperum* x S. *grandiflorum*) 116/4.1x2x4. *60, W. Lancs.: pathside near gardens, Silverdale, SD463754, E. F. & B. D. Greenwood, 2007. *62, N. E. Yorks.: extensive colony in grassland on bank of R. Seven, Sinnington, SE743858, V. Jones, 2001. *85, Fife: well established on waste ground, Bridgend Industrial Estate, Kinross, NO114011, G. H. Ballantyne, 2007, det. R. Leaney.

Symphytum tuberosum 116/4.3. *‡10, Wight: two small patches beneath beeches, Newbarn Down, SZ4386, P. D. Stanley, 2005.

‡**Symphytum caucasicum** 116/4.7. *©7, N. Wilts.: locally abundant on soil dumped on arable land, Haugh, ST807622, J. Presland, 2005. *85, Fife: grassy bank, near gardens, Southerton, Kirkcaldy, NT265910, G. H. Ballantyne, 2007. A garden throw-out in 2004, now establishing.

‡**Borago officinalis** 116/9.1. *110, Outer Hebrides: waste ground, Horogh, Barra, NL657982, R. J. Pankhurst, 2007.

Myosotis ramosissima 116/15.9. *110, Outer Hebrides: old cultivation, Rubha Bheilis, North Uist, NF816780, R. J. Pankhurst, 2007, E. Originally reported from NVC quadrats and apparently correct.

‡**Nonea lutea** 116/NON.lut. *©39, Staffs.: half a dozen very small flowering plants on lane verge, Sutton, SJ768220, I. J. Hopkins, 2007.

‡**Verbena officinalis** 117/1.1. 67, S. Northumb.: single adventive in garden bed, Moorbank, Newcasttle, NZ233658, A. J. Richards, 2006. 1st record since 1970.

Clinopodium calamintha 118/18.3. *©39, Staffs.: rough grassland to the rear of a walled garden, S of Shugborough Hall, SJ992214, J. Woodward, 2007.

©**Thymus xcitriodorus** Pers. (T. *vulgaris* x T. *pulegioides*) 118/21.1x2. *62, N. E. Yorks.: short grassland at edge of path, West Pasture, Kirbymoorside, SE691865, W. A. Thompson, 2005. Ø

Thymus pulegioides 118/21.2. 10, Wight: at 120m, single plant by downland track, Limerstone Down, SZ4383, P. D. Stanley, 2007, det. E. J. Clement, herb. P. D. Stanley. 1st record since 1970. Always rare but believed lost as a native species.

‡*Mentha × villosa* *nervata* (*M. spicata* × *M. longifolia*) 118/23.3×lon. *10, Wight: well established by parking bay along road, at 225m, Ventnor Downs, SZ5678, G. N. Toone, 2007, det. E. J. Clement, **herb. G. N. Toone**.

‡*Mentha requienii* 118/23.6. *38, Warks.: lawn and paving, Winterbourne, Birmingham University Botanical Gardens, SP053838, M. W. Poulton, 2007, conf. J. W. Partridge, **WARMS**. Locally abundant within gardens. Birmingham & Black Country County Flora Project.

‡*Rosmarinus officinalis* 118/24.1. *©7, N. Wilts.: one seedling on vertical riverside stonework, Marlborough, SU189689, J. Oliver, 2005. *©63, S. W. Yorks.: waste ground near Carlton, SE3609, P. Middleton, 2007.

©*Salvia reflexa* 118/25.ref. *10, Wight: a few plants in game cover crop, Cheverton Down, SZ4484, G. N. Toone, 2007, det. E. J. Clement, **herb. G. N. Toone**.

‡*Ligustrum lucidum* W.T. Aiton 123/4.luc. *67, S. Northumb.: Tynemouth, NZ373693, G. & A. Young, 1999, **herb. G. A. Swan**. Ø

‡*Jasminum officinale* 123/JAS.off. *39, Staffs.: edges of bridleway, Goldthorn Hill, SO906965, C. B. Westall, 2007. Probably bird-sown.

©*Verbascum phoeniceum* 124/1.pho. *60, W. Lancs.: brick wall, Lytham St. Anne's, SD32, J. Clarke, 2007.

Linaria × dominii (*L. purpurea* × *L. repens*) 124/13.3×4. *38, Warks.: two or three plants with both parents on side of track, Goldthorne Road, Sheldon, Birmingham, SP152839, L. Bastin, 2007, det. J. W. Partridge, **WARMS**.

‡*Erinus alpinus* 124/15.1. *38, Warks.: brick walls, Winterbourne, Birmingham University Botanical Gardens, SP052838, M. Kingsbury, 2007, conf. J. W. Partridge.

‡*Veronica peregrina* 124/16.18. *©7, N. Wilts.: one plant growing as nursery weed, Atworth, ST851654, P. Green, 2005.

Veronica spicata 124/16.26. *‡38, Warks.: demolished housing, Perry Common, Birmingham, SP099934, M. W. Poulton, 2006, conf. J. W. Partridge, **WARMS**.

‡*Hebe dieffenbachii* 124/17.3. *38, Warks.: wall, Four Oaks Road, Birmingham, SP112989, J. W. Partridge, 2006, conf. E. J. Clement, **WARMS**. Birmingham & Black Country Flora Project.

Euphrasia arctica × *E. nemorosa* 124/20.5×7. *100 (Great Cumbrae), Clyde Is.: roadside verge, Bell Craig, NS160574, R. J. Pankhurst & D. Dupree, 2007, det. A. J. Silverside.

Euphrasia arctica × *E. foulaensis* 124/20.5×12. *110, Outer Hebrides: short turf by saltmarsh, Hacklete, Benbecula, NF810488, R. J. Pankhurst, 2007, det. A. J. Silverside, **E**.

Parentucellia viscosa 124/23.1. ‡67, S. Northumb.: reservoir, Rothbury, NU032002, G. & A. Young, 1998, **herb. G.A. Swan**. 1st published record.

©*Collinsia heterophylla* Buist ex Graham 124/COL.het. *85, Fife: one plant in recently reclaimed ground by car park at Clatto Reservoir (4 miles north of Kennoway), NO364077, G. H. Ballantyne, 2007, conf. C. Page. Possibly brought in with soil. Ø 1st record for Scotland.

©*Sutera cordata* (Thunb.) Kuntze 124/SUT.cor. *38, Warks.: tarmac under window boxes, Birmingham Children's Hospital, SP055861, A. Underhill, 1997, det. E. J. Clement, **herb. E. J. Clement**. Collected as *Bacopa* 'Snowflake'. See *BSBI News* no. 83 p. 36. *62, N. E. Yorks.: colonising base of wall, probably from hanging baskets, Old Cattle Market, Pickering, SE799839, V. Jones & W. A. Thompson, 2005.

Orobanchae hederaceae 125/2.8. *67, S. Northumb.: Benton, NZ280693, A. J. Richards, 2007. Hortal, introduced with an ivy in 1960s. Now about 40 stems over 15 square metres in drive and road.

‡*Pinguicula grandiflora* 128/1.4. *60, W. Lancs.: flush by bog, Birk Bank, Clougha, Quernmore, SD531602, J. M. Newton, 2007. Must have been planted.

Utricularia minor 128/2.6. 100 (Bute), Clyde Is.: Kerrycroy Hill, NS095611, A. C. Hannah, 2007. 1st record since 1970.

Campanula patula 129/1.1. ‡29, Cambs.: one flowering plant on western slope of old clunch pit, Orwell, TL363506, L. Evans, 2006. 1st record since 1857.

‡*Campanula portenschlagiana* 129/1.9. *85, Fife: on old wall, Fraser's Green, Kirkcaldy, NT278910, G. H. Ballantyne, 2007. Becoming naturalised here (and elsewhere) on walls.

©*Campanula cochlearifolia* 129/1.coc. *59, S. Lancs.: bare ground, site of former garden centre, Cable Street, Formby, SD301078, P. H. Smith & M. P. Wilcox, 2006, det. M. P. Wilcox.

‡*Galium spurium* 130/6.12. *©10, Wight: a weed in game cover crop, Cheverton Down, SZ4484, P. D. Stanley, 2007, det. E. J. Clement, **herb. P. D. Stanley**. Subsequently found in similar sown field in SZ4583 and SZ4584 by G. N. Toone.

Viburnum opulus 131/2.1. 107, E. Sutherland: four plants on steep, wooded bank by road, Achany Glen, south of Shin Falls, NH577984, P. Entwistle & M. E. Murray, 2007, conf. P. & I. Evans. 1st record since 1970.

‡*Viburnum tinus* 131/2.3. *62, N. E. Yorks.: several plants self-sown from nearby planting on stone banking at edge of River Tees, Middlesbrough, NZ471202, V. Jones, 2001.

‡*Lonicera pileata* 131/6.1. *38, Warks.: derelict industry, railway, Wood Street, Rugby, SP505761, J. W. Partridge, 2006, conf. E. J. Clement, **WARMS**. Site destroyed 2007.

‡*Lonicera henryi* 131/6.5. *38, Warks.: derelict industry, railway, Wood Street, Rugby, SP505760, J. W. Partridge, 2006, det. E. J. Clement, **WARMS**. Site destroyed 2007.

‡*Lonicera tatarica* 131/6.tat. *39, Staffs.: one shrub by rough track near Penkridge, SJ933139, I. J. Hopkins, 2007.

Dipsacus fullonum 134/1.1. ©100 (Bute), Clyde Is.: Rothesay coup, NS077647, A. C. Hannah, 2006. 1st record since 1970.

‡*Echinops exaltatus* 135/1.2. *85, Fife: by walkway of old railway, east of Lower Largo, NO423026, G. H. Ballantyne, 2007. Probably introduced some years ago; now well established and spreading.

‡*Echinops bannaticus* 135/1.3. *85, Kinross: neglected garden of demolished cottage off B919 near Mawcarse, east of Milnathort, NO155055, G. H. Ballantyne, 1972. Assumed to be *Echinops sphaerocephalus* in 1972; redetermined 35 years later.

‡*Silybum marianum* 135/8.1. 113(S), Channel Is. (Sark): on heap of horse manure, Field 5 of La Ville, WV470672, A. Prevel, 2007, **herb. Société Sercquaise**. 1st record for Sark.

‡*Centaurea jacea* 135/11.jac. *38, Warks.: in crop of lucerne, Milverton, Leamington Spa, SP2967, H. Bromwick, 1898, **BM**. Now extinct.

Lactuca virosa 135/22.2. 67, S. Northumb.: about 20 plants on south side of wall, Hexham Tyne Green, NY933648, J. Bowyer, 2008. 1st record since 1970.

Taraxacum arenastrum 135/25.2. *60, W. Lancs.: limestone pasture, Bowland-with-Leagram, SD6546, E. F. Greenwood, 2007, det. A. J. Richards, **LIV**.

Taraxacum commixtum 135/25.6. *‡62, N. E. Yorks.: grassland by farm track, Fryton Moor near Slingsby, SE679733, V. Jones, 2004, conf. A. J. Richards, **herb. V. Jones**.

Taraxacum inopinatum 135/25.14. *62, N. E. Yorks.: meadow near Kirbymoorside, SE68Y, V. Jones, 1998, det. A. J. Richards, **herb. V. Jones**.

Taraxacum proximiforme 135/25.18. *62, N. E. Yorks.: grassland in small roadside quarry, Cow House Bank, Riccaldale, SE613887, V. Jones, 1995, conf. A. J. Richards, **herb. V. Jones**.

Taraxacum naevosiforme 135/25.41. *62, N. E. Yorks.: woodland, Garbutt Wood, Sutton Bank, SE512831, V. Jones, 2001, det. A. J. Richards, **herb. V. Jones**.

Taraxacum stictophyllum 135/25.45. *29, Cambs.: Gamlingay Wood, TL242534, P. D. Sell, 1957, **CGE**, det. A. J. Richards.

Taraxacum bracteatum 135/25.55. *7, N. Wilts.: a few plants, Lockeridge, SU150674, J. Oliver, 2005.

Taraxacum landmarkii 135/25.70. *29, Cambs.: Wicken Fen, TL563706, Cambridge University Part II Botany Class, 1973, **CGE**, det. A. J. Richards.

Taraxacum olgae 135/25.74. *78, Peebles.: north wall of ruinous kirk, Kilbucho, NT065335, D. J. McCosh, 2007, det. A. J. Richards, **herb. D. J. McCosh**. Notable northerly extension of range; hitherto known only from vice-counties 70 and 73.

Taraxacum atactum 135/25.84. *29, Cambs.: between Isleham and Soham, TL637752, R. R. Aitchison, 1973, **CGE**, det. A. J. Richards.

Taraxacum hamatulum 135/25.88. *62, N. E. Yorks.: road verge at edge of woodland, Battersby, NZ587083, V. Jones, 1998, conf. A. J. Richards, **herb. V. Jones**.

‡*Taraxacum hamiferum* 135/25.90. *29, Cambs.: Wicken Fen, TL563706, P. D. Sell, 1967, **CGE**, det. A. J. Richards.

‡*Taraxacum lamprophyllum* 135/25.92. *29, Cambs.: between Abington Pigotts and Litlington, TL309439, P. D. Sell, 1967, **CGE**, det. A. J. Richards.

- ‡**Taraxacum quadrans** 135/25.99. *29, Cambs.: Soham, TL609727, R. R. Aitchison, 1974, CGE, det. A. J. Richards.
- Taraxacum subhamatum** 135/25.101. *29, Cambs.: Cambridge, TL446573, P. D. Sell, 1967, CGE, det. A. J. Richards.
- ‡**Taraxacum acroglossum** 135/25.103. *29, Cambs.: Fox Hill, Orwell, TL366513, P. D. Sell, 1967, CGE, det. A. J. Richards.
- ‡**Taraxacum acutifidum** 135/25.104. *29, Cambs.: Kneesworth chalkpit, TL351427, P. D. Sell, 1967, CGE, det. A. J. Richards. *62, N. E. Yorks.: road verge near Dundale Beck, Battersby, NZ592082, V. Jones, 1998, det. A. J. Richards, **herb. V. Jones**.
- ‡**Taraxacum acutifrons** 135/25.105. *29, Cambs.: Dimmock's Cote, TL539723, P. D. Sell, 1967, CGE, det. A. J. Richards. *62, N. E. Yorks.: road verge near Fir Tree Farm, Easby, NZ578081, V. Jones, 1998, det. A. J. Richards, **herb. V. Jones**.
- ‡**Taraxacum altissimum** 135/25.109. *29, Cambs.: between Bassingbourn and Abington Pigotts, TL312449, P. D. Sell, 1967, CGE, det. A. J. Richards.
- ‡**Taraxacum angustisquameum** 135/25.113. *29, Cambs.: Fox Hill, Orwell, TL366513, P. D. Sell, 1967, CGE, det. A. J. Richards.
- Taraxacum cophocentrum** 135/25.120. *29, Cambs.: Girton, TL46, F. G. Bell, 1967, CGE, det. A. J. Richards.
- Taraxacum cordatum** 135/25.121. *‡110, Outer Hebrides: old car lanes on pier, Lochboisdale, NF792198, P. A. Smith, 2007, det. A. J. Richards, E.
- ‡**Taraxacum incisum** 135/25.142. *29, Cambs.: Bassingbourn, TL316449, P. D. Sell, 1994, CGE, det. A. J. Richards. *62, N. E. Yorks.: meadow near Kirbymoorside, SE6886, V. Jones, 1998, conf. A. J. Richards, **herb. V. Jones**.
- Taraxacum insigne** 135/25.143. *110, Outer Hebrides: Druim Corcadail, Ardrol, NB047329, P. A. Smith & M. Teneva, 2007, det. A. J. Richards, E.
- ‡**Taraxacum interveniens** 135/25.144. *29, Cambs.: site of Abingdon Pigotts Common, TL312449, P. D. Sell, 1996, CGE, det. A. J. Richards.
- ‡**Taraxacum intumesceus** 135/25.145. *60, W. Lancs.: lane side, Longridge, SD6036, E. F. Greenwood, 2007, LIV.
- ‡**Taraxacum lacerifolium** 135/25.146. *29, Cambs.: Bassingbourn, TL316449, P. D. Sell, 1994, CGE, det. A. J. Richards.
- Taraxacum laticordatum**, 135/25.150. *29, Cambs.: Soham, TL593735, R. R. Aitchison, 1974, CGE, det. A. J. Richards.
- Taraxacum latisectum** 135/25.151. *29, Cambs.: Welches Dam, TL471853, P. D. Sell, 1968, CGE, det. A. J. Richards.
- ‡**Taraxacum leucopodum** 135/25.155. *29, Cambs.: Soham, TL569757, R. R. Aitchison, 1973, CGE, det. A. J. Richards.
- Taraxacum longisquameum** 135/25.158. *29, Cambs.: Kneesworth chalkpit, TL351427, P. D. Sell, 1967, CGE, det. A. J. Richards.
- ‡**Taraxacum macrolobum** 135/25.162. *29, Cambs.: Cambridge, TL446573, P. D. Sell, 1967, CGE, det. A. J. Richards.
- ‡**Taraxacum nitidum** 135/25.170. *62, N. E. Yorks.: rough grassland, Ingleby Greenhow, NZ573069, V. Jones, 2004, det. A. J. Richards, **herb. V. Jones**.
- ‡**Taraxacum ochrochlorum** 135/25.175. *62, N. E. Yorks.: grassy edge of stubble field, Ingleby Greenhow, NZ574068, V. Jones, 2004, det. A. J. Richards, **herb. V. Jones**.
- ‡**Taraxacum pachymerum** 135/25.177. *29, Cambs.: Litlington, TL323410, P. D. Sell, 1994, CGE, det. A. J. Richards.
- ‡**Taraxacum pallescens** 135/25.178. *62, N. E. Yorks.: grassy edge of stubble field, Ingleby Greenhow, NZ573069, V. Jones, 2004, conf. A. J. Richards, **herb. V. Jones**.
- ‡**Taraxacum pannulatum** 135/25.182. *29, Cambs.: Litlington, TL323410, P. D. Sell, 1994, CGE, det. A. J. Richards.
- ‡**Taraxacum planum** 135/25.185. *29, Cambs.: between Burwell and Fordham, TL680630, R. R. Aitchison, 1974, CGE, det. A. J. Richards. *77, Lanarks.: rubble of old steading, Highfield, Coulter, NT016339, D. J. McCosh, 2007, det. A. J. Richards, **herb. D. J. McCosh**.
- ‡**Taraxacum rhamphodes** 135/25.194. *29, Cambs.: Fox Hill, Orwell, TL366513, P. D. Sell, 1967, CGE, det. A. J. Richards.

- Taraxacum sellandii** 135/25.197. *7, N. Wilts.: superabundant in village fields, Lockeridge, SU148672, J. Oliver, 2005. Estimated as 200,000+ plants.
- Taraxacum subcyanolepis** 135/25.203. *29, Cambs.: Stetchworth, TL632601, P. D. Sell, 1994, CGE, det. A. J. Richards.
- Taraxacum sublaeticolor** 135/25.207. *62, N. E. Yorks.: road verge, Mill Lane, Faceby, NZ497032, V. Jones, 2004, det. A. J. Richards, **herb. V. Jones**.
- Taraxacum lepidum** 135/25.209. *62, N. E. Yorks.: grassland by Marton West Beck, Marton, NZ41Y, V. Jones, 1998, det. A. J. Richards, **herb. V. Jones**.
- Taraxacum subundulatum** 135/25.210. *29, Cambs.: Bassingbourn, TL329438, P. D. Sell, 1952, CGE, det. A. J. Richards.
- ‡**Taraxacum tumentilobum** 135/25.215. *62, N. E. Yorks.: grassy bank in woodland, Saltburn, NZ62Q, V. Jones, 1998, conf. A. J. Richards, **herb. V. Jones**.
- ‡**Taraxacum undulatiflorum** 135/25.216. *29, Cambs.: Milton, TL478628, R. J. Pankhurst, 1973, CGE, det. A. J. Richards.
- ‡**Hieracium maculatum** s.s. 135/28.74. *67, S. Northumb.: Haydon Bridge, NY8464, J. & R. Bowyer, 2007. Hortal, introduced by owner from Northampton 40 years previously and now seeding.
- Hieracium pictorum** 135/28.112. *77, Lanarks.: at foot of Knock Burn, Culter Valley, NT032287, D. J. McCosh, 2004, E.
- ‡**Hieracium scotostictum** 135/28.115. ®, 13, W. Sussex: garden escape, present in nearby garden, East Preston, TQ071017, O. & M. Hollings, 2007, conf. R. C. Stern.
- Filago minima** 135/30.4. @10, Wight: a few plants in ex-arable land on sandy soil, Newchurch, SZ5685, G. N. Toone, 2007, **herb. G. N. Toone**. Historic site.
- ‡**Inula hookeri** 135/35.hoo. *60, W. Lancs.: garden throwout on roadside, Borwick Lane corner, Warton, SD514729, J. Clarke, 2007.
- ‡**Erigeron glaucus** 135/43.1. *38, Warks.: five seedlings on roadside, Wylde Green, Birmingham, SP128943, M. W. Poulton, 2007, det. E. J. Clement, **WARMS**. Self-sown.
- ‡**Erigeron karvinskianus** 135/43.4. *85, Fife: a flourishing colony on cobbled pavement, North Street, St Andrews, NO513167, G. Halliday, 2007.
- ‡**Artemisia abrotanum** 135/50.6. 85, Fife: ruins of former Binn House, Burntisland, NT235866, G. H. Ballantyne, 2007. Only previous record in 1961 was as a relic.
- †**Anthemis arvensis** 135/55.2. *100 (Bute), Clyde Is.: disturbed ground, John Street, Rothesay, NS086644, A. C. Hannah, 2005.
- Senecio xalbesens** (*S. cineraria* × *S. jacobaea*) 135/62.1×10. *62, N. E. Yorks.: footpath crack, Carlton, NZ509043, V. Jones & W. A. Thompson, 2006, **herb. V. Jones**.
- ‡**Senecio inaequidens** 135/62.3. 85, Fife: in quantity on waste ground and railway side near ferry terminal, Rosyth, NT118817, G. H. Ballantyne, 2007. Brought in by ferry from continent? Only previous record of 1836 was in ship's ballast.
- ‡**Senecio vernalis** 135/62.16. *59, S. Lancs.: grassy riverbank, Heaton Mersey, banks of river. SJ860900, B. Shaw, 2007.
- ‡**Petasites japonicus** 135/71.2. *96, Easternness: river shingle and adjoining bank by River Nairn south-west of Howford Bridge, NH869532, T. Law, 2007. Had been seen previously - from 2004 onwards - but existence here confirmed in 2007.
- ‡**Ambrosia artemisiifolia** 135/74.1. ©67, S. Northumb.: at Eastern Way, Darras Hall, NZ1570, J. W. Hall, 2006. 1st published record. Birdseed alien.
- ‡**Helianthus xlaetiflorus** (*H. tuberosus* × *H. pauciflorus*) 135/79.2×pau. *38, Warks.: brookside, Coventry Road, Sheldon, Birmingham, SP157837, I. C. Trueman, 2007, conf. J. W. Partridge, **WARMS**. Birmingham & Black Country County Flora Project.
- ©**Galinoga quadriradiata** 135/80.2. *100 (Great Cumbræ), Clyde Is.: disturbed ground, Gray Craigs, NS183564, BSBI meeting, 2007.
- ‡**Cosmos bipinnatus** 135/83.1. *©39, Staffs.: path around a small pool, Kingswinford, SO890893, M. W. Poulton, 2007.
- ‡**Rhagadiolus stellatus** (L.) 135/RHA.ste. *38, Warks.: one plant near bird table in garden, Bilton Road, Rugby, SP4974, M. D. G. Jones, 1965, det. D. A. Cadbury & R. C. Readett, **WARMS**. Herbarium specimen seen. Ø

‡*Tagetes patula* 135/TAG.pat. *38, Warks.: pavement, The Glade, Sheldon, Birmingham, SP156837, J. W. Partridge, 2007, conf. M. W. Poulton, **WARMS**. Self-sown? None nearby.

Alisma lanceolatum 137/4.2. *©100 (Great Cumbrae), Clyde Is.: in old flooded quarry below Creag nan Fitheach, NS150551, BSBI meeting, 2007.

‡*Zantedeschia aethiopica* 147/4.1. *59, S. Lancs.: canal margin, Leeds & Liverpool Canal, Parbold, SD4910, C. Chadwick, 2007. *100 (Great Cumbrae), Clyde Is.: spreading in raised beach marsh below Creag nan Fitheach, NS150552, BSBI meeting, 2007.

‡*Arum italicum* 147/5.2. *67, S. Northumb.: Seaton Sluice, NZ325779, G. & A. Young, 2007. Subspecies not determined; probable hortal.

©*Pistia stratiotes* L.147/PIS.str. *60, W. Lancs.: more than 50 plants in pond, Carleton, SD326408, M. Sutcliffe, 2007. Ø

Lemna trisulca 148/2.3. 100 (Great Cumbrae), Clyde Is.: abundant in old flooded quarry below Creag nan Fitheach, NS150551, A. C. Hannah, 2006. 1st record since 1970.

Juncus compressus 151/1.3. @13, W. Sussex: by village duck pond, Middleton, SU972003, N. & E. Sturt, 2007, conf. T. A. Cope.

Juncus foliosus 151/1.6. *100 (Arran), Clyde Is.: Glen Shurig, NR9936, A. W. Smith & R. Whitla, 2004, det. A. W. Smith.

Juncus filiformis 151/1.24. @110, Outer Hebrides: small lochan, Barcasdale, NB378399, C. Robson, 2002, E. P. A. Smith & M. Teneva revisited this site on 24/8/2007 and found it to be just in a new hectad.

Juncus ×*kern-reichgeltii* (*J. effusus* × *J. conglomeratus*) 151/1.26×27. *100 (Bute), Clyde Is.: Port Glas, NS015669, A. C. Hannah, 2006. With both parents on inland side of road.

Carex otrubae × *C. divulsa* subsp. *divulsa* 152/16.5×9a. *10, Wight: growing on a roadside verge with both parents, Thorncross, Yafford, SZ4381, P. D. Stanley, 2007, det. E. J. Clement, herb. P. D. Stanley.

Carex ×*pseudoaaxillaris* (*C. otrubae* × *C. remota*) 152/16.5×15. 59, S. Lancs.: salt-marsh, Birkdale Green Beach, SD312155, BSBI excursion, 2006. 1st record since 1970.

Carex rostrata 152/16.28. 29, Cambs.: edge of main lake, Milton Country Park, Milton, TL481623, J. D. Shanklin, 2006, **CGE**. 1st record since 1966.

Carex vaginata 152/16.37. *65, N. W. Yorks.: dense patch at 660m in flush just below summit, Great Shunner Fell, SD842967, L. M. Robinson, 2007. Also found by L. M. Robinson on same day at SD843967; scattered plants in flush.

Carex ×*fulva* (*C. hostiana* × *C. viridula*) 152/16.44×46. 38, Warks.: wet moor, Sutton Park, SP1095, M. W. Poulton & I. C. Trueman, 2006, conf. I. C. Trueman. Rediscovered in previous site where it had been thought to be extinct.

[*Carex* ×*elytroides* (*C. acuta* × *C. nigra*) 152/16.65×67. 69, Westmorland, with both parents in marsh west of Roman camp, Ambleside, NY371034, M. S. Porter, 2005, conf. A. O. Chater, **LANC**. Delete "with both parents". *C. acuta* does not occur at this site. *Watsonia* 26: 405 (2007).]

©*Stipa tenuissima* 153/9.ten. *29, Cambs.: several plants on the site of a presumed cattle-feeding station in a field at Croxton, TL248596, J. D. Shanklin, 2007, det. A. C. Leslie, **CGE**. Ø

[*Festuca* ×*fleischeri* (*F. arundinacea* × *F. gigantea*) 153/12.2×3. *70, Cumberland: at least 2 plants on sandy W bank of R. Eden, Wetheral, NY467549, 2005, det A. Copping & T. A. Cope, **LANC**. Recorded by P. D. Stanley not F. J. Roberts.]

Festuca longifolia 153/12.14. *10, Wight: growing on acid headland above maritime cliffs, Barnes Chine, Brighstone, SZ4380, P. D. Stanley, 2007, det. A. Copping, herb. P. D. Stanley.

‡*Festuca brevipila* 153/12.15. *©10: busy roadside verge, Blackwater, Newport, SZ5087, P. D. Stanley, 2007, herb. P. D. Stanley.

‡*Vulpia unilateralis* 153/14.5. 85, Fife: two clumps on waste ground, Cupar, NO370139, W. Hay, 2006, det. T. B. Ryves.

[*Puccinellia* ×*hybrida* (*P. maritima* × *P. distans*) 153/16.1×2. 67, S. Northumb.: Seaton Burn, A1, NZ230755, P. Matthews. Delete record; redetermined by C. A. Stace as *P. distans*.]

Briza media 153/17.1. *100 (Arran), Clyde Is.: in rough moorland 50m west of reservoir, Bennecarrigan, NR946228, R. Whitla, 2007, det. A. W. Smith.

‡*Briza maxima* 153/17.3. *©8, S. Wilts.: one plant on roadside near Tesco store, Trowbridge, ST861578, S. Pilkington, 2005.

- Poa infirma** × **P. annua** 153/18.1×2. *10, Wight: single plant in pavement crack with both parents, Brighstone, SZ4282, P. D. Stanley, 2007, det. T. A. Cope, **herb. P. D. Stanley**. Ø
- †**Avena fatua** 153/28.3. *100 (Bute), Clyde Is.: Little Kilchattan, NS101560, A. C. Hannah, 2005. There are several pre-1970 records, but this plant is not in the VCCC for v.c.100. 1st record since 1970.
- ©**Phalaris paradoxa** 153/38.5. *59, S. Lancs.: arable field, Mawdesley, SD5015, D. P & J. Earl, 2007, det. T. A. Cope, **herb. D. P. Earl**. 1st record since 1970. Locally abundant.
- †**Agrostis gigantea** 153/39.2. *100 (Bute), Clyde Is.: weed in arable field, Kingarth, Blackpark, NS092554, A. C. Hannah, 2007.
- ‡**Mibora minima** 153/45.1. *60, W. Lancs.: stabilized sandy ground, Fleetwood, SD338465, P. Jepson, 2007.
- Alopecurus borealis** 153/47.5. *65, N. W. Yorks.: small colony of 20 - 30 flowering heads at 690m in flush just below summit, Great Shunner Fell, SD844972, L. M. Robinson, 2007.
- ‡**Bromus arvensis** 153/50.1. *10, Wight: about 50 plant in grass ley, Bowcombe Down, SZ4687, P. D. Stanley, 2007, det. E. J. Clement, **herb. P. D. Stanley**. 1st record since 1970. *13, W. Sussex: sandy arable fields, south of Tillington, SU956217, F. Abraham, 2006, conf. P. A. Harmes. 1st record since 1970.
- Bromus commutatus** 153/50.2. ‡85, Fife: waste ground, former harbour, Kirkcaldy, NT285921, G. H. Ballantyne, 2007. Imported with grain, *Bromus secalinus* and *Alopecurus myosuroides*.
- †**Bromus secalinus** 153/50.7. ®39, Staffs.: waste ground, site of long-abandoned petrol station, S of Coven, SJ897044, J. E. Hawksford, 2007.
- ©**Anisantha madritensis** 153/52.5. *67, S. Northumb.: Moorbank, Newcastle, NZ233658, A. J. Richards, 2007, **herb. G. A. Swan**. 1st localised record.
- ‡**Ceratochloa carinata** 153/53.1. *7, N. Wilts.: in field margin, farmland, Bromham, ST968648, J. Newton, 2005.
- ‡**Ceratochloa cathartica** 153/53.3. *85, Fife: weedy vegetable garden, walled garden, Cambo House, Kingsbarns, NO6011, H. J. Noltie, 2006. 1st record since 1904.
- Hordelymus europaeus** 153/58.1. ®39, Staffs.: at 290m on both banks of the Warslow Wood Brook, Upper Elkstone, SK054595, V. H. Riley & J. D. Stanney, 2007, conf. I. J. Hopkins.
- ©**Setaria pumila** 153/70.pum. *62, N. E. Yorks.: one large plant in grassland by cliff path, Robin Hood's Bay, NZ953056, V. Jones, 2001, conf. A. Copping.
- ©**Zea mays** 153/ZEA.may. *62, N. E. Yorks.: one plant at field edge, most likely self-sown, no evidence of previous crop, near industrial estate, Whitby, NZ907095, V. Jones & W. A. Thompson, 2005.
- ©**Eichhornia crassipes** (Mart.) Solms 157/EIC.cra. *60, W. Lancs.: more than 50 plants in pond, Carleton, SD326408, M. Sutcliffe, 2007. Ø
- ‡**Hyacinthoides hispanica** 158/20.3. *113(S), Channel Is. (Sark): at foot of rubbish heap on demolition site, north of The Avenue, WV469758, R. M. Veall, 2007, **herb. Société Sercquaise**. 1st record for Sark.
- ‡**Chionodoxa sardensis** 158/22.2. *59, S. Lancs.: urban woodland, Black Wood, Childwall, SJ4188, D. P & J. Earl, 2006, det. D. P. Earl.
- ‡**Allium roseum** 158/24.3. *85, Fife: well established and spreading at two adjacent sites in woodland on slopes next to the school, East Wemyss, NT339968, G. H. Ballantyne, 2007. Flowers white.
- ‡**Allium triquetrum** 158/24.7. ©7, N. Wilts.: roadside weed, Lockeridge, SU149675, J. Oliver, 2005. 1st record since 1970.
- ‡**Allium paradoxum** 158/24.9. *100 (Bute), Clyde Is.: Kilchattan Bay, NS100560, A. C. Hannah, 2007. First reported by J. Muscott.
- ‡**Leucojum aestivum** 158/31.1. *60, W. Lancs.: wooded limestone pavement near gardens, Silverdale, SD472755, E. F. & B. D. Greenwood, 2007.
- ‡**Leucojum vernum** 158/31.2. *67, S. Northumb.: Codlaw Hill, NY947686, J. & R. Bowyer, 2007, **herb. G. A. Swan**. Probable hort.
- ‡**Sisyrinchium californicum** 159/2.3. *©62, N. E. Yorks.: several self-sown plants in pavement cracks, Nunthorpe, NZ533156, V. Jones, 2005.

‡*Sisyrinchium striatum* 159/2.5. *38, Warks.: at least 20 seedlings on roadside verge, Pilkington Avenue, Wylde Green, Birmingham, SP122947, J. Hardwick, 2007, det. E. J. Clement, WARMS. Self-sown. *©62, N. E. Yorks.: several self-sown plants at base of wall, Yarm, NZ417131, V. Jones & W. A. Thompson, 2006.

‡*Crocus sieberi* 159/8.5. *39, Staffs.: naturalised in churchyard, Wombourne, SO876932, C. B. Westall, 2007.

‡*Crocus biflorus* Miller 159/8.bif. *39, Staffs.: naturalised in grassy area in churchyard, Wombourne, SO877942, C. B. Westall, 2007. Ø

‡*Schizostylis coccinea* 159/SCH.coc. *59, S. Lancs.: shaded hedgerow along a path by houses, Croston, SD4818, D. P & J. Earl, 2007, det. D. P. Earl. *©110, Outer Hebrides: wet verge at end of road, Borge, Barra, NF683015, R. J. Pankhurst, 2007.

Gymnadenia conopsea subsp. *densiflora* 162/16.1b. *110, Outer Hebrides: Isle of Fuday, NF720070, S. Duffield, 2007, det. F. Horsman, conf. R. M. Bateman. ®110, Outer Hebrides: Clachan Sands, N Uist, NF874765, F. Horsman, 2007. ®110, Outer Hebrides: Machair Robach, N Uist, NF863757, F. Horsman, 2007.

Dactylorhiza ×kernerorum (*D. fuchsii* subsp. *hebridensis* × *D. incarnata* subsp. *coccinea*) 162/18.1×3. 110, Outer Hebrides: Island of Berneray, NF908830, F. Horsman, 2007. 1st record since 1970.

Dactylorhiza incarnata subsp. *incarnata* 162/18.3a. *100 (Bute), Clyde Is.: in fen, north of Ardroscaedale, NS036648, A. C. Hannah, 2006.

Dactylorhiza incarnata subsp. *coccinea* 162/18.3b. *100 (Bute), Clyde Is.: raised beach west of Little Dunagoil, NS085533, A. C. Hannah, 2007.

Dactylorhiza ebudensis (Wiefelspütz ex R.M. Bateman & Denholm) P. Delforge 162/18.ebu. ®110, Outer Hebrides: Island of Berneray, NF910830, F. Horsman, 2007. Ø

Book Reviews

The Flora of Monmouthshire. Watsonian Vice County 35. Trevor G. Evans. With accounts of geology by N. Firth and habitats by S. Tyler and G. Peterken. Pp. 582. Chepstow Society, Chepstow. 2007. Price £25. ISBN 0-900278-49-8.

Here is Trevor Evans' long-awaited *Flora of Monmouthshire*, published by the Chepstow Society, with almost 600 pages of small print, maps, line drawings and colour photographs chronicling the flora of VC35. The beautiful county of Monmouthshire, straddling the border between lowland and upland Britain, contains part of the Wye Valley Area of Outstanding Natural Beauty, part of the Black Mountains, the wide Vale of Usk and the lesser water catchments of the Trothy and the Monnow, making up a varied and attractive mosaic of woodland, arable and pasture lands, some upland heaths and limited wetlands, including salt-marshes on the Severn Estuary. The flora is varied and includes some national rarities such as *Euphorbia serrulata* and endemic *Sorbus* species.

In 1970 the National Museum of Wales published A. E. Wade's *Flora of Monmouthshire*. Shortly afterwards in 1972 Trevor Evans became vice-county recorder for Monmouthshire and after his retirement in 1984 has worked on developing a fully documented flora, complete with distribution maps and detailed grid-references, and so over 35 years after the publication of Wade's flora, we have a completely different-looking modern flora, in a larger format, with over twice as many pages and in smaller print, and crammed with detail.

After a Foreword by Tim Rich, acknowledgments and a profile of Trevor Evans by Elsa Wood, the methodology of the recording of plants in the county is introduced by Trevor Evans, followed by chapters on geology by Naylor Firth and habitats by Stephanie Tyler and George Peterken. There is then a list of botanical sites grouped under their habitat types and arranged in order of importance or desirability according to Trevor Evans, with commentaries and brief lists of the more interesting plants. To end the introductory material Trevor Evans provides a short commentary on changes to the flora and a long list of Records of the flora.

Over 500 pages are devoted to species accounts, arranged in two columns under their

Latin (following Stace 1997) and English names. For each species a short diagnosis is provided, up to about 10 lines long, often with particularly important features emboldened or italicised, a very useful memory-jogger for identification purposes. In a few instances analytical sketches are also provided, and these nicely illustrate diagnostic features. After the diagnosis, the distribution and ecology is discussed followed by the past and present distribution; this often very detailed. If a taxon is not native, this is indicated by either a symbol for ancient introductions or a symbol for more recent introductions. Most native and many introduced species are provided with dot maps using a 10 km grid. The Flora ends with a list of extinctions, useful literature and indices. Sandwiched in the middle of the species accounts is a generous 48 page block of 145 colour plates, including topography and geological maps, and pictures of vegetation and plant portraits.

The author has chosen to use grammatically correct sentences for the diagnoses, perhaps to make them more accessible to the general reader, but I caught myself wondering how many pages could have been saved by using a more succinct and orthodox verb- and article-free diagnosis.

The changes in the flora are substantial and with his long interest in the area, Trevor Evans is well qualified to comment on significant changes. He bemoans the loss of 90% of the flower-rich meadows. A few magnificent examples remain (as at New Grove Meadows and Pentwyn Farm on the Trellech Plateau). Woodlands have also changed with the planting of conifers (now being reversed) and the decline of coppicing. Land drainage has also decreased plant diversity and only a few sites of interest remain. The use of herbicide sprays on arable fields has drastically reduced the weed flora. Of course, none of these changes is peculiar to Monmouthshire. The work of Gwent Wildlife Trust and the Monmouthshire Meadows Group in maintaining and improving biodiversity is now of paramount importance

and is highlighted by the author. As I write this review in the middle of the daffodil season, Trevor Evans' rude remarks on the misguided planting of gross hybrid daffodils along village roadside verges in the middle of the headquarters of the range of the dainty wild daffodil, seem particularly appropriate.

In a work of this magnitude, it's inevitable that there should be some errors. The author has provided a Corrigenda/Errata sheet that is available from him on request with a stamped addressed envelope. It lists additional recorders, two additional taxa (*Mentha suaveolens* and *Mentha requienii*) and 47 mostly minor errors. The most important one is the misplacement of the map of *Petasites fragrans* which is embedded in the description of *Ambrosia artemisiifolia*, rather than in the previous column. With these errors pointed out for me, I was hard-pressed to find any others! I did note also a missing symbol for the introduced status of *Lysichiton americanus*.

I do have some very minor criticisms. The colour printing of the plates is varied, sometimes good but at times disappointingly poor, and the print size is verging on being uncomfortably small. The general maps in the introduction are low on detail and provide little help to the reader in distinguishing where exactly the vice-county boundaries lie – the map of botanical districts in Wade's *Flora* is much more useful in this respect. With its immensely useful short diagnoses, the *Flora* could be a great tool in the field, but is scarcely of pocket size and I doubt the paper and cover will put up with much field mistreatment. Nevertheless, I am sure I will wrap it up well in a poly-bag and lug it out at the bottom of my rucksack. The *Flora of Monmouthshire* is a magnificent achievement and should be on the shelves of any naturalist resident in the county. At £25 it is a bargain.

JOHN DRANSFIELD

REFERENCES

- STACE, C. A. (1997). *New Flora of the British Isles* 2nd ed. Cambridge University Press, Cambridge.
WADE, A. E. (1970). *The Flora of Monmouthshire*. National Museum of Wales, Cardiff.

Sedges of the British Isles. Jermy, A. C., Simpson, D. A., Foley, M. J. Y. & Porter, M. S. Pp. ix, 554, (4). B.S.B.I. Handbook no. 1, 3rd edition. Botanical Society of the British Isles, London. 2007. Paper covers. ISBN 978-0-901158-35-2.

The publication of the third edition of "Sedges of the British Isles" in the B.S.B.I. handbook series has been eagerly awaited. Sinker, in his review of the first edition of 1968, hoped that the remaining Cyperaceae might be included in future editions, so it is good to report that 25 years after the second edition was published, this goal has now been achieved. The daunting task of including the first detailed description of British and Irish *Carex* hybrids has also been accomplished and is a further noteworthy addition. These and a detailed ecology section have enlarged the handbook to become the largest in the series at three times the weight and with twice as many pages. The familiar orange soft back cover of the previous editions is retained. The authors state that as far as possible they have kept to the original concept of the handbook series to be an identification manual and predominantly a field guide and not a biological monograph on a group or family.

The scene is set by an introduction, followed by sections on general structure, classification, ecology, hybridisation and keys to identification before the descriptions accompanied by illustrations and maps are reached. Notes on the classification and arrangement of the genera and species are a model of clarity, making it very easy to locate them in the text by their allotted numbers. The section on ecology has tripled in size with the inclusion of Rodwell's National Vegetation Classification (NVC) data relevant to communities supporting members of the Cyperaceae, and unpublished data by Robin Walls used to produce a Principal Components Analysis of soil preferences. Diagrams show how the ecological parameters are arranged in the PCA graph, where sedge species are clustered according to various ecological parameters. Finally a table of the Cyperaceae, giving Ellenberg values modified for the British Flora (Hill *et al.* 1999) is provided.

The section on hybridisation is entirely new and with more than 40 interspecific *Carex* hybrids known from the British Isles, a quarter of the text is taken up with hybrid accounts. A short historical account is followed by a detailed description of sterility which can be complete or partial. Critical characters which may indicate sterility are described with the proviso that they may not apply to the fertile *C. nigra* hybrid group. A list of twelve characters useful for identifying *Carex* hybrids is given, followed by notes on unsubstantiated putative hybrid taxa which the authors feel unable to accept for inclusion. Finally the eye-catching warning of "Caveat Lector Hybridarum" emphasises the point why it can be difficult if not impossible to be certain that one has a hybrid, although the presence of both putative parents in the field can be a useful guide. The authors hope that the hybrid descriptions will provide a basis for further study and clarification.

The keys to fertile sedge material in flower and fruit excluding hybrids, has been redesigned and is now divided into two groups: Key 1 to all species except *Carex* and *Kobresia* and Key 2 to *Carex* species which is subdivided into 6 groups. This makes a much more manageable key than the previous one, and when combined with the ecological data, identification should have a reasonably high success rate. The key to non-flowering members of the Cyperaceae which appeared in previous editions has been abandoned.

Species and hybrid accounts are at the heart of the book and I'm sure will be scanned with anticipation when the handbook is first opened. Readers will not be disappointed. It is a great improvement to have the maps, illustrations and descriptions of every species and hybrid on adjacent pages. Nomenclature follows Kent and Stace but changes have been made to familiar names. *Carex ovalis* becomes *C. leporina*, *C. curta* becomes *C. canescens*, *Carex muricata* ssp. *lamprocarpa* becomes ssp. *pairae*, *Eleogiton fluitans* becomes *Isolepis fluitans*, and *Eleocharis austriaca* is now given as *E. mamillata* ssp. *austriaca*. *Trichophorum cespitosum* and *T. germanicum* are treated as full species. No doubt these changes will be eventually incorporated into new Floras and checklists. Changes have also been made to the nomenclature of the *C. flava* group with new splits into varieties based on morphological and isoenzyme studies. It will be interesting to see how long it will be until further modifications

are made to this group in taxonomic flux. Information on stomatal distribution on leaf surfaces is a useful addition. The value of the accounts is increased considerably by including Rodwell's NVC data as well as information from the *Vascular Plant Red Data List for Great Britain* (Cheffings & Farrell (2005). Where species are considered threatened, the level of threat is indicated. Although believed extinct, *Trichophorum alpinum* and *Carex trinervis* are rather optimistically included, as habitats for them still exist. On the other hand the recently discovered *Carex salina* makes an exciting addition and must surely be added to the Red Data List. More work is still needed on the difficult *Eleocharis palustris* and *E. mamillata* groups.

Hybrids are covered in great detail and are contrasted with their parents in tabulated form. In addition there is a very useful table giving the dominant parental traits within the *Carex nigra* group to show which species may be involved in a putative hybrid. The larger full page maps are easier on the eye and simplified with two date classes: pre-1970 and 1970-2006; updated records since the *New Atlas* have been included. Maps of all but the very rarest hybrids are given for the first time and short captions give useful data on distribution patterns, ecology and history. All illustrations now have scale bars and the artists should be congratulated on portraying the characters of their subjects in such an accurate and pleasing way.

The final section is concerned with dubious records, extinct species and aliens. Published work referred to since the last edition has finally drawn a line under the unsubstantiated Heslop-Harrison records of arctic-alpine sedges from the Hebrides (Preston 2004; Pearman & Walker, 2004). Eighteen alien members of the Cyperaceae have been rarely or occasionally recorded and of these the six most likely to be seen are given brief descriptions. The section on potential British species in the second edition has been omitted, although in the text *Carex subspathacea* as a parent of the stabilised hybrid *Carex salina* is quoted as being a species "not yet!" recorded from the British Isles and *Carex parallela* might possibly occur. The glossary has more than doubled in length, and the impressive quadrupling of the entries in References and Selected Bibliography provides a comprehensive source of information. There are separate indexes for English and Latin names.

I noted only two errors; *Carex atrata* is in v.c. 72, Dumfriesshire and not v.c. 78, Peeblesshire, and Professor Fernald's reputed discovery of *Trichophorum alpinum* in 1931 was at Kinlochewe and not Kinlochleven. Fernald's similarly dubious record of *Eriophorum brachyantherum* Trautv. & Mey. (*E. opacum* Fernald) made nearby on the same Highland excursion "on the slopes of Ben Eaigh (sic) (Eighe)" and referred to in Druce's *Comital Flora* (Druce 1932) and in the first edition of Clapham, Tutin & Warburg (1952) was later discounted as an error. *Carex capillaris* in the Southern Uplands is stated to be "local" but as there is only a single small population it should more accurately be described as "very rare." The map of *Trichophorum* $\times$ *foersteri* shows recorder bias in the North East of England as a result of George Swan's elegant work on this previously greatly misunderstood genus (Swan 1999). The map shows a similar picture in the North West of Ireland and as suggested, this taxon will be found to be more widely distributed as recorders become familiar with it. It is interesting that *Blymus compressus* was not mentioned by Rodwell, and amusing to read

that checking the scabrous hairs on the peduncles of *E. latifolium* is "best detected when peduncle is drawn between the lips." I hadn't thought of that!

Clive Jermy and his co-authors and artists are to be congratulated on a very fine authoritative work. It has been a huge B.S.B.I. team effort and reading through the acknowledgments makes one realise how many individuals and institutions were involved. As a field guide and identification manual it should find a place in all our libraries and those of field centres and institutions. It will be especially welcomed by ecologists and conservationists who need to have a good working knowledge of this group. However a small knapsack rather than the jacket pocket may be the best way of carrying it in the field. Part of the enjoyment of studying sedges and their allies lies in exploring the varied and often unspoilt natural habitats in which they grow and which alas appear to decrease year by year. These can often be very remote wild places, where getting wet feet may be inevitable. This handbook will enthuse many of us to visit such places and keep our eyes open for the elusive hybrid.

R. CORNER

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Charophytes of the Baltic Sea. Edited by H. Schubert & I. Blindow. Baltic Marine Biologists Publication No. 19. Gantner Verlag, 2003. £35. ISBN 3-906166-06-6.

Charophytes (commonly known as stoneworts) are a group of macrophytic algae, usually regarded as a distinct order (Charales) within the Chlorophyta, or green algae. Charophytes are both valuable indicators of water quality and severely threatened by eutrophication (Bryant & Stewart 2002). Over half of the 34 British and Irish species (*sensu* Bryant, Stewart & Stace 2002) are endangered; 57% of British and 45% of Irish species are Red Data Book species (Stewart

& Church 1992). Despite their ecological importance and conservation status, charophytes remain a neglected group. This book encourages botanists to take up the study of charophytes and "aims to improve knowledge about this group". It is therefore potentially a valuable addition to the (sparse) literature on the British and Irish Charales. However it is a pity that this book is not more accessible for beginners, although there is much of interest for everyone.

The book is divided into three main sections including introductory details and an identification key, illustrated species accounts and a section presenting nomenclatural research. The introductory sections provide a very readable overview of charophyte morphology, cytology, reproductive biology, ecology, physiology and phylogenetics. The literature review is comprehensive. There are 25 species in the keys and 28 species accounts. Of these, 23 species (*sensu* Bryant, Stewart & Stace 2002) occur in Britain and Ireland. Species accounts are in a similar format to the B.S.B.I. Handbook series. Each species has a relatively full description, details of its ecology, biology, distribution map and a useful 'compare and contrast' section entitled, rather endearingly, 'risk of confusion'. The illustrations are excellent, showing both diagnostic details and full plant portraits that effectively capture the 'jizz' of each species. It is particularly useful to have attention drawn to, with an illustration, widespread (and often misidentified) variants like *Chara aspera* var. *subinermis*. One new species is described, *Lamprothamnium sonderi* A. Garniel.

The key and associated description of charophyte plant parts are adequate, but it is a shame that the key recycles existing characters and relies heavily on cortex features (particularly the distinction between diplostichous and triplostichous). These can be difficult to observe when plants are encrusted and without at least $\times 30$ magnification. The keys in Stewart & Church (1992) attempt to address this by using reasonably reliable field characters, although unless you are very experienced, microscopic confirmation of species is still essential. Perhaps a multi-access key would enable focus on more user-friendly characters? There are also a few inconsistencies here: for example, spine-cell fascicles are not used in the keys (for good reason) yet are stated as diagnostic characters in some species accounts.

There is apparently still no published diagram of a *whole* charophyte plant, with *all* parts clearly labelled. The information is usually there, but buried in the text, as in this

book. More surprisingly, this book lacks a glossary. Beginners will have to re-read five pages of text every time they need to find definitions for the many specialist terms like 'tylacanthous'. If the reason for this was lack of space, it may have been better to publish the nomenclatural section as a separate academic paper. This research is of tremendous value, particularly as nomenclatural confusion is another barrier to those seeking to get to know charophytes. However, the findings would have been more accessible to amateur taxonomists if synonyms were briefly presented within the relevant species accounts.

The content of the individual species accounts is variable. Understandably, well-known Baltic species receive much more detail, contrasting with the rather thin accounts for species like *Chara vulgaris* (our most widespread species, but rare in the Baltic Sea). The 'risk of confusion' section is also rather variable in its content. The account of *Chara intermedia* states that distinguishing this species from *C. baltica* "remains difficult and vague" but neglects to mention that, when present, bulbils are diagnostic for *C. baltica*. In places, this section is unhelpful, stating that two species can be difficult to distinguish (such as *Chara vulgaris* and *C. contraria*), but not explaining why, or how to approach an identification with difficult material.

This book was an international collaborative project between twenty leading botanists of eight countries; therefore any inconsistencies in treatment in the species accounts should not detract from the considerable achievement that it represents. The extensive review of ecological and physiological charophyte research is perhaps the most valuable part of the book. Overall, this is a useful and broadly accessible book, and which deserves to be more widely known.

ACKNOWLEDGMENTS

Thanks to Nick Stewart for a useful brief discussion about this book.

CLARE O'REILLY

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Monmouthshire County Rare Plant Register. T. G. Evans. Pp. 89. 2007. A4, spiral-bound paperback.

Anglesey (VC52) County Rare Plant Register. Flowering plants and ferns. I. R. Bonner. Pp. 86. Countryside Council for Wales, in conjunction with the BSBI. 2006. A4, spiral-bound paperback.

I can trace only three previous reviews of publications in this rapidly growing genre – those for Carmarthen, Dorset and Sussex. Others have been relatively modest or interim versions, or, more seriously, have slipped under the radar, usually as they have been privately published. Here I would mention those for Shropshire, Co. Down and in particular Berwickshire, which I recommend to all readers for the insights it gives and for the questions it raises.

With these publications we now have four for Wales, with more in the pipeline, thanks to the support of C.C.W., about ten in various formats for England, a small handful for Scotland and two for Northern Ireland – slow but steady progress.

No central formula can be prescriptive for a series of publications produced by volunteers, but all of these are near enough the same in their adoption of criteria for the species covered – nationally rare and scarce, county rare (1–3 sites), and county scarce (4–10 or 15 sites). For a national onlooker this is excellent, and is most important in that one can compare like with like. The variables are less important. The first Rare Plant Register, that from Cardigan, gave grid reference, date, site status and localities. Later publications (Carmarthen, Sussex, Dorset) added notes on habitat together with comments on decline where relevant, thus greatly adding to the interest and greatly increasing the work! For these under review Wiltshire and Antrim do contain those extra notes, whereas the other two are more bare lists, though both have a word or two about the habitat of most of the records.

The most important variable though is over the period covered by each, and here I find myself in a quandary. The intention of a Rare Plant Register must be to put the qualifying

species into a time-frame, since it seems that decline in extant records is a general picture across the country, with relatively rare exceptions. I appreciate that is simplistic, but that statement will have to suffice for a short review. If too long a time frame is used then the picture is distorted – does the fact that all the records of *Blysmus compressus* from Wiltshire date from the 1980s mean that it has gone or that no-one has looked? The introduction of a cut-off date of, say, 1990 (though already 18 years ago) or, even better, 2000, would be far more relevant in knowing whether this species was under real threat. Yet, to use Wiltshire as an example again, it was an astonishing feat for a new county recorder to produce a statement for her county, from scratch, in only three years, and the value of having a such a statement outweighs the significant number of records from the 1980s – at the very least it should encourage botanists to go and look. The same comment applies in varying degrees to the other three under review, and, I think, should serve as a model and a spur to all the other counties that have Rare Plant Registers in progress. It is better to set out a statement, even if not as up-to-date as one would wish, than not to publish at all. For each of these registers has the same message about its special plants. I am not talking about nationally rare and nationally scarce plants, where the picture is relatively well-known, but about the plants that might be common elsewhere but are now down to a few sites in these counties, the ‘county rare and scarce’. The picture is invariably one that is becoming familiar – the 10 km dots are still there, but the sites inside those hectads are down to one or two or a very few and still decreasing. Fascinating reading!

D. A. PEARMAN

Plant Atlas of mid-west Yorkshire. Abbott, P. P., Yorkshire Naturalists' Union, York. 2005. £30 h/b. ISBN: 0 950409 36 7.

This was a long awaited Flora which almost completes the Floras for the County. It now joins a family of more or less up to date Floras for this large and varied county and the final instalment, the *South Yorkshire Flora*, is in preparation. This Flora has been put together in a fairly traditional style in an accurate and organised format and is written with professional brevity given space and financial constraints. From the introduction it is clear why a Flora for this part of Yorkshire was required, as the last one was written in 1888 by F. A. Lees with minor updates along the way. The book has an attractive cover depicting a *Geranium sylvaticum* – Northern Hay Meadow, a rare and fast disappearing habitat which can still be found in vice-county 64.

In the subsequent section, all the recorders, referees and other contributors are fully acknowledged. The following chapters, the geology and soils, are written skilfully by guest contributors who clearly know their subject and though brief, guide the reader through a vice-county which has a plethora of interest in these subjects. There is a reference section for each which guides us to more detailed accounts. Though technical for the beginner, the geology section gives very useful explanations of some of the terms. Maps are provided for soil types, the geology of the area and physical features. There is also a map which delimits the boundary of this large vice-county.

The next section 'A botanical tour of Mid-West Yorkshire' (pp. 20–25) is written by the principal author and is a wonderful description of the vice-county by habitats and the plants found in this part of Yorkshire. It is also useful to view the photographs in plates IV–XVI when reading this section. The 76 photographs show some of the special habitats, (such as calcareous grasslands), landscapes (stunning views of Ingleborough, Wharfedale and Pen-y-ghent) and the plants (e.g. Lady's-slipper Orchid) of v.c. 64. This is a blessed county not only for a multitude of habitats, landscapes and

common plants, but the special and rare plants too. The Lady's-slipper Orchid (*Cypripedium calceolus*) is very special, being at its last known native site in Britain (though there are now introductions elsewhere). *Carex muricata* spp. *muricata* is also a very rare plant and recently *Carex flava* was shown to exist at Malham Tarn Moss, only the second known site in Britain (and previously thought to have been a hybrid). *Senecio eboracensis* new to science is endemic to York and therefore to this vice-county, found nowhere else in the world!

The book is comprehensive and has accounts for nearly 1,800 taxa with nearly 1,000 of these having maps. They are arranged in the usual fashion from Lycopodiaceae to Orchidaceae, and species not considered native to the area are marked with an asterisk, though a few were missed (e.g. *Selaginella kraussiana* is not native in the UK). This flora has not shied away from the apomictic species with 52 *Hieracium*, 62 *Rubus* and 27 *Taraxacum* micro-species noted (some with maps). Recording continues, and new plants have been found for the vice-county since publication. There are probably close to 2,000 taxa recorded now. There are almost no typing errors, the few there are being too insignificant to mention.

It must be said that this is a mammoth effort on behalf of the recorders, contributors and the principal author, and it is something that as a Society we should be proud of. More importantly, the author is to be congratulated on an excellent addition to the British and Irish Floras. These achievements should not go unnoticed, having been carried out with dedication, organisation and an overall enthusiasm for botany. I share this enthusiasm for botany and this vice-county and use this book regularly. It is an important reference source for the geology, soils, and above all the wonderful and special plants of this part of Yorkshire – 'God's own County' obviously!

M. P. WILCOX

Flowering Plant Families of the World. V. H. Heywood, R. K. Brummitt, A. Culham & O. Seberg. Pp. 424. Royal Botanic Gardens, Kew, 2007. Price £27.95. ISBN 1-84246-165-6.

Flowering Plants of the World (1978), the starting point for the present volume, quickly established itself as the standard reference on the subject for specialists and non-specialists, amateurs and professionals, alike. With the rapid advances in our knowledge of the world's flora made over the past 30 years, especially but not entirely derived from new insights into evolutionary relationships, at the family level by the analysis of DNA sequences, an updated replacement work is timely. All the attractive features of the earlier publication are retained; these were summarised in the review by J.F.M. Cannon in *Watsonia* 12: 365–367 (1979), and most need not be repeated here. In brief, the book is largely an account of the world's flora family by family, including all 506 of those recognised (only 306 were accepted in the earlier work). In each case it includes its distribution, description, classification (both inter- and intra-familial), economic uses, and (new in the 2007 book) a highly selective (often strange or puzzling) list of key references. A world distribution map is provided for every family, and all those of any size are illustrated by attractive drawings, about half of which are in colour.

Although the general appearance and content of the two books are similar at a glance, there are many changes in detail. The original entries, written by 44 contributors, have been redrafted and considerably though variably updated, mainly by the four authors. More corrections and updates could have been made if some of the original authors had been consulted. Many of the additional data, including most of the references cited, relate to phylogenetic analyses that have had a bearing on the classification. American spellings are still used throughout, as is the annoying and misguided habit of referring to families in the singular ("the Ranunculaceae is..."). They are, however, sensibly referred to primarily by their more modern name ending in -aceae (Asteraceae rather than Compositae, etc.).

The excellent illustrations appear to be the same as those in the 1978 book (at least, I spotted no additions), with the result that most of the additional small families recognised as a result of DNA study are not illustrated, even the now famous Amborellaceae. Some of these, e.g. the Madagascan Didymelaceae and Diegodendraceae, were not referred to by

family or genus in the 1978 book. The difficulties of producing accurate world distribution maps was commented upon in Cannon's review, and is mentioned in the Preface to the 2007 book, but even so the reasons for some of the changes are not easily understood. For example, the map of the Combretaceae in the earlier book is accurate, but it has been considerably altered and now is grossly inaccurate in several respects.

Perhaps the most intriguing aspect of the new work is the extent to which the families have been realigned to follow the latest DNA-based classification (known as APGII). The answer is not straightforward, as the changes dictated by DNA sequences and the imposition of mono-phyly have been very subjective and therefore patchily adopted. The reason for this seems to be that the four authors represent a wide spectrum of opinion regarding the APG classification, and each appears to have been given a free hand. Hence, whereas *Hydrocotyle* is now placed in the Araliaceae, *Aesculus* and *Acer* are in the Sapindaceae, and many small families (e.g. Parnassiaceae, Aucubaceae and Acoraceae) are newly or re-accepted, the Scrophulariaceae are retained in almost their traditional sense, but also including the Orobanchaceae, yet still excluding Callitrichaceae, Buddlejaceae and Plantaginaceae, *inter alia*. This unevenness is somewhat obscured by the fact that the families are treated in two alphabetical sequences, dicots and monocots, itself contrary to the APGII system, as opposed to the systematic sequence preferred in 1978. The families are, however, listed in their APGII sequence at the front of the book, but with the family circumscriptions altered to agree with those adopted in the main text.

Since all the taxa are adequately indexed, the alphabetical versus systematic sequence and the subjective circumscription of the families are of little practical significance. Here is a book that will remain a standard reference work of great value to many biologists and naturalists. Providing that the user does not believe all the data to be complete or wholly accurate, or to represent a consensus (impossible aims in a compilation such as this), *Flowering Plant Families of the World* will justifiably continue to represent the preferred first port of call for many in seeking

information about the world's plants. It cannot be recommended, however, as an ideal guide to the APGII classification. Moreover, there is still a need for a modified version of the APGII

system that is less slavish to cladistic tenets and accepts paraphyletic taxa in certain justifiable circumstances, because there will always be a sizeable proportion of botanists who prefer it.

C.A. STACE

The Flora of Rum. An Atlantic island Reserve. D. A. Pearman, C. D. Preston, G. P. Rothero & K. J. Walker. Pp. 480. Published by the authors, Truro. 2008. £25 h/b. ISBN 978-0-9538111-3-7.

This is a justifiably big Flora of a small island that has long held a special place in the minds of botanists. It uses all the traditional methods of Flora-writers and introduces several new ones. It gives equal prominence to bryophytes and vascular plants, and is based both on all the available historical information and on very intensive bursts of recording by the authors and others in 2003 and 2004.

Introductory chapters occupy a third of the book, and there are 28 fine colour plates and a series of exemplary maps that will enable readers to orientate themselves easily in the text. A long chapter vividly recounts the history of the island and the struggles of the successive owners to manage this remote and intractable property for a variety of ends, by low key farming, as a sporting estate, as a sheep ranch, as a National Nature Reserve and as a research station. Especially fascinating is the authors' elucidation of the deliberations within the Nature Conservancy about how the new NNR should be managed. Given a completely free hand when they acquired it in 1957, did they make the right decisions, and have their successors done justice to the island? It is a pity though that the account ends in 1992 when Scottish Natural Heritage inherited Rum. An equally interesting chapter on the history of botanical exploration inevitably recounts in detail the activities of J. W. Heslop Harrison, whose deliberate planting of rarities to provide fraudulent records, probably chiefly to bolster his theories of periglacial survival, has overshadowed his enormous valid contributions to the botany of Rum and the other Hebrides which are given due credit here. One can perhaps add that his plantings confused only the botanists, and not to any significant extent the vegetation of the island which has been both depleted and added to on a grand scale by the various owners, including conservationists, over the centuries.

The plant communities are described in National Vegetation Classification (NVC)

terms, with the bryophytes mostly relegated to separate paragraphs. Standing waters are analysed in particular detail. Both here and in the chapter on the phytogeography of the Rum flora comparisons are made with other islands. The latter chapter gives us much information of a kind not previously presented in detail in a local Flora, which would ideally have merited more extensive discussion by the authors. The floristic elements are analysed in relation to Scotland as well as to Britain as a whole, and the mean number of tetrads of their constituent species is given. The life-forms of plants on the island are similarly analysed, as are their habitat preferences, and detailed comparisons are made with Skye. Diversity at a tetrad scale of the various taxonomic and status groups is shown on a series of maps (but the accompanying keys to dot sizes are themselves at a different scale, and so are difficult to use). Changes in the flora are discussed as far as the available evidence allows, and one of the greatest values of the present Flora will be as a baseline for a future survey by some other equally fortunate and competent group of botanists.

The species accounts comprise a readable paragraph summarising the habitats, distribution and, where relevant, the history of the species, and a second paragraph usually containing either a list of records or a list of NVC communities. First records and altitudinal ranges are given. The records include grid references, recorders and dates. Numbers of tetrads are given, and also, for the vascular plants, a novel category of information, the abundance of the species within tetrads based on a DAFOR scale. This shows a general positive relationship between frequency and abundance, but with many exceptions such as *Sedum acre* in only one tetrad but frequent there, or *Ranunculus flammula* in all but one tetrad but on average rare in each. Habitat preferences explain much of this, but it is an approach that deserves further application and

analysis in other local Floras, and at other scales of mapping, in the hope that it may provide new insights. Tetrad maps are given for all but the rarer species, with 2000 onwards and pre-2000 date classes. The two-column format and the small number of tetrads involved (41) has resulted in the dots being distractingly big, detracting from the appearance of an otherwise very well-produced book.

Coverage, even of the remotest corners, appears to have been very reasonable (one of the maps usefully shows the routes taken by the recent recording parties). Coverage of critical

groups since Heslop Harrison's time has been patchy. *Hieracium* has been reasonably well covered, *Euphrasia* has received a lot of attention but merits still more, and *Rubus* has had no recent expert attention in the field. Intraspecific taxa in general require more attention. Rum can now be visited more easily than in the past and anyone reading this Flora will long to go, and will find it an ideal companion. Armchair readers are in for a treat, and those embarking on a local Flora project will find new and stimulating ideas in it.

A. O. CHATER

Obituaries

JOHN ('JACK') GREGORY HAWKES

1915–2007

Potato taxonomist, biosystematist and genetic conservationist Professor J. G. Hawkes died in Reading on 6 September 2007. His death robs the international botanical and conservation communities of a supremely able researcher, practitioner and teacher, who, together with Sir Otto Frankel, did as much as anybody to put conservation of genetic resources centre stage as an applied scientific discipline. To this end he devoted a long and productive career to the study of the diversity and evolution of cultivated plants and their wild relatives. Born in Cam near Bristol on 27 June 1915, he was educated at Cheltenham Grammar School. As a boy he drew inspiration from exploring the countryside of the Cotswolds and remained an enthusiastic field botanist throughout his life. From school he went up to Christ's College, Cambridge, where in 1937 he graduated in Natural Sciences with 1st class Honours. He stayed on at Christ's for a PhD on the genetics and taxonomy of the potato, the world's fourth most important food crop (incidentally, 2008 is the Year of the Potato), which he would go on to research for more than six decades. Well before Hawkes had finished his PhD research, E. K. Balls and W. Balfour Gourlay invited him to join the British Empire Potato Collecting Expedition to South America. This journey, which took them on a meandering path through the Andes, from Argentina to Columbia but especially through Peru and Bolivia, resulted in the collection of 1164 potato samples – wild and domesticated species and landraces or local cultivated varieties. This considerable collection, a resource of useful genes for disease resistance and other attributes still used today, has been conserved at the Scottish Crops Research Institute, Invergowrie. Hawkes returned home in September 1939, via Halifax in Canada, just after war had been declared. Before setting off on his South American travels in December 1938, Hawkes had taken the opportunity to visit the Soviet Union to learn about wild potatoes from the specialists S. M. Bukasov and J. W. Juzepczuk at the All-Union Institute of Plant Industry in Leningrad. Here he was befriended by the visionary geneticist Nikolai Ivanovich Vavilov

(1887–1943), who had originally proposed the concept of Centres of Crop Origins, global centres of crop diversity and evolution. Hawkes also met, in Moscow, T. D. Lysenko and warned Vavilov about the sinister intent of his colleague ("a dangerous man"), an ambitious, fraudulent and fanatical individual who drew his 'scientific' methods from Marxist-Leninist ideology and dogma. Denounced and hounded by Lysenko, Vavilov would die in prison during World War II, vaguely and falsely accused of espionage.

On his return from South America, Hawkes continued the research at Cambridge, completing his PhD in 1941. He was able to describe 31 new wild and five new cultivated potato species. He remained on the staff of the Commonwealth Bureau of Plant Breeding and Genetics until 1948. From there he returned to South America with his growing family to become the first Director (1948–1951) of the Colombian Ministry of Agriculture's new Potato Research Station in Bogota. In 1952, back again in the UK, he took up the post of lecturer in taxonomic botany at the University of Birmingham, where he remained for the rest of a distinguished career. Appointed Professor of Plant Taxonomy (1961) and Mason Professor of Botany (1967), he remained head of the Plant Biology Department until his official 'retirement' in 1982.

He was always active in national and international organisations and committees. His greatest intellectual and practical contribution arose directly from his work on potatoes. In 1969 he established the influential MSc course in 'Conservation and Utilisation of Plant Genetic Resources', which has since trained and inspired over 1,500 students from Britain and over 45 countries all over the world. In 1972, with his colleagues Erna Bennett and Sir Otto Frankel, Hawkes was instrumental in setting up the International Board for Plant Genetic Resources (I.B.P.G.R.) and the development of regional crop gene-banks now known as the CG Centres. Always a keen field worker, Hawkes took part in 15 potato-collecting expeditions, while always stressing the value of *situ* conservation for the protection

and evolution of wild and landrace germplasm. He rightly appreciated how much crop plants need to be able to evolve in the presence of both wild relatives and natural pathogens.

Hawkes retained a broad range of botanical interests, from taxonomy, biosystematics and evolution to the origins of agriculture and management of genetic resources, and he published nearly 250 papers and books on potatoes, wider aspects of crop plant diversity and genetic conservation. A major research project was his taxonomic study, including the then innovative use of serology (protein-antibody reactions), of 230 wild species of potato. His books included *The diversity of crop plants* (1983), *The potato: evolution, biodiversity and genetic resources* (1990), *The potatoes of Argentina, Brazil, Paraguay and Uruguay* (with J. P. Hjerting, 1969), *The potatoes of Bolivia* (1989), and with Birmingham colleagues, *Plant genetic conservation: the in situ approach* (1997) and *The ex situ conservation of plant genetic resources* (2000).

He joined the Botanical Society of the British Isles in 1953. Of particular interest to many B.S.B.I. members was his *Flora of Warwickshire*, *A Computer-mapped Flora*,

published in 1971. Since then the compilation of computer mapped plant records has become a standard procedure in the production of Local Floras. Hawkes also edited *The reproductive biology and taxonomy of vascular plants* (1967), the proceedings of the Society's 1966 Conference, which he had organised and convened in Birmingham. Hawkes's last book, *Hunting the wild potato in the South American Andes* (2004), a characteristically thorough exercise in tidying up unfinished business, took him back to that memorable expedition to South America, and also paid tribute to his friend and mentor Vavilov.

Jack Hawkes was a modest person but held in great esteem by colleagues and former students. He had the gravitas of a professor but was a friendly man who would encourage younger botanists. In 1975 he received the International Botanical Congress Medal, appropriately in Leningrad. In 1984 the Linnean Society of London, of which he later became President (1991–1994), awarded him their Linnean Medal for Botany. In 1984 Queen Elizabeth awarded him the O.B.E.

J. R. AKEROYD

JOHN OUNSTED

1919–2007

With the death of John Ounsted on 2 December 2007 our Society has lost a loyal supporter, and one of the rapidly diminishing band of field botanists who contributed not only to the first Atlas (1962) but also to its heavyweight successor 40 years later. Many of us have also lost a good friend – he was a man of great wisdom and energy, and his beaming smile and sense of fun, no less than his botanical insights, will be greatly missed.

John was born in London on 24 May 1919, and joined the Botanical Society and Exchange Club, the forerunner of the B.S.B.I., in 1947. His early interest in natural history, particularly in birds and plants, was nurtured by his experiences whilst a pupil at Winchester College; here, he found himself sharing a dormitory with John N. Mills. It was Mills – five years his senior – who introduced him to “mountains, Youth Hostels, but above all Botany” (Ounsted 2002). John spent much of his free time exploring the countryside within cycling distance of college, and the chalk grassland of Twyford Down was a frequent

haunt. In 1934, at the age of fifteen, he accompanied Mills to Snowdonia, where he gained his first experience of mountains and his first sighting of *Lloydia serotina* “... visible but inaccessible up a vertical cliff.” They also botanised together close to their parents’ homes, and one spring walked the Pilgrim’s Way to Canterbury in just three days, where the finding of *Lathraea squamaria* led to a “... lively debate on whether the ‘oo’ in Toothwort was ‘as in foot’ or ‘as in hoot’!”. Later, when the two Johns both had children of their own, they took family camping holidays together, often by the sea and always, it seems, at locations deliberately selected to offer considerable scope for plant-hunting.

For John, botany was just one interest amongst many. Academically he was outstanding, and his great intellect and scholarship was combined with a genuine interest in people and an openness and approachability that was to win him friends wherever he went. A scholar at Winchester, and also at Trinity College, Cambridge, he earned a double first in

Mathematics and Moral Sciences. At about this time he developed an enthusiasm for Russian, teaching himself that language well enough to contribute translations to two anthologies of foreign classical poetry, much of the work for these being done while still at university.

John graduated in 1940, and left Cambridge a convinced pacifist. He was ready to go to prison, but after appearing before a call-up board was excused military service as a conscientious objector on religious conviction. Instead, he embarked on a lifetime in education: first as a Mathematics teacher at King Edward VI School, Birmingham; then, in 1948, as headmaster at Leighton Park, a small Quaker boys' school on the outskirts of Reading. In Birmingham, during the War, there were few young male teachers, and John found himself teaching not only Maths but a whole range of other subjects and 'out of school' activities – it was at about this time that he became actively involved in the scout movement. It was also here, in Edgbaston and Bournville, that he met other conscientious objectors, many of them Quakers.

John and Irene married in 1940, within months of his graduation, and by the end of their time in Birmingham they already had four children. There were camping expeditions in the school holidays – to Norfolk, Somerset, Cornwall, Isle of Wight, the New Forest – and term-time forays nearer to home too. John's eldest daughter, Tanya, recalls her father heading off from their flat in Birmingham, vasculum under his arm; and at the end of the day Irene would take the plants he had found and use her water colour paints to colour the illustrations in Fitch's companion to Bentham's 'Handbook' (Fitch 1939), John then carefully annotating the drawings with dates and localities.

The decision to move to Leighton Park was a bold one – and we shouldn't underestimate the courage involved, of the school's governors as much as of John himself. On his appointment, at the age of 28, he was not only the youngest person on the school staff, he was also the youngest headmaster of an independent school in Britain. The son of a high Anglican, John was a man of deep religious beliefs, but he was not (and never did become) a member of the Society of Friends – he was the school's first non-Quaker headmaster, and the governors had to think long and hard before taking him on. As John noted, "legend has it that in the early days of Leighton Park, when Friends were strongly evangelical, the governors hesitated long over a



John Ounsted in his study at Leighton Park, c. 1954. (Photo: Leighton Park School archives).

candidate for the headship as they suspected he didn't believe in the Virgin Birth; and that 40 years later they hesitated over a candidate as they suspected that he did" (Ounsted 1990).

Leighton Park was to be John's home for the next 22 years. Plant-hunting holidays continued, and there were camping trips to Guernsey and Jersey in 1950, to the Isles of Scilly in 1951, and to Alderney and the west coast of Scotland (including Rum) in 1953. John's notes on Alderney's plants, together with some additional records from David McClintock, provided the first reasonably comprehensive account of the island's flora since the German occupation (Ounsted 1954). Whether in school or with his growing family, John was determined to communicate his love of the outdoors, and of plants and birds in particular. In the 1950s and early 1960s he helped run the school's Bird Group – including an ambitious ringing programme – and compiled a check list of the vascular plants to be found within the school grounds. In his own garden, next to the school, he found one particularly noteworthy species: "In the autumn of 1954 I was weeding a herbaceous border that is usually left to my gardener when, to my great surprise, my nostrils were suddenly assailed by the unmistakable odour of *Mentha pulegium*... A search revealed two patches of the plant in the weedy turf of the corner of the lawn on which I was kneeling" (Ounsted 1956).

Amidst all this activity, botanical or otherwise, he will chiefly be remembered within the B.S.B.I. as one of the co-founders (with Cecil Prime and Alick Westrup) in 1952 of the 'Junior Activities Committee'. John was instrumental in organising and leading many junior meetings, including trips to Austria (1956), the Mediterranean shores of France (1958) (Ounsted 1960), and – with Cecil Prime and James Cadbury – Switzerland and Italy (1968) (Cadbury 1968). Several long-serving members of the B.S.B.I. found their way into botany thanks to these field meetings, and John remained a member of the Committee until its eventual demise in 1969. In the 1950s he was also the Society's 'local secretary' in North Hampshire (v.c. 12) and Berkshire (v.c. 22) – the recorders at that time for these vice-counties being E. C. Wallace and E. F. Warburg, respectively. He was later appointed to Council, and served the Society in this capacity from 1963 to 1967.

Alongside his botanical interests, of course, he had a school to run. At the end of the Second World War, Leighton Park was financially in a precarious position. It had huge debts, relatively high fees and an intake so small that those in the lower sixth and sixth forms numbered only 40 – hardly enough to offer the required choice of subjects or make a reputation for university entrance. By the time he left, 22 years later, the school was flourishing: the debts were paid off, numbers of pupils had gone up from about 200 to more than 300, the sixth form offered a full range of A levels, and the school could boast a disproportionately large Oxbridge entry. He had established its reputation as a high-achieving 'progressive' school with a strong Quaker ethos and a distinctly 'modern' outlook – no corporal punishment, no fagging, and a clear emphasis on community service and overseas links – that was later to be emulated by many of the larger, and politically embattled, public schools in the 1970s and 1980s. And while other public schools were encouraging military service in school cadet corps Leighton Park ploughed a very different furrow, selling fudge to raise money to dig wells in India, adopting an elderly 1956 Hungarian refugee, and housing the Easter Aldermaston marchers for nuclear disarmament in the school gym.

His own subject was Mathematics – he had a particular enthusiasm for *polyhedra* – but when necessary he could turn his hand to a wide range of other subjects. He ran special essay

classes for sixth form students, and a Poetry Group, and helped to establish the school chess club. He also introduced 'hobby Russian' – which eventually led to the school's pioneering of Russian at GCE – and took a six week sabbatical in 1961 to visit Moscow and Leningrad. Curiously, he never taught botany, but we shouldn't be surprised that Leighton Park, with John's support, continued to offer A Level Botany (taught by Richard Schardt, himself an accomplished field botanist) long after most other schools had abandoned separate Botany and Zoology A Levels in favour of biology or environmental science.

Under his leadership Leighton Park gained a reputation for the study of natural history (particularly birds), and produced a string of boys who went on to specialise in the 'natural sciences' (Gould 1990). His ex-pupils include the botanists James Cadbury, Alistair Fitter, Quentin Kay, Simon Leach and John Richards, the lichenologist Dennis Brown, and entomologists John Brady and Martin Luff. Budding ornithologists abounded, and John's bird-watching 'old boys' include Philip Bacon, Stephen Baillie, Nicholas Blurton-Jones, Brian Dickinson, Humphrey Dobinson, Christopher Hancock, Michael Ounsted, Jeremy Sorensen, and the wildlife artist Robert Gillmor.

One boy to make his mark in the 1950s was Nicholas Blurton-Jones, who undertook a special study of Canada Geese at Englefield Park, near Theale, and then, while still at school, organised the BTO's first national census of that species. In the late 1950s four members of the school's Bird Group were planning an expedition to Ireland and it was suggested to them that they should try to visit Cape Clear Island. The Cape Clear Bird Observatory was established as a direct result of that trip, with Humphrey Dobinson, one of the original quartet, serving as the observatory's secretary for the first seven years.

Without doubt, John's enthusiasm mattered a great deal to his pupils. I well remember, as a shy 13 year-old, getting a short piece about the birds at Reading Sewage Farm published in *Animals* magazine. The achievement of 'being in print' was far less important to me than John's *recognition* of that achievement, and it was his evident delight – rather than the achievement itself – that made the deepest impression on me. Quite simply, if John was interested in something you'd done, then you knew it *must* have been something worth doing! His keen interest in the activities – and antics – of his 'old boys', long after they (and he)

had left the school, was quite remarkable, doubtless aided by a formidable memory. Leighton Park was a close-knit community, and amongst former pupils there was a great sense of loyalty to both the school and its headmaster. It is noteworthy that several chose to return to teach there, including James Cadbury (Zoology), Robert Gillmor (Art), Anthony Hodge (Art) and Michael Leach (Mathematics).

In 1970 John and Irene left Leighton Park and moved to Essex where, for eleven years, he was an HM School Inspector, doing much to raise standards and stimulate educational thinking in Outer London and Essex. Until 2001 he was a trustee of the Educational Trust Fund of the Mercers' Company, one of the richest of the London livery companies. And he remained one of the driving intellectual exponents of both boarding education, in which he believed deeply, and of the principle of choice and diversity. He was, over years, to change his views. Boarding, he came to feel, was not necessarily in tune with changes in society (Ounsted 1990); and towards the end of his time at Leighton Park his growing enthusiasm for co-education helped pave the way for the introduction of girls to the Sixth Form in the mid 1970s – something that fellow headmaster, old school friend and birding companion John Dancy had already pioneered at Marlborough College. He was a keen supporter of the school's later transition to full co-education.

Whilst in Essex, John continued to interweave his professional life with his numerous other interests, including botany. In customary fashion, he ensured that his botanical records found their way to those who would make best use of them. He contributed records to Stanley Jermyn's survey of the flora of Essex (Jermyn 1974), and took part in the B.S.B.I.'s Wild Service-tree survey. In 1982 he retired, and he and Irene moved from Essex to Woodgreen Common, a small and scattered hamlet on the western edge of the New Forest, overlooking the River Avon. Here, John immediately set about recording the flora of his local patch which straddled the Hampshire/Dorset border. In 1985 he was invited to join the Hampshire Flora Committee – an invitation which he gently declined, preferring to offer his services in other ways. He was regularly in contact with Paul Bowman, Lady Anne Brewis, Humphrey Bowen, Paul Stanley and others, and organised two B.S.B.I. field meetings in the New Forest (Ounsted 1985, 1986). Many of his records found their way into the Floras of Hampshire

(Brewis *et al.* 1996), Dorset (Bowen 2000) and the Isle of Wight (Pope *et al.* 2003). In 1986 he discovered *Filago arvensis* in Hampshire – a first record for the county, and only the sixth for Britain. He also had a fondness for *Fallopia dumetorum*, his records from both sides of the county boundary clearly demonstrating the importance of the area for this species (Brewis *et al.* 1996, Edwards & Pearman 2006) – which he delighted in calling 'Left-handed Bindweed' on account of its habit of twisting the opposite way to *Convolvulus arvensis* around the plants it climbs up (Ounsted 2006).

His continuing passion for overseas trips – especially to France – led him to participate in a number of B.S.B.I. field meetings and conferences, and he helped to organise a return visit to Alderney in 1995, 42 years after his first visit there. John served the Society in the capacity of Vice-president between 1989 and 1993, and was a member of Meetings Committee between 1991 and 1995. In 1997, 50 years after joining the Society, he was elected an Honorary Member in recognition of his contributions to British field botany and the life of the Society.

John was a slight, intense and charismatic figure, whose nickname at Leighton Park – 'The Duke' – seemed peculiarly apt. Teaching, and learning, was something of a compulsion, and he could never keep his intellectual curiosity to himself. Throughout his long life he was, indeed, a "champion of the young" (Burns 1997). In retirement he completed a 'total immersion' course in French at the University of Southampton, and became an authority on the works of the 19th century French novelist George Sand, reading all 10,000 of her published letters.

In June 2007, just eight weeks after his wife's death, he was invited back to Leighton Park to open a new Maths block, fittingly named in his honour 'The John Ounsted Building'. After watching the first lesson take place John made a short speech and formally cut the ribbon. All agreed, it was a most moving and joyful occasion. He was, to the end, a man of extraordinary enthusiasm and energy, and will long be remembered with great warmth and affection. John's sense of humour was legendary, and it is typical of the man that he chose to list his recreational pursuits in *Who's Who* as botany, camping and "...being overtaken when motoring".

He is survived by a son and four daughters and their families, to whom we extend the Society's deepest sympathies. He was a lovely man who will be sorely missed.

ACKNOWLEDGMENTS

I wish to thank members of John's family, in particular Tanya Hawley and Michael Ounsted, for their assistance in preparing this account. Thanks also to Ailsa Burns, Michael Leach and

David Pearman for their comments on the draft, and to John Allinson and John Gould for tracking down a suitable photograph. I am especially grateful to Michael Binyon for allowing me to draw upon the obituary written by him which appeared in *The Times* on 21 December 2007.

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SIMON J. LEACH

PETER CHARLES HALL
(1917–2008)

Peter Hall died in Poole, Dorset, on 7 March 2008, a few weeks short of his ninety-first birthday and less than four years after his beloved wife Joan. During their 54 years of marriage they were an inseparable pair – at work, socially and in their botanical pursuits – so many of the points made in Joan's obituary (*Watsonia* **25**: 441–442, 2005) are equally applicable to Peter and mostly will not be repeated here.

Peter was born on 30 April 1917 in Southgate, now in London. He told me that he did not have a very happy childhood, either at home or as a boarder to Brentwood School, which he did not like, not enjoying either academic work or any sports. Most of his holidays he spent not at home but with his paternal grandparents in Poole. These were, he said, idyllic periods at a time before motor vehicles



Peter Hall, at his retirement in 1977

were common (though his father had a large car), and fond memories of the place were the reason for Peter and Joan's final move there in 1994. After school, with few qualifications, he briefly joined his father's accountancy business, but he did not take to that and in 1935 he took examinations and passed into the Scientific Civil Service as a chemist (chemistry being his favourite school subject). He was stationed at Woolwich Arsenal, specialising in petroleum products, but on the outbreak of war he was moved to an I.C.I. laboratory in Dumfries, returning to Woolwich at the end of the war. In 1946 he was seconded to Risley, Cheshire, where he took charge of the oil laboratory. It was there that he met Joan, a paint specialist, sharing with her a love of rambling in the northern hills and dales. They were posted back to Woolwich a few years later, and they married soon after in 1950, setting up home in Erith. Other secondments to the British Army and N.A.T.O. saw Peter working in Chessington, Paris and Brussels, and visiting further afield in Hong Kong. Joan retired in 1969, and Peter in 1977, aged 60, spending his last three years working in the Admiralty Oil Laboratory in Cobham, Kent. Within two years they moved to Monmouth, where they spent 15 happy years gardening, visiting National Trust properties (especially those with good gardens), and taking part in botanical excursions. Peter was always very interested in words, and they became expert crossword solvers, winning several national competitions in the broadsheet newspapers and *The Listener*. Their library included many dictionaries and related works, including a forbidding series called *Difficult Crosswords*. Late in life Peter also took up Sudoku. He enjoyed watching sport, especially horse-racing, show-jumping and rugby.

Enthusiasm gained from reading J. E. (Ted) Lousley's *Wild Flowers of Chalk and Limestone*, and then a chance meeting with the man himself in the field at Box Hill, Surrey, persuaded them to join the B.S.B.I. in 1952. In the same year they joined the London Natural History Society, in which they became especially friendly with E.B. (Ted, or Bang) Bangerter, with whom they continued in correspondence after his emigration to New Zealand until his death in 2001. Peter became the Botanical Meetings Secretary of the L.N.H.S., taking pride in arranging trips to benefit from the cheap excursions offered by British Rail. One such that I attended was to the Lewes downs and levels in 1961. Peter and

Joan were among the founder members of the Kent Field Club in 1955. In 1979 W. T. Stearn sponsored Peter for election to Fellowship of the Linnean Society.

Peter served as a B.S.B.I. Council member from 1956 to 1959, as a member of Meetings Committee from 1955 to 1968, as a member of Records Committee from 1966 (when it commenced) to 1980, and, most importantly, as Honorary Field Secretary from 1956 to 1967. This last period took the Society through its first *Atlas* project and beyond. The post involved much effort in organising and liaising, two of Peter's strong points, and he claimed to have taken part in every field excursion of the B.S.B.I. in England and Wales while the *Atlas* data were being gathered. Additionally, he helped Francis Rose and Paul Jovet to organise a highly successful trip to France in July 1959, centred on Boulogne and Abbeville, our first official foreign excursion. In recognition of all his hard work for the B.S.B.I. he was elected an Honorary Member in 1967.

Peter and Joan became expert field botanists without ever forming an herbarium, and many less experienced people, myself included, benefited greatly from their help so willingly and graciously given. As mentioned above, they were very much a pair. Joan was very happy to remain more in the background, but she was undoubtedly the brains and driving force and she derived much pleasure from seeing Peter in the limelight. In the 1970s and 1980s they made trips to many botanical hotspots on the Continent, particularly Spain, the Alps, Yugoslavia and Crete, for which Peter made extremely detailed preparatory notes and



Left to right, Brenda Howitt, Leaver Howitt and Peter Hall

Joan wrote extensive diary-style reports. Peter's most tangible contribution to botany was *Sussex Plant Atlas* (1980), completed just before they left the south-east for Monmouth and summarising the work of the Sussex Flora Committee from 1966 to 1978. His convivial nature and friendly smiling face, however, are more vivid in the minds of many of his friends and companions. Peter was known by all as a jovial character with a keen sense of humour and a thirst for knowledge, and he mixed well with everybody.

Two of the many friends that Joan and Peter made during the period of *Atlas* recording were R. C. L. (Leaver) and Brenda Howitt, authors of *A Flora of Nottinghamshire* (1963). Their obituaries can be found in *Watsonia* **15**: 417–419 and **14**: 291 respectively, but there were no

accompanying photographs. The larger photograph reproduced here shows Brenda, Leaver and Peter at a Scottish Field Meeting in 1955, planning the day's *Atlas* recording. The image of Joan (*Watsonia* **25**: 442, 2005) used for her obituary was taken from the same group photograph (wrongly dated there as "around 1960").

We regret the passing of yet another of the B.S.B.I. 'old guard', those who were instrumental in the Society winning its spurs and moving into its 'golden age'. Neither Peter nor Joan had any siblings, and they had no children.

Peter himself provided me with many of the above details. I am also grateful to David Allen for reading a draft and for supplying a number of additional historical points.

CLIVE STACE

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The cover illustration of *Primula scotica* Hook. (Scottish Primrose) was drawn by Rosemary Wise.

Some new British and Irish *Sorbus* L. taxa (Rosaceae)

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ABSTRACT

Nine new *Sorbus* taxa are described from Britain and Ireland: *S. admonitor* M. C. F. Proctor, sp. nov., *S. cambrensis* M. C. F. Proctor, sp. nov., *S. cuneifolia* T. C. G. Rich, sp. nov., *S. eminentiformis* T. C. G. Rich, sp. nov., *S. margaretae* M. C. F. Proctor, sp. nov., *S. × motleyi* T. C. G. Rich, hybr. nov., *S. scannelliana* T. C. G. Rich, sp. nov., *S. stenophylla* M. C. F. Proctor, sp. nov. and *S. stirtoniana* T. C. G. Rich, sp. nov.

KEYWORDS: agamospecies, Britain, Ireland, isozymes, whitebeam.

INTRODUCTION

Some new *Sorbus* L. (Rosaceae) names are required for taxa to be included in an identification handbook (T. C. G. Rich *et al.*, in preparation). Some taxa, such as the form of *S. anglica* Hedl. from Llangollen with narrower cuneate bases to the leaves or the more deeply lobed form of *S. devoniensis* E. F. Warb., have been known for many years, whilst other taxa have only recently been discovered. The new taxa are described below.

METHODS

Broad leaves from the short, vegetative shoots in sunlit situations, excluding the oldest and youngest leaf (Aas *et al.* 1994), were measured on herbarium material in NMW. Lobing was measured perpendicular to the main vein at the centre of the leaf. The numbers of individual veins or pinnae are described rather than number of pairs as the veins or pinnae are usually alternate or subopposite rather than being strictly opposite. Fruits were measured

on fresh material, and the colours matched against the Royal Horticultural Society colour charts (Royal Horticultural Society 1966).

Conservation status assessments were made for the new species following the I.U.C.N. (2001) guidelines. These are largely based on known population sizes or estimates as there are no data on population trends.

NEWS SPECIES DESCRIPTIONS

***Sorbus admonitor* M. C. F. Proctor, sp. nov.**

HOLOTYPE: large tree above scree, Watersmeet, v.c. 4 North Devon, England, SS744490, 10 October 2007, T. Rich & D. Cann (NMW, accession no. V.2007.1.225; ISOTYPE: **BM, CGE**).

Diagnosis: *S. devoniensis* E. F. Warb. similis sed foliis in centro laminae 10–23(–25) partibus centesimis ad costam profundius lobatis (non, ut in *S. devoniensis*, 6–18(–23) partibus centesimis) differt.

Similar to *S. devoniensis* E. F. Warb. but differing in having leaves more deeply lobed 10–23(–25)% of the way to the midrib at the centre of the lamina (not 6–18(–23)% as in *S. devoniensis*).

Sorbus admonitor is a member of the *S. latifolia* group, and is characterised by the ovate to obovate, shallowly but acutely lobed leaves 1.2–1.5 times as long as wide and cut 10–23% of way to the midrib with broadly rounded to broadly cuneate bases and greenish-white undersides, and by the large brownish berries. Compared to *S. devoniensis* the leaves are also glossier. Figure 1 shows typical leaves of *S. admonitor* and *S. devoniensis*.

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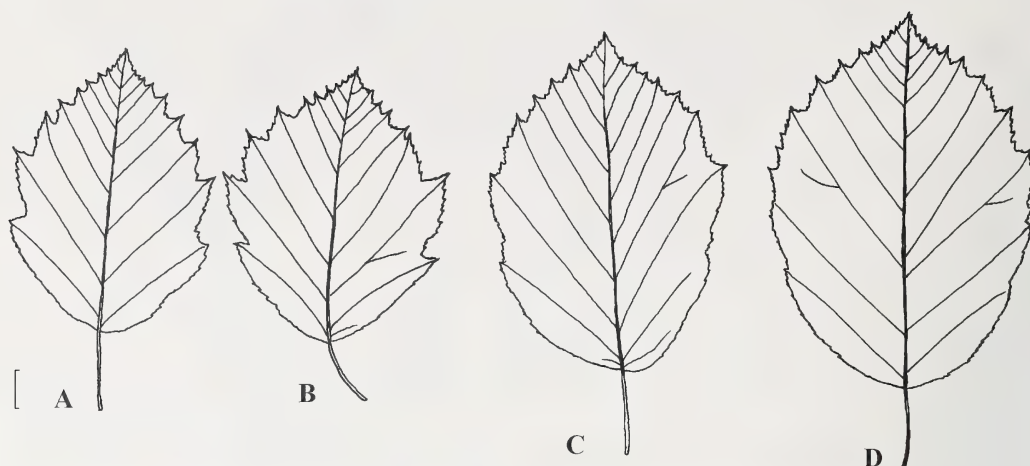


FIGURE 1. Typical leaves of *S. admonitor* (A, B) and *S. devoniensis* (C, D). Scale bar 1 cm.

Sorbus admonitor has been known for many years as the large tree at Watersmeet car park, Devon with a 'No Parking' notice nailed to it, which had leaves more deeply lobed than the widespread form of *S. devoniensis* (Martin & Fraser 1939; Sell 1989). Studies of isozymes by Proctor *et al.* (1989) showed that *S. admonitor* differs consistently from *S. devoniensis*. The specific epithet '*admonitor*' (i.e. to admonish) was first coined by E. F. Warburg as a jocular reference to the 'No Parking' notice.

Sorbus admonitor is endemic to the Watersmeet area where there are at least 108 trees in the East Lyn Valley and two trees nearby above Sillery Sands, Lynmouth (Rich & Cann 2009). *Sorbus devoniensis sensu stricto* does not grow in the East Lyn Valley area and the two taxa have not been confirmed growing together. *Sorbus admonitor* differs from *S. subcuneata* Wilm., with which it does grow, in having broader leaves with rounded bases, and a denser crown.

The I.U.C.N. (2001) conservation assessment is 'Endangered' based on the Rich & Cann (2009) survey data.

***Sorbus cambrensis* M. C. F. Proctor, sp. nov.**

HOLOTYPE: face of railway cutting cliff, Cwm Clydach, SO218120, 9 July 2001, T. C. G. Rich, R. Preece & G. Motley (NMW, accession no. V.2001.25.74a).

DESCRIPTION

Frutex vel arbor parva ad 8 m. Cortex truncorum majorum griseibrunneus. Gemmae lanceoloideae, acutae, pilis albis vestitae. Folia

lata brachyblastorum 6.0–11.0(–12.5) × (4.0–) 4.5–8.0(–8.5) cm, obovata, 1.3–1.6plo longiora quam latiora, ad longitudinis suae 53–67 partes centesimas latissima, apice obtuso, basi cuneata (angulo inter marginem et costam 34–54(–58)°), sine lobis vel lobis non profundis secta, marginibus biserratis, dentes plerumque exstantes ferentibus sed in 1–3 cm infimis prope petiolum fere integris, venis 18–24, in centro laminae ad angulum (28–)31–41(–48)° a costa tentis; pagina superior atro-viridis; pagina inferior griseialba tomentosa. Inflorescentiae ad 8 cm diametro, aggregatae, tholiformes, ramulis sparsim tomentosis instructae. Sepala triangularia vel deltata, viridia vel tomentosa. Petala 7–8.5 × 5–6 mm, elliptica, alba. Antherae cremaeae vel cremaeae roseinctae. Styli 2, plus minusve per dimidium longitudinis conjuncti, ad basin pilosi. Fructus maximi 10.5–12.5 × 11.5–13 mm, 0.8–1.0plo longiores quam latiores, saepe aspectu globoso, in maturitate saturate coccinei, lenticellarum mediocrium numero modico praediti.

Shrub or small tree to 8 m or more tall. Bark of larger trunks greyish-brown. Buds lanceoloid, acute, clothed with white hairs. Broad leaves of short sterile shoots 6.0–11.0(–12.5) × (4.0–) 4.5–8.0(–8.5) cm, obovate, 1.3–1.6 times as long as wide and widest 53–67% of the way along the leaf length, with the apex obtuse and the base cuneate (with the angle between the margin and the midrib 34–54(–58)°, unlobed or shallowly lobed, with the margins biserrate with teeth usually directed outwards but nearly entire in the lowest 1–3 cm near the petiole,

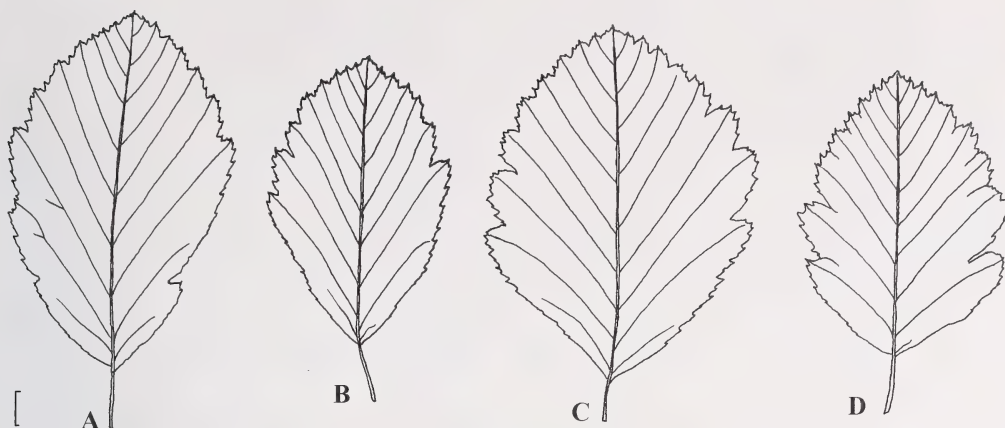


FIGURE 2. Typical leaves of *S. cuneifolia* (A, B) and *S. anglica* (C, D). Scale bar 1 cm.

with 18–24 veins, held at an angle of $(28)31$ – $41(48)^\circ$ to the midrib at the centre of the lamina; upper surface dark green; lower surface greyish-white tomentose. Inflorescences to 8 cm in diameter, crowded, domed, with branchlets sparsely tomentose. Sepals triangular to deltate, green or tomentose. Petals $7\text{--}8.5 \times 5\text{--}6$ mm, elliptic, white. Anthers cream or cream with a hint of pink. Styles 2, joined for about half their length, pilose at the base. Largest fruits $10.5\text{--}12.5 \times 11.5\text{--}13$ mm, $0.8\text{--}1.0$ times as long as wide, often looking globose, deep red at maturity (R.H.S. colour chart 33A, 42A, 44A, 45A, 46A), with a moderate number of medium lenticels.

Sorbus cambrensis is a member of the *S. porrigentiformis* E. F. Warb. group within the *S. aria* (L.) Crantz group, and is characterised by the obovate, biserrate leaves which are greyish-white underneath and the large subglobose fruits.

Studies of *S. porrigentiformis* by Proctor & Groenhof (1992) demonstrated that trees from Coed Pantydarren (cited as Darren Disgwylla), Craig-y-Cilau and other crags in the Llangatock area had a different isozyme profile to the widespread lowland form of *S. porrigentiformis*, and also differed in leaf tootching and fruit size and shape. They also noted that plants at Tarren yr Esgob differed slightly from *S. cambrensis*, and these are described separately below as *S. stenophylla*.

Sorbus cambrensis is endemic to v.c. 42 Breconshire, Wales. It has been recorded scattered widely within Cwm Clydach, at Blackrock, at Craig-y-Cilau, and at Coed Pantydarren. The total population is probably about 100 plants.

Sorbus cambrensis is very similar to *S. porrigentiformis* and *S. stenophylla*. It tends to grow into a larger tree than *S. porrigentiformis* with usually more robust shoots, has leaves somewhat more oblong in outline and biserrate, and has larger, subglobose fruits (length:width ratio $0.85\text{--}0.95$) which are brighter red. *Sorbus stenophylla* has narrower leaves with a narrower cuneate base and deeper biserrate tootching. Morphologically the leaves are similar to those of *S. leptophylla* E. F. Warb. but that species has fruits longer than wide. For leaf silhouettes of *S. cambrensis*, see Figures 5j–l of Proctor & Groenhof (1992).

The provisional I.U.C.N. (2001) conservation assessment is 'Endangered'.

Sorbus cuneifolia T. C. G. Rich, **sp. nov.**

HOLOTYPE: Creigiau Eglwyseg (Cefn Fedw), Llangollen, v.c. 50 Denbighshire, Wales, 10 July 2002, T. C. G. Rich & S. O. Hand (NMW, accession no. V.2002.17.161).

Diagnosis: *S. anglicae* Hedl. similis sed foliis basi angustius cuneatis, angulo inter marginem et costam $(29)32\text{--}44(46)^\circ$ (non, ut in *S. anglica*, foliis basi late cuneatis, angulo inter marginem et costam $(38)40\text{--}59(65)^\circ$) differt.

Similar to *S. anglica* Hedl. but differing in having leaves more narrowly cuneate at the base with the angle between the margin and the midrib $(29)32\text{--}44(46)^\circ$ (not broadly cuneate with the angle between the margin and the midrib $(38)40\text{--}59(65)^\circ$ as in *S. anglica*).

Sorbus cuneifolia is a member of the *S. anglica*/*S. intermedia* group, and is characterised by the elliptic to obovate leaves with distinct obtuse lobes cut up to about a quarter

to one third of the way to the midrib; they are greyish-white tomentose beneath with 'feathery' intermediate veins between the main veins, and have cuneate leaf bases.

Sorbus cuneifolia was first recognised as distinct by A. J. Wilmott and E. F. Warburg who used a working epithet '*castelli*' after its occurrence on the ruined walls of Castell Dinas but they never published it. The epithet *cuneifolia* refers to the narrower leaf bases, its distinguishing feature from the closely related *S. anglica*. Figure 2 shows typical leaves of *S. cuneifolia* and *S. anglica*.

Sorbus cuneifolia is a rare tree confined to the west-facing Carboniferous Limestone crags of Eglwyseg Mountain north of Llangollen, Denbighshire (v.c. 50), Wales. About 240 plants are known (Morgan 1987, Woods 1998), and its I.U.C.N. (2001) conservation assessment is thus 'Endangered'.

Sorbus eminentiformis* T. C. G. Rich, *sp. nov.

HOLOTYPE: coppiced tree in woodland, Seven Sisters, Great Doward, v.c. 36 Herefordshire, England, SO546153, 23 September 2002, T. C. G. Rich (NMW, accession no. V.2002.17.150).

Diagnosis: *S. eminenti* E. F. Warb. similis sed foliis subrhombicis ad basin late cuneatis (non, ut in *S. eminente*, orbicularibus ad basin rotundatis) differt.

Similar to *S. eminens* E. F. Warb. but differing in having subrhombic leaves broadly cuneate at the base (not orbicular and rounded at the base as in *S. eminens*).

Sorbus eminentiformis is a member of the *S. aria* group and is characterised by the obovate-orbicular to subrhombic leaves 1.0–1.3 times as long as wide with a broadly cuneate base (the lowest part of the leaf looking triangular) and regular, neat, uniserrate, acuminate teeth, and the broad, red fruits.

When Warburg (1957) described *S. eminens* from Offa's Dyke, Tidenham in the Wye Valley, he noted that plants from around Symonds Yat differed from the form he described from the Wye Valley and Avon Gorge in having subrhombic leaves with rather deeper teeth. Molecular studies by Proctor & Groenhof (1992), Chester *et al.* (2007) and Cowan *et al.* (2008) have confirmed that they differ from each other. For leaf silhouettes of *S. eminentiformis* see Figures 4a–b of Proctor & Groenhof (1992), and Figures 4c–f for *S. eminens*.

Sorbus eminentiformis is endemic to the Lower Wye Valley in England and Wales, where it occurs in v.c. 34 West Gloucestershire, v.c. 35 Monmouthshire and v.c. 36 Herefordshire (Rich *et al.* 2009). The total population is probably under 100 trees, the bulk of which occur on the Great Doward. The I.U.C.N. (2001) conservation assessment is 'Endangered'.

Sorbus margaretae* M. C. F. Proctor, *sp. nov.

HOLOTYPE: Desolate, v.c. 4 North Devon, SS7849, 31 May 1997, M. C. F. Proctor (NMW, accession no. V.2003.19.388).

Diagnosis: *S. vexanti* E. F. Warb. similis sed fructibus latis atrorubrioribus latioribus quam longioribus differt.

Similar to *S. vexans* E. F. Warb. but differing in having broad, darker red fruits that are wider than long.

Sorbus margaretae is a member of the *S. aria* group, and is characterised by the unlobed, obovate leaves with biserrate teeth which are densely white-tomentose underneath and the red, very broad fruits.

Sorbus margaretae was first recognised as distinct by Margaret E. Bradshaw during her surveys of the rare whitebeams of South-west England in 1984, and it is named after her. It was provisionally named 'Taxon D', and isoenzyme studies showed that it is genetically distinct from the related species *S. rupicola* (Syme) Hedl. and *S. vexans* (Proctor *et al.* 1989). It is probably the plant referred to as '*S. rupicola* "Devon form"' by Martin & Fraser (1939).

Sorbus margaretae is endemic to the coast of South-west England from Combe Martin, North Devon (v.c. 4) to Culbone, South Somerset (v.c. 5). The total population is at least 120 plants. The I.U.C.N. (2001) conservation assessment is 'Endangered' based on the available data.

Sorbus margaretae is distinguished from *S. vexans* by the darker red fruits which are much broader than long, and by minor leaf characters (Proctor *et al.* 1989). It is distinguished from *S. rupicola* – which has elliptic-obovate leaves with single toothing – by the broader obovate leaves with biserrate toothing. *Sorbus porrigentiformis* also grows in some of the same localities and is similar but has broader leaves. Figure 3 shows typical leaves and fruits of *S. margaretae*, *S. rupicola* and *S. vexans*.

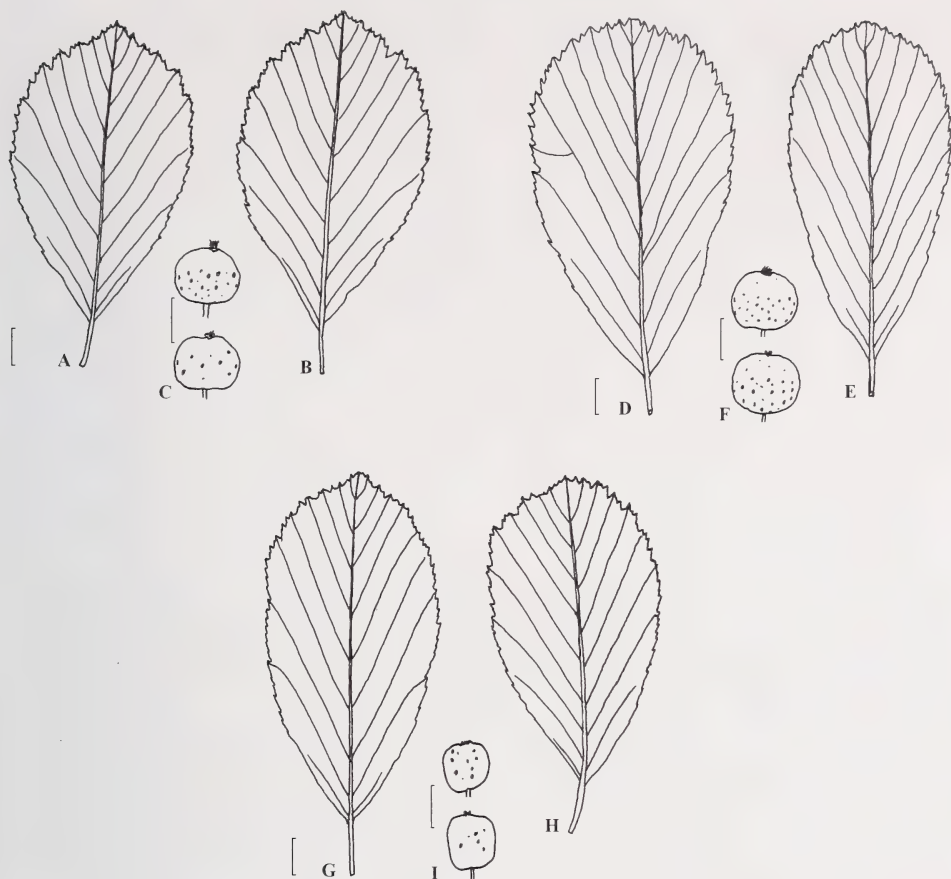


FIGURE 3. Typical leaves and fruits of *S. margaretae* (A–C), *S. rupicola* (D–F) and *S. vexans* (G–I). Scale bars 1 cm.

Sorbus × *motleyi* T. C. G. Rich, **hybr. nov.**
= *Sorbus aucuparia* L. × *S. leyana* Wilm.

HOLOTYPE: Coed Penmailard, Brecon (v.c. 42), Wales, T. C. G. Rich, 11 June 2002 (NMW, accession no. V.2002.17.074).

DESCRIPTION

Arbor juvenis caulibus erectis. Petioli 10–14 mm. Folia lata brachyblastorum 65–86 × 50–60 mm, 1.25–1.65 plo longiora quam latiora, elliptica, ad longitudinis suae 40–55 partes centesimas latissima, venis 13–17, in centro laminae ad angulum 37–55° a costa tentis, profunde lobata, ad basin pinnis lateralibus 4–7 discretis ellipticis acutis et foliolo terminali multo ampliore late ovato obtuso lobato praedita, marginibus magis minusve uniserratis, dentes acutos prorsum projectos ferentibus, supra glabrescentia, infra

viridulialba tomentosa, aestate exeunte glabrescentia. Inflorescentiae ad 8 cm diametro, aggregatae, tholiformes, ramulis sparsim tomentosis instructae. Flores 12–18 mm diametro. Sepala triangularia, tomentosa, glandulis paucis in marginibus praedita. Petala 7–9 × 5–6 mm, elliptica, alba. Antherae cremeae roseitinctae. Styli 2, plus minusve per unum longitudinis trientem conjuncti, ad basin pilosi. Fructus maximi 9–12 × 10–13 mm, (0.75–)0.8–1.0 plo longiores quam latiores, aspectu plerumque latiores quam longiores, in maturitate coccinei, lenticellis paucis parvis praediti.

Young tree with erect stems. Petioles 10–14 mm. Broad leaves of short shoots 65–86 × 50–60 mm, 1.25–1.65 times as long as wide, elliptic, widest 40–55% of the way along the leaf length, with 13–17 veins, held at an angle

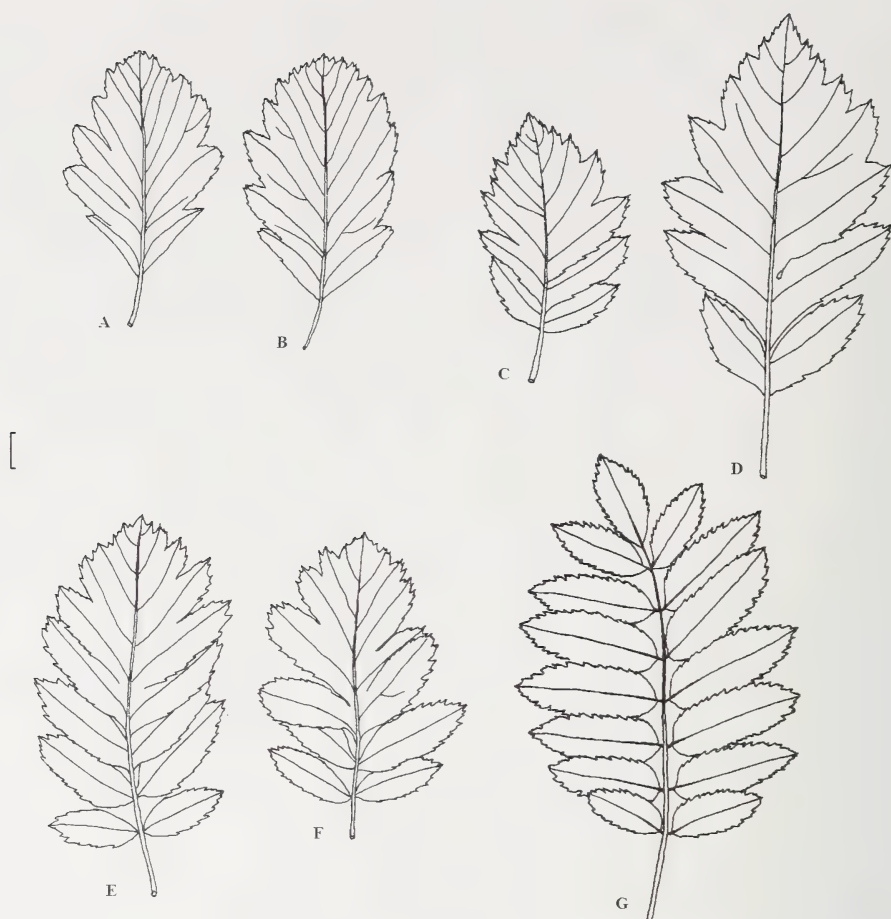


FIGURE 4. Leaves from *Sorbus* species at Coed Penmailard. A, B, Broad leaves of short shoots of *S. leyana*. C, D sucker leaves of *S. leyana*. E, F Broad leaves of short shoots of *S. x motleyi*. G, *S. aucuparia*. Scale bar = 1cm.

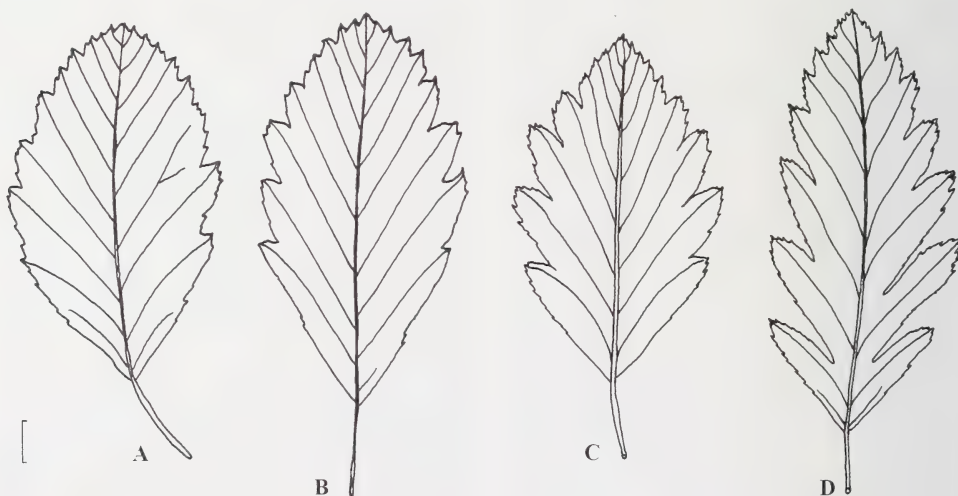


FIGURE 5. Typical leaves of *S. scannelliana* (A, B), and *S. arranensis* (C, D). Scale bar 1 cm.

of 37–55° to the midrib at the centre of the lamina, deeply lobed with 4–7 free, elliptic, acute, lateral pinnae at the base and a much larger broadly ovate, obtuse, lobed terminal leaflet, with the margins $\pm$ uniserrate with acute, forward-pointing teeth, glabrescent above, greenish-white tomentose beneath, becoming glabrescent in late summer. Inflorescences to 8 cm in diameter, crowded, domed, with branchlets sparsely tomentose. Flowers 12–18 mm in diameter. Sepals triangular, tomentose, with a few glands on the margins. Petals 7–9 $\times$ 5–6 mm, elliptic, white. Anthers cream with a hint of pink. Styles 2, joined for about a third of their length, pilose at the base. Largest fruits 9–12 $\times$ 10–13 mm, (0.75–)0.8–1.0 times as long as wide and usually looking wider than long, widest at of below the middle, scarlet at maturity (R.H.S. colour chart 45B) with a few small lenticles.

Sorbus $\times$ motleyi is a member of the *S. anglica/S. intermedia* group, and is characterised by the leaves with 4–7 free leaflets and a larger terminal lobe, and greenish white underneath. The wild saplings are too young to fruit, and the description of flowers and fruits here is based on grafted material which flowered at the National Botanic Garden of Wales in 2008.

Sorbus $\times$ motleyi (Figure 4E–F) differs from *S. leyana* (Figure 4A, B) in having leaves with four or more free lateral pinnae, the lowest of which are typically constricted at their base where they join the petiole. *Sorbus leyana* leaves from sunlit situations are generally deeply lobed but lack free pinnae (Figure 4A, B), but in deep shade or on sucker regrowth from damaged stems, they may have 1–3 free pinnae at the base of the leaf, usually with the lamina adnate to the midrib on both sides (Figure 4C, D). *Sorbus $\times$ motleyi* differs from *S. aucuparia* (Figure 4G) in having a broad, lobed, terminal leaflet much larger than the lateral leaflets.

Sorbus $\times$ motleyi is more likely to be confused with two other hybrids than either of its parents. It differs from *S. $\times$ thuringiaca* (Ilse) Fritsch (= *S. aucuparia* $\times$ *S. aria*) in having broader leaves with fewer veins and obtuse apices (leaves 1.5–2.0 times as long as wide with 16–27 veins and acute apices in *S. $\times$ thuringiaca*). *Sorbus $\times$ motleyi* differs from *S. $\times$ liljeforsii* T. Rich (= *S. aucuparia* $\times$ *S. intermedia*) in having broader leaves with greenish-white-tomentose undersides to the leaf (1.4–2.0 times as long as wide and

greenish-tomentose underneath in *S. $\times$ liljeforsii*; Rich 2008).

In 1999, G. S. Motley, after whom it is named, found a sapling with leaves intermediate between *S. leyana* and *S. aucuparia* under a *S. aucuparia* tree at Coed Penmailard, which he interpreted as a hybrid between them. A second, younger sapling was found nearby in 2004. AFLP data confirmed the hybrid origin of the first sapling (unpublished data; R. S. Cowan, pers. comm. 2002).

Sorbus $\times$ motleyi is analogous in origin to *S. pseudofennica* E. F. Warb., which arose as a *S. arranensis* Hedl. $\times$ *S. aucuparia* hybrid on Arran (Robertson *et al.* 2004a, b). The two *S. $\times$ motleyi* saplings appear to be different ages, and must have arisen independently; Robertson *et al.* (2004a, b) found that *S. pseudofennica* had also arisen on more than one occasion. The older of the two *S. $\times$ motleyi* saplings probably originated in c. 1990 after the damage inflicted to the woodland by the second Great Storm of 1989 (cf. Rich *et al.* 2005). The chromosome number is not known.

Sorbus $\times$ motleyi is endemic to Wales, and has only been found at Coed Penmailard, v.c. 42 Brecon. Currently only two saplings are known which could easily be accidentally trampled if care is not taken when visiting the site. It is I.U.C.N. (2001) threat category 'Critically Endangered'.

Sorbus scannelliana T. C. G. Rich, **sp. nov.**

HOLOTYPE: wooded limestone ridge east of Blue Pool, Ross Island, Killarney, V9469588161, v.c. H2 North Kerry, Ireland, 9 September 2008, R. Hodd, A. McVeigh & T. Rich (NMW, accession number V.2008.1.3; ISOTYPE: **BEL, BM, DBN, TCD**).

Diagnosis: *S. arranensis* Hedl. similis sed foliis obtusis, in centro laminae 14–24 partibus centesimis ad costam non tantopere profunde lobatis (non, ut in *S. arranensis*, acutis, in centro laminae 30–60 partibus centesimis ad costam lobatis) differt.

Similar to *S. arranensis* Hedl. but differing in having obtuse leaves not so deeply lobed 14–24% of the way to the midrib at the centre of the lamina (not acute and lobed 30–60% of the way to the midrib at the centre of the lamina as in *S. arranensis*).

Sorbus scannelliana is a member of the *S. anglica/S. intermedia* group, and is characterised by the shallowly lobed, elliptic leaves which are greenish-white tomentose

underneath. It has probably evolved as a hybrid between *S. aucuparia* and *S. rupicola* (analogous in origin to *S. arranensis*) in the Killarney area where both parents occur. The epithet honours Maura J. P. Scannell, whose knowledge of Irish botany is unrivalled.

Sorbus scannelliana is endemic to Ross Island, Killarney, Kerry (v.c. H2), Ireland, and was first found in June 1988 by T. Rich and N. Taylor. The population size in September 2008 was found to be only five plants, and the I.U.C.N. (2001) conservation assessment is 'Critically Endangered'.

In the Killarney area, *S. scannelliana* is only likely to be confused with *S. anglica* which is locally frequent on Ross Island and the Muckross Peninsula, and *S. intermedia*. *Sorbus anglica* has broader leaves which are whiter underneath with distinct cross venation between the main leaf veins (Figure 2c, d). *Sorbus intermedia* is also naturalised on Ross Island and differs in having more deeply lobed leaves with fewer veins. *Sorbus scannelliana* differs from *S. leyana* Wilm. in having shallower leaf lobes, and from *S. minima* (Ley) Hedl. in having larger, broader leaves. Figure 5 shows typical leaves of *S. scannelliana* and *S. arranensis*.

***Sorbus stenophylla* M. C. F. Proctor, sp. nov.**

HOLOTYPE: Tarren yr Esgob, v.c. 42 Breconshire, Wales, SO252305, 6 September 1970, M. Porter (NMW).

DESCRIPTION

Frutex vel arbor parva ad 8 m. Gemmae lanceoloideae, acutae, pilis albis vestitae. Folia lata brachyblastorum (5.5–)7.0–11.5(–12.5) × 4.5–7.0(–7.5) cm, obtrullata vel oblonga, 1.35–1.75plo longiora quam latiora, ad longitudinis suae 52–67 partes centesimas latissima, apice obtuso vel rotundato interdum acuminato vel acuto, basi cuneata (angulo inter marginem et costam 30–42°), plerumque sine lobis sed interdum lobis non profundis secta, marginibus dentes acutos biserratos, prope apicem plerumque curviserratos, ferentibus sed in 1–3 cm infimis prope petiolum fere integris, venis (13–)14–20(–21), in centro laminae ad angulum (25–)27–33(–37)° a costa tentis; pagina superior atroviridis; pagina inferior griseialba tomentosa. Inflorescentiae ad 6 cm diametro, tholiformes, aggregatae, ramulis tomentosis instructae. Sepala triangularia, aut sparsim tomentosa aut viridia et solum in marginibus tomentosa. Petala 6–9 × 6–7 mm,

late elliptica vel late ovata, alba. Antherae roseae. Styli 2, plus minusve per dimidium longitudinis conjuncti. Fructus maximi 11.5–13.5 × 12–14 mm, 0.85–1.0plo longiores quam latiores, aspectu plerumque latiores quam longiores, in maturitate rubri, lenticelliarum parvarum vel magnarum numero modico praediti.

Shrub or small tree to 8 m tall. Buds lanceoloid, acute, clothed with white hairs. Broad leaves of short sterile shoots (5.5–)7.0–11.5(–12.5) × 4.5–7.0(–7.5) cm, obtrullate to oblong, 1.35–1.75 times as long as wide and widest 52–67% of the way along the leaf length, with the apex obtuse to rounded, occasionally acuminate or acute, and the base cuneate (with the angle between the margin and the midrib 30–42°), usually unlobed or occasionally with shallow lobes, with the margins biserrate, with acute teeth usually curving towards the apex near the top, but with the lowest 1–3 cm near the petiole nearly entire, with (13–)14–20(–21) veins, held at an angle of (25–)27–33(–37)° to the midrib at the centre of the lamina; upper surface dark green; lower surface greyish-white tomentose. Inflorescences to 6 cm in diameter, domed, crowded, with branchlets tomentose. Sepals triangular, either sparsely tomentose or green and tomentose only on the margins. Petals 6–9 × 6–7 mm, broadly elliptic to broadly ovate, white. Anthers pink. Styles 2, joined for about half their length. Largest fruits 11.5–13.5 × 12–14 mm, 0.85–1.0 times as long as wide and usually looking wider than long, red at maturity (R.H.S. colour chart 42A, 44A, 45A), with a moderate number of small to large lenticels.

Sorbus stenophylla is a member of the *S. porrigentiformis* group within the *S. aria* group, and is characterised by the narrowly cuneate, obtrullate to oblong leaves with deeply incised teeth, and fruits which are wider than long.

Specimens named by E. F. Warburg show that he included material from the Llanthony Valley in his *S. porrigentiformis*. Studies of the isozymes by Proctor & Groenhof (1992) demonstrated that the isozyme profiles differed from *S. porrigentiformis* and were similar to *S. cambrensis*, differing from the latter in clearer separation of two bands. As the leaf shape is consistently different, they are treated as a distinct species. For leaf silhouettes showing *S. stenophylla* see Figures 5m–o of Proctor & Groenhof (1992). For differences from *S. cambrensis*, see above.

Sorbus stenophylla is endemic to the Llanthony Valley, Wales at Darren, Cwmyoy (v.c. 35), Tarren yr Esgob (in both v.c. 35 and v.c. 42) and Darren Lwyd (v.c. 42). Some plants at Craig-y-Cilau (v.c. 42) and Pwll-du Quarry, Govilon (v.c. 35) match *S. stenophylla* in morphology but require verification from DNA analysis. The population size at Tarren yr Esgob is c. 50 plants, there are seven trees at Darren Lwyd, and 50–100 at Cwmyoy. The I.U.C.N. (2001) conservation assessment is 'Endangered'.

***Sorbus stirtoniana* T. Rich, sp. nov.**

HOLOTYPE: Tree c. 5 m tall with many trunks above track just west of junction, West Crag, Craig Breidden, v.c. 47 Montgomeryshire, Wales, grid reference SJ288139, T. C. G. Rich, A. Law, L. Houston, C. Charles and A. C. Tillotson, 19 June 2001 (NMW, accession no. V.2001.025.184), with photographs of fruits and measurements 2 October 2002.

Diagnosis: A *S. leptophylla* E. F. Warb. foliis ovatis vel ellipticis (non obovatis), ad vel infra (non supra) medium latissimis, differt.

Differs from *S. leptophylla* E. F. Warb. in having ovate or elliptic (not obovate) leaves, widest at or below (not above) the middle

Full description: Tree or small shrub to 5 m, with trunk ascending or appressed to the rock surface. Broad leaves of short shoots (50–)60–110(–135) mm long $\times$ (32–)40–75(–77) mm wide, 1.3–1.8 times as long as wide, ovate to elliptic, widest at (37–)38–55(–56)% along the leaf length, cuneate at the base, acute at the apex, with margins simple or weakly lobed, serrate to biserrate, with a total of (16–)18–24 veins, the veins at the middle of the leaf held at an angle of (28–)29–47(–48) $^{\circ}$ to the midrib, glabrescent above, white-tomentose below. Fruits 11–15(–16) mm long $\times$ (10–)11–13 mm wide, 0.9–1.3 times as long as wide and usually

appearing longer than wide, dark red (RHS 1966 colour chart 46b), with few medium-sized lenticels scattered mainly at the base.

Sorbus stirtoniana is a member of the *S. aria* group, and is characterised by the elliptic to ovate, acute, cuneate leaves with 18–24 veins which are white-tomentose below, and the large fruits which are usually longer than wide. Leaf outlines are given in Figures 2a–e of Rich *et al.* (2005). It is tetraploid (Bailey *et al.* 2008).

Sorbus stirtoniana differs from *S. leptophylla* E. F. Warb., to which it is most closely related, in having leaves wider below rather than above the middle (cf. Figure 1 of Rich *et al.* 2005). It shares the same *Aria* chloroplast type 'D' with *S. leptophylla* (Chester *et al.* 2007), which is also found in *S. aria* (L.) Crantz (frequent) and in *S. porrigentifomis* (rare). *Sorbus stirtoniana* differs from *S. porrigentifomis* and *S. rupicola* in having fruits longer than wide, and in having leaves widest below the middle. *Sorbus stirtoniana* differs from the diploid *S. aria* in having larger leaves and fruits, and in ploidy level.

At least 35 plants are known on the cliffs of the West Crag of Craig Breidden, and two on the North Crag (Rich *et al.* 2005), to which it is endemic. It is I.U.C.N. (2001) 'Critically Endangered'.

Named in honour of Prof. Charles Stirton in recognition of his inspirational work in establishing the National Botanic Garden of Wales.

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Five new *Sorbus* (Rosaceae) taxa from the Avon Gorge, England

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ABSTRACT

One new *Sorbus* species and four new hybrids are described from the Avon Gorge, Bristol. *Sorbus* × *avonensis* is a hybrid between *S. aria* and *S. porrigentifformis*. *Sorbus* × *houstoniae* is a hybrid between *S. aria* and *S. bristoliensis*. *Sorbus leighensis* is a distinct clone of *S. aria* × *S. porrigentifformis* and is locally frequent in the Avon Gorge; it is treated as a species. *Sorbus* × *robertsonii* is a hybrid between *S. aria* and *S. eminens*. *Sorbus* × *proctoris* is a hybrid between *S. aucuparia* and the cultivated *S. scalaris*.

KEYWORDS: Apomixis, hybrid, species, whitebeam, rowan.

INTRODUCTION

The Avon Gorge in South-west England is a large Carboniferous Limestone gorge about 3 km long with wooded slopes and open rocks, cliffs and quarries on the western edge of the city of Bristol. It is designated as a Site of Special Scientific Interest (S.S.S.I.) and Special Area of Conservation (S.A.C.) for its outstanding flora and ravine woodlands (Ratcliffe 1977), and is the most diverse *Sorbus* site in Britain with endemic species such as *S. bristoliensis* Wilm. and *S. wilmottiana* E. F. Warb. (Rich & Houston 2004; Houston *et al.* 2008). During the course of a three-year project funded by the Leverhulme Foundation to elucidate the origin of the endemic *Sorbus* species in the Avon Gorge, five new *Sorbus* taxa have been discovered and their origins

ascertained by analysis of nuclear microsatellites (Robertson *et al.*, in preparation). In this paper the new taxa are described.

All the taxa have originated by hybridisation. It is likely that most *Sorbus* taxa derived from independent crossings of an apomictic polyploid with a variable sexual diploid would result in genetically different, apomictic, polyploids. Such apomictic hybrids could be considered species in their own right as they are reproductively isolated and genetically distinct, but we have adopted the following approach in deciding whether to treat them as hybrids or species. Following normal practice in other groups, the taxa are treated as hybrids if there are one or a few individuals of the same parentage which have probably originated from different hybridisation events (i.e. are polyphyletic), irrespective of whether they are apomictic or not, or polyploid or not. Where only a few such spontaneous hybrids occur in a number of different locations which cannot be differentiated morphologically, it is better to treat them as hybrids rather than describe a myriad of different species which are impractical to tell apart without DNA markers. Additionally, as the biological success of many of these hybrids appears to be low since they do not increase with time (although we do not know when they originated), these may be only short-lived, 'temporary' taxa. However, where there are significant numbers of individuals of a morphologically distinct, monophyletic, apomictic clone (i.e. they are biologically successful), they are treated as species, even if

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of the same parentage as previously described taxa. For example, the locally frequent and distinct *S. leighensis* and the two slightly different examples of the hybrid *S. × avonensis* described below are all derived from *S. aria* (L.) Crantz $\times$ *S. porrigentiformis* E. F. Warb., but are morphologically different from each other and from the readily recognised existing species *S. wilmottiana* E. F. Warb. and *S. whiteana* T. Rich & L. Houston which also have the same parentage (Robertson *et al.*, in preparation). If some of the hybrids should subsequently prove to be successful apomictic clones which become more frequent in the future, their rank could be raised to species.

METHODS

Broad leaves from the short, vegetative shoots in sunlit situations, excluding the oldest and youngest leaf (Aas *et al.* 1994), were measured on herbarium material in NMW. Fruits were measured on fresh material, and the colours matched against the Royal Horticultural Society colour charts (Royal Horticultural Society 1966).

Potential pollen viability was investigated using Alexander's Stain (Alexander 1969) on the flowering collections available. Anthers were removed from herbarium specimens with tweezers under a low-power binocular microscope, and placed on a slide with a drop of Alexander's Stain, warmed briefly on the hotplate, then broken up with the tweezers. The preparation was then covered with a cover-slip and replaced on the hotplate to improve the uptake of the stain. The slides were then examined under a high-power compound microscope for areas of dense pollen grains. Potentially viable grains were counted as those which were large and rounded-triangular with cell walls which stained green and with cytoplasm inside which stained uniformly bright red. Small deformed grains or those staining green only with very little or no red staining inside (i.e. no cytoplasm) were considered infertile. The numbers of pollen grains counted are cited for individual trees; averages and ranges of other species cited are taken from Rich (2009).

Soil pH was measured with a calibrated pHep2 Hanna pocket-sized pH meter in a 50:50 mixture with distilled water on soil samples collected from around the roots.

For nuclear microsatellite methods and results, see Robertson *et al.* (in preparation).

DESCRIPTIONS

Sorbus aria (L.) Crantz $\times$ *S. porrigentiformis* E. F. Warb. = *S. × avonensis* T. Rich, **hybr. nov.**

HOLOTYPE: St Vincent's Rocks South, Avon Gorge, v.c. 34 West Gloucestershire, England, ST/565.730, flowers 21 May 2007, L. Houston, and fruits and photographs 19 September 2007, T. C. G. Rich & L. Houston (NMW, accession number V. 2007.1.132).

ISOTYPE: BM, CGE.

Vernacular name: Avon Gorge Whitebeam.

Frutex vel arbor parva ad 7 m ut minimum. Gemmae ovoidoconicae, virides, ad apicem pilis exalbidis pilosae. Folia lata brachyblastorum 5.5–10.0 $\times$ 4.0–7.5 cm, 1.2–1.4plo longiora quam latiora, obovata vel late elliptica, ad longitudinis suae 51–62 partes centensimas latissima, apice obtuso, basi late cuneata, in centro laminae 0–15 partibus centensimis ad costam leniter lobata, marginibus leniter biserratis dentes prorsum projectos ferentibus, sed 1–2 cm infimis prope petiolum fere integris; pagina superior atroviridis glabra; pagina inferior viridialba tomentosa, venis 15–20 ad angulum 25–32° a costa tentis. Petioli 8–20 mm. Inflorescentia ad 8 cm lata, aggregata, ramulis tomentosis instructa. Flores circa 16–18 mm lati, fragrantis. Sepala anguste triangularia, ad apicem viridula sed ad basin tomentosa, in marginibus sine glandibus. Petala circa 6 $\times$ 5 mm, late elliptica, cupulata, alba. Antherae roseae. Styli 2, usque ad basin discreti, virides, basi pilosa. Fructus maximi 10–11 $\times$ 10–12 mm, 0.85–1.0plo longiores quam latiores, plerumque aspectu magis minusve globoso, in medio latissimi, in maturitate rubri, lenticellis paucis parvis vel magnis praediti. Semina perfecte formata.

Shrub or small tree to at least 7 m. Buds ovoid-conical, green, pilose at tip with whitish hairs. Broad leaves of short shoots 5.5–10.0 $\times$ 4.0–7.5 cm, 1.2–1.4 times as long as wide, obovate to broadly elliptic, widest at 51–62% along leaf length, with apex obtuse and base broadly cuneate, weakly lobed 0–15% of way to midrib at centre of leaf; margins weakly biserrate with teeth directed forwards, but with lowest 1–2 cm near the petiole nearly entire; upper surface dark green, glabrous; lower surface greenish-white tomentose, with 15–20 veins held at an angle of 25–32° to the midrib. Petioles 8–20 mm.

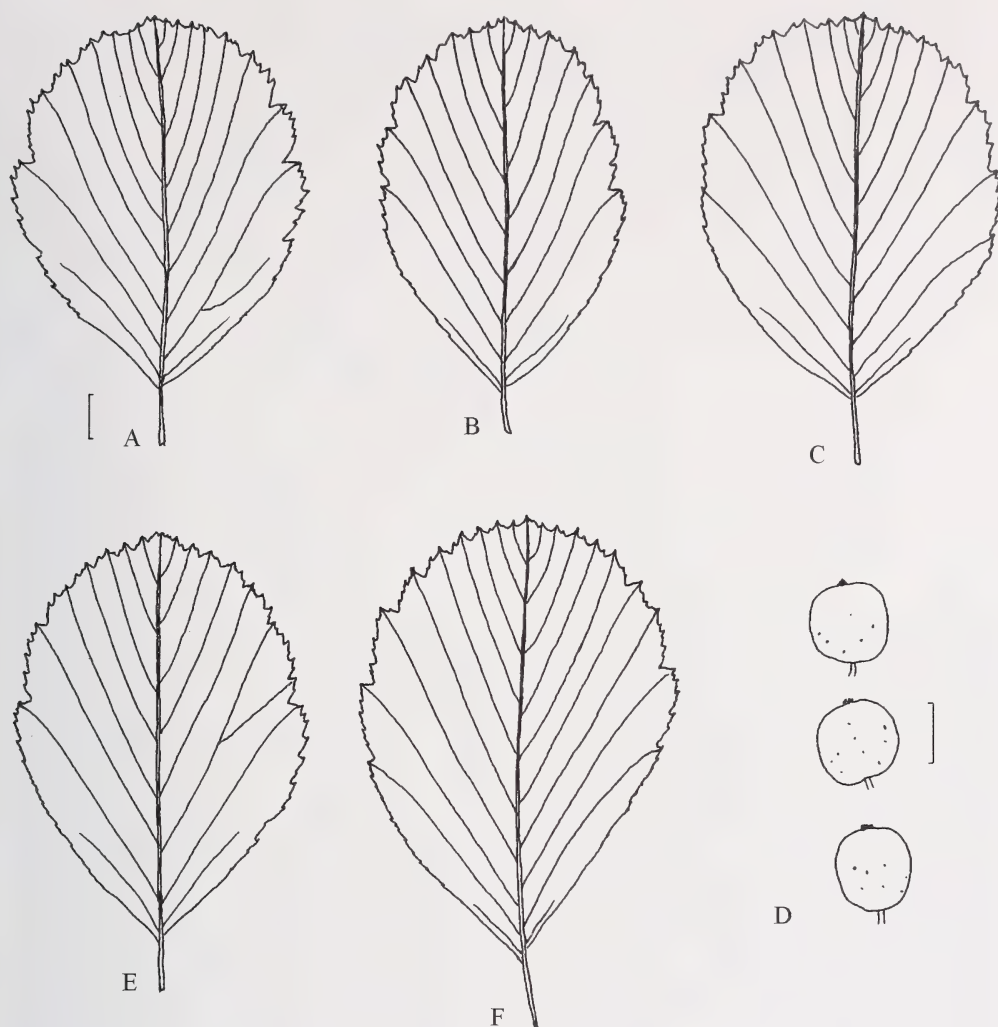


FIGURE 1. Leaves and fruits of *Sorbus* $\times$ *avonensis*. A–D, type. E–F, second tree. Scale bars 1 cm.

Inflorescence to 8 cm across, crowded; branchlets tomentose. Flowers c. 16–18 mm across, fragrant. Sepals narrowly triangular, greenish at tip but tomentose at base, without glands on margins. Petals c. 6 $\times$ 5 mm, broadly elliptic, cupped, white. Anthers pink. Styles 2, split to base, green, pilose at base. Largest fruits 10–11 $\times$ 10–12 mm, 0.85–1.0 times as long as wide but usually looking more or less globose, widest at the middle, red at maturity (RHS colour chart 44A, 45A), with a few small to large lenticels. Seeds fully formed.

Sorbus $\times$ *avonensis* is a member of the *Sorbus aria* group. The description is based on both the type tree and the second tree known from the opposite side of the gorge, which is identical genetically but differs slightly morphologically, though this may be due to environmental conditions.

Hybridisation seems to occur repeatedly between *S. aria* and *S. porrigentifomis* in the Avon Gorge. This has given rise to a series of morphological forms, some of which appear to have reproduced to form stable clones with a

significant number of plants (e.g. *S. eminens*, *S. whiteana*, *S. wilmottiana* and the new *S. leighensis* described below), and many of which have not; we intend this hybrid name to be applied to spontaneous *S. aria* × *S. porrigentiformis* plants which do not form significant populations. *Sorbus* × *avonensis* (Fig. 1) resembles *S. porrigentiformis* more than *S. aria*, with broadly obovate, weakly biserrate leaves and fruits globose to wider than long (length/width ratio 0.85–1.0), and has been recorded as *S. porrigentiformis* in the past in the Avon Gorge. *Sorbus porrigentiformis sensu stricto* has obovate, unlobed, obtuse, weakly biserrate leaves, and fruits usually wider than long (length/width ratio 0.8–1.0(–1.1)). *Sorbus aria* has white-tomentose undersides to the leaves, usually more veins and fruits usually longer than wide.

Nuclear microsatellite data suggest that, in the Avon Gorge at least, *S. porrigentiformis sensu stricto* is consistently tetraploid and that *S. × avonensis* is triploid (Robertson *et al.*, in preparation). Counts of $2n = 51$ previously referred to *S. porrigentiformis* (e.g. by Warburg 1962, who interpreted *S. porrigentiformis* broadly, including both triploids and tetraploids) probably refer to hybrids. Pollen stainability in one *S. × avonensis* tree was 66% (167 pollen grains counted), lower than in *S. aria* (average 85%, range 23–100%) and slightly lower than in *S. porrigentiformis* (average 73%, range 61–84%). Fruits of *S. × avonensis* have apparently well-formed seeds, and some at least are viable.

The plastid DNA of the type tree is the widespread *Aria* type 'A' (Chester *et al.* 2006).

The only occurrences of *S. × avonensis* confirmed by nuclear microsatellites are two places on opposite sides of the Avon Gorge (Fig. 2; v.cc. 6, 34). One isolated tree occurs on open Carboniferous Limestone rocks and the other in taller woodland with *S. aria* and *S. bristoliensis* between the railway line and the towpath. Neither tree occurs with *S. porrigentiformis*. *Sorbus × avonensis* is likely to occur wherever the parents overlap in SW England and Wales. In particular we have seen triploid material from Burrington Combe (v.c. 6) and Blaise Castle (v.c. 34), and material of unknown ploidy from the Wye Valley (v.cc. 34, 36) which could be this hybrid, but DNA analysis may be the only certain method of verifying their identity.

The epithet '*avonensis*' relates to its occurrence in the Avon Gorge.

Sorbus aria (L.) Crantz × *S. bristoliensis* Wilm. = *S. × houstoniae* T. Rich, **hybr. nov.**

HOLOTYPE: rocks, Stokeleigh Camp, v.c. 6 North Somerset, England, ST/561.732, flowers 24 May 2005, T. C. G. Rich & L. Houston, and fruits 31 October 2004, T. C. G. Rich, A. Robertson & L. Houston (**NMW**, accession numbers V.2005.1.148 and V.2004.26.276).

Vernacular name: Houston's Whitebeam.

Arbor parva ad 5 m ut minimum. Gemmae ovoidoconicae, virides, ad apicem pilis exalbidis pilosae. Folia lata brachyblastorum 7.0–9.5 × 4.5–6.5 cm, 1.4–1.6plo longiora quam latiora, obovata vel obovatoelliptica, ad longitudinis suae 50–70 partes centensimas latissima, apice acuminato, basi late cuneata, in centro laminae 7–14 partibus centensimis ad costam valde lobata, marginibus leniter biserratis dentes prorsum projectos ferentibus, sed 1–2 cm infimis prope petiolum integris; pagina superior atroviridis glabra; pagina inferior viridialba tomentosa, venis 17–22 ad angulum 32–39° a costa tentis. Petioli 8–25 mm. Inflorescentia ad 8 cm lata, aggregata, ramulis tomentosis instructa. Flores 16–18 mm lati, fragrant. Sepala anguste triangularia, ad apicem viridula sed ad basin tomentosa, in marginibus sine glandibus vel glandes 1–2 ferentes. Petala 5.5–7.5 × 5.5–6 mm, late elliptica vel fere orbicularia, cupulata, alba. Antherae roseae. Styli 2, per unum longitudinis trientem conjuncti, virides, glabri. Fructus maximi (11–)12–14(–14.5) × (11.5–)12–14.5(–15) mm, 0.9–1.1plo longiores quam latiores, plerumque aspectu magis minusve globoso, in medio latissimi, in maturitate croceorubri, lenticellarum parvarum mediocriumque numero modico praediti. Semina perfecte formata.

Small tree to at least 5 m. Buds ovoid-conical, green, pilose at tip with whitish hairs. Broad leaves of short shoots 7.0–9.5 × 4.5–6.5 cm, 1.4–1.6 times as long as wide, obovate to obovate-elliptic, widest at 50–70% along leaf length, with apex acuminate and base broadly cuneate, distinctly lobed 7–14% of way to midrib at centre of leaf; margins weakly biserrate with teeth directed forwards, but with lowest 1–2 cm near the petiole entire; upper surface dark green, glabrous; lower surface greenish-white tomentose, with 17–22 veins held at an angle of 32–39° to the midrib. Petioles 8–25 mm. Inflorescence to 8 cm across,

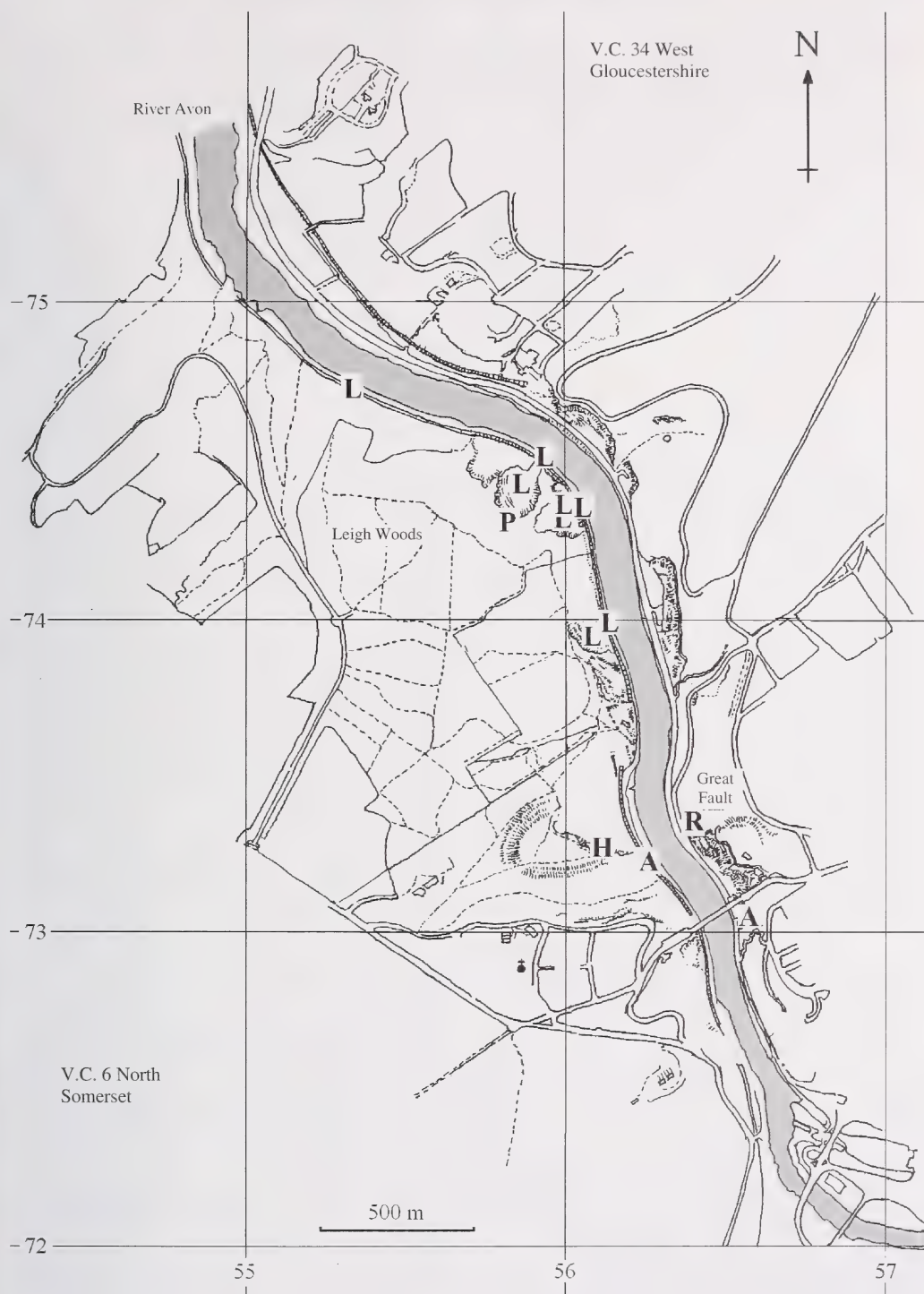


FIGURE 2. Distribution of new *Sorbus* taxa within the Avon Gorge, South-west England. A, *S. × avonensis*. H, *S. × houstoniae*. L, *S. leighensis*. P, *S. × proctoris*. R, *S. × robertsonii*. Base map courtesy L. Houston.

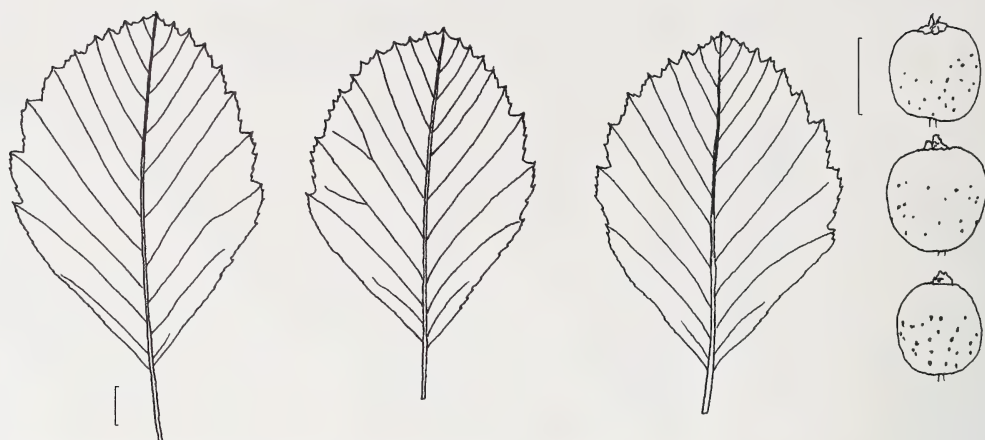


FIGURE 3. Leaves and fruits of *Sorbus* $\times$ *houstoniae*. Scale bars 1 cm.

crowded; branchlets tomentose. Flowers 16–18 mm across, fragrant. Sepals narrowly triangular, greenish at tip but tomentose at base, without or with 1–2 glands on margins. Petals 5.5–7.5 $\times$ 5.5–6 mm, broadly elliptic to nearly orbicular, cupped, white. Anthers pink. Styles 2, united for one-third of length, green, glabrous. Largest fruits (11–)12–14(–14.5) $\times$ (11.5–)12–14.5(–15) mm, 0.9–1.1 times as long as wide but usually looking more or less globose, widest at the middle, orangey-red at maturity (RHS colour chart 33A, 34A, 44A), with a moderate number of small and medium lenticels. Seeds fully formed.

Sorbus $\times$ *houstoniae* is a clear member of the *S. latifolia* group, intermediate between the *S. aria* group and *S. torminalis* (L.) Crantz.

Sorbus $\times$ *houstoniae* (Fig. 3) looks similar to *S. bristoliensis*, with which it is very easily confused. Both taxa have shallowly, acutely lobed, elliptic-ovate leaves that are greenish-white beneath, and orangey-red fruits. *Sorbus* $\times$ *houstoniae* differs from *S. bristoliensis* in having relatively broader leaves. *Sorbus* $\times$ *houstoniae* is not likely to be confused with *S. aria* which has red fruits and leaves white-tomentose beneath and usually without acute lobes.

Nuclear microsatellites and plastid DNA have shown that *S. x houstoniae* is a tetraploid derived from fertilisation of an unreduced triploid ovule of *S. bristoliensis* by normal haploid *S. aria* pollen (Robertson *et al.* in preparation). Microsatellite data do not support Challice & Kovanda's (1978) suggestion that an odd *S. bristoliensis* tree in the former Bristol University Botanic Garden at North Road, Leigh Woods is of this origin, though we are

not certain whether we sampled the same tree. The one hybrid tree had an average of 98% (50 pollen grains counted) stainable pollen, probably equivalent in fertility to *S. aria* (average 85%, range 23–100%) but much higher than *S. bristoliensis* (average 27%, range 11–38%). Fruits with fully-formed seeds occur, but it is not known if they are viable.

The sole tree confirmed by nuclear microsatellites occurs on a north-facing, vertical Carboniferous Limestone cliff below Stokeleigh Camp, Leigh Woods, North Somerset (v.c. 6), growing near both parents as well as other *Sorbus* species (Fig. 2). The tree is inaccessible without ropes. The main threat to its survival is growth of ivy.

Named after Ms Libby Houston, the “guardian angel” of the Avon Gorge, who not only first discovered it, but whose natural habitat also seems to be the same – clinging to impossible cliffs in remote parts of the gorge.

***Sorbus leighensis* T. Rich, sp. nov.**

HOLOTYPE: Quarry 4, Leigh Woods, v.c. 6 North Somerset, England, ST/561.739, flowers 15 May 2007, T. C. G. Rich & A. Robertson, and fruits and photographs 19 September 2007, T. C. G. Rich & L. Houston (NMW accession number V. 2007.1.180).

ISOTYPE: BM, CGE

Vernacular name: Leigh Woods Whitebeam.

Frutex vel arbor parva ad 10 m ut minimum. Gemmae ovoidoconicae, virides, ad apicem pilis albis pilosae. Folia lata brachyblastorum (6.5–)7.0–10.5 $\times$ (4.5–)5.0–7.0(–8.5) cm, 1.2–1.5(–1.6)plo longiora quam latiora, plerumque obovata, aliquando elliptica, ad longitudinis

suae (50–)55–65 partes centesimas latissima, apice truncato vel late obtuso, basi anguste rotundata vel cuneata, in centro laminae 6–13 partibus centesimis ad costam plerumque lobis non profundis obtusis secta, marginibus leniter biserratis dentes parvos exstantes ferentibus, sed parte infima prope petiolum circa 1 cm fere integra; pagina superior pallide viridis glabra; pagina inferior alba vel viridialba tomentosa, venis 15–19 ad angulum (22–)24–31(–35)° a costa tentis. Petioli 8–16 mm. Inflorescentia ad 9 cm lata, aggregata,

ramulis tomentosis instructa. Flores 18–20 mm lati, fragantes. Sepala anguste triangularia vel deltoidea, ad apicem viridula sed ad basin tomentosa, in marginibus sine glandibus. Petala 7–8 × 5–6 mm, late elliptica, cupulata, alba. Antherae cremeae, leniter roseae. Styli 2(–3), usque ad basin discreti, virides, basi pilosa. Fructus maximi 10–12(–13) × 10–14(–14) mm, 0·8–1·1plo longiores quam latiores, plerumque aspectu globoso, in maturitate rubri, lenticellis paucis parvis vel mediocribus praediti. Semina perfecte formata.

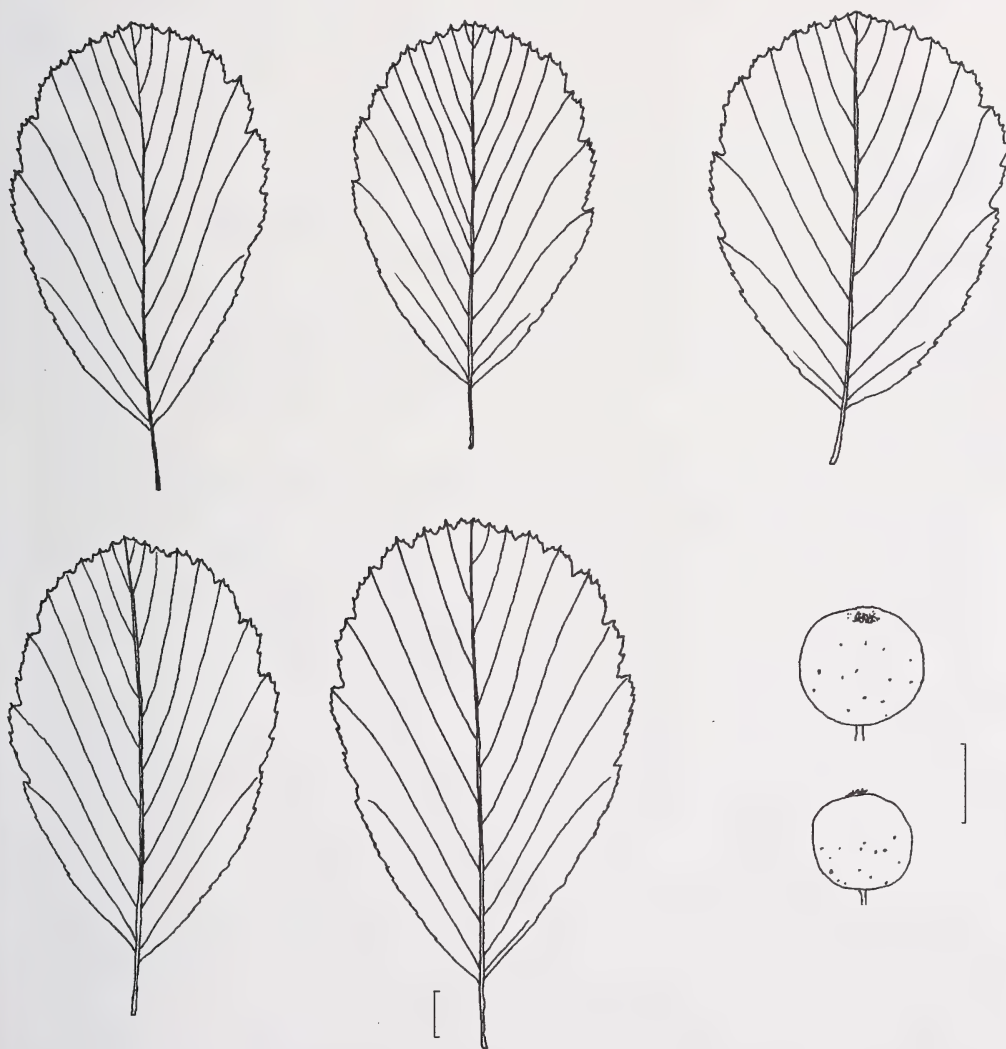


FIGURE 4. Leaves and fruits of *Sorbus leighensis*. Each leaf from a different tree. Scale bars 1 cm.

Shrub or small tree to at least 10 m. Buds ovoid-conical, green, pilose at tip with white hairs. Broad leaves of short shoots (6.5–)7.0–10.5 × (4.5–)5.0–7.0(–8.5) cm, 1.2–1.5(–1.6) times as long as wide, usually obovate, sometimes elliptic, widest at (50–)55–65% along leaf length, with apex truncate to broadly obtuse and base narrowly rounded to cuneate, usually with shallow, blunt lobes cut 6–13% of way to midrib at centre of leaf; margins weakly biserrate with small teeth directed outwards, but with lowest c. 1 cm near the petiole nearly entire; upper surface light green, glabrous; lower surface white to greenish-white tomentose, with 15–19 veins held at an angle of (22–)24–31(–35)° to the midrib. Petioles 8–16 mm. Inflorescence to 9 cm across, crowded; branchlets tomentose. Flowers 18–20 mm across, fragrant. Sepals narrowly triangular to deltoid, greenish at tip but tomentose at base, without glands on margins. Petals 7–8 × 5–6 mm, broadly elliptic, cupped, white. Anthers cream with a hint of pink. Styles 2(–3), split to base, green, pilose at base. Largest fruits 10–12(–13) × 10–14(–14) mm, 0.8–1.1 times as long as wide but usually looking globose, red at maturity (RHS colour chart 42A, 45A, 45B, 46A), with a few small to medium lenticels. Seeds fully formed.

Sorbus leighensis is a clear member of the *Sorbus aria* group. It can be readily distinguished from the other species in the *S. aria* group by the obovate, truncate leaves with small but distinct, shallow, blunt lobes (Fig. 4). Usually only one leaf in each short shoot is truncate at the apex, the others are obtuse.

This taxon has been known since at least the 1980s. It has been variously referred to as *S. 'Bristol porrigentiformis'* or '*Bristol pseudo-porrigentiformis*' by Proctor *et al.* (1989) and Proctor & Groenhof (1992). The tree sampled as '*S. wilmottiana* 23' by Lemche (1999) is also *S. leighensis*. Nuclear microsatellite markers show that *S. leighensis* is a triploid apomict derived from *S. aria* × *S. porrigentiformis* (Robertson *et al.* in preparation), and has the widespread *S. aria* plastid type 'A' (Chester *et al.* 2007). It has a distinct isozyme profile (Proctor & Groenhof 1992).

Sorbus leighensis is endemic to the Somerset side of the Avon Gorge (Fig. 2), where it is locally frequent. At least two plants occur in Quarry 2, at least 12 plants (possibly 20) are known in Quarry 3, at least 63 plants in Quarry 4 and at least three along the towpath. One easily found tree occurs on the sea wall

opposite the entrance to Quarry 2. Surprisingly, it has not been found on the Bristol side of the Avon Gorge (v.c. 34 West Gloucestershire). Some trees with virtually identical leaves occur in Burrington Combe, North Somerset (v.c. 6) but remain to be compared with plants from Avon Gorge using molecular markers.

The pollen stainability of four trees was variable: 6% (54 pollen grains counted), 13% (67 counted), 28% (72 counted) and 45% (88 counted; A. Patto, pers. comm. 2007), giving a mean of c. 23% which is fairly typical of triploids (Rich 2009). However it has fertile fruits and grows well from seed.

Sorbus leighensis occurs on open Carboniferous Limestone rocks and scree, and in open scrub with *S. aria*, *S. porrigentiformis* and *S. wilmottiana*. Soil from under the type tree had pH 7.8.

Sorbus leighensis has an I.U.C.N. (2001) conservation status of 'Endangered' due to the small population size (at least 80 plants, but not fully surveyed) and its restricted occurrence on one site. However, the whole population occurs within the Avon Gorge S.S.S.I. and S.A.C., and most trees occur on land owned by the National Trust. The main threats are scrub development, or clearance along the towpath.

The epithet '*leighensis*' is derived from its occurrence in Leigh Woods.

Sorbus aria (L.) Crantz × *S. eminens* E. F. Warb. = *S. × robertsonii* T. Rich, **hybr. nov.**

HOLOTYPE: Great Fault, Avon Gorge, Bristol, v.c. 34 West Gloucestershire, England. ST/564.733, flowers 15 May 2007, T. C. G. Rich, and fruits and photographs 19 September 2007, T. C. G. Rich & L. Houston (NMW, accession number V.2007.1.175).

ISOTYPE: BM, CGE, OXF.

Vernacular name: Robertson's Whitebeam.

Arbor ad 12 m ut minimum, truncis multis praedita. Gemmae ovoidconicae, virides, ad apicem pilis exalbidis pilosae. Folia lata brachyblastorum 10.0–14.0(–14.5) × 7.5–10.0(–10.5) cm, (1.1–)1.2–1.6(–1.7)plo longiora quam latiora, obovata vel late elliptica, ad longitudinis suae 50–63(–69) partes centensimas latissima, apice obtuso, basi rotundata, marginibus non lobatis biserratis dentes parvos exstantes ferentibus, sed parte infima prope petiolum circa 1–3 cm fere integra; pagina superior viridis glabra; pagina inferior alba vel viridialba tomentosa, venis 20–26(–27) ad angulum 25–40° a costa tentis. Petioli 12–26 mm. Inflorescentia ad 7 cm lata,

aggregata, ramulis tomentosis instructa. Flores 14–17 mm lati, fragrantes. Sepala anguste triangularia, ad apicem acuminata viridula sed ad basin tomentosa, in marginibus sine glandibus. Petala 7–8 × 6 mm, late ovata vel late elliptica, cupulata, alba. Antherae cremeae. Styli 2, usque ad basin discreti, virides, glabri. Fructus maximi (12–)13–16(–17) × 10–15 mm, (0.95–)1.0–1.2plo longiores quam latiores, plerumque aspectu longiore quam latiore, in medio latissimi vel obconici, in maturitate rubri, lenticellarum parvarum vel mediocrium numero modico praediti. Semina perfecte formata.

Tree to at least 12 m, with many trunks. Buds ovoid-conical, green, pilose at tip with whitish hairs. Broad leaves of short shoots 10.0–14.0(–14.5) × 7.5–10.0(–10.5) cm, (1.1–)1.2–1.6(–1.7) times as long as wide, obovate to broadly elliptic, widest at 50–63(–69)% along leaf length, with apex obtuse and base rounded; margins unlobed, biserrate with small teeth directed outwards, but with lowest c. 1–3 cm near the petiole nearly entire; upper surface green, glabrous; lower surface white to greenish-white tomentose, with 20–26(–27) veins held at an angle of 25–40° to the midrib. Petioles 12–26 mm. Inflorescence to 7 cm

across, crowded; branchlets tomentose. Flowers 14–17 mm across, fragrant. Sepals narrowly triangular, acuminate and greenish at tip but tomentose at base, without glands on margins. Petals 7–8 × 6 mm, broadly ovate to broadly elliptic, cupped, white. Anthers cream. Styles 2, split to base, green, glabrous. Largest fruits (12–)13–16(–17) × 10–15 mm, (0.95–)1.0–1.2 times as long as wide but usually looking longer than wide, widest at the middle or obconical, red at maturity (RHS colour chart 44A, 45B, 46A), with a moderate number of small to medium lenticels. Seeds fully formed.

Sorbus × *robertsonii* is a member of the *Sorbus aria* group.

The above description applies to the one tree in the Avon Gorge, Bristol whose identity has been confirmed from nuclear microsatellites (Robertson *et al.* in preparation). Apart from the obconical fruits, *S.* × *robertsonii* (Fig. 5) is approximately morphologically intermediate between its parents. *Sorbus aria* has ovate to elliptic, often shallowly lobed leaves which are acute to obtuse at the apex and have weakly biserrate to strongly biserrate margins, with fruits usually longer than wide or globose (length/width ratio 0.9–1.2). *Sorbus eminens* in its strict sense (i.e. excluding the trees with

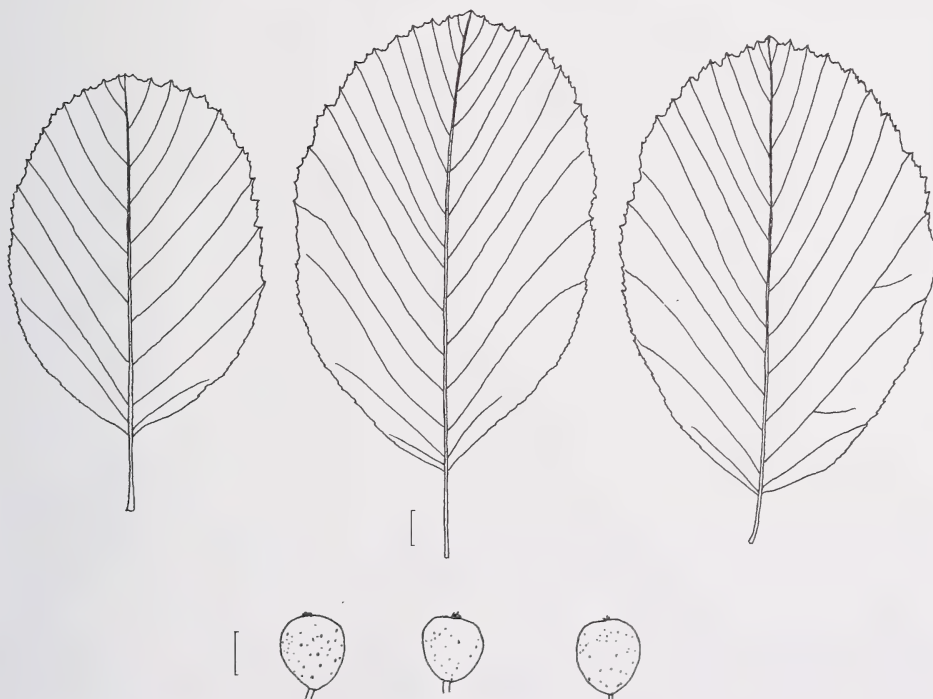


FIGURE 5. Leaves and fruits of *Sorbus* × *robertsonii*. Scale bars 1 cm.

cuneate leaf bases from the Symonds Yat area, West Gloucestershire/ Herefordshire, cf. Proctor & Groenhof 1992) has larger, usually more or less orbicular, unlobed, obtuse leaves with fine, uniserrate teething, and has fruits wider than long (length/width ratio 0.7–0.9). *Sorbus* × *robertsonii* has broadly elliptic to obovate leaves with weak biserrate toothing and fruits longer than wide to globose or obconical (length/width ratio 1.0–1.2).

Nuclear microsatellite data indicate that the hybrid is probably triploid, and thus intermediate between the diploid *S. aria* and the tetraploid *S. eminens*. Pollen stainability in the one hybrid tree was 74% (80 pollen grains counted), lower than in *S. aria* (average 85%, range 23–100%) but similar to that in *S. eminens* (average 80%, range 60–89%) (A. Patto pers. comm. 2007). Fruits have well-formed seeds which are presumably viable but this has not been tested yet.

The tree occurs at the top of a scree slope at the Great Fault, Avon Gorge, v.c. 34 West Gloucestershire (Fig. 2). It grows in open woodland in an area with both parents, and has soil pH 7.4. It is probable that hybrids also occur in several other mixed populations in the Bristol area, the Mendips and the Wye Valley in v.cc. 6, 34, 35 and 36, where morphologically intermediate plants have been observed; however they await confirmation from DNA.

The hybrid is named after Ashley Robertson for his outstanding work in elucidating the origins of the Avon Gorge endemics (Robertson *et al.* in preparation), which, to quote White's (1912) *Flora of Bristol*, "pass ... the wit of many to disentangle".

Sorbus aucuparia L. × *S. scalaris* Koehne = *S.* × *proctoris* T. Rich, **hybr. nov.**

HOLOTYPE: Top edge of Quarry 2, Leigh Woods, v.c. 6 North Somerset, England, ST/557.743, flowers 11 May 2007, T. C. G. Rich & A. Robertson, and fruits and photographs 19 September 2007, T. C. G. Rich & L. Houston (NMW, accession number V.2007.1.125).

ISOTYPE: BM, CGE, E, LIV, OXF.

Vernacular name: Proctor's Rowan.

Arbor ad 8 m ut minimum, erecta ramis verticalibus, sine surculis. Stipulae 5–8 × 11–15 mm, magnae, depressovatae, dentatae, persistentes. Gemmae ad 15 × 7 mm, lanceoloideae, obtusae, brunneolae; pilis

exalbidis in superficie marginibusque vestitae. Folia sterilia rosulata 15–18 × 6–8 cm, oblonga vel oblongoelliptica, pinnata, folioliorum lateralium paribus 9–10 folioloque terminali parvo sed simili praedita. Folia lateralalia 35–45 × 10–15 mm, maxima in medio folii, ad basin apicemque versus paulo minora, oblonga, acuta, ad basin rotundata aliquantumque asymmetrica, per longitudinis suae tres partes quartas superiores dentibus prorsum projectis dentata, subsessilia, in pagina superiore atroviridia glabra, in pagina inferiore vivide cinereoviridia papillosa glabrescentia, costa sparsim tomentosa praedita. Petioli 2–3 cm, non alati, rubritincti. Inflorescentia ad 12 cm lata, tholiformis, densa, ramulis tomentosis instructa. Flores 8 mm in diametro. Sepala late triangularia, obtusa, dentes glanduliferos 0–3 in utroque margine ferentia. Petala 3–4.5 mm × 2.5–3.5 mm, late ovatorbicularia vel late elliptica, alba. Antherae roseae. Styli (2–)4. Fructus (7–)8–9 × (7–)8–9 mm, plerumque globosi vel nonnulli aliquantum latiores quam longiores vel longiores quam latiores, infra medium latissimi, in maturitate croceorubri, sine lenticellis vel lenticellas paucissimas parvas ferentes. Semina abortiva.

Tree to at least 8 m, erect with upright branches, not suckering. Stipules 5–8 × 11–15 mm, large, depressed-ovate, toothed, persistent. Buds to 15 × 7 mm, lanceoloid, obtuse, brownish with whitish hairs on surface and margins. Sterile rosette leaves 15–18 × 6–8 cm, oblong to oblong elliptic, pinnate with 9–10 pairs of lateral leaflets and a small but similar terminal leaflet. Lateral leaflets 35–45 × 10–15 mm, largest at the centre of the leaf and a little smaller at base and towards the apex, oblong, acute, rounded and slightly asymmetrical at the base, toothed for upper three-quarters of length with forward-directed teeth, subsessile, dark green and glabrous above, strongly greyish-green, papillose and glabrescent beneath with a sparsely tomentose midrib. Petioles 2–3 cm, not winged, red-flushed. Inflorescence to 12 cm across, domed, dense, with branchlets tomentose. Flowers 8 mm in diameter. Sepals broadly triangular, obtuse, with 0–3 glandular teeth on each edge. Petals 3–4.5 mm × 2.5–3.5 mm, broadly ovate-orbicular or broadly elliptic, white. Anthers pink. Styles (2–)4. Fruits (7–)8–9 × (7–)8–9 mm, mostly globose or some slightly wider than long or longer than wide, widest below the middle, orangey-red at maturity (RHS colour chart 33A), without or with a very few, small lenticels. Seeds abortive.

The identity of this hybrid was suggested by Hugh McAllister. *Sorbus* $\times$ *proctoris* is a member of *Sorbus* Subgenus *Sorbus*. It is intermediate between its parents with 19–21 free leaflets which tend to taper to the tip, large persistent stipules, pink anthers and fruits 7–9 mm (Fig. 6). *Sorbus aucuparia* has leaves with 13–17 free, oblong, more or less parallel-sided leaflets, small, deciduous stipules, yellow anthers and fruits (8–)9–11(–12) mm. *Sorbus scalaris* has leaves with 21–33 free, narrowly oblong, lanceolate to narrowly ovate leaflets somewhat tapering to the apex, large persistent stipules, pink anthers and fruits 6–7 mm.

Both parents are reported to have chromosome numbers of $2n = 34$ (McAllister 2005) but preliminary molecular data suggest that the Leigh Woods hybrid is triploid. In 2007 the hybrid tree had 95% (60 pollen grains counted) pollen stainability (A. Patto, pers. comm. 2007) but, despite setting abundant fruit, was sterile with aborted seeds.

Sorbus scalaris, an ornamental tree from China closely related to *S. aucuparia*, is occasionally cultivated in Britain. It is self-incompatible, so isolated trees tend to produce hybrid progeny, and this hybrid has been

obtained in cultivation (McAllister 2005). So far one tree of this hybrid has been found in the wild in mixed deciduous woodland at the top edge of Quarry 2 in Leigh Woods (Fig. 2; v.c. 6) with *S. aucuparia*, *S. intermedia* (Ehrh.) Pers. and *S. aria* on soil pH 6.2. We do not know how it came to be at this location as we do not know of any *S. scalaris* trees in the area, though it is possible that one occurs in a garden opposite on the Bristol side of the gorge where other *Sorbus* species are planted (e.g. *S. decipiens* (Bechst.) Irmisch). It is most likely to have originated from seed dispersed across the gorge by a bird from a garden tree of either *S. scalaris* or *S. aucuparia*, but could have originated *in situ* from pollen of *S. scalaris* carried across the gorge by bees which fertilised local *S. aucuparia* in Leigh Woods.

The occurrence of this hybrid gives the potential for genes from a non-native species to enter the *Sorbus* gene-pool in the Avon Gorge. If this has not already happened and they are perceived to be a threat to the indigenous species, one option would be to remove the tree.

Named in honour of Michael C. F. Proctor for his excellent work on *Sorbus* (Proctor *et al.* 1989; Proctor & Groenhof 1992).

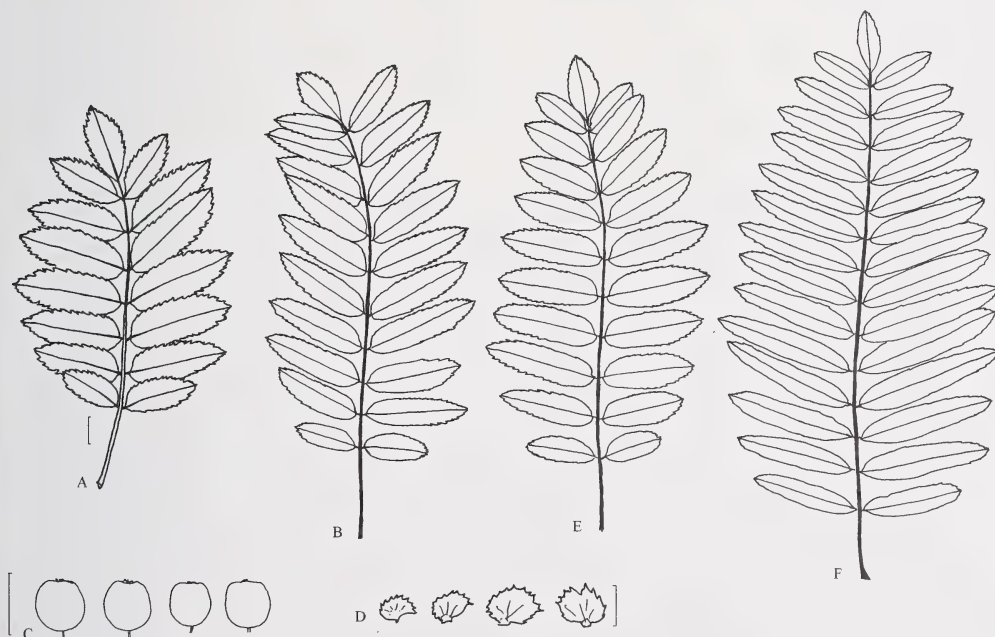


FIGURE 6. Leaves, stipules and fruits of *Sorbus* $\times$ *proctoris*, and leaves of its parents. A, *S. aucuparia*. B–E, *S. x proctoris*. F, *S. scalaris*. Scale bars 1 cm.

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The distribution and conservation of *Eriophorum gracile* Koch ex Roth (Cyperaceae), Slender Cotton-grass, in Ireland

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ABSTRACT

Eriophorum gracile is a rare semi-aquatic plant which has a very local distribution throughout most of western Europe. The distribution and current conservation status of known Irish populations are presented in this paper. Floating rafts of vegetation which develop along the margins of lakes in the Connemara region of Co. Galway constitute the most important habitat for the species in Ireland. Small populations also occur in habitats such as flushed areas of lowland blanket bog, the lagg areas of raised bog and calcareous basin fen; however, populations in such habitats are generally small in size. The main threats to the existing populations of the species are site drainage and surface water eutrophication, which are primarily caused by farming-related activities on land in close proximity to sites. It is clear that the future survival of the species in Ireland will depend on the safeguarding of favourable hydrological and edaphic conditions.

KEYWORDS: Protected plant species, Connemara, bog flush, scragh, *E. gracile*.

INTRODUCTION

Eriophorum gracile W. D. J. Koch ex Roth (Cyperaceae), Slender Cotton-grass is a member of a widespread, mainly circumpolar genus which in Europe is represented by seven species (Tutin *et al.* 1980). Although the species is superficially similar to a number of other members of the genus, it is relatively easy to distinguish by the combination of rather slender leaves (0.5–2 mm), short “cotton” (1–2.5 cm), minutely scabrid peduncles and the presence of a short, erect uppermost leaf on the flowering stem (Clapham *et al.* 1987). The species occurs throughout northern Eurasia and

North America and is very rare south of the latitude 45° N (Hultén 1962). In Europe it reaches its southern limit along a line extending from the Pyrenees, through northern Italy to southern Bulgaria. The species is found throughout northern Asia, occurring as far east as the Kamchatka Peninsula and northern Japan; however, it appears to be rather rare in central Asia (Hultén 1962). In North America *E. gracile* has a widespread, though local, distribution throughout the northern states of the United States of America and the southern states of Canada (Decker *et al.* 2006).

Throughout much of its range *E. gracile* grows in habitats which are constantly wet, such as flushed areas of bogs, calcareous fens and lake margins (Tutin *et al.* 1980). Even within these wetland areas the species often grows in the wettest areas of floating rafts of vegetation close to open water (Winship 1994). Such habitats are very vulnerable to drainage and there has been a substantial population decline in the recent past, particularly in western Europe. In England, for example, there has been a drastic decline of the species from 26 sites to only 3 sites since the species was first recorded in 1838 (Winship 1994; Cox 1995). This decline is thought to have been brought about by drastic changes in the habitat of the species due to modification of the water supply and quality. Such modification is generally the result of drainage and/or eutrophication of surface waters. As a result of the species’ rarity and decline throughout western Europe, *E. gracile* is categorised as vulnerable within the European Community (Council of Europe 1983) and is protected by law in a number of countries including the United

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TABLE 1. DETAILS OF *ERIOPHORUM GRACILE* SITES IN IRELAND

Site location	Grid ref.	Habitat	First reported	Confirmed by the authors in the period 1990–1995
South Kerry (v.c. H1)				
Broaghnbinnia	V7981	Flush in blanket bog	J. Ryan 1977 (unpublished record)	No
North Kerry (v.c. H2)				
Sheheree bog	V9888	Lagg of raised bog	M. Sheehy Skeffington 1983 (unpublished record)	Yes
West Cork (v.c. H3)				
Derreenatra	V9531	Cutover blanket bog	FitzGerald 1993 (unpublished record)	Not surveyed
West Galway (v.c. H16)				
Killarone	M1540	Marsh	Scannell <i>et al.</i> (1968)	No
Lake N.W. of Maam Cross	L9746	Lake scragh	Scannell <i>et al.</i> (1968)	Yes
Bunscanniff	L9445	Flush in blanket bog	This study	Yes
2.5 km E. of Cashel	L8242	Flush in blanket bog	This study	Yes
Lettershinna	L8543	Flush in blanket bog	Douglas and Grogan (1987)	No
1.5 km E. of Cashel	L8142	Flush in blanket bog	This study	Yes
Loughanillaun	L8540	Flush in blanket bog	Scannell <i>et al.</i> (1968)	No
Callaherick Lough	L7938	Lake scragh	Scannell <i>et al.</i> (1968)	Yes
	& L8038			
N. of Carna	L7833	Flush in blanket bog	This study	Yes
Dohola Lough	L7833	Lake scragh	This study	Yes
Letterdife	L7142	Flush in blanket bog	This study	Yes
Lough Nalawney	L6941	Flush in blanket bog	This study	Yes
Cregduff Lough	L7139	Lake scragh	Rose and McClintock (1967)	Yes
W. of Errisbeg Hill	L6839	Flush in blanket bog	Donald (1980)	Yes
	& L6840			
Lake W. of Lough Rannaghaun	L6640	Lake scragh	This study	Yes
Lake S. of Glinsk	L7835	Lake scragh	This study	Yes
Murvey Lough	L6639	Lake scragh	van Groenendael <i>et al.</i> (1979)	Yes
Namanawaun Lough	L6639	Lake scragh	van Groenendael <i>et al.</i> (1979)	Yes
Aturtaun Lough	L6739	Lake scragh	van Groenendael <i>et al.</i> (1979)	No
Cloonagat Lough	L6947	Lake scragh	Scannell <i>et al.</i> (1968)	Yes
Lake N.W. of Cloonagat Lough	L6847	Lake scragh	This study	Yes
Lake N.E. of Doo Lough	L6848	Lake scragh	This study	Yes
Tonabrucky	M2526	Lake scragh	J. Conaghan 2000 (unpublished record)	Discovered in 2000
Offaly (v.c. H18)				
Sharavogue bog	S0498	Fen in cutover bog margin	J. Conaghan 1997 (unpublished record)	Discovered in 1997
Westmeath (v.c. H23)				
Scragh bog	N4559	Basin fen	Scannell <i>et al.</i> (1968)	Yes
West Mayo (v.c. H27)				
Cloonooragh	G0720	Flush in blanket bog	J. Conaghan 2002 (unpublished record)	Discovered in 2002

Kingdom (Wigginton 1999) and Ireland (Curtis & McGough 1988; Flora (Protection) Order 1999). Despite the rarity and the apparent recent decline of the species there is a paucity of research into the distribution and ecology of *E. gracile* throughout Europe. Although the status of the species in England has been addressed (Winship 1994; Cox 1995), in Ireland there is an urgent need to assess its status and to anticipate the threats which may affect populations of the species in the future. In the following account, the status of previously reported Irish sites is outlined and details are given of additional sites discovered by the authors. The population size and habitat of the species at each site is described and the conservation status of these sites is considered.

THE HISTORY OF THE DISCOVERY OF *ERIOPHORUM GRACILE* IN IRELAND

E. gracile was discovered in Ireland in the summer of 1966, coincidentally by two separate groups (Scannell, Synnott & Webb 1968). In July of that year the species was noted by Dr V. Westhoff at Cregduff Lough, some 2 km to the south of Roundstone village, Co. Galway. The species was subsequently noted in September of that year by Dr Francis Rose in the same lake. The subsequent paper (Rose 1967) was the first documented account of the species in Ireland. Its belated discovery in Ireland is somewhat surprising when one considers that the Connemara region had been one of the most intensively studied regions of Ireland, both by Irish and British botanists. Previously C. C. Babington had collected a specimen named *E. gracile* from the Cong area in 1836 (Stelfox 1970). However, the herbarium specimen was subsequently determined to be a small specimen of *E. angustifolium* Honck. (Kertland 1971). The eventual location of the correct species in 1966 alerted other botanists to its presence and within two years, details were published of a further six sites; five from the Connemara region of West Galway (H16) and one at Scragh bog, Co. Westmeath (H23) (Scannell *et al.* 1968). Between 1968 and 1990, a further seven sites were discovered in the Connemara region; three in lakes to the west of Roundstone village, (van Groenendaal *et al.* 1979) and one north-west of Cashel (Douglas & Grogan 1987). In 1977, the range of *E. gracile* in Ireland was extended southwards when the species was recorded

from the MacGillycuddy's Reeks mountain range in South Kerry (H1) (J. Ryan, pers. comm.). Six years later a site was added in the neighbouring vice-county, North Kerry (H2) by the second author.

METHODS

During the period 1990 to 1993 all previously recorded sites for *E. gracile* in Ireland, listed in the Protected Plant Species database held by the National Parks and Wildlife Service, were visited with a view to confirming the presence of the species and to documenting the habitat conditions at each site. In addition to visiting previously reported sites, an extensive survey of lake and bog habitats was carried out in areas of counties Galway, Mayo and Kerry, in an effort to locate further sites for the species. At each site in which *E. gracile* was found, a range of data were recorded; including grid reference, the habitat composition and land use surrounding the site, percentage of lake surface covered by a scragh (i.e. a floating raft of vegetation), distance from the sea and the size of the *E. gracile* population present. During 1992 an estimate of population size at each site was obtained by counting the number of flowering heads present. At larger sites the population size was estimated by counting the number of flowering heads within a given area (usually 2 × 2 m) and multiplying this figure by the area of the site in which the species was observed to occur; the numbers are quoted to the nearest hundred.

Because of the relatively small size and vulnerability of populations, site locations are described in terms of four-figure grid references. More precise details have been lodged with the National Parks and Wildlife Service, Dublin. Nomenclature follows Stace (1997) for vascular plants, Smith (2004) for mosses and Paton (1999) for liverworts.

RESULTS

The distribution of *E. gracile* in Ireland as shown on a hectad basis (Fig. 1) illustrates the rarity of the species on the island and its western bias. The Connemara region of west Galway is the main centre of distribution with a small number of outlying stations scattered along the western seaboard and in the mid-lands. Table 1 lists all sites in which *E. gracile*

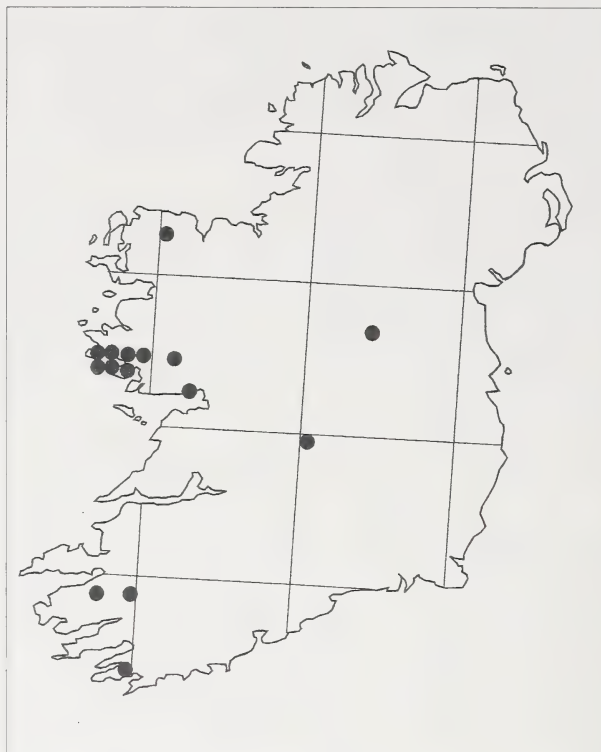


FIGURE 1. The distribution of *Eriophorum gracile* in Ireland, on a 10-km square basis.

has been recorded in Ireland. Of the 14 sites recorded before the onset of this survey in 1990, ten were confirmed. Where populations were not re-found, it was often difficult to identify suitable habitat for the species, but it is possible that the populations could have been missed if flowering at that site was poor at the time of visit, or if the populations are very small. In addition to confirming ten sites, the species was recorded from eleven new locations in the Connemara region of West Galway during 1990–1992. Another site was discovered in West Cork (H3) by R. FitzGerald in 1993, constituting a new vice-county record for the species. Between 1997 and 2002 a further three important populations were discovered by the first author in West Galway (H16), Offaly (H18) and West Mayo (H27). The last two are new vice-county records (Scannell & Synnott 1987).

DISTRIBUTION IN SOUTH KERRY (V.C. H1)

In 1977 a population of *E. gracile* was reported by J. Ryan from a small flush in lowland blanket bog to the south of the Caragh river in Broaghnbinnia townland which lies on the western side of the MacGillycuddy's Reeks

mountain range. Although the population was not re-found during this survey, it was re-found during a rare plant survey of Co. Kerry conducted by R. FitzGerald in the mid-1990s.

DISTRIBUTION IN NORTH KERRY (V.C. H2)

A small population of *E. gracile* grows in the lagg which surrounds Sheheree Bog, a small raised bog to the S.E. of Killarney, Co. Kerry. The bog and associated wet lagg system lie at an altitude of approximately 60 m, occupying a hollow surrounded by good quality agricultural grassland. A large proportion of the lagg is colonised by carr woodland in which *Alnus glutinosa*, *Betula pubescens* and *Salix* spp. are dominant. *E. gracile* is largely confined to low-growing marsh vegetation dominated by *Carex rostrata*, *Juncus articulatus* and *Calliergonella cuspidata* which occurs along the edge of wet woodland.

DISTRIBUTION IN WEST CORK (V.C. H3)

In 1993 a population of *E. gracile* was discovered by R. FitzGerald growing in an area of revegetating cutover bog in Derreenatra townland, approximately 3.5 km SW of Ballydehob village. This is the most southerly known population in the country.

DISTRIBUTION IN WEST GALWAY (V.C. H16)

This vice-county is the headquarters of *E. gracile* in Ireland. Between 1966 and the onset of this study, *E. gracile* had been recorded from eleven sites in the Connemara region (T. Curtis, pers. comm.). The species has been confirmed from seven of these previously reported sites and has been discovered in twelve previously undocumented locations. This brings the total number of recently confirmed sites in the Connemara region to 19 (Fig. 2).

All of the Connemara sites for *E. gracile* occur below an altitude of 60 m, with the majority of sites lying below 30 m. The majority of sites are also located within 8 km of the sea (Fig. 2), with the exception of the unnamed lake N.W. of Maam Cross. In the Connemara region *E. gracile* grows in two different habitat types; quaking rafts of vegetation which develop in the margins of lakes (known as scraghs in Ireland) and flushes in lowland Atlantic blanket bog. Both of these habitats remain in a very wet condition throughout much of the year and the scragh

habitat in which *E. gracile* is found, is invariably treacherous. The lake habitats can be further subdivided into coastal lakes, which are located in close proximity to the sea (<1.5 km) and generally have a large amount of their surface (60% or more) covered with scragh and 'inland' lakes in which the scragh cover is generally less than 5% (Table 2). These lake types also differ in terms of the dominant vegetation types present. The vegetation in which *E. gracile* occurs in the coastal lake habitat tends to be more luxuriant and is typically dominated by *Phragmites australis*, *Equisetum fluviatile*, *Menyanthes trifoliata*, *Potentilla palustris* and *Mentha aquatica*, while at the inland lake habitats, the species typically occurs in scragh vegetation dominated by *Cladium mariscus*, *Molinia caerulea*, *Menyanthes trifoliata*, *Eleocharis multicaulis* and *Eriocaulon aquaticum*. There is also a marked difference in the habitats surrounding the different lake types. Lake sites in close proximity to the coast are more usually surrounded by dry heath and rough grazing land,



FIGURE 2. The distribution of *Eriophorum gracile* in the Connemara region of West Galway (H16), on a 1-km square basis. ● = records confirmed during this study. ○ = previous records not confirmed during this survey. NB The Killarone and Tonabrocky sites lie within H16 but occur east of the map area.

TABLE 2. SURROUNDING LAND COVER, APPROXIMATE NUMBER OF FLOWERING HEADS AND % OF LAKE SURFACE COVERED BY SCRAW, FOR *ERIOPHORUM GRACILE* SITES SURVEYED IN IRELAND

Site name	Surrounding land cover	Approximate number of flowering heads present	% of lake surface covered by a scragh
Coastal lake sites (within 1.5 km of sea)			
Cregduff Lough	Dry heath	>4000	50
Callaherick Lough	Dry heath and road	>2000	85
Murvey Lough	Dry heath & semi-improved pasture	1200	60
Namanawaun Lough	Dry heath & semi-improved pasture	500	50
Inland lake sites (1.5 km to 10 km of sea)			
Lake north-west of Maam Cross	Lowland blanket bog and road	800	50
Cloonagat Lough	Lowland blanket bog	450	<5
Lake west of Lough Rannaghaun	Lowland blanket bog	400	<5
Lake south of Glinsk	Cutover lowland blanket bog and road	100	65
Dohola Lough	Lowland blanket bog	300	<5
Lake north-east of Doo Lough	Lowland blanket bog	25	30
Lake north-west of Cloonagat Lough	Lowland blanket bog	20	<5
Blanket bog flush sites			
West of Errisbeg Hill	Lowland blanket bog	400	-
Tonabrucky	Dry heath & lowland blanket bog	350	-
Letterdife	Lowland blanket bog	190	-
2.5 km east of Cashel	Lowland blanket bog	150	-
Cloonooragh	Lowland blanket bog	50	-
North of Carna	Lowland blanket bog	25	-
Bunscanniff	Lowland blanket bog	15	-
Lough Nalawney	Lowland blanket bog	13	-
1.5 km east of Cashel	Lowland blanket bog	3	-
Other sites			
Scragh bog	Improved agricultural grassland	250	-
Sheheree bog	Improved agricultural grassland	170	-
Sharavogue bog	Raised bog	25	-

whereas sites further inland are generally surrounded by unmodified Atlantic blanket bog.

The flush habitat in which *E. gracile* grows, occurs in areas of intact Atlantic blanket bog where there is some convergence of water flow due to topography. There are eight of these sites, which also tend to be confined to the coastal fringe of the Connemara region (Fig. 2). At some of these sites, e.g. the flush north-west of Letterdife House, *E. gracile* grows in a

quaking raft of vegetation which has developed along the margins of a narrow bog stream, while at others, e.g. the flush north-west of Errisbeg hill, the species grows in old drainage channels which have become filled with an unconsolidated, soupy peat. The dominant species in these flushed areas of bog are generally *Carex lasiocarpa*, *Carex limosa*, *Juncus subnodulosus*, *Schoenus nigricans* and *Potamogeton polygonifolius*.

The population size of *E. gracile* in Connemara varies with habitat (Table 2). Bog flush sites generally contain the smallest populations of the species, ranging from 3 to c. 400 flowering heads per site; the inland lake sites generally support larger populations, from 20 to c. 800 flowering heads. Populations found in coastal lakes are the largest, ranging from 500 to >5000 flowering heads per site.

DISTRIBUTION IN OFFALY (V.C. H18)

In August 1997 a small population of *E. gracile* was found growing along the margins of a base-rich pool in the cut-over edge of a raised bog at Sharavogue, Co. Offaly. This bog is notable in that it is one of the few remaining raised bogs in Ireland which retains lagg-type vegetation along its margins. This population of *E. gracile* is one of only two known east of the river Shannon.

DISTRIBUTION IN WESTMEATH (V.C. H23)

E. gracile occurs in Scragh Bog, one of the best remaining examples of a calcareous basin fen in Ireland (O' Connell 1981). This population was first reported by Scannell *et al.* (1968) and it remains the most easterly known population on the island. At this site *E. gracile* occurs in quaking scragh vegetation dominated by *Schoenus nigricans*, *Menyanthes trifoliata*, *Scorpidium revolvens* and the nationally rare bryophyte *Cinclidium stygium*.

DISTRIBUTION IN WEST MAYO (V.C. H27)

The most northerly population of *E. gracile* in Ireland occurs at Cloonooragh, north-west of the town of Crossmolina in County Mayo. At this location the species grows in a very wet flush, dominated by *Carex limosa*, which is surrounded by intact lowland blanket bog. This population was discovered in August 2002.

DISCUSSION

E. gracile is now known to be much more common than previously thought, especially in the Connemara region of county Galway. The recent discovery of additional sites for *E. gracile* outside Connemara suggests that further populations may exist in more remote areas of western Ireland. As *E. gracile* was re-found in many of its previously reported Irish sites, this suggests that the habitats of the species have not been subject to the same scale of degradation which has taken place in England over the past 150 years (see Winship 1994). However, the failure to re-find the

species at five previously documented Irish sites gives cause for concern. It is also likely, given the comparatively recent discovery of *E. gracile* in Ireland, that many sites were destroyed prior to its discovery in 1966. Although documentary proof is lacking, many wetland areas which may have supported *E. gracile* have been lost in the past 150 years (Irish Peatland Conservation Council 1992). This loss is especially pronounced in the midlands and east of the country, which have experienced a greater level of agricultural intensification and peatland exploitation than in the west, particularly over the past 100 years.

For Britain, it is presumed that *E. gracile* depends largely on vegetative spread as a means of population expansion at sites (Winship 1994). This is also apparent at many Irish sites. The spread of the species is most clearly seen in lakes where *E. gracile* grows in very sparsely vegetated areas e.g. Dohola Lough and the lake west of Cloonagat Lough. At these locations extensive networks of *E. gracile* rhizomes can be observed in shallow water close to the lake shores, spreading out from the scragh surface and colonising deep muddy peat. Although seeds of *E. gracile* germinate easily on moistened filter paper at 20°C (Conaghan 1995), seedlings of the species were not observed in the field during this survey. Indeed, little is known about the ability of seeds of *E. gracile* to germinate and establish in field conditions, and it seems likely that the establishment of seedlings in the wild is a comparatively rare event. What is apparent, however, is that once the species has become established at a site, it can spread well by means of vegetative growth, providing there is suitable habitat available to colonise. Hence it is likely that only a very low rate of seedling establishment may be necessary in order to ensure the survival of the species at a particular site.

The occurrence of the species at certain sites suggests that it may be part of a relict community of early post-glacial times. If many of the populations encountered are relict populations, then conditions at the sites at time of establishment may have been quite different. Its occurrence on Scragh Bog, alongside several other nationally rare species of current more northerly distribution such as *Pyrola rotundifolia*, *Dactylorhiza traunsteineri* and the moss *Tomentypnum nitens*, indicates that this fen is a refuge for such species in the Irish midlands, a region where many fens have long

since given way to raised bog (O'Connell 1981). In the rare occasions where a lagg remains relatively intact around a raised bog, it supports a 'relict' fen community dominated by species such as *Carex rostrata*, *C. lasiocarpa* and *Potentilla palustris*. It is in such a community that *E. gracile* occurs in the N. Kerry and Offaly sites. It is also notable that a suite of rare bryophytes, with current boreal distributions, such as *Tomentypnum nitens*, *Paludella squarrosa* and *Leiocolea rutheana*, have been located at a number of blanket bog flush sites in Co. Mayo (Lockhart 1999) which are within 5 km of the recently discovered *E. gracile* site in that county.

The different types of habitat in which *E. gracile* was located contain populations which vary greatly in size. These differences in population size are primarily related to the size of suitable habitat available to the species. For example, the larger scragh systems found in the Connemara coastal lake sites contain a large area of suitable habitat, i.e. scragh edge, for *E. gracile* to colonise and therefore they contain the largest populations of the species. Since it is likely that many of the populations which occur in bog flush, calcareous fen and raised bog lagg habitats are relict populations, they may be remnants of much larger populations which occurred when there was more open water present in these locations.

Although it may be argued that the habitats in which *E. gracile* grows often represent comparatively short-lived stages in seral succession, there is little doubt that drainage and/or eutrophication of water can accelerate the rate of succession from low-growing, species-rich plant communities to taller, species-poor ones (Tallis 1983; Wheeler 1983). The observed ecological preferences of *E. gracile* at its Irish sites, coupled with recent experiences in England (Winship 1994) and North America (Decker *et al.* 2006), suggest that the species is one of the first to disappear when open water conditions are eliminated. Therefore it is imperative that protective measures, such as the prevention of site drainage and surface water eutrophication, be imposed in order to slow down the rate of seral progression at sites. This safeguarding of the water quantity and quality at sites will ultimately result in a much longer "life span" of *E. gracile* populations.

Although all the different *E. gracile* habitats are potentially threatened by drainage and eutrophication, the extent of these threats

differs between sites. At present, lake sites occurring in the Connemara region are the least threatened because it is unlikely that they will be drained or otherwise interfered with in the near future. However, van Groenendael *et al.* (1993) noted that the rate of seral progression in coastal lakes in southwestern Connemara accelerated in the time period between the mid-1970s and the early 1990s due to the increased use of artificial fertilisers on land within the lake catchments. This could accelerate the disappearance of *E. gracile* along with the open water.

Populations of *E. gracile* which occur in blanket bog flush sites are more susceptible to drainage than those in lakes because their hydrology is intimately linked with that of the surrounding blanket bog and thus they are at a greater risk from the effects of damaging operations such as peat-cutting or afforestation in adjacent areas of land. This is further compounded by the fact that these populations are generally very small, both in flowering head number (Table 2) and extent and are therefore less likely to survive a damaging event such as drainage than a larger, more widely dispersed population. The sites where *E. gracile* occurs in Westmeath and North Kerry are both nature reserves and are thus legally protected from drainage and reclamation. However, the adjoining land is not protected at present and there is a danger that drainage or fertiliser application on this land may damage the ecology of the sites.

From the point of view of species conservation, one of the most crucial questions that needs to be addressed is at what point in the succession process does *E. gracile* disappear from a site. Winship (1994) has implicated the encroachment of dense reed swamp vegetation dominated by *Phragmites australis* in the elimination of *E. gracile* from English sites; however, in at least one of the Irish lake sites, the species is demonstrating the ability to persist for some time after open water conditions have disappeared. In the northern half of Cregduff Lough the species is common in an area of lake scragh, dominated by the tall reed swamp species *Phragmites australis*, *Carex lasiocarpa* and *Schoenoplectus lacustris*, in which there is no open water present. This suggests that the species may survive for a considerable time in areas of closed swamp vegetation which are still sufficiently wet. The future monitoring of *E. gracile* at this site will reveal much about the ability of the species to persist in habitats where open water is absent.

CONCLUSIONS

Although this survey suggests that there may have been a small decline in the number of Irish *E. gracile* sites in the past quarter of a century, it has also shown that the species is more common than was previously thought. Further intensive searches of the unconfirmed sites are recommended before it can be stated categorically that these populations have become extinct. Although this paper records 13 new sites for *E. gracile* in Ireland, it is felt that the species should remain on the Irish list of protected plant species. The main reasons for the continued protection of the species are (1) the decline of the species throughout the rest of Europe (Curtis & McGough 1988), (2) the relatively threatened nature of the species' habitat in Ireland and (3) the fact that many populations are small and vulnerable to habitat interference. It is imperative that the remaining Irish sites be monitored on a regular basis to ensure that they are protected from damaging

operations. Experiences in other countries (Winship 1994; Decker *et al.* 2006) have shown that protection of the existing hydrological balance within sites is needed in order to ensure the long-term survival of *E. gracile*.

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Neotypification of *Aira setacea* Hudson (Poaceae)

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ABSTRACT

Deschampsia setacea (Hudson) Hackel is a slender grass described originally as *Aira setacea* Hudson on a plant collected in Stratton Strawless (Norfolk) in the first edition of the *Flora Anglica*. It has never been typified, and since the herbarium of Hudson has been lost to fire, a neotype is chosen in order to preserve the current application of the name.

KEYWORDS *Deschampsia setacea*, Hudson, Neotypification, *Flora Anglica*

INTRODUCTION

The preparation of a revision of *Deschampsia* (Poaceae: Aveneae) in South America has made evident the lack of an extant type specimen for *Deschampsia setacea* (Hudson) Hackel. The ‘Bog Hair-grass’ is a slender grass occasionally found in bogs, pools and ditches in Great Britain (Perring & Walters 1962; Stace 1997). Outside Britain *D. setacea* is found in Ireland, Central Europe (Conert 1987; Jansen 1951) and Scandinavia (Hylander 1953). Some scattered populations also exist in central Chile (Parodi 1949), thus giving this taxon a disjunct distribution between Europe and South America. *Deschampsia setacea* (Hudson) Hackel is based on *Aira setacea* Hudson, which was described in the *Flora Anglica* (Hudson 1762) on the basis of a plant collected in East Anglia.

CHARACTERS USEFUL IN DISTINGUISHING *DESCHAMPSIA SETACEA* FROM OTHER *DESCHAMPSIA* SPECIES

Deschampsia setacea is a perennial cespitose grass with densely packed erect bristle-like blades 2.5–10 cm long, 1–1.5 mm wide, inrolled, sharply pointed, scabrous on mid and lateral nerves of both abaxial and adaxial sides. The ligules are narrowly lanceolate, 4.5–11 mm long, hyaline, acuminate, and the panicles

loose, lanceolate, 8–18 cm long, 1.5–5 cm wide, with spikelets 2-flowered, purplish, often clustered at the end of branches, the lower glume is narrowly lanceolate, (3)–4–5 mm long, 1-nerved, the upper glume lanceolate (3.5)–4.5–6 mm long, the lower lemma is 3–4 mm long, 4–(5) toothed, teeth irregular, the lateral longer; the awn bent and twisted, 4.5–6 mm long, inserted in the inferior third or at the base, brownish in the lower half, purple in the upper half, scabrous. It can be readily distinguished from the widespread *D. cespitosa* by the leaves, which are almost filiform in *D. setacea* and up to 5 mm wide in *D. cespitosa*, and the narrower and shorter inflorescences than that of *D. cespitosa*. The awn differs too in the two species, being generally more bent and exerted in *D. setacea* and nearly straight and barely exceeding the glumes in almost all specimens of *D. cespitosa*. Another related taxon, *Avenella flexuosa* (L.) Drejer (formerly treated as *Deschampsia flexuosa* (L.) Trin.) differs by the obtuse ligules, the larger panicles and by forming rhizomes. All the mentioned taxa are remarkably variable and show often clinal variation along environmental gradients.

PROTOLOGUE OF HUDSON'S *AIRA SETACEA*

The protologue of *Aira setacea* Hudson (Fig. 1) does not mention a particular specimen or illustration to be selected as type material (ICBN Art. 9.2, McNeill *et al.* 2006), only indicating the locality of the type collection: ‘Habitat in ericeto Strattoniensi in comitatu Norfolk, D. Stillingfleet reperit’, roughly translated as [Habitat in peat heath in Stratton, County Norfolk, collected by Stillingfleet].

SELECTION OF A NEOTYPE

While the specimens adjoined to Hudson located at other herbaria (CGE, E, K, LINN) are not those on which he made his original

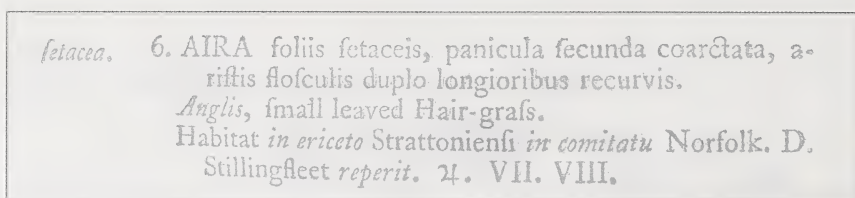


FIGURE 1. Protologue of *Aira setacea* Hudson (*Fl. Anglica* 1: 30. 1762), photograph taken from an original copy held at the Library of the Institute of Botany, University of Vienna, Austria.



FIGURE 2. Distribution of *D. setacea* (Huds.) Hackel in Britain & Ireland 10 km squares using size scaled dots to show different date classes, with progressively larger dots for more recent records. Where a plant has been recorded more than once in a grid square, only the most recent record is mapped.



FIGURE 3. Type specimen of *Aira setacea* Huds. [= *Deschampsia setacea* (Huds.) Hack].

descriptions (Stafleu & Cowan 1979), most of Hudson's herbarium is considered lost to the fire that destroyed his house in 1783 (Dixon 1959), and the remaining specimens (excluding algae) are located at the Buddle Herbarium in **BM** (M. Spencer, pers. comm.). Inquiries with curators of the herbaria above mentioned resulted in no single sheet of *Aira setacea*, thus allowing for the selection of a specimen not belonging to Hudson's collection. The recommendations ICBN 9A and 9B on designation of lecto and neotypes state that all aspects of the protologue should be considered for the selection of the new type material; in the present case the only clue is the place of the original collection, a locality in Norfolk close to Norwich, Stratton Strawless. A search in **BM** yielded a specimen collected in Norfolk, Litcham Common, 'Ex Herb. F. J. Hanbury, 18th July 1883' (Fig. 3), which is a good

example of the species and therefore designated here as Neotype, in agreement with ICBN Art. 9.14. *Deschampsia setacea* was last recorded in Norfolk in 1974 (Fig. 2), and probably represents a case of local extinction due to either urban or agrarian development common in nearby regions of Cambridgeshire (Preston 2000).

ACKNOWLEDGMENTS

I am very grateful to M. Spencer (**BM**) for helping to find a specimen, and for providing the image, A. Lockton for preparing the distribution map and S. Renvoize and T. Cope (**K**) for checking the specimen. Curators at **CGE**, **E**, **K**, **LINN** helped with the search of Hudson's specimens, M. Sanford critically read the manuscript, helping to improve it.

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Notes

BRITISH SPECIES OF *RUBUS* L. (ROSACEAE) IN MAINE AND NORTH BRITTANY, FRANCE

For the latest in a long-running series of cross-Channel forays to investigate how far, if at all, British representatives of the *Rubus fruticosus* aggregate have ranges that extend to the nearer parts of France, two sharply contrasting areas were chosen in 2006.

The last week in June proved ideal timing that season to catch the group in full flower in the largely agricultural belt between Normandy and the Loire, the northern part of which holds the two *départements*, Mayenne and Sarthe, that comprise the administrative region (and former province) of Maine. Extensive study of the *Rubus* flora of the *département* immediately to the south, Maine-et-Loire – roughly coinciding with the former province of Anjou – was undertaken during the first quarter of the twentieth century by one of France's then leading specialists in the group, the Angers-based G. Bouvet; that area above it, however, seems to have been left virtually unexplored. The particular part of it selected on this occasion, approximately midway between the cities of Laval and Le Mans, has large tracts of basic soils, with poor *Rubus* diversity as a consequence; but the primarily Maine-et-Loire speciality that Bouvet named *R. andegavensis* (after Angers) is abundant and conspicuous in the hedges on those, in compensation. Considerable broad-leaved woodland, some clearly of very considerable age, nevertheless provides oases of interest in the more acid parts.

Though at least half the *Rubus* species encountered were ones not known to occur in Britain, three of the commonest – *R. questieri* Lef. & P. J. Mueller, *R. adscitus* Genev. and *R. rubritinctus* W. C. R. Watson – are shared with England, though their range on the north side of the Channel is markedly south-western. To a British batologist they thus give the *Rubus* flora of Maine (and of the regions of France to the east as well) an unexpectedly western tilt. Adding emphasis to that, two species with a more south-eastern range in England, *R. asperidens* (Sudre ex Bouvet) Bouvet and *R. flexuosus* P. J. Mueller & Lef., are less in evidence, and on the whole less plentiful than in comparable habitats across the Channel. Well behind all those in frequency, however,

and mostly represented by a single bush at best, are such very widespread English species as *R. bertramii* G. Braun, *R. plicatus* Weihe & Nees, *R. pyramidalis* Kaltenb., *R. cardiophyllus* Lef. & P. J. Mueller and *R. echinatus* Lindley, the last two, seen only in field hedges on the summit of the principal hill, Mont Richard (363 m), probably brought from afar by birds.

That greater affinity with England's south-western *Rubus* flora than its south-eastern one that the brambles of Maine display is all the more obvious, as is only to be expected, on the northern seaboard of Brittany, the other region chosen for investigation – a week later, given that degree of retardation imposed on the *Rubus* flowering period by its more northern position. On a previous visit, in 1999, it had nevertheless come as a surprise how strongly south-western, 'Cornubian' even, that English affinity is along the comparatively sheltered, west-facing stretch of that coastline that is popularly known as the Côte de Granit Rose. Chiefly responsible for that is the prevalence and even local abundance there of *R. hastiformis* W. C. R. Watson. Two further species, up till then similarly believed endemic to the south-west of the British Isles, *R. aequalidens* Newton and *R. peninsulae* Rilstone, were also met with there on that earlier occasion but very much more sparsely (Allen 2002). A wider search, to check the accuracy of that initial impression and in the hope of finding at least one further compatriot of those, was many years overdue.

In the combined list below of the more noteworthy finds in one or other region † indicates a specimen from the locality in question has been seen also by A. Newton and the determination confirmed by him. All voucher material has been lodged in BM.

MAINE

R. elegantispinosus (A. Schumach.) H. E. Weber : Mayenne: Bois de la Forge, Chammes, colony in a clearing near the south margin. This is now the fourth wood (and fourth *département*) in the general region of the middle Loire in which finds of this species

have been made since 1994 (contrary to the statement in Allen 2007), earlier herbarium specimens having been detected from Sarthe (Forêt de Pincé, Sablé) and Loire-et-Cher (Forêt de Boulogne, nr. Chambord), a solitary clump in each case. This virtually exclusive woodland distribution is sharply at variance with the situation in Britain, where the species is patently a garden escape and more or less confined to waste places in urban areas. The possibility that it is indigenous in that part of France seems to deserve consideration.

R. neomalacus Sudre Mayenne: grassy roadside by south margin of Bois de la Forge; Bois de Bergault. Sarthe: along roadside margin of Forêt de Grande Charnie W. of Étival-en-Charnie. Single clump or patch in each case. These finds back up the two recorded from Maine-et-Loire by Bouvet (1912), suggesting that this region constitutes a 'stepping-stone' between the two strikingly disparate centres otherwise known for this species: the mouth of the Loire and the west half of Surrey, v.c. 17.

R. trichodes W. C. R. Watson Sarthe: margin of broad-leaved woodland by Les Faucheries cross-lanes, Forêt de Grande Charnie †. Third record for France, extending the known Continental range some 300 km south-westwards.

R. botryeros (Focke ex Rogers) Rogers Mayenne: clump in field hedge, summit of Mont Rochard. A strongly western species near its eastern limit here.

R. tamarensis Newton Mayenne: one patch, Bois de la Forge. A semi-western species with isolated outliers southwards from its centre in Normandy's Orne Valley.

R. scaber Weihe Mayenne: one bush, Bois de la Forge. Apparently very rare in N. W. France, in contrast to its frequency in southern England and very incongruous local abundance in the west of Connaught in Ireland.

NORTH BRITTANY

Côte de Granit Rose (*dép.* Côtes-du-Nord): *R. leuchostachys* Schleicher ex Sm. Patch among bracken on cliff-top, public footpath between Truzugal and Kerbalanec, N. W. of Louannec – the same unusual habitat for this species in which it occurs, apparently exclusively, in Guernsey and Sark (Allen 2001). Technically the first record for the European mainland, but subsequently a specimen collected by Genevier (Vendée: Mortagne, 1857, sub nom. *R. vestitus*) has come to light in herb. Déséglise in NMW (xerox copy in BM).

R. aequalidens Newton Locally common 2 km inland in plantations and hedges around Varac'h Château, S. of Louannec; a bush in a *Thuja* hedge 1 km E. of Beg Léguer. (Also common in woodland divided by D786 S. W. of Lanmeur, 8 km into *dép.* Finistère.)

R. peninsulae Rilstone Two populations c. 200 m apart in scrub and full sun, cliff-top public footpath between Truzugal and Kerbalanec; in and around Marais du Quellen (wooded lagoon, now a nature reserve, on N. outskirts of Trébeurden)†; one bush in hedge of house by Beg Léguer viewpoint.

R. venetorum D. E. Allen Though common over most of Brittany, anomalously rare on this stretch of coast: patch among bracken, roadside S. of Marais du Quellen, Trébeurden.

Continual re-scrutiny of herbarium material collected on previous cross-Channel forays has also resulted in one further addition for mainland Europe:

R. lanaticaulis Edees & Newton Manche: hedge of D122 W. of La Glacerie (village), 3.5 km S. of Cherbourg, 1987 (BM)†. A starved example of this common species of western Britain and Ireland long expected to be found in Normandy and/or Brittany.

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THE STATUS OF *RUBUS BABINGTONIANUS* W. C. R. WATSON (ROSACEAE)

Like many *Rubus* species, *R. babingtonianus* has had a chequered history since it was first determined as *R. althaeifolius* of Host. by Babington in Babingtons' British *Rubi* in 1869. Babington assigned a number of sites for it round Cambridge but also gave it a much wider range in England. W. Moyle Rogers does not mention the plant at all in his *Handbook of British Rubi* published in 1900.

W. C. R. Watson gave the plant a new name *R. babingtonianus* in 1946 with the note "*Rubus althaeifolius* Bab 1869 non Host. 1823" However, in *Rubi of Great Britain and Ireland* (1956), Watson gives a distribution covering 14 British vice counties from Kent to South Uist and one Irish v.c.

Edees & Newton (*Brambles of the British Isles* 1988), having sorted the wheat from the chaff, gave the plant local endemic status almost confined to Cambs v.c. 29 with one record just in West Suffolk v.c. 26, and this status remained in place in the *Atlas of British and Irish Brambles* (Newton & Randall 2004) with just one extra hectad dot since the 1988 publication.

The present author had not knowingly seen *Rubus babingtonianus* so was delighted when A. Newton gave him a grid reference for a site between Chippenham and Snailwell in east Cambridgeshire, where he himself had collected specimens.

A visit was made on 6 August 1997, specimens collected and these were duly confirmed by A. Newton.

On 16 July 2001 whilst paying a visit to some 'Breckland rarities', a stop for lunch was made beside a Forest Enterprise plantation at Barton Mills v.c. 26 and, after eating, a stroll

down the road revealed a low thicket of brambles that had the appearance of *Rubus babingtonianus*. Once seen, it was found again less than three weeks later whilst plant recording for the Flora of Suffolk on 4 August 2001 in an area at Thetford known as the Horse Meadows (administrative Norfolk but v.c. 26). A third site was found on 20 August 2001, this time at Thompson Common, a Norfolk Wildlife Trust reserve in v.c. 28. All were confirmed by A. Newton.

Since that date, new sites have been found almost annually in v.c.c. 25, 26, 27 and 28 as well as a colony found with Dr A. C. Leslie deep in the Fens at Littleport v.c. 29.

The statement in Edees & Newton (1988) that it is a plant of clay soils appears to be not strictly true as the subsequent finds have covered a wide range of soil types; from sandy Breck to chalky clay to peaty fen, though it does seem to like stream banks and the margins of wet ditches and pools.

Once acquainted with *Rubus babingtonianus* it is quite an easy plant to pick out, especially as it grows in areas where other species are limited in diversity. In addition to the regularly lobate leaf margin, the panicle becomes increasingly compound as the season advances and the neat pink flowers can be found from late May to early August when most other *Corylifolii* have long since gone over. It is also remarkably constant throughout its range.

No attempt has yet been made to map all the sites for *Rubus babingtonianus* but in order to confirm its status as a regional rather than a local endemic, there follows a list of exsiccatae to be found in **Herb. A. L. Bull** most of which have been approved by A. Newton.

Vice-county	Date	Location	Grid Ref.
25 East Suffolk	17 06 2006	Wortham Ling	TM0879
	07 08 2004	Hedgerow, Wilby	TM2370
26 West Suffolk	28 07 2004	Castlings Heath, Groton	TL9743
	26 07 2003	Coney Weston Crossroads	TL9438
	16 07 2001	Roadside, Barton Mills	TL7271
	04 08 2001	Horse Meadows, Thetford	TL8483
27 East Norfolk	24 06 2006	Saxlingham Road, Bayfield	TG0340
	31 07 2004	Bylaugh, near Swanton Morley bridges	TG0218
	09 09 2004	Stokesby road Billockby near the Muck Fleet bridge	TG4111
28 West Norfolk	20 08 2001	Thompson Common	TL9396
	11 08 2008	By bridge at Madhouse Plantation Tottington	TL9094

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ELEVEN NEW COMBINATIONS IN THE BRITISH FLORA

Some new combinations are required for forthcoming floristic works.

1. *Ficaria* Schaeff.

Molecular work has confirmed that *Ficaria* Schaeff. should be treated as a separate genus from *Ranunculus* L., so that *R. ficaria* L. should now be known as *F. verna* Huds. Moreover Laegaard (2001) demonstrated that the type of *Ranunculus ficaria* is the tetraploid taxon hither to known as subsp. *bulbilifer* Lambinon, not the fertile diploid as concluded by Sell (1994). The correct subspecific epithets for the tetraploid and diploid respectively are therefore *verna* and *fertilis*. There appears to be no valid combination for the latter:

Ficaria verna* Huds. subsp. *fertilis* (Lawralrée ex Laegaard) Stace, **comb. nov.*

Basionym: *Ranunculus ficaria* L. subsp. *fertilis* Lawralrée ex Laegaard, *Nordic J. Bot.* 20: 526 (2001)

Laegaard (2001) actually gave the authority for his combination as "A. R. Clapham ex Laegaard", but in fact Clapham published his invalid *fertilis* as a variety, not as a subspecies; Lawralrée later published it illegitimately as a subspecies (Sell 1994).

Of the other two subspecies recognised in Britain, the combination *F. verna* subsp. *ficariiformis* (F. W. Schultz) B. Walln. already exists, but subsp. *chrysocephala* requires validation:

Ficaria verna* Huds. subsp. *chrysocephala* (P. D. Sell) Stace, **comb. nov.*

Basionym: *Ranunculus ficaria* L. subsp. *chrysocephalus* P. D. Sell, *Bot. J. Linn. Soc.* 106: 117 (1991).

2. *Dysphania* R. Br.

The glandular species of *Chenopodium* are now generally segregated into the genus *Dysphania*, under which two casual hybrids require combinations:

***Dysphania carinata* (R. Br.) Mosyakin & Clemants (*C. carinatum* R. Br.) × *D. cristata* (F. Muell.) Mosyakin & Clemants (*C. cristatum* F. Muell.)**

= ***Dysphania* × *bontei* (Aellen) Stace, **comb. nov.****

Basionym: *Chenopodium* × *bontei* Aellen, *Verh. Nat. Ges. Basel* 44: 317 (1933)

***Dysphania pumilio* (R. Br.) Mosyakin & Clemants (*C. pumilio* R. Br.) × *D. carinata* (R. Br.) Mosyakin & Clemants (*C. carinatum* R. Br.)**

= ***Dysphania* × *christii* (Aellen) Stace, **comb. nov.****

Basionym: *Chenopodium* × *christii* Aellen, *Verh. Nat. Ges. Basel* 44: 317 (1933)

3. *Callitriche* L.

With justification Lansdown (2006) relegated *Callitriche hamulata* to an infraspecific variant of *C. brutia*, on the grounds that the two taxa are not distinguishable unless fruiting in dry or damp (as opposed to aquatic) conditions, when *C. brutia* alone develops fruit-stalks 2–10 mm long. The presence or absence of fruit-stalks is, however, correlated with a striking difference in chromosome number: $2n = 28$ in *C. brutia*; $2n = 38$ in *C. hamulata*. This correlation has been demonstrated in 29 accessions (6 of *C. brutia*, 23 of *C. hamulata*) according to data in the B.S.B.I. Cytological Database. Accordingly, I consider that subspecific status is more appropriate than the varietal status chosen by Lansdown.

Callitriche brutia* Petagna subsp. *hamulata* (Kütz. ex W. D. J. Koch) Stace, **comb. nov.*

Basionym: *C. hamulata* Kütz. ex W. D. J. Koch, *Syn. Fl. Germ.* 246 (1837)

Synonyms: *C. intermedia* Hoffm. subsp. *hamulata* (Kütz. ex W. D. J. Koch) A. R. Clapham, in Clapham, Tutin & E. Warb., *Fl. Brit. Isl.* 622 (1952)

C. brutia var. *hamulata* (Kütz. ex W. D. J. Koch) Lansdown, *Watsonia* 26: 113 (2006)

4. *Mimulus* L.

The plant described by Clos as a variety of *M. luteus* is better recognised at species level according to Silverside (1994); the combination is made here:

Mimulus nummularius (Clos) Stace, **comb. nov.**

Basionym: *Mimulus luteus* L. var. *nummularius* Clos, in Gay, *Fl. Chil.* 5: 140 (1849)

5. × *Schedolium* Holub

The three broad-leaved species of *Festuca* L. are now segregated into the genus *Schedonorus* P. Beauv., and their hybrids with species of *Lolium* L. have been allocated to nothogenus × *Schedolium*. Combinations under the latter have already been provided by Holub (1998) and Scholz (2007) for four of the six hybrids between the three species of *Schedonorus* (*S. pratensis*, *S. arundinaceus* and *S. giganteus*) and *Lolium perenne* and *L. multiflorum*; the other two are made here:

Schedonorus pratensis (Huds.) P. Beauv. (*Festuca pratensis* Huds.) × *Lolium multiflorum* Lam.

= × *Schedolium braunii* (K. Richt.) Stace, **comb. nov.**

Basionym: *Festuca* × *braunii* K. Richt., *Pl. Eur.* 1: 103 (1890)

Synonym: × *Festulolium braunii* (K. Richt.) A. Camus, *Bull. Mus. Hist. Nat. (Paris)*, Sér. I, 33: 538 (1927)

Schedonorus giganteus (L.) Holub (*Festuca gigantea* (L.) Vill.) × *Lolium multiflorum* Lam.

= × *Schedolium nilssonii* (Cugnac & A. Camus) Stace, **comb. nov.**

Basionym: × *Festulolium nilssonii* Cugnac & A. Camus, *Bull. Soc. Bot. France* 91: 19 (1944)

6. × *Dactylodenia* Garay & H. R. Sweet

When the three British *Gymnadenia* taxa are treated as separate species rather than as subspecies of *G. conopsea* (L.) R. Br. the allocation and synonymy of the binomials for hybrids between them and species of *Dactylorhiza* Necker ex Nevski (= × *Dactylodenia*) have to be reconsidered. Of the ten combinations of × *Dactylodenia* known from the British Isles, five already have a legitimate binomial, four have no epithets that can be applied, and one can be provided with a legitimate binomial by the following new combination:

× *Dactylodenia evansii* (Druce) Stace, **comb. nov.**

Basionym: *Orchis* × *evansii* Druce, *Rep. Bot. Exch. Club Brit. Isles* 2: 199 (1907)

Synonyms: *Habenaria* × *evansii* (Druce) Druce, *Rep. Bot. Exch. Club Brit. Isles* 8: 875 (1929)

× *Orchigymnadenia evansii* (Druce) T. & T. A. Stephenson, *J. Bot.* 60: 35 (1922)

= *Gymnadenia borealis* (Druce) R. M. Bateman, Pridgeon & M. W. Chase × *Dactylorhiza maculata* (L.) Soó

The above new combination was previously published invalidly and inaccurately by Averyanov in *Bot. Zhurn. (Moscow & Leningrad)* 71: 93 (1986). The type of *Orchis* × *evansii* came from Berwickshire, where *G. borealis* rather than *G. conopsea* occurs. The publication of legitimate binomials for the remaining four combinations demands the collection of new material in order to provide type specimens.

7. *Dactylorhiza* Necker ex Nevski

Wilmott's *Orchis kerryensis* remains a distinctive taxon, best recognised as a variety of *Dactylorhiza occidentalis*, for which a new combination is required:

Dactylorhiza occidentalis (Pugsley) P. Delforge var. *kerryensis* (Wilmott) R. M. Bateman & Denholm, **comb. nov.**

Basionym: *Orchis kerryensis* Wilmott, *Proc. Linn. Soc. Lond.* 148: 126 (1936)

8. × *Anacamptorchis* E.G. Camus

The transfer of *Orchis morio* to *Anacamptis* means that the hybrid *O. mascula* × *O. morio* becomes an intergeneric hybrid under × *Anacamptorchis*, for which the new combination is made:

× *Anacamptorchis morioides* (Brand) Stace, **comb. nov.**

Basionym: *Orchis* × *morioides* Brand, *Syn. Deut. Schweiz. Fl.*, ed. 3, 3: 2427 (1905)

= *Anacamptis morio* (L.) R. M. Bateman, Pridgeon & M. W. Chase (*O. morio* L.) × *Orchis mascula* (L.) L.

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THE RE-DISCOVERY OF *ARENARIA NORVEGICA* SUBSP. *NORVEGICA* IN IRELAND

The only Irish record for *Arenaria norvegica* was made by the late John [Jack] Heslop Harrison in June 1961 during a visit to the Burren, County Clare (H9), with a party of botany students from the University of Birmingham (Heslop Harrison, Wilkins & Green 1961). During their stay they discovered a small colony growing in “shallow crevices and solution hollows on an area of limestone pavement” at c. 800 ft (244 m) on “the south slope of Gleninagh Mountain overlooking Caher Lower” (Heslop Harrison *et al.* 1961). The precise locality is unclear as Gleninagh Mountain does not have a southern slope, but extends southwards in a long ridge to the east of Caher Lower. A more likely locality occurs on the adjacent mountain of Carnsefin at c. M164092 “or not far away” on a series of south-facing limestone pavements (Webb & Scannell 1983) but despite repeated searches no plants have been found in either locality. This led some botanists to conclude that the plant is either extinct or that the original record was erroneous (Webb & Scannell 1983; Curtis & McGough 1988). There is no doubt, however, as to the identity of Heslop Harrison’s specimen: this was shown to Geoffrey Halliday who counted the chromosomes of a plant grown from seed extracted from it ($2n = 80$) (G. Halliday, pers. comm.). This confirmed the presence of *Arenaria norvegica* subsp. *norvegica* for Ireland, a taxon then only known from Scotland, Norway, Sweden and Iceland.

On 25 May 2008 two small colonies of *A. norvegica* subsp. *norvegica* were discovered a few kilometres away from Gleninagh Mountain on the southwest slopes of Carnsefin Mountain

overlooking the coast at Fanore. The first colony, of around 10–20 plants, was confined to Carboniferous limestone outcrops in the middle of the “green road” between Morroogh and Black Head. Plants were growing in shallow gravel filled solution hollows extending over 20 m of the track. Only a few other species were growing in the same habitat (*Bellis perennis*, *Minuartia verna*, *Plantago lanceolata*, *Thymus polytrichus*). All other species listed in Table 1 (quadrat 1) were associated with pockets of *Festuca ovina*-*Sesleria caerulea* grassland. The community most closely resembled *Festuca ovina*-*Minuartia verna* grassland (67% fit to *Cladonia* species sub-community, OV37c,) and was almost identical to sites in Yorkshire where *Arenaria norvegica* subsp. *anglica* grows on a green lane on Ingleborough (Walker 2000).

A second larger population was located nearby on limestone exposures at a slightly higher altitude (c. 100 m). Here, around 30 flowering plants extended over 50 m growing in soil and gravel-filled crevices and solution hollows adjacent to *Dryas* heath with abundant *Gentiana verna* and *Helianthemum oelandicum* subsp. *canum*. Again the vegetation was very open with scattered plants of *Arenaria norvegica*, *Agrostis capillaris*, *Asperula cynanchica*, *Carex flacca*, *Festuca ovina*, *Saxifraga tridactylites* and *Thymus polytrichus* (Table 1; quadrats 2 & 3). This community most closely resembled *Festuca ovina*-*Agrostis capillaris*-*Thymus polytrichus* grassland (CG10c; 26 and 34% fit to *Saxifraga aizoides*-*Ditrichum flexicaule* sub-community).

% COVER OF SPECIES GROWING WITH *ARENARIA NORVEGICA* SUBSP. *NORVEGICA*
IN THE BURREN, COUNTY CLARE (1 M² QUADRATS)

Species	1	2	3	Species	1	2	3
<i>Achillea millefolium</i>	+	+		<i>Festuca ovina</i>	20	5	5
<i>Agrostis capillaris</i>		2	5	<i>Gentiana verna</i>		+	+
<i>Antennaria dioica</i>		1		<i>Helianthemum oelandicum</i>			+
<i>Anthyllis vulneraria</i>		3	+	<i>Lotus corniculatus</i>	+	+	+
<i>Arenaria norvegica</i>	+	+	+	<i>Minuartia verna</i>	+		
<i>Armeria maritima</i>	+			<i>Plantago lanceolata</i>	+		
<i>Asperula cynanchica</i>		+		<i>Plantago maritima</i>		+	
<i>Bellis perennis</i>	+			<i>Prunella vulgaris</i>		+	
<i>Briza media</i>	1			<i>Saxifraga tridactylites</i>			+
<i>Calluna vulgaris</i>		2		<i>Sesleria caerulea</i>	2		
<i>Campanula rotundifolia</i>		+		<i>Succisa pratensis</i>		2	+
<i>Carex caryophyllaea</i>		+		<i>Thymus polytrichus</i>	2	3	1
<i>Carex flacca</i>		2	1	<i>Viola riviniana</i>		+	+
<i>Carex pulicaris</i>		+		Vegetation cover	25	20	15
<i>Dryas octopetala</i>			+	Bare rock, soil and gravel	75	80	85

Species confined to solution hollows are highlighted in **bold**.

Site 1, "ruts" of green road between Morroogh and Black Head, M15091021, alt. 80 m; sites 2 & 3, solution hollows on limestone pavement nearby, M15111059 & M15081060, alt. 100 m.

Irish plants of *Arenaria norvegica* were similar to Scottish subsp. *norvegica* in having small flowers (<10 mm) with 4 styles and obovate leaves (subsp. *anglica* has larger flowers, greater than 11 mm, with 3 styles and narrowly ovate leaves (Stace 1997)). The leaves were characteristically succulent, glossy-green and had an indistinct midrib and a few basal cilia (greater than a third in *A. ciliata* subsp. *hibernica*). However, there were notable differences. Irish plants appear to flower about a month earlier than in Scotland as in May 2008 many capsules already contained seed. The flowers were also noticeably smaller. Although Irish plants displayed the characteristic trailing habit of Scottish subsp. *norvegica* the leaves were noticeably smaller (2.5–4 mm) and more obovate. The reasons for these differences are unclear and would warrant further investigation.

How *Arenaria norvegica* has eluded botanists for so long is a mystery. Heslop Harrison only realised the significance of his find on examining specimens at the end of a long day's botanising and neither he, nor any of his students ever returned to confirm the

locality (G. Halliday, pers. comm.). If their recollections of the precise locality were incorrect then subsequent botanists have been looking in the wrong place which is admittedly a very large area that "would take a dozen botanists...a week's hard work to demonstrate conclusively that the plant was absent" (Webb & Scannell 1983).

The 2008 discovery therefore confirms the presence of this rare arctic-montane species for Ireland at its most southerly station in the world (53°N). A more thorough examination of the adjacent slopes is planned and will hopefully reveal a more extensive population.

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WATER-BORNE DISPERSAL OF *CARDAMINE BULBIFERA* (L.) CRANTZ
(BRASSICACEAE) IN MID-WEST YORKSHIRE (V.C. 64)

In Britain *Cardamine bulbifera* (Coralroot) is a localised perennial herb of ancient woodlands, shady stream-sides and roadside banks in South East England (Showler & Rich 1993). It is classified as Nationally Scarce (Cheffings 2004) and has been recorded as a native in 143 tetrads in 25 10-km squares (Nicholson *et al.* 2004). These populations are concentrated in two main areas: on dry, basic soils in beech woods in the Chilterns (Buckinghamshire, Hertfordshire and Middlesex) and wet, generally acidic woodlands of the High Weald (Kent and Sussex). Elsewhere in the British Isles, it has been recorded as a naturalised alien in a variety of habitats. These include large populations in the ancient Needwood Forest, Staffordshire (v.c. 39) where it was formerly considered to be native (Nicholson *et al.* 2004). The majority of established populations are referable to the alpine forma *ptarmicifolia* (DC) O. E. Schulz which has been confirmed from a number of vice-counties (South & North Devon, North Somerset, South Essex, Salop, Mid-west Yorks, Westmorland, Dumfries, Kincardineshire, County Dublin). This form, which originates from the mountains of Central and Eastern Europe, is often grown in gardens, where it can become invasive, and is easily distinguished from native plants (forma *bulbifera*) by the shape of the leaves, which are more ovate and asymmetrical in outline and with broadly serrate margins (see figures in Showler & Rich 1993; Rich & Jermy 1998). It is also taller with larger, browner bulbils produced in the leaf

axils. This purpose of this note is to document the water-borne spread of this uncommon alien along one river valley near to Harrogate, Mid-west Yorks (v.c. 64) where its range is increasing rapidly via the dispersal of bulbils during floods.

ORIGIN

Cardamine bulbifera has been known from the banks of the Oak Beck (SE25), a small tributary of the River Nidd, to the west of Harrogate, since at least 1998 (Manson, 2003; Wallace, 2005). This population was thought to have originated from the Royal Horticultural Society's gardens at Harlow Carr through which a small tributary of the Oak Beck stream flows. This was confirmed in April 2007 when 1000s of plants were found along the rear perimeter fence of the gardens and in an adjacent area of woodland next to this stream. Here *C. bulbifera* was the dominant species over approximately 50 × 30 m area growing with a number of other garden plants that have also become established along the lower reaches of the stream (e.g. *Cardamine raphanifolia*, *Doronicum pardalianches*, *Lysichiton americanus*, *Petastites japonicus*, *Ranunculus aconitifolius*, *Tellima grandiflora*, *Symphytum grandiflorum*). The origin of the Coralroot was thought to be in peat brought with lily bulbs from Essex sometime in the 1980s (Manson 2003). It soon became invasive in the garden borders, where it still survives despite excessive weeding.

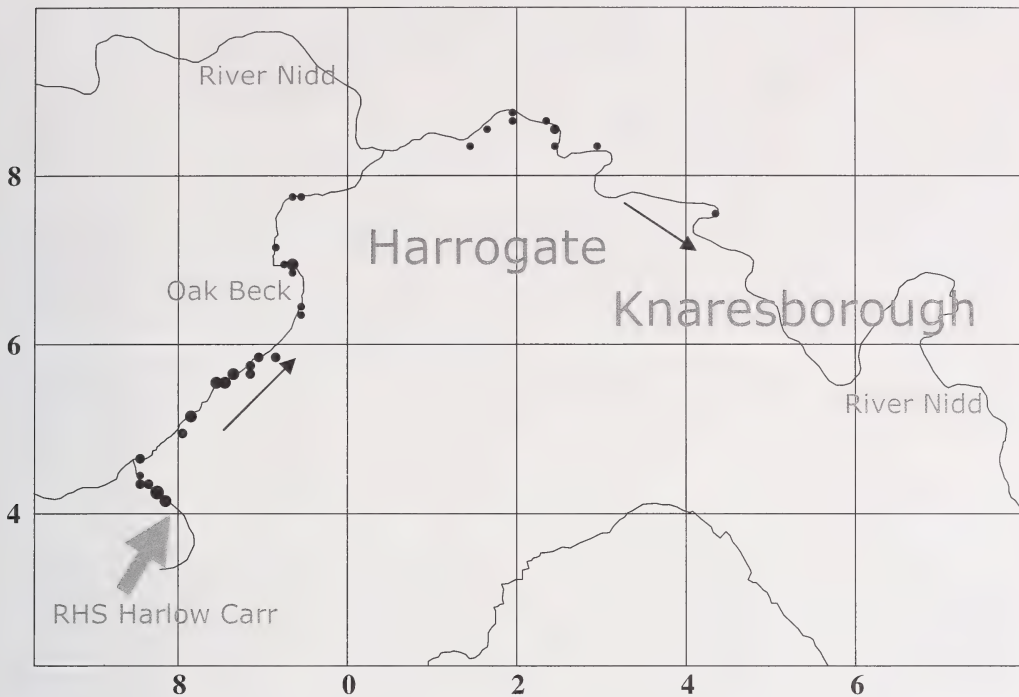


FIGURE 1. The distribution of *Cardamine bulbifera* along Oak Beck and the River Nidd in v.c. 64. Arrows denote the direction of river flow and the size of circles the size of populations.

DISTRIBUTION AND SPREAD

A survey of the entire course of the Oak Beck and River Nidd, as far east as Knaresborough, was carried out by the author in April 2007 (Fig. 1). This showed *C. bulbifera* to be present along c. 5 km of the Oak Beck from its confluence with the Harlow Carr stream up to where it meets the River Nidd. It also occurs sporadically on both banks of the Nidd up to c. 6 km downstream from the Oak Beck as far as Knaresborough. Plants are more or less continuously encountered along the upper stretches of the Oak Beck where extensive patches, in a few cases with 1000s of stems, occur on the shaded, sandy banks, islands or in damp woodland in the adjacent flood zone. In a few places the plant also grows above the flood zone as well as in grassland bordering a residential estate. The species is much less common along the River Nidd where small populations occur in similar habitats, but also on sandy river banks with no tree cover. The reason for this may be the greater 'scouring' of the riverbanks during winter rains (Wallace 2005) but also because these colonies have had

less time to become established than on the Oak Beck; it will be interesting to observe the behaviour of these small populations over the coming years.

HABITATS AND ECOLOGY

These established populations are almost exclusively confined to sandy soils within the narrow flood zone of the two main water-courses. These areas are subject to frequent 'scouring' and re-deposition of sand/silt during short floods which occur throughout the year. Consequently the habitats often show signs of disturbance with large areas often covered in deposited sand and tree litter. The ground flora is relatively uniform along both rivers, and is typical of *Allium ursinum* sub-community of *Fraxinus excelsior*-*Acer campestre*-*Mercurialis perennis* woodland (W8f; Rodwell 1991). Stands with *C. bulbifera* are usually shaded and dominated by a dense carpet of *Allium ursinum*, with *Galium aparine*, *Geum urbanum*, *Ranunculus ficaria* and *Urtica dioica*. The canopy is usually a mixture of *Acer pseudoplatanus*,

TABLE 1. VASCULAR PLANT SPECIES RECORDED WITH *CARDAMINE BULBIFERA* IN 2 × 2 M QUADRATS IN MID-WEST YORKSHIRE (N = 11)

Species	% sites	Species	% sites
Canopy		<i>Circaea lutetiana</i>	18
<i>Acer pseudoplatanus</i>	18	<i>Deschampsia cespitosa</i>	27
<i>Alnus glutinosa</i>	36	<i>Galium aparine</i>	64
<i>Corylus avellana</i>	9	<i>Geranium robertianum</i>	36
<i>Crataegus monogyna</i>	18	<i>Geum urbanum</i>	55
<i>Fagus sylvatica</i>	9	<i>Hedera helix</i>	18
		<i>Heracleum sphondylium</i>	27
Ground flora		<i>Hyacinthoides non-scripta</i>	45
<i>Aegopodium podagraria</i>	45	<i>Impatiens glandulifera</i>	64
<i>Allium ursinum</i>	100	<i>Luzula sylvatica</i>	45
<i>Anemone nemorosa</i>	45	<i>Mercurialis perennis</i>	27
<i>Angelica sylvatica</i>	18	<i>Oxalis acetosella</i>	27
<i>Anthriscus sylvestris</i>	45	<i>Ranunculus ficaria</i>	100
<i>Brachypodium sylvaticum</i>	27	<i>Rubus</i> spp.	45
<i>Cardamine flexuosa</i>	27	<i>Silene dioica</i>	36
<i>Carex pendula</i>	27	<i>Urtica dioica</i>	55

Only species recorded in 15% or more of sites are included; additional species recorded are listed below:

Agrostis capillaris, *Alliaria petiolata*, *Blechnum spicant*, *Cardamine raphanifolia*, *Cardamine* sp., *Conopodium majus*, *Doronicum pardalianches*, *Epilobium* sp., *Filipendula ulmaria*, *Geranium* sp., *Juncus effusus*, *Lysichiton americanus*, *Narcissus* sp., *Petasites hybridus*, *Phyllitis scolopendrium*, *Poa trivialis*, *Pteridium aquilinum*, *Ranunculus acris*, *R. repens*, *Ribes nigrum*, *Rosa canina*, *Sanicula europaea*, *Stellaria holostea*, *Taraxacum officinale*, *Ulmus* sp., *Valeriana dioica*, *Veronica beccabunga*, *V. chamaedrys*, *V. montana*, *Vicia sepium*.

Fraxinus excelsior with *Alnus glutinosa* confined to the edge of the watercourses (Table 1). The riverbanks also support large populations of *Impatiens glandulifera* which are present as seedlings during the flowering period of *C. bulbifera*. Other frequent associates are *Aegopodium podagraria*, *Anemone nemorosa*, *Anthriscus sylvestris*, *Hyacinthoides non-scripta*, *Luzula sylvatica* and *Rubus fruticosus* agg. *C. bulbifera* also occurs in *Carex remota*-*Cirsium palustre* sub-community of *Alnus glutinosa*-*Fraxinus excelsior*-*Lysimachia nemorum* woodland (W7b) but in these stands many of the NVC constants are absent. Many other neophytes originating from Harlow Carr grow with *C. bulbifera* including *Cardamine raphanifolia*, *Doronicum pardalianches*, *Lathraea clandestina*, *Lysichiton americanus*, *Ranunculus aconitifolius*, *Tellima grandiflora* and *Symphytum grandiflorum*.

C. bulbifera is a vernal woodland-gap species which, like many shade-loving plants, completes its reproductive cycle before ground flora vegetation has reached its full extent in July. In Harrogate leaves of *C. bulbifera* are clearly visible in February and by early March these

have extended well above the surrounding leaves of *Allium ursinum*. Flowering is usually in full force by early April and completed by mid-June after when the leaves rapidly senesce to leave bare, withered stems in situ (these persist through the winter). In Harrogate a variety of insects have been observed visiting flowers, mostly notably Orange-tip (*Anthocharis cardamines* L.) and Green-veined White (*Pieris napi* L.) butterflies (the former mainly visiting *C. amara*). However, most flowers fail to set seed. Almost uniquely for a British woodland plant dispersal is therefore primarily by bulbils. These are produced very early in the leaf-axils and are dislodged by physical movement of the stems from late April onwards. Plants in Harrogate produce around twice as many bulbils as flowers: the average for 20 plants measured in 2008 was 12.8 (± 0.7) bulbils (range 7–18) versus 6.4 (± 0.5) flowers (range 2–10). Patches of say 500 stems, which are not uncommon on riverbanks, therefore produce anywhere between 3500 and 9000 bulbils annually. Individual bulbils vary in size but are relatively heavy weighing around 0.15 g. The majority therefore probably fall close to the parent plant. Secondary

dispersal probably occurs in a number of ways. Hegi (1958) reports dispersal by ants in continental Europe but Showler & Rich (1993), in noting that localities in Kent and Sussex are on, or close to river-banks and ditches, favour water-borne dispersal, presumably via ground-wash into streams and then physical movement by the current. Rose (1966) also suggested this as the main mechanism accounting for the micro-distribution of *C. bulbifera* in the Weald. Physical transport in the soil (as in this case of bulbils being introduced to Harlow Carr in peat) is likely to be less common (e.g. on boots, paws, hooves) but may account for the occurrence of isolated patches tens of metres above the flood zone.

CONCLUSION

The garden form of the Biodiversity Action Plan species *C. bulbifera* is now well naturalised along the River Nidd in v.c. 64 where it is undergoing a dramatic expansion in range, via water-borne dispersal of bulbils, into disturbed, sandy niches within the flood zone. Over the last decade tens of thousands of plants have become established and it has spread over 10 km downstream from its point of origin. It will be interesting to observe the behaviour of these populations, especially the rate and extent to which they expand along the River Nidd into the Vale of York over the next ten years.

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CIRSIMUM × *SEMIDECURRENS* H. RICHTER IN GLAMORGAN

The distinctive hybrid between *Cirsium tuberosum* (L.) All. and *C. palustre* (L.) Scop. (*C.* × *semidecurrens* H. Richter) has been recorded from three sites in Britain growing amongst large stands of *C. tuberosum* in mosaics of scrub and calcareous grassland on moderate N- to NW-facing slopes with *C. palustre* growing nearby. This hybrid was first reported in Britain in 1932 by J. L. Bruce and J. S. L. Gilmour "...in the well-known locality for *C. tuberosum* near Nash Point" (BM) Glamorgan, although there is an earlier 1928 specimen in NMW collected by S. L. Bruce (Gilmour 1933). In 1947 Donald Grose discovered a single plant in South Wiltshire (v.c. 8) whilst searching for *C. tuberosum* close to where it

was originally discovered by A. B. Lambert in 1812 although the site was subsequently ploughed-up (Grose 1942, 1949, 1953, 1957). A second specimen from this site (Great Ridge), collected in 1939 and mis-labelled as *Cirsium tuberosum*, was re-determined as *C.* × *semidecurrens* (RNG; conf. W. A. Sledge). In 1986 a further plant was discovered nearby (Stockton Down, K, Everett 1993). The record for Montgomeryshire (v.c. 47) given in Stace *et al.* (2003) is an error and it has not been recorded in North Wiltshire (v.c. 7) despite both parents growing together in rank *Bromopsis erectus* grassland on Salisbury Plain. On the continent it has been recorded in France, Germany, Switzerland and Italy.



FIGURE 1. *Cirsium* × *semidecurrens* growing at Cwm Nash, Glamorgan, August 2001.

Cirsium × *semidecurrens* was refound at Cwm Nash in Glamorgan (v.c. 41) by the author in August 2001 (Fig. 1) presumably growing very close to where it was originally discovered by Bruce over 70 years ago. A specimen was collected and verified by Clive Stace (NMW). This is the fifth British record (Appendix) and the first for Glamorgan since 1932 although botanists have noted putative hybrids in the Nash Point area in recent years (J. Woodman and Q. Kay, pers. comm.). Indeed, Kay & John (1995) cultivated a specimen of “*C. tuberosum*” from Cwm Nash which was morphologically unlike its seed parent with a tall branching flowering stem suggesting that it may have been an inter-specific hybrid, most likely with *C. palustre*, although other characters were more typical of *C. tuberosum*. In addition, achenes collected from a plant of *C. tuberosum* at Cwm Marcross, Glamorgan in 1994 also turned out to be this hybrid (Kay & John 1995).

At Cwm Nash *Cirsium* × *semidecurrens* grows amongst an apparently pure colony of *C. tuberosum* on the moderately steep (30°) NW-facing slope of a small valley running down to the sea. The site overlies Jurassic limestone and is c. 2 km to the NW of the main Glamorgan colony of *C. tuberosum* at Nash Point Light-house. Cattle grazing has been re-introduced to the site recently (J. Woodman, pers. comm.)

TABLE 1. FREQUENCY AND ABUNDANCE OF SPECIES GROWING WITH *CIRSIIUM TUBEROSUM* AND *C. × SEMIDECURRENS* AT CWM NASH, GLAMORGAN

Species	Frequency	%	Species	Frequency	%
<i>Agrostis capillaris</i>	3	13	<i>Koeleria macrantha</i>	1	+
<i>Anthoxanthum odoratum</i>	1	+	<i>Leontodon hispidus</i>	1	+
<i>Brachypodium sylvaticum</i>	1	2	<i>Linum catharticum</i>	1	+
<i>Briza media</i>	1	+	<i>Lolium perenne</i>	2	+
<i>Campanula glomerata</i>	1	+	<i>Lotus corniculatus</i>	3	1
<i>Carex flacca</i>	3	1	<i>Phleum pratense</i>	1	+
<i>Centaurea nigra</i>	3	7	<i>Plantago lanceolata</i>	3	3
<i>Cirsium arvense</i>	2	+	<i>Potentilla erecta</i>	1	+
<i>Cirsium tuberosum</i>	3	12	<i>Potentilla reptans</i>	1	+
<i>Cirsium</i> × <i>semidecurrens</i>	1	2	<i>Primula veris</i>	1	+
<i>Cynosurus cristatus</i>	1	+	<i>Prunella vulgaris</i>	3	+
<i>Dactylis glomerata</i>	3	2	<i>Ranunculus bulbosus</i>	1	+
<i>Daucus carota</i>	2	+	<i>Sanguisorba minor</i>	3	4
<i>Festuca rubra</i>	3	40	<i>Serratula tinctoria</i>	1	1
<i>Galium verum</i>	3	+	<i>Stachys officinalis</i>	3	+
<i>Holcus lanatus</i>	3	3	<i>Succisa pratensis</i>	2	4
<i>Hypochaeris radicata</i>	2	+	<i>Trifolium pratense</i>	1	+

(Recorded in three 1 × 1 m quadrats). Species with average abundance < 1% are denoted by a “+”.

and this has created a relatively short (c. 17 cm), species-rich sward (22 species m⁻²) dominated by *Festuca rubra*, with abundant *Agrostis capillaris*, *Centaurea nigra*, *Cirsium tuberosum*, *Sanguisorba minor* and *Succisa pratensis* and frequent *Carex flacca*, *Galium verum*, *Lotus corniculatus* and *Stachys officinalis* (Table 1). The grassland most closely resembles *Galium verum* sub-community of *Cynosurus cristatus*-*Centaurea nigra* mesotrophic grassland (55% fit to MG5b) but with affinities to *Festuca rubra*-*Holcus lanatus* maritime grassland (MC9). Over 60 patches of *Cirsium tuberosum* are scattered across the slope as well as a single patch of the hybrid between *C. tuberosum* and *C. acaule* (*C. x*

medium) which has been known from this locality since 1935 (Bruce & Vachell 1935). *Cirsium palustre* does not occur on the same slope but is present by the stream at the bottom of the valley.

The stems of the hybrid were tall (to 60 cm) and branched, with a mixture of arachnoid and jointed hairs especially towards the apex, and shortly decurrent, spinous wings extending for a few centimetres below the leaf bases (not present on all stems). The stems were topped with very lax racemose clusters of up to four capitula (as in Wiltshire) on relatively short (1–10 cm) densely felted peduncles. The capitula were intermediate in size and shape, being narrower and shorter (mean 11 × 12 mm) than

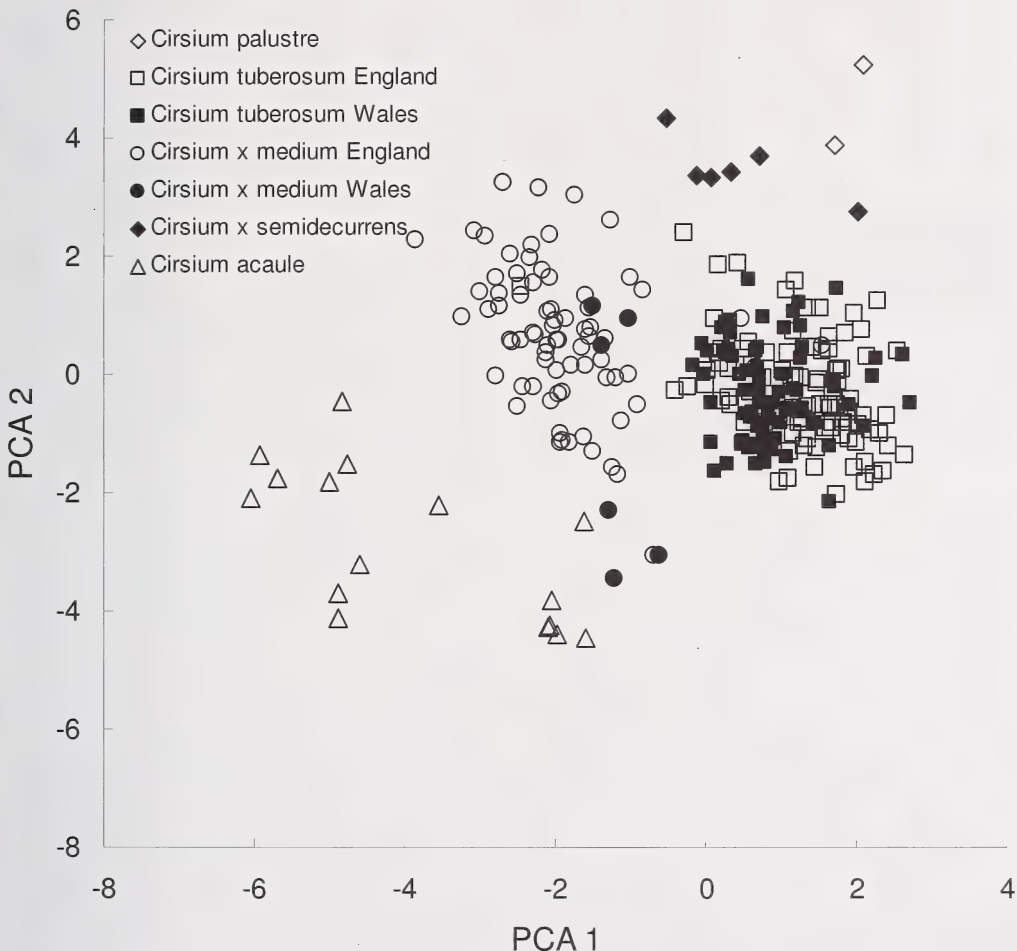


FIGURE 2. A Principal Components Analysis (PCA) showing the similarity between *Cirsium tuberosum* and British hybrids (*C. x semidecurrans* and *C. x medium*) and parental species (*C. acaule*, *C. tuberosum*, *C. palustre*) based on morphological characters. English and Welsh plants of *C. tuberosum* and *C. x medium* are shown with different symbols.

those of *C. tuberosum* (mean 13×14 mm), and with more-or-less adpressed, sparsely arachnoid outer phyllaries with the purple callosity indicative of *C. palustre*. The plant therefore differed from *C. tuberosum* in having almost twice as many capitula on each branch, shortly-decurrent, spinious wings and a mixture of arachnoid and jointed hairs on the stem, smaller, narrower involucre (Fig. 1), and $\pm$ adpressed, sparsely arachnoid outer phyllaries. A Principal Components Analysis of a range of morphological characters measured on British hybrids and the parental species (*C. acaule*, *C. palustre* and *C. tuberosum*) is shown in Figure 2. These data show a clear separation between *C. acaule*, *C. \times medium* and *C. tuberosum* on the first axis and between these species and *C. palustre* and *C. \times semidecurrans* on the second (Fig. 2).

Although originally thought to be sterile (Gilmour 1933, Grose 1949), a small sample of hybrid fruits collected from the Glamorgan plant showed 50% germination (2 of 4 seeds). These were presumably backcrosses with *C. tuberosum* and in cultivation these hybrids continued to flower and produce a small number of viable achenes for over four years. *C. palustre* appears to hybridise readily with other thistles and is a parent to half of the natural thistle hybrids including the two most frequently recorded in the British Isles, *C. \times forsteri* and *C. \times celakovskianum*. The reason for this is unknown but may be due to its wider ecological range and the nectar being more

readily accessible, and therefore more regularly visited by insects, than in other species of *Cirsium*. *C. \times semidecurrans* is one of the rarest, presumably because of the rarity of *C. tuberosum*, but also because *C. palustre* is confined to moister mesotrophic and/or shaded habitats (e.g. colluvium, scrub edge) on calcareous soils where *C. tuberosum* is abundant. Cross-pollination is therefore likely to be limited in such habitats. Successive backcrossing and introgression with one or more parents has been reported for a few *Cirsium* hybrids, most notably between *C. \times medium* and *C. tuberosum* on heavily grazed downland in Wiltshire where pure *C. tuberosum* is now very uncommon. This is also likely to occur at Cwm Nash where presumably all the seed produced by the hybrid will be back-crossed with *C. tuberosum* as the male parent. The Cwm Nash plant appears to be long-lived and, like *C. tuberosum*, may be spreading indefinitely via its large underground tubers. It will be interesting to see how long the plant survives and the extent to which backcrossing occurs in the future.

ACKNOWLEDGMENTS

I am grateful to Clive Stace for determining the specimen, Tim Rich and Stephen Jury for the loan of specimens and Julian Woodman and Gill Barter (Countryside Council for Wales) for providing information on the Glamorgan populations.

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APPENDIX

Confirmed records of *Cirsium \times semidecurrans* in the British Isles:

SS96, GLAMORGAN, V.C. 41:

With both parents at St. Donat's Cliff [Cwm Nash], near Nash Point, J. L. Bruce & J. S. L. Gilmour, August 1932 (Gilmour 1933), **BM**.

Cwm Nash, near Nash Point, single plant growing amongst colony of *Cirsium tuberosum*, SS905699, K. J. Walker, 7 August 2001, NMW.

ST93, SOUTH WILTSHIRE, V.C. 8:

Great Ridge, J. D. Grose, 7 August, 1939, **RNG** [specimen labelled *C. tuberosum* but later re-determined as *C. × semidecurrans* by W. A. Sledge, det. 10 August, 1951].

Great Ridge, growing with *C. tuberosum* on a N-facing dowlund in A. B. Lambert's original 1812 station, J. D. Grose, July 1947 (Grose 1942), det. W. A. Sledge.

Stockton Down near Great Ridge, single plant growing with *C. tuberosum* on edge of scrub, ST975358, S. Everett, 30 July 1986 (Everett 1993), **K** [the specimen could not be traced but there is a photocopy of the specimen in Everett (1988)].

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VASCULAR PLANTS FROM SWANSEA UNIVERSITY HERBARIUM (UCSA) NOW INCORPORATED INTO THE WELSH NATIONAL HERBARIUM (NMW)

In 2006, the vascular plants component of the Swansea University herbarium (UCSA) were donated to the National Museum of Wales (NMW). The bryophyte collection has been retained at Swansea. The collection consisted of about 5000 vascular plant specimens, but after curation consisted of 4256 specimens as material which had been seriously damaged by insects or was inadequately labelled was discarded. The material has all been remounted on conservation grade mounting card, and documented on the museum's collection management system.

Swansea University was founded in 1920, and the herbarium probably dates from about that time with 586 specimens collected from 1920 to 1949. Most of the material was collected after 1950 (3290 specimens) coincident with expansion of the school of Biological Sciences. Some historic material was also acquired, an interesting undated and anonymous collection from about the 1830s centred around Monmouthshire.

As might be expected from a university herbarium compiled by staff and students, about half of the material was collected in South Wales. The following vice-counties were represented: 1–31, 33–46, 48–50, 52–59, 61–66, 69–70, 72–73, 78, 83–85, 88–94, 96–97, 100, 103–105, 107–108, 110–112, H1–H3, H9, H15–H16, H24, H27–H28, H38 and the Channel Islands. Material had also been collected on university field trips or whilst attending conferences in Greece (423 specimens), Spain

(395), Iceland (212), Norway (114), India (88), France (46), Sweden (41), Austria (35) and Kenya (23), with small amounts of material from Australia, Belgium, Bulgaria, Denmark, Germany, Greenland, Italy, Malawi, Netherlands, New Zealand, Portugal, Switzerland, Tanzania, West Indies and Zaire.

There was a broad taxonomic coverage, but notable was the relatively large Poaceae collection (1100 specimens compared with the three top other families Asteraceae (329), Cyperaceae (306) and Fabaceae (274)) which included a collection which had formerly belonged to C. Bucknall. The only significant research collections were of Q. O. N. Kay (mainly Asteraceae, unfortunately badly damaged) and some *Melampyrum* material from A. J. E. Smith.

The main collectors are Q. O. N. Kay (1224 specimens collected between 1959 and 1990), A. J. E. Smith (982 specimens 1956–1963), J. Hayward (226 specimens, 1950–1962), C. R. Hipkin (176 specimens, 1962–1984, mostly collected with H. Hipkin), R. Webb (128 specimens, 1954–1970) and M. L. Page (108 specimens, 1975).

The data from the collection will be made available on the National Museum of Wales website, or can be requested from T. Rich.

ACKNOWLEDGMENTS

We would like to thank Rosalind Codd, Chris Heron, John Owen and David Price for helping to curate the collection.

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Plant Records

Records for publication must be submitted to the appropriate Vice-county Recorder (see *BSBI Year Book 2008*), and not to the Editors. Following publication of the *New Atlas of the British & Irish Flora* and the *Vice-county Census Catalogue*, new criteria have been drawn up for the inclusion of records in *Plant Records*. (See *BSBI News* no. 95, January 2004 pp10 & 11). These are outlined below:

- First records of **all** taxa (species, subspecies and hybrids) included in the VCCC, designated as native, archaeophyte, neophyte or casual.
- First record since 1970 of the taxa above, except in the case of *Rubus*, *Hieracium* and *Taraxacum*.
- Records demonstrating the rediscovery of all taxa published as extinct in the VCCC or subsequently.
- Newly reported definite extinctions.
- Deletions from the VCCC (e.g. through the discovery of errors, the redetermination of specimens etc.) **NB** – only those errors affecting VCCC entry.
- New 10km square records for Rare and Scarce plants, defined as those species in the *New Atlas* mapped in the British Isles in 100 10km squares or fewer. (See *BSBI News* no. 95, January 2004 pp 36–43).

Records for the subdivisions of vice-counties will not be treated separately; they must therefore be records for the vice-county as a whole. However, records will be accepted for the major islands in v.cc. 100, 102–104, 110 and 113.

In the following list, records are arranged in the order given in the *List of Vascular Plants of the British Isles* and its supplements by D.H. Kent (1992), from which the species' numbers, taxonomy and nomenclature are taken. The Ordnance Survey national grid reference follows the habitat and locality. With the exception of collectors' initials, herbarium abbreviations are those used in *British and Irish Herbaria* by D. H. Kent & D. E. Allen (1984). Records are field records if no other source is stated. For all records 'det.' or 'conf.' appear after the herbarium if the determination was based on material already in an institutional herbarium, otherwise before the herbarium.

The following signs are used:

* before the vice-county number: to indicate a new vice-county record.

† before the species number: to indicate that the plant is an archaeophyte.

‡ before the species number: to indicate that the plant is a neophyte.

© before the species number: to indicate that the plant is a casual.

The above 3 signs may also be used before the vice-county number to indicate the status of the plant in that vice-county.

® before the vice-county number: to indicate that this is an additional hectad for a Rare or Scarce plant.

Ø at end of entry: established taxon not in Vice-County Census Catalogue. Name of authority provided.

[] enclosing a previously published record: to indicate that that record should be deleted or changed.

From now on records will be published in two separate sections – 1) NATIVES (including archaeophytes) and 2) ALIENS (neophytes and casuals).

The following list contains the second set of records up to and including the year 2007. Records up to and including the year 2008 will be published in the next issue of *Watsonia*.

ARCHAEOPHYTES AND NATIVES

Osmunda regalis 6/1.1. *31, Hunts.: wet ditch, Holme Fen NNR, TL1989, D. A. Broughton, 2007, conf. T. C. E. Wells. Origin unknown but not planted; colonisation from native source no less likely than non-native source.

Gymnocarpium dryopteris 16/4.1. *17, Surrey: TQ05, R. Skipper, 2007.

Polystichum setiferum 17/1.1. 31, Hunts.: ancient woodland, Waresley Wood, TL263546, T. Balbi, 2000. 1st record since 1846.

Polystichum ×bicknellii (**P. setiferum** × **aculeatum**) 17/1.1×2. *64, Mid-W. Yorks.: limestone pavement, Malham Cove, SD897641, B. Brown, 2007.

Dryopteris ×complexa (**D. filix-mas** × **affinis**) 17/3.2×3. *64, Mid-W. Yorks.: woodland on hillside, Otley Chevin, SE213444, B. Brown, 2007, det. K. Trewren.

Helleborus foetidus 28/3.1. *© 45, Pembs.: frequent, in full flower, on roadside bank, Uzmaston Road, Haverfordwest, SM956155, S. B. & A. E. Evans, 2007. A location where garden waste is dumped.

†**Fumaria parviflora** 31/5.9. *44, Carms.: waste ground opposite end of New Dock Road, Llanelli, SS510988, G. Hutchinson & I. K. Morgan, 1992, det. T. C. G. Rich, NMW.

†**Chenopodium ficifolium** 43/1.13. *50, Denbs.: field edge, Sutton Green, SJ415488, M. Stead, 2007, conf. G. Kay.

Atriplex portulacoides 43/3.10. *‡64, Mid-W. Yorks.: road verge, Stonehouse, SE1558, Wharfedale Nats. Soc. 2007, det. N. Vernon.

Spargularia marina 46/17.3. *‡31, Hunts.: roadside, Great Stukeley, TL219746, K. J. Walker, 2004.

†**Silene gallica** 46/20.11. 70, Cumberland: 30 stems in disused sandpit, New Cowper, NY117458, D. Muscat, 2007, LANC. 1st record since early 19th C.

Rumex ×abortivus (**R. conglomeratus** × **obtusifolius**) 47/8.14×19. *44, Carms.: by cycle track (northern verge), Penclacwydd Wildfowl & Wetlands Centre, E. of Llanelli, SS533980, M. O. Stead & BSBI meeting, 2006, det. G. Kitchener, NMW.

Hypericum linariifolium 51/1.11. 43, Rads.: Dolyhir near Stanner, SO246.583, A. Shaw, 2006. 1st record since 1945.

Lavatera arborea 53/2.1. *‡62, N. E. Yorks.: several self-sown plants in rough grassland, Skelton, NZ658193, V. Jones & M. J. Yates, 2007.

[**Helianthemum canum** subsp. **levigatum** 56/2.3c. 64, Mid-W. Yorks. & 69, Westmorland. Delete. The VCCC records are errors for subsp. *incanum*.]

Frankenia laevis 59/1.1. *‡46, Cards.: mat 50 × 25 cm in shingly waste ground, presumably self-sown from flowerbed 7 m away where it grows, S end of Borth, SN607889, A. O. Chater & J. P. Poland, 2007.

†**Salix ×rubens** (**S. fragilis** × **alba**) 61/2.2×3. *78, Peebles.: one large tree on the v.c boundary, Well Burn, Eastfield, near Biggar, NT035356, D. J. McCosh, 1999.

Salix ×reichardtii (**S. caprea** × **S. cinerea**) 61/2.10×11. 44, Carms.: willow-dominated scrub, Huntsman Chemical Works, Bynea, Llanelli, SS556986, Llanelli Naturalists meeting, 2007, det. G. Hutchinson. 1st recent record.

†**Erysimum cheiranthoides** 62/7.1. 51, Flints.: many plants in weedy field, Tyn-y-ffordd, Bodfari, SJ087701, J. A. Green, 2007. 1st recent record.

Rorippa islandica 62/12.3. *70, Cumberland: grazed, muddy hollow, Gilwilly Industrial Estate Penrith, NY507307, R. W. M. Corner, 2007, conf. T. C. G. Rich, LANC.

†**Camelina sativa** 62/24.1. *‡69, Westmorland: abundant in field by A684, Killington, SD599918, A. M. Boucher, 2007, LANC. Relict of 'conservation mixture'.

Pyrola rotundifolia subsp. **maritima** 66/1.3b. *49, Caerns.: disused quarry floor, Trefriw, SH7861, I. Fraser, 2007.

Potentilla tabernaemontani 75/9.12. @64, Mid-W. Yorks.: grassland, Whitewell, SD653465, P. C. G. Green, 2007.

Rosa ×sabinii (**R. spinosissima** × **mollis**) 75/21.5×17. *78, Peebles.: Innerleithen, NT33, A. Craig Christie, 1873, E, det A.L. Primavesi. Amongst large collection at E determined by A. L. Primavesi.

Rosa ×**dumalis** (**R. canina** × **caesia** subsp. **vosagiaca**) 75/21.12×13b. *105, W. Ross: roadside scrub, Camusterrach, NG7141, R. Maskew, 2005. Hybrid with *R. caesia* as female parent.

[**Rosa** ×**molletorum** (**R. canina** × **mollis**) 75/21.12×17. 37, Worcs.: delete from VCCC. Specimen corresponding to single 1999 record now considered a complex indeterminate hybrid (R. Maskew 2006).]

Rosa caesia subsp. **caesia**, 75/21.13a. 37, Worcs.: delete from VCCC. Specimen corresponding to single 1991 record re-determined as *R. canina* c.v. (R. Maskew 2004).]

Rosa caesia subsp. **caesia**, 75/21.13a. *46, Cards.: about ten bushes in roadside hedges, 1.5 km E of Oakford, SN467578, R. Maskew & A. O. Chater, 2007, det. R. Maskew, NMW.

Rosa caesia subsp. **vosagiaca** 75/21.13b. 105, W. Ross: roadside scrub, Camusterrach, NG7141, R. Maskew, 2005. Last confirmed v.c. record 1938.

Rosa ×**rogersii** (**R. caesia** subsp. **vosagiaca** × **tomentosa**) 75/21.13b×15. *37, Worcs.: scrub on edge of bridleway, Abbots Morton, SP036555, R. Maskew, 2001, **herb. R. Maskew**, det. R. Maskew & A. L. Primavesi as hybrid with *R. tomentosa* as female parent. Ø

Rosa caesia subsp. **vosagiaca** × **sherardii** 75/21.13b×16. 105, W. Ross: roadside scrub, Camusterrach, NG7141, R. Maskew, 2005, **herb. R. Maskew**, hybrid with *R. caesia* as female parent. Last confirmed v.c. record 1938. Ø

Rosa ×**xobovata** (**R. caesia** subsp. **vosagiaca** × **rubiginosa**) 75/21.13b×18. *108, W. Sutherland: single bush on roadside, Kyle of Tongue, NC5554, R. Maskew, 2007, **herb. R. Maskew**, hybrid with *R. rubiginosa* as female parent. Ø

Rosa ×**avrayensis** (**R. tomentosa** × **rubiginosa**) 75/21.15×18. *37, Worcs.: two bushes with both parents, in scrub, Penny Hill Quarry, Martley, SO752614, R. Maskew, 2006, **herb. R. Maskew**, hybrid with *R. tomentosa* as female parent.

Rosa mollis 75/21.17. 36, Herefs.: several bushes on rocky hillside, Black Darren, SO295295, M. Jannink, 2007, conf. R. Maskew *in situ*, **herb. R. Maskew**. Only previous confirmed v.c. record 1907.

Rosa ×**bigeneris** (**R. rubiginosa** × **micrantha**) 75/21.18×19. *37, Worcs.: few bushes with both parents, in scrub, Penny Hill Quarry, Martley, SO752615, R. Maskew, 2006, **herb. R. Maskew**, hybrid with *R. micrantha* as female parent.

†**Pyrus pyraeaster** 75/26.2. 44, Carms.: one tree near old cottage, bank of Nanrhydw, Pontantwn, SN434139, J. A. Green, 2007, det. A. O. Chater & G. M. Kay, NMW.

Vicia lutea 77/14.13. *‡44, Carms.: six robust plants in compacted development plateau, presumably introduced with seed mix, Parc Hendre development site, Capel Hendre, SN599109, B. Stewart, 2007, NMW.

Vicia bithynica 77/14.14. ‡17, Surrey: near to remains of gravel pit lake, Molesey Heath, West Molesey, TQ132673, R. Alder, R. D. Baker, M. Parslow, B. M. Spooner & Whitfield, 2007. A good colony with *Rumex palustris* and *Euphorbia* ×*pseudovirgata*. 1st record since 1970.

Epilobium ×**subhirsutum** (**E. hirsutum** × **parviflorum**) 84/1.1×2. *38, Warks.: with both parents in field near disused railway, Burton Green, near Coventry, SP2775, G. D. Kitchener, 2007, **WARMS**. With 7 other *Epilobium* hybrids!

Epilobium ×**brevipilum** (**E. hirsutum** × **tetragonum**) 84/1.1×5. *38, Warks.: with both parents in set-aside field, Burton Green, near Coventry, SP2775, G. D. Kitchener, 2007, **WARMS**.

Epilobium ×**waterfallii** (**E. hirsutum** × **palustre**) 84/1.1×9. *44, Carms.: rank grassland, with both parents, West Tip, Cross Hands, SN561134, R. D. & K. A. Pryce, 2007, det. G. Kitchener, NMW. 1st confirmed record.

Epilobium ×**palatinum** (**E. parviflorum** × **tetragonum**) 84/1.2×5. *38, Warks.: with both parents in set-aside field, Burton Green near Coventry, SP2775, G. D. Kitchener, 2007, **WARMS**.

Epilobium ×**dacicum** (**E. parviflorum** × **obscurum**) 84/1.2×6. 38, Warks.: with both parents in field near railway, Burton Green, near Coventry, SP2775, G. D. Kitchener, 2007, **WARMS**. 1st record since 1874.

Epilobium ×**interjectum** (**E. montanum** × **ciliatum**) 84/1.3×8. *38, Warks.: about 10 plants, Stables farmyard, Snitterfields, SP252597, J. W. Partridge, 2004, det. G. D. Kitchener, **WARMS**.

Epilobium ×**lamotteanum** (**E. lanceolatum** × **obscurum**) 84/1.4×6. *44, Carms.: lane bank off bend in driveway up to Forge Farm, Forge Quarry, Cwmduwyfran, SN408257, G. Hutchinson, 1997, det. G. Kitchener, NMW.

Epilobium xsemiobscurum (*E. tetragonum* x *obscurum*) 84/1.5x6. *38, Warks.: with both parents in set-aside field, Burton Green, near Coventry, SP2775, G. D. Kitchener, 2007, **WARMS**.

Epilobium xmentiensi (*E. tetragonum* x *ciliatum*) 84/1.5x8. 38, Warks.: with both parents in set-aside field, Burton Green, near Coventry, SP2775, G. D. Kitchener, 2007, **WARMS**. 1st record since 1965.

Euphorbia serrulata 91/2.7. *©44, Carms.: garden weed, abundantly self-sowing, Garregwen Farm, Penrhiwgoch, SN561185, G. Hutchinson, R. D. & K. A. Pryce, 2005, det. T. Walker, **NMW**. Also seen, in 2007, by M. Stead & BSBI group in river shingle at Llanwrda (SN716307).

Geranium rotundifolium 103/1.4. *31, Hunts.: improved grassy verge by cyclepath, Woodston, TL1797, D. A. Broughton, 2007.

Pimpinella major 107/13.1. 70, Cumberland: roadside verge, Storms, east of Keswick, NY290243, R. E. Groom, 2007, **LANC**. 1st record since 1939.

Ligusticum scoticum 107/36.1. *‡70, Cumberland: one non-flowering plant in dunes, Blitterlees, Silloth, NY099519, R. E. Groom, 2007, **LANC**.

†**Vinca minor** 109/1.1. 48, Merioneth: in quantity near houses on a roadside, near Mallwyd, SH81, P. M. Benoit, 2007. 1st record since 1970.

†**Hyoscyamus niger** 110/4.1. ®52, Anglesey: disturbed ground, Penial Dowyn, SH293832, J. Rees, 2007. New hectad and 1st record in the v.c. since 1979.

Calystegia sepium subsp. *roseata*, 111/3.2b. *31, Hunts.: locally abundant on edge of birch woodland in fen, Holme Fen NNR, TL1989, D. A. Broughton, 2007.

†**Lamium hybridum** 118/5.4. *43, Rads.: near Howey, SO067586, B. Laney, 2007.

Nepeta cataria 118/13.1. ‡49, Caerns.: many plants on disturbed soil mound, Llandygai industrial estate, SH5971, W. McCarthy, 2007. 1st record for at least 40 years.

Clinopodium acinos 18/18.5. 50, Denbs.: rocky path, Eglwysleg, Llangollen, SJ223468, J. L. Roberts, 2007, conf. J. A. Green, **NMW**. 1st record since 1970.

Mentha xgracilis (*M. arvensis* x *spicata*) 118/23.1x3. *‡31, Hunts.: woodland ride, Folksworth, North Wood, TL133897, K. J. Walker, 2004.

Mentha suaveolens 118/23.4. ‡50, Denbs.: roadside, Coedpoeth, SJ302512, J. L. Roberts, 2007. 1st record since 1970.

Callitriche brutia 120/1.6. *51, Flints.: mesotrophic pond, Maes-y-grug between Alltami and Northophall, SJ262665, S. Whild, 1994. 1st record (although in VCCC).

Euphrasia nemorosa x *confusa* 124/20.7x9. *17, Surrey: two colonies in firebreak, Chobham Common, SU968652, A. Wragg, 2007. Voucher specimen retained. *48, Merioneth: in long grass by road junction, Trystion valley above Cynwyd, SJ04, S. E. Stille, 2007, det. A. J. Silverside.

Pedicularis palustris 124/25.1. 31, Hunts.: mixed fen community, Woodwalton Fen, TL229848, N. Millar, 2005. First record since 1913.

†**Sambucus ebulus** 131/1.4. 78, Peebles.: North Slipperfield, NT1251, J. H. Penson, 1970. Source - J. H. Penson's notebooks. 1st record since 1970. Site searched in 2007; not found.

†**Valerianella carinata** 133/1.2. *31, Hunts.: ditch bank by road, Conington, TL194869, W. R. Meek, 2005.

Centaurea xmoncktonii (*C. nigra* x *jacea*) 135/11.7xjac. *35, Mons.: 2 plants near the bottom of a barish grassy bank on the edge of A466, near Wyndcliff, ST523970, T. G. Evans, 2007. 1st record since 1970 & 1st Welsh record as a spontaneous hybrid. This rayed knapweed has colourless combs of different shapes on its outer phyllaries ranging from those on *C. jacea* to some approaching those of *C. nigra*.

Picris hieracioides 135/17.2. 69, Westmorland: one plant on verge of M6, Dillicar, Lowgill, SD622982, M. S. Porter, 2007. 1st record since 1970.

Taraxacum naevosiforme 135/25.5.41. *46, Cards.: road verge, SW of Maesnant, Pumlumon, SN773878, S. P. Chambers, 2007, det. A. J. Richards, **NMW**.

Hieracium consociatum Jord. ex Boreau 135/28.7.con. *44, Carms.: on the cliff E of the spillway and the parking area, Llyn Brianne, SN793484, J. Sawtschuk, 2006, det. D. J. McCosh, **NMW**. *47, Monts.: a few plants on old bridge, Abermule Dingle, SO167935, A. K. Thorne, 2007, det. D. J. McCosh. Ø

Hieracium cinderella 135/28.8.135. 47, Monts.: a few plants on rock-face in woodland, Dolforwyn Wood, SO156958, A. K. Thorne, 2007, det. D. J. McCosh. 1st record since 1970 and new site.

Senecio xostenfeldii (*S. jacobaea* × *aquaticus*) 135/62.10×11. *78, Peebles.: Ada Hill, Eddleston, NT234488, L. Gaskell, 2006.

Senecio erucifolius 135/62.12. *69, Westmorland: north side of canal, opposite garage, Crooklands, SD539828, J. Clarke, 2007, **LANC.** 1st definite record.

Alisma lanceolatum 137/4.2. 51, Flints.: mesotrophic pond, Maes-y-grug between Alltami and Northophall, SJ262665, S. Whild, 1994. 1st record since 1930.

Potamogeton xsparganiifolius (*P. natans* × *gramineus*) 142/1.1×6. *46, Cards.: abundant on silty shoals among *Myriophyllum alterniflorum*, in Afon Teifi just above Pont Einon, Cors Caron, SN671614, R. V. Lansdown, 2005, det. C. D. Preston, NMW, **CGE**. The *P. gramineus* parent is not known in the river or in the v.c.

Juncus xdiffusus (*J. inflexus* × *effusus*) 151/1.25×26. 49, Caerns.: disused quarry floor, Trefriw, SH7862, W. McCarthy, 2007, conf. P. Benoit. 1st record since 1970.

Juncus xkern-reichgeltii (*J. effusus* × *conglomeratus*) 151/1.26×27. *44, Carms.: frequent in unimproved acid grassland, Hafod Wenol SSSI, Mynydd Betws, SN676095, BSBI meeting, 2007, conf. A. O. Chater & J. P. Poland. 1st published record.

Trichophorum cespitosum nothosp. **foersteri** (*T. cespitosum* subsp. *cespitosum* × *cespitosum* subsp. *germanicum*) 152/2.2a×2b. *46, Cards.: hollows in raised bog, Gors Goch, 800 m NW of Llyn Fanod, SN597649, A. O. Chater & S. D. S. Bosanquet, 2007.

Schoenoplectus lacustris 152/7.1. 35, Mons.: many patches on south margin of Tesco attenuation pond, between Magor and Llanwern, ST404864, S. J. Tyler, 2007, conf. T. G. Evans. 1st record since 1970 and a new hectad for this very uncommon v.c. plant.

Carex paniculata 152/16.1. 48, Merioneth: four plants on wet wooded slope, Dolgoch ravine, SH60, P. M. Benoit, 2007. 1st recent record: a rediscovery of the locality and updating for the hectad from K. M. Stevens, 1969.

Carex diandra 152/16.3. 43, Rads.: Rhosgoch Common, SO194481, S. D. S. Bosanquet, 2007. Also seen in 2007, by A. Ferguson, at SO200486 on Rhosgoch Common. 1st recent records. Previously reported from Llandrindod Wells (1919) and Rhosgoch Common (1948).

Carex xsubgracilis (*C. acutiformis* × *acuta*) 152/16.25×65. *17, Surrey: large colony with both parents present, Chertsey Meads, Area 3b, TQ063662, G. Hounsome & B. W. Phillips, 2007. Known for some years but only just determined.

Carex viridula subsp. **brachyrrhyncha** 152/16.46a. 47, Monts.: upland runnel, Bryncoch Farm, SJ013081, D. Reed, 2007, conf. A. Jones. 4th site but 1st confirmed record.

Festuca ovina subsp. **hirtula** 153/12.8b. *62, N. E. Yorks.: several plants in heathy grassland, Biller Howe Dale, NZ912017, V. Jones & M. J. Yates, 2007.

Lolium xboucheanum (*L. perenne* × *multiflorum*) 153/13.1×2. *31, Hunts.: margin of arable adjacent to improved grassland, Sawtry, TL168826, D. A. Broughton, 2008. *62, N. E. Yorks.: set-aside, by River Rye near Helmsley, SE626827, V. Jones & W. A. Thompson, 2007, conf. A. Copping, **herb. V. Jones**.

Poa infirma 153/18.1. *31, Hunts.: road verge, Conington, TL189863, W. R. Meek, 2005, det. A. C. Leslie.

Agrostis xmurbeckii (*A. capillaris* × *stolonifera*) 153/39.1×4. *44, Carms.: sunny places on poached ground by gate at N side of enclosure, Caeau Blaenau Mawr SSSI, Capel Hendre, SN594122, A. O. Chater, 2006, NMW.

***Agropogon littoralis** (*Agrostis stolonifera* × *Polypogon monspeliensis*) 153/39×46/4×1. *63, S. W. Yorks.: waste ground, old mill site, Bradford, SE133333, B. A. Tregale & M. Wilcox, 2007.

†**Apera spica-venti** 153/44.1. *48, Merioneth: two plants in dirt at base of fence separating the railway track from the footway, Barmouth Viaduct, SH61, P. M. Benoit, 2007.

Alopecurus xbrachystylus (*A. pratensis* × *geniculatus*) 153/47.1×2. *63, S. W. Yorks.: damp grassland edge near Maythorn, SE1805, P. Middleton, 2007.

Phleum arenarium 153/49.5. *63, S. W. Yorks.: sandy acidic terrain, Lower Whitley Edge, SE1804, M. J. Lucas, 2003.

Brachypodium pinnatum 153/54.1. *42, Brecks.: patch about 2 sq.m. in disused limestone quarry, Penwyllt, SN857156, M. & C. Porter, 2007, det. M. Porter. **herb. M.P.**

Elytrigia ×acuta subsp. **obtusiuscula** (**E. atherica** × **juncea**) 153/56.2×3a. *44, Carms.: Dune slope, W of Ginst Point, Laugharne, SN322077, A. O. Chater & S. D. S. Bosanquet, 2006, NMW. Pollen empty, somewhat shrunken.

Hordelymus europaeus 153/58.1. @69, Westmorland: several tufts on semi-shaded limestone slope in woodland, Witherslack, SD428870, I. Taylor, 1994, LANC (2007).

Allium schoenoprasum 158/24.1. *‡64, Mid-W. Yorks.: road verge, Greenhow Hill Road, SE1558, Wharfedale Nats. Soc. 2007, det. N. Vernon.

×**Dactylodenia st-quintinii** (**Gymnadenia conopsea** × **Dactylorhiza fuchsii**) 162/16×18.1×1.

*78, Peebles.: Glenfield Farm, Peebles, NT24, W. Bell, 1998, det. R. Bateman.

Dactylorhiza fuchsii × **D. incarnata** subsp. **coccinea** 162/18.1×3b. *63, S. W. Yorks.: Woodhall Quarry near Calverley, SE197353, M. Wilcox, 1997.

NEOPHYTES AND CASUALS

‡**Selaginella kraussiana** 2/1.2. *35, Mons.: 10 x 2 m on barish patches in grass, below N wall of church, Llangybi, ST373967, S. D. S. Bosanquet, 2006.

‡**Pinus nigra** subsp. **nigra** 20/7.2a. 44, Carms.: disturbed, quite dry dune slack, Tywyn Burrows, SN363055, BSBI meeting, 2007, det. A. O. Chater. Also seen in 2007, by M. & J. Iliff, in Ystrad Ffin Churchyard (SN787471). 1st records as neophyte.

‡**Helleborus orientalis** 28/3.3. *42, Brecks.: hedge near Llangynidr, SO165198, M. & C. Porter, 2007. First seen here in 2000.

‡**Nigella damascena** 28/5.1. 46, Cards.: pathside bank disturbed in c.2005, Cefn-llan, Llanbadarn Fawr, SN599814, S. P. Chambers, 2007. 1st record as neophyte.

‡**Anemone blanda** 28/9.bla. *46, Cards.: well naturalised on shaded stream bank, Llanrhystud, SN541698, A. O. Chater, 2007, NMW.

‡**Ranunculus ficaria** subsp. **ficariiformis** 28/13.17c. *31, Hunts.: shady footpath in village, Alwalton, TL134962, R. Woodall, 2002, conf. T. C. E. Wells, Specimen in ABRN.

‡**Berberis thunbergii** 29/1.2. 46, Cards.: self-sown bush in scrub on pasture slope, north bank of Cwm Rheidol Reservoir, SN698793, A. O. Chater, 2007. 1st record as neophyte. *62, N. E. Yorks.: bird-sown in rough wasteland, N of A66, South Bank, NZ532209, V. Jones & W. A. Thompson, 2007.

‡**Berberis wilsoniae** 29/1.4. 44, Carms.: two self-sown bushes plus several seedlings and small plants in vicinity on limestone-aggregate surfaced yard of derelict Ennis Caravans site, Cross Hands, SN559128, R. D. & K. A. Pryce & G. Hutchinson, 2007.

‡**Berberis wilsoniae** × **aggregata** 29/1.4×5. *70, Cumberland: bank of River Ehen, exit from Ennerdale Lake, NY088152, R. E. Groom, 2007, LANC. 1st noted 2003. Ø

‡**Berberis julianae** 29/1.7. *44, Carms.: waste ground at front of disused caravan-park, Cross Hands, SN559128, G. Hutchinson, 2007, NMW. 1st Welsh record.

‡**Berberis darwinii** 29/1.9. *52, Anglesey: well established around rocky outcrop, Trearddur, SH265796, I. Bonner & C. Aron, 2007. *62, N. E. Yorks.: several bird-sown bushes on bare ground by railway N of Teesside Park, NZ476194, V. Jones & W. A. Thompson, 2007.

‡**Morus nigra** 35/1.1. *44, Carms.: hedgerow near to exit of field, near house, Glan Rhydw, Pontantwn, SN433134, G. M. Kay *et al.* 2007. 1st v.c. record outside garden.

‡**Nothofagus alpina** 39/2.2. *69, Westmorland: two trees by path east of Birkbeck Cottage, Coniston, SD317965, G. Lines, 2007, LANC.

‡**Betula ermanii** Chamisso 40/1.erm. *51, Flints.: Nature Reserve on old industrial site, Rhydymwyn, SJ205668, J. Phillips, 2006, det. G. Hutchinson, NMW. Ø 1st Welsh record.

‡**Alnus rubra** 40/2.rub. *62, N. E. Yorks.: several, naturally regenerating, by side of forestry track, Battersby Plantation near Ingleby Greenhow, NZ598066, V. Jones, 2007, herb V. Jones.

©**Chenopodium urbicum** 43/1.11. *77, Lanarks.: rough ground at King George V Dock, Glasgow, NS5366, P. Macpherson, 2007, det. E. J. Clement.

‡**Atriplex halimus** 43/3.9. *70, Cumberland: one bush in shelter-belt by railway sidings, Maryport, NY030361, R. E. Groom, 2007, LANC.

©**Corispermum leptopterum** (Asch.) 43/COR.lep. *51, Flints.: scattered plants in light sandy soil on industrial site, Paper Mill, Deeside, SJ307719, L. Charter, 2007, det. G. M. Kay, conf. E. J. Clement. Ø

- ©*Amaranthus hybridus* 44/1.2. *31, Hunts.: disturbed ground, Upwood Airfield, TL265846, A. Wallis, 2006, conf. T. C. E. Wells.
- ‡*Lychnis chalconica* 46/18.cha. *70, Cumberland: roadside bank, Borrowdale Road, Keswick, NY267229, Moffat, 2006, **LANC** 2007.
- ‡*Persicaria capitata* 47/1.cap. *70, Cumberland: cracks in garden path, Cockermouth, NY117306, S. R. Cowen, 2006, det. R. E. Groom, **LANC**.
- ‡*Fallopia xbohemica* (F. *japonica* x *sachalinensis*) 47/5.1x2. *62, N. E. Yorks.: large patches in woodland, Peasholm Glen, Scarborough, TA033892, V. Jones & W. A. Thompson, 2007, **herb. V. Jones**.
- ‡*Rheum xhybridum* (R. *palmatum* x *rhaponticum* 47/7.palxrha. *49, Caerns.: persisting on soil dumped by coast path, Criccieth, SH4837, W. McCarthy & M. Stead, 2007.
- ‡*Rumex scutatus* 47/8.2. *77, Lanarks.: trackside, Harthill, NS9064, P. Macpherson & J. R. Hawell, 2007, det. E. J. Clement, **herb. P.M.** Probably the result of fly tipping.
- ‡*Paonia officinalis* 49/1.off. 51, Flints.: dense birch woodland, no doubt an established garden throw-out but some distance from houses, Caerestyn, E of Caergwrle, SJ316575, G. Wynne, 1999. 2nd published record but predates that published in Welsh Plant Records 2006.
- ‡*Hypericum xinodorum* (H. *androsaemum* x *hircinum*) 51/1.3x4. *31, Hunts.: near buildings, Monks Wood Experimental Station, TL201798, K. J. Walker, 2006. Colonised from nearby garden. *52, Anglesey: naturalised by former habitation, Holyhead, SH224823, O. Mountford, 2006. 69, Westmorland: plant 2–3 m tall in old quarry, Levens, SD499870, G. Halliday, 2007, **LANC**. Garden outcast. 1st record since early 19th C.
- ‡*Hypericum 'Hidcote'* 51/1.Hid. *44, Carms.: established on roadside bank near Amroth, SN182076, A. O. Chater *et al.* 2007, det. G. Hutchinson.
- ©*Hypericum olympicum* 51/1.oly. L. *62, N. E. Yorks.: a few plants self-sown at base of wall, Kirklevington, NZ429099, V. Jones, 2007, conf. E. J. Clement, **herb. V. Jones**. Ø
- ‡*Lavatera xclementii* (L. *olbia* x *thuringiaca*), 53/2.olbxthu. *69, Westmorland: waste ground by infilled canal, Kendal, SD518930, A. M. Boucher, 2007, **LANC**.
- ‡*Cucurbita pepo* 60/CUT.pep. *17, Surrey: probably a single large plant on top of manure heap on arable field edge to W of Raikes Farm, Sutton Abinger, TQ103463, S. D. Mellor, 2007. Large, glaucous, globose fruits.
- ‡*Sisymbrium altissimum* 62/1.5. 46, Cards.: reseeded road verge, Waun crossroads, Aberystwyth, SN599821, S. P. Chambers, 2007, conf. T. C. G. Rich, **NMW**. 2nd post-1930 record & 1st as neophyte.
- ‡*Erophila glabrescens* 62/22.3. *48, Merioneth: weed of flower beds, Barmouth, SH61, P. M. Benoit, 2007.
- ‡*Lepidium sativum* 62/30.1. 46, Cards.: path-side, Cwm Padarn, Llanbadarn Fawr, SN600814, S. P. Chambers, 2007. 2nd post-1950 record and 1st as a neophyte.
- ‡*Brassica napus* subsp. *oleifera* 62/34.2a. 44, Carms.: several plants in corner of construction site, Whitland, SN203167, R. D. Pryce, 2007. 1st record of subspecies.
- ‡*Lysimachia ciliata* 69/4.4. *42, Brecks.: probable bird-seed introduction into garden near Bwlch, SO142229, J. Hieatt, 2007, det. M. Porter, **herb. M.P.**
- ‡*Lysimachia punctata* 69/4.5. *31, Hunts.: legume-rich verge, Conington Airfield, TL194868, N. Crossman, 2006, conf. T. C. E. Wells.
- ‡*Deutzia scabra* 71/DEU.sca. *17, Surrey: small bush in hedgerow, Hoyle Hill, Capel, TQ176421, P. Follett & S. A. Follett, 2007.
- ‡*Hydrangea macrophylla* 71/HYD.mac. *49, Caerns.: sandy bank at top of beach, Porth Dinllaen, SH2741, W. McCarthy, 2007. Also seen by W. McCarthy on slate quarry waste at Llanllechid (SH6369). *52, Anglesey: naturalised by former habitation, Holyhead, SH224823, O. Mountford, 2006.
- ‡*Rodgersia podophylla* 74/2.1. *52, Anglesey: several sizeable clumps well established in woodland, Pwll-fanogl, Llanfair-Pwllgwyngyll, SH5271, N. Brown, 2007.
- ‡*Bergenia xschmidtii* (B. *crassifolia* x *ciliata*) 74/3.1xcil. *46, Cards.: one clump established on grassy slope by scrub, SSW of Lifeboat Station, New Quay, SN389597, A. O. Chater & J. P. Poland, 2007. Ø
- ‡*Tolmiea menziesii* 74/7.1. *44, Carms.: originally introduced but well established on shady riverside bank, Maes-yr-Hafod, Trelech, SN303331, R. D. & K. A. Pryce, 2007.

- ‡**Tellima grandiflora** 74/8.1. **43**, Rads.: near Ednol Hill, Radnor Forest, SO235642, R. G. Woods, 2007. 1st record since 1961.
- ‡**Spiraea ×rosalba** (*S. salicifolia* × *alba*) 75/3.1×2. ***52**, Anglesey: naturalised by former habitation, Holyhead, SH224823, O. Mountford, 2006.
- ‡**Aruncus dioicus** 75/4.1. ***62**, N. E. Yorks.: persisting and naturally regenerating by pool in village, Thornton-le-Dale, SE836831, V. Jones & W. A. Thompson, 2007.
- ‡**Holodiscus discolor** 75/5.1. ***62**, N. E. Yorks.: three large and four small plants in mere-side scrub, the latter presumably natural regeneration, The Mere, Scarborough, TA035859, V. Jones & W. A. Thompson, 2007, **herb. V. Jones**.
- ‡**Filipendula ×purpurea**, 75/6.pur. ***62**, N. E. Yorks.: several long-established plants at edge of damp woodland, Grey Towers, Nunthorpe, NZ533135, V. Jones & W. A. Thompson, 2007, conf. E. J. Clement, **herb. V. Jones**. Previously known as *Filipendula camtschatica*
- ‡**Kerria japonica** 75/7.1. ***42**, Brecks.: hedge, near Bwlch, SO162223, M. & C. Porter, 2006. ***44**, Carms.: self-sown in mortared stone wall, Llandovery Castle, SN767342, R. D. Pryce, 2007, NMW. 1st published record.
- ‡**Rubus armeniacus** 75/8.134. ***31**, Hunts.: woodland edge on edge of village, Alwalton, TL132961, D. A. Broughton, 2007.
- ‡**Potentilla recta** 75/9.7. ***42**, Brecks.: seeding on gravel paths in garden (not planted), Llangynidr, SO151198, M. Tillotson, 2006, det. M. Porter, **herb. M.P.**
- ‡**Duchesnea indica** 75/12.1. ***69**, Westmorland: beneath trees in St Thomas's churchyard, Kendal, SD513931, A. M. Boucher, 2007, **LANC.**
- ‡**Acaena ovalifolia** 75/18.3. ***62**, N. E. Yorks.: appeared as a garden weed, Ingleby Greenhow, NZ580063, V. Jones, 2007, conf. E. J. Clement, **herb. V. Jones**. May have been brought in by visiting birds.
- ‡**Acaena inermis** 75/18.4. ***69**, Westmorland: weed of garden path, Kendal, SD5192, M. James, 2007, **LANC.**
- ‡**Alchemilla conjuncta** 75/19.2. ***44**, Carms.: garden escape at seaward end of valley, Morfa Bychan, near Pendine, SN2207, J. Rees, 1996, det. G. Hutchinson, **NMW**. Also seen, by G. Hutchinson, in 2007, spreading on Carboniferous Limestone wall top, Crwbin (SN473131).
- ‡**Rosa rugosa** 75/21.6. ***31**, Hunts.: road verge on urban fringe, Peterborough, Orton Southgate, TL140942, D. A. Broughton, 2007. ***108**, W. Sutherland: a few scattered bushes on roadside, Scourie, NC1543, R. Maskew, 2007.
- ‡**Rosa rubiginosa** 75/21.18. **48**, Merioneth: in quantity and flourishing in a newly planted hedge near Coleg Meirion, Dolgellau, SH71, P. M. Benoit, 2007. 1st recent record.
- ‡**Rosa majalis** Herm. 75/21.maj. ***37**, Worcs.: Wannerton Downs near Kidderminster, SO8778, W. Mathews, 1849, **WOS**, det. R. Maskew. Ø Only confirmed v.c. record.
- ‡**Rosa sempervirens** L. 75/21.sem. ***37**, Worcs.: bushy place around pit in field, Madresfield, SO8047, R. F. Towndrow, 1881, **MANCH**, **NMW WOS**, det. R. Maskew. Ø Many specimens, the latest dated 1920. Only confirmed British records.
- ‡**Prunus persica** 75/22.1. ***69**, Westmorland: small sapling in layby outside rugby ground, Kendal, SD521940, A. M. Boucher, 2007, **LANC.**
- ‡**Sorbus 'Joseph Rock'**, 75/28.Jos. ***44**, Carms.: tree planted in waste ground with seedlings becoming established in vicinity, Bynea, SS551987, G. Hutchinson, 2006, **NMW**. Ø
- ‡**Cotoneaster dammeri** 75/32.11. ***38**, Warks.: ten in fruit on grass road verge, Manby Road, Castle Vale, Birmingham, SP143917, J. W. Partridge, 2007, det. J. Fryer, **WARMS**. Var. 'major'. ***44**, Carms.: naturalized & spreading in garden of Dylan Thomas' Boathouse, West Tip, Cross Hands, SN306110, R. D. Pryce, 2001, det. J. Fryer, **NMW**. Also seen, in 2007, by R. D. & K. A. Pryce on trackside at Laugharne (SN561131).
- ‡**Cotoneaster ×suecicus** (*C. dammeri* × *conspicuus*) 75/32.11×18. ***38**, Warks.: three or four on trackside, Warmington Road, Birmingham, SP153841, J. W. Partridge, 2007, det. J. Fryer, **WARMS**. Birmingham & Black Country Flora Project.
- ‡**Cotoneaster lacteus** 75/32.13. ***62**, N. E. Yorks.: bird-sown bush on waste ground by railway, E of Riverside Stadium, Middlesbrough, NZ510205, V. Jones & W. A. Thompson, 2007.
- ‡**Cotoneaster integrifolius** 75/32.16. **38**, Warks.: roadside cement kerb, Sydenham, Leamington Spa, SP328644, J. W. Partridge, 2007, det. J. Fryer, **WARMS**. 1st record since 1932.

- ‡*Cotoneaster hjelmqvistii* 75/32.22. *69, Westmorland: cemetery wall by infilled canal, Parkside Road, Kendal, SD518919, A. M. Boucher, 2007, conf. J. Fryer, **LANC**.
- ‡*Cotoneaster divaricatus* 75/32.26. *38, Warks.: one on wall by pavement, The Boulevard, Chester Road, Birmingham, SP116937, J. W. Partridge, 2007, det. J. Fryer, **WARMS**. Birmingham & Black Country Flora Project.
- ‡*Cotoneaster villosulus* 75/32.29. *17, Surrey: one small shrub in pit, Howell Hill, Ewell, TQ239619, E. J. Taylor & P. Wakeham, 2007.
- ‡*Cotoneaster dielsianus* 75/32.37. *70, Cumberland: west end of roadside crags, north side of A66, Dubwath, NY194310, M. S. Porter, 2002, conf. J. Fryer, **LANC** photo.
- ‡*Cotoneaster franchetii* 75/32.39. *38, Warks.: two or three by fence on derelict land, Gravelly Industrial Park, Birmingham, SP100894, J. W. Partridge, 2006, det. J. Fryer, **WARMS**. Birmingham & Black Country Flora Project.
- ‡*Cotoneaster sternianus* 75/32.40. *38, Warks.: one fruiting seedling in alley, Red House, Leamington Spa, SP328654, J. W. Partridge, 2005, det. J. Fryer, **WARMS**.
- ‡*Pyracantha rogersiana* 75/33.2. *69, Westmorland: thicket near end of canal, Stainton, SD520853, A.M. Boucher, 2007, **LANC**.
- ‡*Crataegus persimilis* 75/35.5. *62, N. E. Yorks.: single large bush in old hedgerow, by A168 near Thornton-le-Moor, SE393899, V. Jones & M. J. Yates, 2007, conf. W. A. Thompson.
- ‡*Cercis siliquastrum* 76A/CER.sil. *17, Surrey: a self-sown seedling in a flower bed in the War Museum Park, Geraldine Mary Harmsworth Park, Lambeth, TQ315790, N. H. Bertrand, 2007. Ø
- ‡*Trifolium incarnatum* subsp. *incarnatum* 77/19.19a. *70, Cumberland: single large plant on graded soil on site of flood defence works, Strand Road, Carlisle, NY407502, H. & B. Spencer, 2007, **LANC**. 1st record since 1970.
- ‡*Laburnum ×watereri* (*L. anagyroides* × *alpinum*) 77/22.1×2. *44, Carms.: hedge, Llech-Sion, NE of Cwmdud, SN394325, A. O. Chater, 1997, **NMW**. 1st record as a neophyte and pre-dating records already published.
- ‡*Elaeagnus umbellata* 78/2.1. *44, Carms.: Bronwydd Arms, SN4123, A. S. Lewis, 2002, det. G. Hutchinson, **NMW**.
- ‡*Myriophyllum aquaticum* 79/2.2. *31, Hunts.: in lake, Crown Lakes Country Park, Farcet, TL196942, N. Millar, 2002, conf. T. C. E. Wells.
- ‡*Fuchsia magellanica* 84/5.1. *70, Cumberland: one bush on wall by River Caldew, Carlisle, NY397556, R. E. Groom, 2007.
- ‡*Cornus sericea* 85/1.2. *31, Hunts.: scrub between river and railway, Woodston, TL1898, D. A. Broughton, 2006. Well naturalised in public open spaces around Peterborough.
- ‡*Euonymus fortunei* (Turcz.) Hand.-Mazz. 88/1.for. *64, Mid-W. Yorks.: Blubberhouses, SE1658, Wharfedale Nats. Soc., 2007. Ø
- ‡*Ilex xaltaclerensis* (*I. aquifolium* × *perado*) 89/1.1×per. *62, N. E. Yorks.: several self-sown bushes in woodland by railway bank, Valley Road, Weaponess, Scarborough, TA035876, V. Jones & W. A. Thompson, 2007. Ø
- ‡*Euphorbia dulcis* 91/2.5. *44, Carms.: Dylan Thomas' Boathouse garden, Laugharne, SN306110, J. Rees, 1992, det. T. Walker, **NMW**.
- ‡*Euphorbia amygdaloides* subsp. *robbiae* 91/2.16b. *38, Warks.: on quarry spoil heap, Griff, Nuneaton, SP364893, B. Proctor, 2007, det. J. W. Partridge, **WARMS**.
- ©*Euphorbia characias* subsp. *characias* 91/2.17a. *62, N. E. Yorks.: a few self-sown plants at base of wall, Briggswath, NZ874089, V. Jones, 2007, conf. Perry's garden centre.
- ©*Euphorbia characias* subsp. *veneta* 91/2.17b. *62, N. E. Yorks.: several self-sown plants at top of wall, back alley by Askham Bryan College, Guisborough, NZ617163, V. Jones, 2007, conf. E. J. Clement, **herb. V. Jones**.
- ‡*Euphorbia oblongata* 91/2.obl. *38, Warks.: building site, New Bond Street, Birmingham, SP085863, M. W. Poulton, 2004, det. E. J. Clement, **WARMS**.
- ‡*Acer cappadocicum* 99/1.2. *52, Anglesey: woodland, Plas Newydd, SH524704, P. Denne, 2007. *69, Westmorland: 2 m sapling in hedgerow near lake shore, south of Pooley Bridge, NY468240, C. S. Crook, 1991, **LANC**.
- ‡*Acer saccharinum* 99/1.5. *62, many self-sown amongst planted trees and in adjacent wasteland, N of A66, South Bank, NZ533209, V. Jones & W. A. Thompson, 2007, **herb. V. Jones**.

- ©*Ruta graveolens* L. 101A/RUT.gra. *17, Surrey: one plant on a waste site behind railings, the ruins of St. Agnes Terrace, south of Waterloo, Lambeth, TQ314775, N. H. Bertrand, 2007. Ø
- ©*Impatiens balfourii* Hook.f. 105/1.bal. *17, Surrey: N side, at entrance to yard between nos. 20b and 24, on small patch of waste ground, Chestnut Grove, Balham, TQ2873, R. Vickery, 2007, BM. Ø
- ©*Lycopersicon esculentum* 110/7.1. *48, Merioneth: one plant at base of wall, Barmouth railway station, SH61, P. M. Benoit, 2007.
- ©*Solanum sisymbriifolium* 110/8.sis. *35, Mons.: plants of unknown origin in greenhouse and garden, Steppes Cottage, Jingle Street, Wonastow, SO476107, H. V. Colls, 2007.
- ‡*Petunia ×hybrida* (*P. axillaris* × *integrifolia*) 110/PET.axixint. *64, Mid-W. Yorks.: town centre, Otley, SE202455, B. Brown, 2007. *69, Westmorland: pavement weed, Library Road, Kendal, NY513928, A. M. Boucher, 2007, LANC.
- ‡*Calystegia silvatica* subsp. *disjuncta* Brummitt 111/3.4b. *44, Carms.: roadside hedge-bank, NW of Pont-ar-llechau, SN719254, A. O. Chater & R. D. Pryce, 1997, NMW. 1st v.c. record pre-dating previously reported records. Ø
- ©*Gilia achilleifolia* Benth. 114/GIL.ach. *62, N. E. Yorks.: four plants self-sown at edge of woodland by road verge, N of Seamer, NZ492112, E. Gendle, 2007, det. E. J. Clement, herb. V. Jones. Ø
- ‡*Symphytum orientale* 116/4.6. *46, Cards.: road verge, N side of Ffordd Sulien, Llanbadarn Fawr, SN598809, S. P. Chambers, 2007, conf. C. O'Reilly, NMW.
- ‡*Anchusa azurea* 116/6.3. *52, Anglesey: roadside hedgerow, 20yds. from old school, Llangoed, SH619799, E. Phenna, 2006.
- ‡*Amsinckia micrantha* 116/12.2. *46, Cards.: re-seeded road verge, Waun crossroads, Aberystwyth, SN599821, S. P. Chambers, 2007, NMW.
- ‡*Cerinthe major* L. 116/CER.maj. *17, Surrey: in dumped soil, Thirty Acres Barn, Ashted, TQ199571, P. Follett & S. W. Gale, 2007. Ø
- ‡*Cerinthe minor* L. 116/CER.min. *46, Cards.: road verge and rocky banks, Frondolau, Aber-arth, SN479638, R. D. Pryce & K. A. Pryce, 2007, NMW. Ø 1st Welsh record.
- ©*Lappula squarrosa* 116/LAP.squ. 17, Surrey: on disturbed soil, probably brought in, on top of river bank, R. Mole, Leatherhead, TQ162562, D. Skinner, 2007. Seen also at Beddington Park (TQ295655) by D. Skinner. 1st records since 1970.
- ©*Verbena bonariensis* 117/1.bon. *45, Pembs.: single flowering plant on roadside verge, Fishguard bypass, SM948374, S. B. Evans, 2007. Possibly accidentally introduced during shrub planting on wide roadside verge north-east of lowest roundabout. *46, Cards.: naturalised along base of wall by old cottages just NW of Pont Llannon, Llannon, SN513667, A. O. Chater, 2006. 1st Welsh record as neophyte.
- ‡*Melissa officinalis* 118/16.1. *31, Hunts.: woodland edge, Upton Wood, TL177792, D. A. Broughton, 2008.
- ©*Origanum majorana* L. 118/20.maj. *17, Surrey: Wiggie Lane Allotments, Redhill, TQ283511, C. Bateman, 2007. Ø
- ©*Mentha requienii* 118/23.6. *50, Denbs.: garden paving, Denbigh, SJ069659, J. A. Green, 2007, conf. E. J. Clements.
- ‡*Salvia officinalis* L. 118/25.off. *©63, S. W. Yorks.: rough grassland, near railway cutting, south of Tickhill, SK588913, E. Ellis, 2005. Ø
- ‡*Lavandula stoechas* L. 118/LAV.sto. *©63, S. W. Yorks.: self-seeded in car park, Forster Square, Bradford, SE163338, B. A. Tregale & M. Wilcox, 2000. Ø
- ‡*Fraxinus angustifolia* Vahl 123/2.ang. *31, Hunts.: hedgerow, Ferry Meadows Country Park, TL141972, D. A. Broughton, 2007. Subspecies *oxycarpa*. Ø
- ‡*Jasminum nudiflorum* 123/JAS.nud. *17, Surrey: a clump established on top of a wall on the south side of Spring Street, a few metres east of Lyncroft Gardens, Ewell, TQ218626, G. Hounsborne, 2007.
- ‡*Jasminum officinalis* 123/JAS.off. *62, N. E. Yorks.: single plant established in rough grassland, west of Tees Barrage, Middlesbrough, NZ461188, V. Jones & W. A. Thompson, 2007.
- ‡*Verbascum blattaria* 124/1.1. ©31, Hunts.: vegetable garden, Easton, TL137716, B. N. K. Davis, 2006. 1st record since 1967.

- ‡**Verbascum bombyciferum** 124/1.4. *38, Warks.: waste ground, Castle Vale, Birmingham, SP149914, J. W. Partridge, 2007, det. V. Johnstone, **WARMS**.
- ‡**Chaenorhinum origanifolium** subsp. **origanifolium** (L.) Kostel. 124/8.1. *35, Mons.: 7 plants on vertical surface and 3 on top of remnant of riverside wall, near Monnow Bridge, SO504124, H. V. Colls, 2006. 1st British record of this subspecies. These plants have deep blue flowers some fading with age. Ø
- ‡**Hebe salicifolia** 124/17.1. *44, Carms.: self-sown in dock wall, Burry Port Harbour, SN445004, A. O. Chater & BSBI meeting, 2007.
- ‡**Hebe ×franciscana** (**H. elliptica** × **speciosa**) 124/17.ell×spec. *64, Mid-W. Yorks.: old quarry, Otley Chevin, SE199441, B. Brown, 2007.
- ‡**Hebe odora** (Hook.f.) Ckn. 124/17.odo. *70, Cumberland: well established on edge of recently felled woodland, Butterburn road N of Gilsland, NY66J, M. Gregory & J. Parker, 1995, det. D. R. McKean, **LANC**. Ø
- ‡**Sutera cordata** (Thunb.) Kuntze 124/SUT.cor. *44, Carms.: naturalised on grave in churchyard, Bethel Chapel, N of Glyn-dreiniog, Glanamman, SN681144, I. K. Morgan, 2007, det. E. J. Clement, **NMW**. *©63, S. W. Yorks.: weed, Bingley old Main Street, SE106393, B. A. Tregale & M. Wilcox, 2001. Ø
- ‡**Campanula persicifolia** 129/1.4. *48, Merioneth: one plant well established on track verge at entrance to forestry, near Llanuwchllyn, SH82, D. O. Elias, 2006-07.
- ‡**Campanula medium** 129/1.5. *46, Cards.: old mortared wall, behind Public Library, Aberystwyth, SN592818, A. O. Chater, 2007. 1st Welsh record as a neophyte.
- ‡**Campanula portenschlagiana** 129/1.9 *38, Warks.: pavement wall edge, Clapham Terrace, Leamington Spa, SP365653, J. W. Partridge, 2007, det. M. W. Poulton, **WARMS**.
- ‡**Campanula poscharskyana** 129/1.10. *48, Merioneth: frequent by tracks and on walls, Barmouth, SH61, P. M. Benoit, 2007. *70, Cumberland: shady bank by track, Bowness-on-Solway, NY223625, R. E. Groom, 2007, **LANC**.
- ©**Lobelia erinus** 129/7.2. *45, Pems.: small plants growing in mortar of wall, Royal Oak PH, Fishguard, SM957370, S. B. & A. E. Evans, 2007. There had been hanging baskets in 2006.
- ‡**Viburnum tinus** 131/2.3. *77, Lanarks.: abandoned industrial site, Gorbals, Glasgow, NS589633, P. Macpherson, 2006, det. E. J. Clement, **herb. P.M.** Probably originally planted but now surviving 'in the wild'.
- ‡**Symphoricarpos ×chenaultii** (**S. microphyllus** × **orbiculatus**) 131/3.mic×orb. *49, Caerns.: slate quarry waste tip, Llanllechid, SH6369, W. McCarthy, 2007.
- ‡**Lonicera xylosteum** 131/6.4. *78, Peebles.: banks of R. Tweed at foot of Alder, Haylodge Park, Peebles, NT246403, R. Singleton, 2007, det. D. R. McKean, **E**.
- ‡**Lonicera japonica** 131/6.6. *48, Merioneth: conifer plantation, Morfa Harlech, SH53, P. M. Benoit, 2006.
- ‡**Lonicera xitalica** (**L. caprifolium** × **etrusca**) 131/6.8×etr. *70, Cumberland: tip on waste ground, Aspatria, NY141425, R. E. Groom, 2007, **LANC**.
- ‡**Lonicera ×purpusii** Rehder (**L. fragrantissima** × **standishii**) 131/6.fraxsta. *70, Cumberland: near footpath, Wetheral Woods, NY466536, G. Lines, 2007, det. D. R. McKean, **LANC**. Ø
- ‡**Scabiosa atropurpurea** 134/5/2. *©63, S. W. Yorks.: waste ground, Thurcroft, SK5088, E. Ellis, 2007.
- ‡**Echinops exaltatus** 135/1.2. *77, Lanarks.: rough grassland, Greenhead Moss, NS8054, P. Macpherson & Glasgow NHS, 2007, det. E. J. Clement, **herb. P.M.** Established.
- ‡**Centaurea jacea** 135/11.jac. *©63, S. W. Yorks.: Horton Bank Country Park, Bradford, SE127308, B. A. Tregale & M. Wilcox, 2006, conf. E. J. Clement.
- ‡**Lactuca sativa** 135/22.sat. *©63, S. W. Yorks.: several records from waste ground in Barnsley District, SE3508, SE3703, SE3811, SE4011, P. Middleton, 2007.
- ‡**Taraxacum lancidens** 135/25.93. *44, Carms.: garden, Woodlands, School Road, Pwll, SN476011, R. D. Pryce, 2006, det. A. J. Richards, **NMW**.
- ‡**Taraxacum angustisquameum** 135/25.113. 44, Carms.: flower bed weed, Peniel School near Carmarthen, SN436241, R. D. & K. A. Pryce, 2007, det. A. J. Richards, **NMW**.
- ‡**Taraxacum lacerifolium** 135/25.146. *69, Westmorland: gravel path by infilled canal, off Parkside Road, Kendal, SD518919, A. M. Boucher, 2007, det. A. J. Richards, **LANC**.

- ‡**Taraxacum pseudoretroflexum** 135/25.189. *31, Hunts.: improved grass verge with *Urtica dioica*, Peterborough, Woodston, TL179980, D. A. Broughton, 2007, det. A. J. Richards.
- ‡**Taraxacum cestrense** T. Edmondson ined. 135/25.cest. *69, Westmorland: pavement, Whinlatter Drive, Kendal, SD525906, A. M. Boucher, 2007, det. A. J. Richards, **LANC.** Ø
- ‡**Hieracium scotostictum** 135/28.8.115. *47, Monts.: S facing dry scrubby bank, Melinbyrhedyn, Machynlleth, SN815985, T. Brown, 2007, det. D. J. McCosh.
- ‡**Helichrysum bracteatum** (Vent.) 135/34.bra. *©63, S. W. Yorks.: waste ground near car park, Cusworth Hall, SE5403, G. T. D. Wilmore & M. J. Midgley, 2004. Ø
- ‡**Conyza sumatrensis** 135/44.2. *48, Merioneth: in quantity with *C. canadensis* on a disused platform at Barmouth railway station, SH61, P. M. Benoit, 2007. The conspicuously hairy plant and invariably 5-lobed corollas of the disc florets were confirmed.
- ©**Anthemis punctata** subsp. **cupaniana** 135/55.1a. *62, N. E. Yorks.: a few self-sown plants at base of wall, Sutton-under-Whitstonecliffe, SE485825, V. Jones & W. A. Thompson, 2007.
- ‡**Anthemis tinctoria** 135/55.4. *46, Cards.: well naturalised in rough grass, Felin-y-mor Road, Aberystwyth, SN580806, A. O. Chater, 2006, **NMW.**
- ©**Anthemis austriaca** Jacq. 135/55.aus. *17, Surrey: following deep soil disturbance above rail tunnel, Bookham Common, Church Road Woods, TQ130556, S. D. Mellor, 2007. E. J. Clement comments: 'not quite typical, but seems OK'. Ø
- ‡**Cotula squalida** 135/61.4. *62, N. E. Yorks.: edge of moorland track, Golden Heights, Rudland Rigg, SE648959, T. Denney, 2006, det. B. Wurzell.
- ‡**Rudbeckia hirta** 135/78.1. *©63, S. W. Yorks.: waste ground, Nailor's Rough, Bradford, SE123359, B. A. Tregale & M. Wilcox, 2000.
- ‡**Helianthus tuberosus** 135/79.2. *31, Hunts.: waste ground, Church End, TL207824, D. A. Broughton, 2008. Forming a virtual monoculture over at least 30 × 30 m.
- ‡**Galinoga quadriradiata** 135/80.2. *45, Pems.: roadside gutter on the A478, New Hedges, SN128028, T. Rich, 2007.
- ‡**Guizotia abyssinica** 135/GUI.abby. *©17, Surrey: a few plants on disturbed soil, R. Mole, Leatherhead, TQ162562, D. Skinner, 2007.
- ‡**Tagetes erecta** 135/TAG.ere. *©63, S. W. Yorks.: pavement weed, Leeds Road, Idle, SE179384, B. A. Tregale & M. Wilcox, 2001.
- ‡**Tagetes patula** 135/TAG.pat. *©63, S. W. Yorks.: hedge bottom, Austerfield, SK6694, G. Coles, 2005.
- ‡**Aponogeton distachyos** 139/1.1. *35, Mons.: abundant in small pond above colliery tip, below Twyn yr Hafod, SO151058, S. D. S. Bosanquet, 2002.
- ‡**Lemna minuta** 148/2.4. *49, Caerns.: among stones in stream near Llanddeiniolen, SH5466, W. McCarthy & L. Ball, 2007. *62, N. E. Yorks.: abundant in ditch on heath, Strensall Common, SE649589, V. Jones & M. J. Yates, 2007, conf. W. A. Thompson.
- ‡**Juncus anthelatus** (Wiegand) R.E.Brooks 151/1.ant. *63, S. W. Yorks.: waste ground, old mill site, Bradford, SE133333, B. A. Tregale & M. Wilcox, 2007, det. T. A. Cope. Ø Possibly only 2nd record for British Isles.
- ‡**Luzula nivea** (L.) DC. 151/2.niv. *70, Cumberland: established garden outcast on rough grassland by copse east of Oldkiln, Mawbray, NY088447, R. E. Groom, 2007, **LANC.** Ø
- ‡**Sasa palmata** 153/3.1. *52, Anglesey: woodland, well established, Pwll-fanogl, Llanfair-Pwllgwyngyll, SH5271, N. Brown, 2007.
- ‡**Pseudosasa japonica** 153/5.1. *63, S. W. Yorks.: riverbank, Bingley, SE1039, B. A. Tregale & M. Wilcox, 2001.
- ©**Stipa tenuissima** Trin. 153/9.tes. *17, Surrey: two tufts on the edge of the traffic island on the north-east (old A3) junction of the roundabout, self-sown from plantings on the roundabout itself, Burnt Common, Send, TQ038547, G. Hounscome, 2007. *©63, S. W. Yorks.: waste ground, old mill site, Bradford, SE133333, B. A. Tregale & M. Wilcox, 2007, det E. J. Clement. Ø
- ‡**Vulpia unilateralis** 153/14.5. *31, Hunts.: thin soil overlying a concrete sill among grassland, Kimbolton Airfield, TL108695, B. N. K. Davis, 2006, conf. T. A. Cope.
- ‡**Briza maxima** 153/17.3. *49, Caerns.: many plants along wall-base, below Twt hill, Caernarfon, SH4862, W. McCarthy & M. Stead, 2007. Also seen by W. McCarthy & M. Stead on Dinas Hill, Criccieth (SH4937). 1st non-casual records. *69, Westmorland: shrubby weed, Homebase car-park, Kendal, SD516930, A. M. Boucher, 2007, **LANC.**

- ‡**Poa chaixii** 153/18.7. *48, Merioneth: a number of plants (probably originally planted) on roadside bank near house at Mallwyd, SH81, P. M. Benoit, 2007.
- ‡**Trisetum flavescens** subsp. **purpurascens** 153/30.1b. *©63, S. W. Yorks.: waste ground, Horton Bank Country Park, SE127308, M. Wilcox, 2003.
- ‡**Polypogon viridis** 153/46.2. *31, Hunts.: on gravel in garden of a pub, Alconbury Weston, TL179768, J. O. Mountford, 2003.
- ‡**Anisantha diandra** 153/52.1. *69, Westmorland: near nature reserve entrance, Humphrey Head, SD388746, W. Nelson, 2007, **LANC**.
- ‡**Ceratochloa carinata** 153/53.1. 38, Warks.: front garden, Balsall Heath, Birmingham, SP074840, I. C. Trueman, 2007, det. T. B. Ryves, **WARMS**. Birmingham & Black Country Flora Project. *45, Pems.: scattered in scruffy grassland by ASDA car park, Pembroke Dock, SM969038, S. D. S. Bosanquet, 2007.
- ©**Hordeum vulgare** 153/59.vul. *62, N. E. Yorks.: scattered self-sown plants by woodland track, Beadale Wood, N of Wreton, SE774870, V. Jones, 2007, conf. W. A. Thompson.
- ‡**Cortaderia selloana** 153/62.1. *31, Hunts.: edge of arable field, Ramsey, TL282859, D. A. Broughton, 2008.
- ‡**Cortaderia richardii** 153/62.ric. *17, Surrey: Papercourt Marshes NR, Send Marsh, TQ034562, G. Groome, 2007.
- ‡**Spartina pectinata** 153/67.4. *46, Cards.: clump c. 1 m diameter with pioneer culms beyond on grassy bank of brackish ditch, N side of B4353 road 100 m from beach, S end of Borth, SN609889, A. O. Chater & J. P. Poland, 2007, **NMW**. Not growing nearby and apparently not being grown for biomass in the vicinity.
- ‡**Anemanthele lessoniana** (Steud.) Veldkamp 153/ANE.les. *17, Surrey: a small tuft at the foot of a wall, self-sown from nearby gardens, south of Waterloo, Lambeth, TQ313792, N. H. Bertrand, 2007. Seen also at Warren Mere, Thursley (SU916407) by G. Hounscome. *69, Westmorland: self-sown in pavement from garden opposite Eversleigh, Kirkby Lonsdale, SD609786, A. M. Boucher, 2007, **LANC**. *77, Lanarks.: in pavement cracks, Garnet Street, Glasgow, NS582660, A. Rutherford, 2007, **herb. P.M.** Ø
- ‡**Miscanthus sinensis** Andersson 153/MIS.sin. *©63, S. W. Yorks.: large clump on roadside, Hollow Meadows, SK2487, J. Middleton, 2005. Garden escape? Ø
- ‡**Panicum miliaceum** 153/PAN.mil. 46, Cards.: pavement weed by Aberystwyth Station, SN585815, A. O. Chater, 2007. 1st record as neophyte.
- ‡**Phyllostachys bambusoides** Siebold & Zucc. 153/PHY.bam. *52, Anglesey: well established in woodland, Pwll-fanogl, Llanfair-Pwllgwyngyll, SH5271, N. Brown, 2007. 1st Welsh record. Ø
- ‡**Phyllostachys nigra** (G. Lodd.) Munro 153/PHY.nig. *44, Carms.: naturalised by road-bridge over stream on v.c. 44 side of boundary, Amroth, SN173072, A. O. Chater *et al.*, 2007, det. G. Hutchinson, **NMW**. Ø
- ‡**Phyllostachys viridiglaucescens** (Carrière) C. Rivière & Rivière 153/PHY.vir. *52, Anglesey: well established in woodland, Pwll-fanogl, Llanfair-Pwllgwyngyll, SH5271, N. Brown, 2007. 1st v.c. & 2nd Welsh record. Ø
- ‡**Hemerocallis fulva** 158/5.1. *62, N. E. Yorks.: small patch established by pool on raised beach, Cayton Bay, Scarborough, TA063852, V. Jones & M. J. Yates, 2007.
- ‡**Muscari armeniacum** 158/23.2. *50, Denbs.: grassy sand dune, Kinnel Bay, SH987807, J. A. Green, 2001.
- ‡**Muscari latifolium** J. Kirk. 158/23.lat. *©63, S. W. Yorks.: waste ground, old mill site, Bradford, SE133333, B. K. Byrne & B. A. Tregale, 2007. Ø
- ©**Allium subhirsutum** 158/24.5. *62, N. E. Yorks.: self-sown over 2 m in crack at base of wall, Welbury, NZ399023, V. Jones & W. A. Thompson, 2007, conf. E. J. Clement, **herb. V. Jones**.
- ‡**Allium triquetrum** 158/24.7. *48, Merioneth: by railway at Cumberland Place, Barmouth, SH61, P. M. Benoit, 2008. *69, Westmorland: seaward side of embankment, west side of Humphrey Head, SD397756, W. Nelson, 2007. 1st definite record.
- ©**Allium porrum** 158/24.por. *45, Pems.: roadside bank, Porthgain, SM816324, S. B. Evans, 2007.

‡**Tristagma uniflorum** 158/28.1. *49, Caerns.: base of wall, Marine Drive, Great Orme, SH7682, J. Benson, 2007.

‡**Alstromeria aurea** 158/36.1. *70, Cumberland: one plant in dunes, Mawbray Banks, NY038475, G. Lines, 2007, photo LANC.

‡**Erythronium dens-canis** 158/ERY.den. *62, N. E. Yorks.: long-established and naturally regenerating in woodland, grounds of Wydale Hall, N of Snainton, SE927834, V. Jones & M. J. Yates, 2007.

‡**Puschkinia scilloides** Adams 158/PUS.sci. *64, Mid-W. Yorks.: at 420 m. beside track near farm in calcareous grassland, Dale Head, SD841715, Bradford Botany Group, 2007, det. E. J. Clement. Ø

‡**Crocus speciosus** 159/8.8. *70, Cumberland: west side of lane under hedge, Wetheral, NY457541, M. Roberts, 2006, photo LANC.

‡**Crocus ancyrensis** 159/8.anc. *62, N. E. Yorks.: a few plants in short grassland, Hutton Rudby, NZ471063, V. Jones, 2007.

‡**Gladiolus communis** subsp. **byzantinus** 159/9/2b. *©63, S. W. Yorks.: waste ground, trackside east of Kiveton railway station, SK489829, G. Coles, 2006.

©**Schizostylis coccinea** 159/SCH.coc. *44, Carms.: edge of wall/hedge, Parc Gitto, Llwynhendy, SS537996, I. K. Morgan, 2007.

‡**Cordylina australis** 160/3.1. *45, Pems.: single plant of several years growth in S facing sandy estuarine blackthorn scrub, Newport Estuary, SN056399, S. B. & A. E. Evans, 2007. Away from any gardens and no obvious reason why it should have been planted.

Book Reviews

British alpine hawkweeds. D. Tennant & T. Rich; line drawings by D. Tennant, paintings by R. C. Booth. Pp. 234. B.S.B.I., London. 2008. Price £30 (hardback), ISBN: 978-090115-838-3; £25 (paperback). ISBN 978-090115-839-0.

When I opened this book the first thing which went through my mind was the memory of glorious days on the Scottish hills with Cyril West, Norman Douglas Simpson, Archie Kenneth, Mary McCallum Webster and Ursula Duncan. The next thing which crossed my mind was how wonderful it would be if we had the whole British and Irish flora set out like this.

The alpine hawkweeds as a group are fairly easily recognisable in the field and occur mainly in the Scottish mountains with an isolated species in the Lake District and another in Snowdonia. The opening chapters in the book describe the thrill of botany in the mountains; the scenery, the weather and the distance you may have to walk to find the plant you are looking for. A detailed account of the discovery of each species of alpine hawkweed from John Ray (1627–1705) to the present day is given. A section then follows on the geographical areas in which the plants are found, pointing out ecological factors which make the adjacent areas so different. A summary is given of which species occur in each vice-county, ten or more being found in favoured localities. Tennant has searched for and mostly found nearly all the localities given on old herbarium sheets. (I should perhaps mention at this point that Edward Shearburn Marshall's original collection is in **CGE**, not **BM**). A list of species with rarity and threat category follows.

Anyone who has tried to grow alpine hawkweeds in ordinary garden soil will know the result is not very satisfactory. Tennant describes how he has found a method of growing them so that they look like they do in nature. His collection of cultivated plants allowed Clive Stace and colleagues at Leicester University to study their chromosomes and DNA. This information is included in the book.

The main part of the book then deals with each of the 39 taxa in detail. The nomenclature and synonymy are completely up to date. The detailed descriptions give not only morphology but also what the ornithologists call 'jizz', the look of the living plant, the way it holds itself,

its colour and its variation. One of the most important things discussed is the variation within a species. This variation may be that some plants in a population can be slightly different from others, or it may be when plants from two different populations are compared they are slightly different from one another. The taxonomist has to decide whether the difference is great enough to describe as a new species or whether it is better to keep them in a variable species. Different ecology can also make them look different. In cultivation many of the differences may be ironed out. This sort of variation is discussed under each individual species. Sometimes it is worthwhile calling a particular variant a forma as in *Hieracium hanburyi* (p. 116).

The whole book is copiously illustrated. Breath-taking colour photographs show the type of terrain you will have to walk in if you wish to seek alpine hawkweeds. David Tennant has carefully drawn each species in black and white showing the general aspect of the plant, its height, spread of flowers, shape of capitulum and undulation of leaves. Separate drawings show the range of leaves from the outer ovate short primordial to the narrower, longer inner ones. Colour photographs also show the general aspect of the plants. Drawings and photographs in the introduction show types and density of hairs, type of leaf teeth, shape of capitula, apices and shape of leaves and drawings and coloured photographs of the spread of ligules as seen from above. Each species is individually mapped. On top of it all Raymond C. Booth has made fine full page paintings of *Hieracium holosericeum*, *H. backhousei*, *H. insigne* forma *insigne* and *H. notabile*.

Because of their rarity, species of alpine hawkweeds should no longer be collected, unless material is needed to describe a new species. They need to be examined and checked against the illustrations in the field. The book is rather too large to fit comfortably into a rucksack, but modern equipment such as digital cameras will enable you to take the images into the field.

I really cannot find anything missing from this wonderful book, and I have lived with hawk-weeds, both in the field and the herbarium, for nearly 60 years. The authors are to be congratulated for putting together this fine book for the

B.S.B.I. in conjunction with National Museum Wales, and I strongly recommend it to all people, amateur or professional, who are interested in wild plants and particularly to those who love the mountains.

P. D. SELL

Orchids of Europe, North Africa and the Middle East, by Pierre Delforge, 3rd edition, 2006. A. & C. Black, London. ISBN 0-7136-7525-X. Price £29.99.

Pierre Delforge, a leading authority on European orchids, has now published a new third edition of his well-known reference source and guide to the orchids of the region. Its forerunner was first published in 1994 and now the updated French third edition has been translated into English by Laurent Penet and Carine Collin and edited by Simon Harrap. This is a hard-back volume approximating to A5-size and so fits comfortably into the field botanist's pocket, although at 640 pages and printed on good quality paper its weight might deter some.

In all, the book contains about 1270 colour photographs, many of which have been taken by the author; these are usually arranged two to four to the page with descriptive text in the adjacent column. The latter includes information relating to etymology, taxonomy, flowering season, habitat, geographical distribution and, in some cases, additional brief notes and discussion on details of special interest. Introductory chapters relate to the understanding of orchids such as their anatomy, life cycle and methods of reproduction and fertilisation. Then follow chapters on orchid nomenclature and systematic classification, identification, aberrants, hybrids, and finally a section on threats and conservation. These are also illustrated with colour photographs. After these introductory chapters come the species accounts which form the main body of the book and run to a total of 592 pages. Finally, there is a list for further reading, a glossary and a much-needed index of scientific names.

The book, which covers twenty-eight genera, is obviously the culmination of a great amount of field study and extensive research and, whilst it is presented in a scholarly manner, it will still be very usable as a field guide. Despite this, one wonders how many botanists will cope with the author's predilection for recognising at species and subspecies level, what often must surely be relatively minor taxonomic varieties and forms. One

manifestation of this is in *Ophrys* where the genus (split into two sections) covers around 250 species and runs to a total of 265 pages; this represents more than 40% of the book. Another curious anomaly is the relationship between the taxonomic rank listed in the index and that given on the relevant page entry. As an example, the index recognises 37 subspecies of *O. sphegodes* and 36 of *O. fusca*, but on turning to the appropriate page they are treated as full species. Quite apart from any technical inconsistency, this makes the use of the index confusing. Also, whilst considering nomenclature and taxonomic rank, recent molecular work within the Orchidaceae has led to the development of a new nomenclature within several genera. In the book, however, whilst the author claims to have taken this into account, he has usually retained the more traditional names, only indicating new ones under synonyms.

The treatment of the two supposed British endemics, *Epipactis dunensis* and *E. sancta*, is also a little confusing. These taxa are very difficult to separate on morphological characters alone, with the later-described *O. sancta* relying almost solely on genetic evidence. Nevertheless it is retained at species level but placed in a separate 'group' to *E. dunensis*. Whilst no doubt technically correct, when using the book in the field, this makes a comparison of the two species difficult. There are also similar examples. The adoption of a more stable taxonomy would also have been advantageous since excessive splitting may cause confusion and frustration for the user and so, inevitably, detracts a little from the book's value. Nevertheless it is a mine of information and, although not to the taste of 'lumpers', it will be a very valuable source of information. This fact, combined with its excellent colour photographs, makes it a very useful field guide, especially for those visiting the Mediterranean area.

M. J. Y. FOLEY

Nouvelle Flore de la Belgique, du Grand-Duché de Luxembourg, du Nord de la France et des Régions Voisines (Ptéridophytes et Spermatophytes). 5th edition. J. Lambinon, L. Delvosalle & J. Duvalneaud. Pp. cxxx + 1167. Jardin Botanique National de Belgique, Meise. 2004. Hardback. 48 Euro. ISBN 90-72619-58-7.

Like several other relatively small and species-poor countries of north-western Europe (e.g. The Netherlands, Denmark, Sweden, Great Britain), Belgium has a compact 1-volume Flora which covers its native and alien wild plants and is periodically updated by new editions. This fifth French-language edition follows earlier editions in 1973, 1978, 1983 and 1992 [1993], and there have also been three Dutch-language editions in 1985, 1988 and 1998; in future it is intended to alternate the language versions, so that the most up-to-date edition might be in either language. The well-established *Nouvelle Flore* covers not only Belgium and Luxemburg but also some adjacent areas of France, Germany and the Netherlands. A map is provided, although the various boundaries on it are not as clear as could be wished. The status classes of plant included are native, naturalised, adventive, subspontaneous and cultivated. Many in the last category are covered, e.g. *Magnolia*, *Hamamelis* and *Canna*. I found no numerical inventory, but a rough estimate produced a figure of approximately 2500 species.

The Flora adopts the format of successive keys to families, genera and species, the last followed by species entries which provide authorities, synonyms, vernacular names (French, Dutch and German), plant growth-form and height, flowering time, habitat and distribution, but no chromosome numbers and no further descriptive matter. There is a detailed 22-page introduction, about 160 pages of very well executed line-drawings, four indices (Latin and the vernacular languages), a good illustrated glossary, with a ruler and a list of signs and abbreviations on the rear endpapers. An additional interesting feature is a vegetative key to trees and shrubs, occupying 48 pages and covering all the cultivated species treated in the Flora down in size to the likes of *Hypericum calycinum* and *Cotoneaster dammeri*, but not to *Helianthemum inter alia*.

The sequence and taxonomy adopted is best described as classical late 20th Century, with

no attempt made to follow more recent evidence from DNA data. The family sequence is more or less that of Cronquist, but with frequent divergences, e.g. Amygdalaceae and Malaceae split from Rosaceae, a few (but not many) families such as Alliaceae and Amaryllidaceae split from Liliaceae, and Lobeliaceae split from Campanulaceae. Hence the dicots and Scrophulariaceae are retained in their classical senses, *Acorus* remains in Araceae, *Cardaminopsis* is still separate from *Arabidopsis*, and the Orchidaceae still include Burnt Orchid, Lady Orchid and Green-winged Orchid (as well as Man Orchid) in one polyphyletic genus *Orchis*.

The Flora is a mine of useful information, and a detailed study amply repays the time invested. It is fascinating to discover the many ways in which the treatment differs from that usual in Britain, and since neither practice can be correct every time we have much to learn from both the deeper understanding and the errors inherent in the Belgian approach. There are numerous divergences from the treatment in our standard list, involving both nomenclatural conclusions and taxonomic judgements. The following give a sense of the contrasts: *Phyllitis*, but not *Ceterach*, is included in *Asplenium*; *Pilosella* is included in *Hieracium*; *Comarum* is separated from *Potentilla*; and *Ranunculus ficaria* follows the *Flora Nordica* treatment, whereby Sell's typification of the species is considered invalid and the two subspecies are called *ficaria* and *fertilis*. In addition there are some notable differences from our flora in species composition, e.g. two species of *Anthericum*, five species of *Thesium*, and five species of *Gagea* (including *G. bohemica*, discovered 1998!), all native, yet only two wild species of *Cotoneaster* (one native).

The *Nouvelle Flore* is essential to any botanist either visiting its area or wishing to learn more about those species which are common to here and there, for which it is thoroughly recommended.

C. A. STACE

The Wild Flowers of the Isle of Purbeck, Brownsea and Sandbanks. Edward A. Pratt. Pp. 296 + 32 of colour photographs and 24 of sketch-maps. Brambleby Books, Luton. 2008. £18 p/b. ISBN: 978-0-9553928-4-9.

The front cover of this book, with a bright flowering spike of Dorset Heath (*Erica ciliaris*) inset alongside a view of Corfe Castle and green hills beyond, immediately invites any botanist to open it and investigate further. Here one quickly observes that the author is The Rev. Edward A. Pratt M.A. and that the book is dedicated to Almighty God, with two biblical quotations, formulas more reminiscent of a Victorian Flora than of the numerous local wildflower books published nowadays. In the same vein Professor Sir Ghilleen Prance's foreword harks back to his childhood botanising as a member of the Wild Flower Society, aided by The Rev. H. J. Riddelsdell's *Flora of Gloucestershire*, published 60 years earlier. But thereafter there is nothing old-fashioned about this delightful local Flora.

After an evocative description of a sunny late May afternoon's walk over Ballard Down (which can be followed on sketch-map 20), with accounts of sightings of "a dazzling male Adonis Blue" and a Peregrine Falcon stooping as well as of some of the down's floral riches, the book settles down to 14 pages of introduction, with headings such as "Purpose and Content", "Richest area in Britain" (SY98 having the highest total of any hectad), "Geology and soils" (especially important in this astonishingly varied area), "Identification Books" (a very well-informed account including a list of B.S.B.I. Handbooks), "Dorset Flower Books", "Reporting Finds" and, inevitably in today's safety-conscious world, "Warnings". Next come brief accounts of 44 "Flower-rich Locations", cross-referenced to the relevant sketch-maps and plates, a calendar of special sights, and suggestions for 20 walks.

The main plant list, starting on page 53, is preceded by exemplary explanations of its layout and terminology. Plant names generally follow Stace's *New Flora* (1997), but the author rejects the "excessive and inconsistent use of hyphens" in English names. "Stars-in-grass" is adopted for a local speciality, *Thesium humifusum*, without any mention of its usual English name Bastard Toadflax; so some

readers may be puzzled by the final words of its account: "Quite unlike Toadflaxes, except perhaps when in young leaf and very small. It is deserving and worthy of its new name." For status, "Early Introduction" and "Introduction" replace "Archeophyte" and "Neophyte". Species are categorised as abundant, frequent, occasional or rare (within their usual habitats): the N.V.C. distinction between frequency and abundance is not applied. The terms "*Dorset Rare*" and "*Dorset Scarce*" are used as well as "*Nationally Rare*" and "*Nationally Scarce*", and Cheffings & Farrell's 2005 *Red Data List* threat categories are added.

Unusually, very precise instructions for locating the less frequent species are included, generally with reference to the footpath numbers shown on the excellent sketch-maps rather than by map references. Finally, some species accounts end with helpful identification features, occasionally illustrated by small line drawings. As an example, the account of *Ranunculus parviflorus* ends: "In this area it grows close to the ground and usually has only one or two narrow petals, unlike illustrations in books. Foliage is green, not greyish. See Plate 9."

My criticisms are few. The index is simple but, as far as I have sampled it, reliable; however, in using it, I found it mildly irritating that it is located before the plates and sketch-maps rather than at the very end of the book. There are clear references in the text to the 107 colour photographs of habitats and species, but only English names of plants are used in the captions without any cross-referencing to the species accounts. The pictures are generally well-chosen, but the quality of reproduction varies greatly, so that, while most of the eight orchid photos are acceptable, those of the "Rare hybrid of Sweetbriar and Small-flowered Sweetbriar" and "The three species of Gorse in flower together" are worthless.

Genesis 1: 31 is quoted at the beginning of this book: "God saw all that He had made, and it was very good." This account of a small part of God's creation is very good too!

P. H. OSWALD

Obituaries

TERENCE (TERRY) CHARLES ERNEST WELLS 1935–2008

Terry Wells was born and spent his childhood in Bedfordshire. He died on 4 September 2008, having been suffering from Parkinson's disease for several years, and more recently from cancer. Terry was B.S.B.I. vice-county recorder for Huntingdonshire for 40 years, but his main contribution was in the fields of grassland management, plant ecology and demography.

Botany was an early interest in his life when he made a collection of pressed leaves for a scout badge. This interest was encouraged by his history teacher at Luton Grammar School, John Dony. Terry often accompanied Dr. Dony on field excursions, gathering information for both the Flora of Bedfordshire (Dony 1953), and later on for the Flora of Hertfordshire (Dony 1967). He studied Agricultural Botany at Reading University, where his professor was Hugh Bunting, and where he met his wife, Sheila. After graduating, he spent three years in Jamaica as an agronomist, returning to the UK in 1962 to take up the post of Grassland Ecologist at the newly-established Nature Conservancy Experimental Station at Monks Wood, near Huntingdon. He remained there throughout his professional career, retiring in 1995.

It was at Monks Wood that I first met Terry, becoming his botanical assistant in 1965. His main work at this time was on the effects of grazing and mowing on chalk grassland, and regular field trips to Barton Hills, Bedfordshire, were an essential part of this. The short 'clippings' from the experimental plots were then sorted into species in the laboratory, and Terry taught me how to identify all these species, especially grasses, from pieces as small as one centimetre. During this process, we discussed sport, beer, general conservation issues, and writing a Flora of Huntingdonshire.

One of the major projects at that time was the Nature Conservation Review (Ratcliffe 1977), with Terry being the main author of the calcareous grasslands section and a major contributor to that on mixed heath and rich grasslands. The Grasslands team would set off in an old, long-wheeled base Landrover with no power-steering, each Monday morning, returning late on a Friday, having visited and recorded many of the calcareous areas in England. We were joined by Derek Wells, also



a former agricultural botanist, which caused some confusion – hence the nicknames Terry 'Dry' Wells (who preferred the well-drained chalk) and Derek 'Wet' Wells (who preferred wet, alluvial meadows). This was a happy, explorative time, when wonderful sites such as Parsonage Down in Wiltshire were discovered.

In addition to his main research on grassland management, he began a series of studies on individual species. The first was on *Spiranthes spiralis* at Knocking Hoe, Bedfordshire, which was set up using the co-ordinate method, which gave a unique reference for each plant. This is now one of the longest demographic studies in the world. The early results were published in the classic paper (Wells 1967). The study continues to this day, although the population has declined over the years and no longer takes five days to record but a mere half a day. Other long-term studies were initiated on *Herminium monorchis*, *Ophrys apifera* and *Orchis morio*, and he collaborated with Jo Willems from the University of Utrecht, organising a European conference on terrestrial orchids (Wells & Willems 1991). Then he widened his perspective and published two Biological Floras on *Pulsatilla vulgaris* (Wells & Barling 1971) and *Hypochoeris maculata* (Wells 1976).

During the 1970s Terry became very interested in the restoration of grassland habitats, and from his considerable knowledge of ancient grassland and population dynamics of rare species, he pioneered development of seed mixtures for establishing amenity grasslands on roadside verges and in country parks. His booklet *Creating attractive grasslands using native plant species* (Wells, Bell & Frost 1981) sold 8,000 copies. He also developed techniques for recreating apparently 'ancient grassland communities'. Indeed his chalk grassland plots at Therfield Heath, Hertfordshire, which are still monitored to this day, were one of the first attempts to recreate chalk grassland, and now, over 30 years later, they are almost indistinguishable from the adjacent chalk downland (Wells 1990). Another 'first' was undertaking a scientific survey of the Ministry of Defence ranges on Porton Down, Wiltshire (Wells, Sheail, Ball & Ward 1976). Terry and his team, through meticulous survey and historical research, were able to show the importance of past land-use in determining the current composition of the vegetation and how, in some cases, apparently ancient swards were actually quite recent in origin. This site is now recognised as being of international significance and is a refuge for wildlife of the chalk as it is surrounded by agricultural land.

That grassland needed constant, but not necessarily the same management from year to year, was one of the main themes of Grassland section at Monks Wood (Duffey, Morris, Sheail, Wells & Wells 1974). It seems obvious to many of us now, but 40 years ago nature reserves were often designated, a fence and a notice erected, and then the area was left to fend for itself. Sites began to lose their wildlife interest through neglect and grasslands had soon turned to scrub and, in some cases, woodland. Terry was one of the first in assessing how the biological richness should be conserved, using farm stock and traditional methods as 'management tools' for nature conservation. Farmers were an important part of the scene and began to feel less threatened by these 'new approaches'.

Much of Terry's spare time was devoted to work in the area in which he lived around Upwood and in the county of Huntingdonshire. In 1967 he became B.S.B.I. vice-county recorder and finally published the *Flora of Huntingdonshire and the Soke of Peterborough* (2003). Terry loved being out in the field, leading many meetings for the Huntingdonshire Fauna

and Flora Society, the Wildlife Trusts and the B.S.B.I. He always encouraged young and new members and often involved them in his regular recording of particular species. Sheila and his two daughters, Sarah and Beverley, spent many hours outside, and soon became familiar with Latin names. Sheila herself, decided to study fungi whilst Terry concentrated on the vascular plants, but they also shared their botanical interests, so it was a very fruitful partnership.

One of Terry's delights was the discovery of a series of meadows just behind his home at Upwood. 'There was this superb set of old meadows, not improved by fertilizers, with some cracking plants, right on my doorstep. Why had I not seen it before?' His dedication, meticulous recording and ability to champion a cause resulted in this area becoming an S.S.S.I., Wildlife Trust Reserve and an N.N.R. – a fitting and lasting tribute to his efforts.

Being involved in the local scene meant exactly that. He was Botanical referee for the H.F.&F Society, their chairman and latterly their president. He was also a Council member of the Wildlife Trusts and was honoured by them in 2007. But he was also influential in other countries, starting with an exchange year with C.S.I.R.O. in Western Australia working on terrestrial orchids. He returned to that country in 1982/1983 on a Winston Churchill Travelling Fellowship, but this time to the eastern part, to lecture on habitat restoration and learn from what the Australians were doing on this topic. He also set up an Earth Watch project in the Albufera Marshes, Mallorca, and gave a lecture tour on conservation management in Japan. In 1997 he received an O.B.E. for his services to botany and conservation.

Terry was, to many of us, a larger-than-life character – a jovial, bustling, vigorous person, full of energy, enthusiasm and ideas, which he shared with his family, friends and colleagues. He was a keen sportsman, and had been a champion pole-vaulter at school, a rugby player for English Universities, and a member of the Upwood cricket team. In his quieter moments he liked listening to classical music and playing the recorder. He loved a beer, and could often be found in the pub, chatting with the locals – no doubt a valuable asset when he became chairman of the parish council.

Terry will be missed by all who knew and worked with him, but his achievements and legacy will live on for future generations to see and enjoy.

ACKNOWLEDGMENTS

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comments on my account. Sheila kindly supplied the photograph of Terry.

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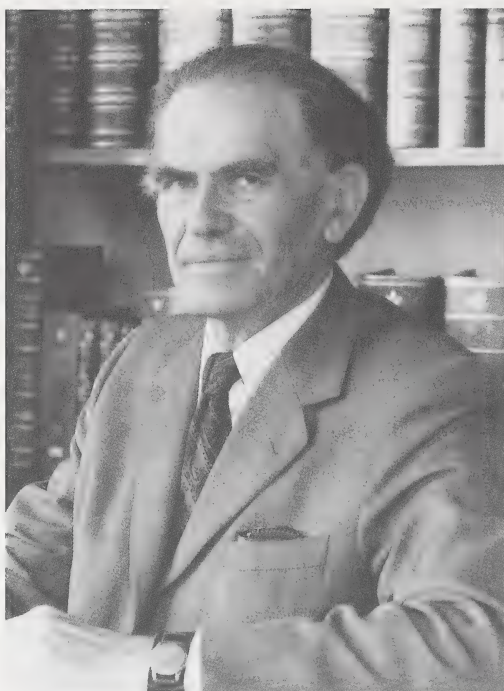
LYNNE FARRELL

JOHN FRANCIS MICHAEL CANNON
1930–2008

John Cannon was born on 22 April 1930, in Selsdon, in Surrey, then a rural village on the edge of Greater London. After primary schooling in Selsdon, he went to the Whitgift School, where in his sixth-form years he was taught biology by Cecil Prime, author of the *New Naturalist* on 'Lords and Ladies' (*Arum* species) who would have stimulated his interest in botany.

Conscription of school-leavers into H.M. Forces was still in force when, in 1947, John, having acquired his 'A-levels', had to consider the options available in the Army. He found that if he joined up as soon as his school education had finished he could enter a scheme whereby he could take up a university place a year hence. In fact, after primary and junior officer training, he left the Army after twelve and a half months, and in October, 1949, enlisted at Newcastle University College (then part of Durham University), to study botany, graduating three years later with a First Class Honours degree.

On graduating, John was offered the chance to study for a PhD at Newcastle working under Katie Blackburn on the cytology of Illecebraceae, but the draw of matrimony was uppermost in his mind and another three years as a low-paid student was weighed against getting a permanent job. Also during his vacations, John had worked at both Kew and the British Museum (Natural History) [The Natural History Museum] and knew that this kind of botany would give him great satisfaction. He applied to the Civil Service Commission and was offered a research fellowship (without tenure) at Kew to work on the Flora of Tropical East Africa project, which he accepted but shortly afterwards was approached by the Keeper of Botany at the BM who offered him a tenure post as a Scientific Officer post at the Museum. As this offered a more stable environment in which to get married, he withdrew from the Kew post and started a taxonomic career with the Trustees of the British Museum that took him through to retirement.



John Cannon c. 1977

John's initial job at the Museum was in the General Herbarium, as it was termed, which contained the larger bulk of the phanerogamic extra-European collections, and where he was to help with the curation and identification of material from West Africa and the former Portuguese colonies of Central Africa under the guidance of Arthur Exell, the Deputy Keeper. At that time, work was in progress repairing the war damage done by incendiary bombs to the top floor of the East Wing which had held the European and un-mounted collections. The main floor was redesigned to become the Cryptogamic Herbarium, hitherto scattered in several floors in the Central Tower, but within it, a mezzanine floor was constructed, half of which was to become studies for research staff; the other half, a public Exhibition Gallery dedicated to botany only, something badly needed in the Museum where animals predominated!

The Gallery, of some 50 exhibition cases would cover the whole vegetable kingdom (including fungi) and touched on genetics, anatomy and ecology. To carry the project further the Museum Exhibition Department had contracted out the design, modelling and artwork to an outside firm, to which a member of Museum staff, well versed in the subject

matter, would be attached to help the contractor. The Keeper of Botany, not wanting to take senior research staff off their projects, considered young Cannon, the latest recruit, and recently graduated from university, as the obvious choice.

It was John's brief to prepare the factual data to be displayed (the 'story-board'), writing any labelling that was necessary, researching for artwork or photographs and generally working as part of the contractor's team. He was given the freedom to call on the specialist knowledge of colleagues throughout the Department to help him, an aspect that required tact, gentle persuasion – and sometime persistence, to get the best results. John in his quiet way had all of these. The completed Gallery was opened by Her Majesty Queen Elizabeth, the Queen Mother, on 31 October 1962. It fell to John to escort H.M. round the exhibit – and she was not to be hurried! Cannon was kept on his toes with her in-depth questions – and her visit lasted twice as long as originally planned!

Working as liaison officer with the Gallery brought John into contact with most of the Department staff and he formed close friendships especially with those of us in the Cryptogamic Herbarium who were of the same generation. The Museum was at that time revitalising its research and curation potential in lower plants but flowering plants still dominated the Department's image and thinking! So, in 1964, when some of us in the 'Crypt' thought that surveying the plants (of all groups) of a maritime locality which would also help to train younger curatorial staff we appraised our flowering plant colleague, John Cannon, of our thoughts. If anyone could sell it to top management it would be him. John showed some cautious enthusiasm but took it to the Keeper, James Dandy, and eventually, Trustees approval was obtained, together with the appropriate field expenses for a 5-year project. John became the leading organiser, taking on the compiling of the flowering plant section (with E. Bangerter) and producing all the maps (as camera-ready copy not at that time by computer!). The Island of Mull was chosen and an intensive programme of visits made throughout 1966–1970. We had the support of several institutes in Scotland and logistical support by the Royal Navy Air Station at Lossiemouth. The project enabled us to record some 5280 species in 1600 genera in a book of some 640 pp.

In 1966, on the retirement of Jim Dandy, Robert Ross (a diatomist) succeeded to the

Keepership of Botany, with Dr A Melderis as his deputy. When the latter retired in 1972, John Cannon was appointed to the Deputy Keepership and in 1977, John succeeded Bob Ross as Keeper of Botany. John continued to work on the African flora contributing papers on Apiaceae, Araliaceae and Cornaceae for *Flora Zambesiaca* and the *Flora de Mocambique* but saw himself primarily as a manager.

In the early 1980s the Museum was beginning to widen its potential for taxonomic research. Some Botany members had already a close relationship with the Chelsea Physic Garden Curator and his staff and used space there to cultivate plants that they were studying. This gave facilities for cytology and, seeing this potential, John got the Trustees' support for the establishment of a staff member to work at Chelsea, and found money to hire space in the laboratory there and enlarge greenhouse facilities for our Departmental use. As a result, the staff member hired later returned to the Museum campus and played a significant part in developing molecular studies in the Botany Department.

In 1979 the Government published a Report on *'Taxonomy in Britain'* a document that stimulated response from taxonomic research institutes as to the value of their work. As a result John was involved in co-writing, with the Keeper of the Herbarium at Kew, an application to S.E.R.C. that gave an initial three-year grant to the Linnean Society to assess the feasibility of producing a catalogue of the types of Linnaean names. The grant was awarded and the post based at the Museum. At the end of the three years, the original occupant was taken onto the permanent staff and, at the time of writing has continued to develop this important aspect of the Museum's work.

In 1958–1960 a young scholar from California, Peter Raven, had a visiting Fellowship at the Museum studying Onagraceae. He and John set up a close friendship. Twenty-five years later, Raven, then Director of Missouri Botanical Gardens, proposed an international project to compile a Flora of the countries in Central America. He had the support of Mexican botanists and as a European counterpart he invited his old friend John Cannon and the Natural History Museum to be the third member of the organising institutes. *Flora Mesoamericana* has been a long-term project in which the Department has deployed staff and played a significant role in organisation, field collecting, taxonomic accounts, editing and publication and continues to this day.

This cannot be a catalogue of Departmental work but the above is given as examples of some of the important developments that took place during John Cannon's Keepership. John had had, as Assistant Keeper, Peter James, a lichenologist, who had joined the Museum at about the same time, and, with his help, similar initiatives were developed in the Cryptogamic Sections.

Looking back on John Cannon's time as Keeper, he was seen by many of his staff as the architect of the current system of research and curation throughout the Department, some of which are detailed above. He was one of the few Keepers that did make the effort to come and see his staff. He introduced regular management meetings and would sound out members of his staff for items on the agenda, seeing himself as a facilitator of the ideas put forward. As a result foundations of important programmes were laid which have continued to be developed by the staff concerned.

He may have often appeared to be asleep when you were explaining anything technical but could suddenly pose an astute question to bring you to earth!

John Cannon joined the B.S.B.I. in 1951. After the Flora of Mull was published he took on the Recordership for the Island from 1966 till 1979. He was on various committees of the Society, including Development and Rules, becoming Secretary of its successor, the Coordinating Committee in 1970 onwards; also on Meetings and Publications Committees and Council. He was President 1983–1984; his address to the Society on *Posidonia* and other plant balls was both instructive and entertaining.

John Cannon retired in 1990 and for some time continued work on floristic accounts, some with his wife, Margaret, a competent botanist in her own right. One notable joint outcome was a book on natural dyes for wool and other fabrics *Dye Plants and Dyeing*, John and Margaret Cannon, illustrated by Gretel Dalby-Quenet, A. & C. Black, 2002. Throughout his life, John's family had come first and in retirement he was able to enjoy time with his grand-children. He was also active in his village of Rodwell being Church Warden and writing a history of the church with others.

I would like to thank former colleagues and present staff for their help in preparing this account; and also Paul, Pippa and Simon for allowing me access to their father's own notes on his earlier career. Our condolences go to them and their families.

CLIVE JERMY

TONY BRADSHAW FRS FLS
1926–2008



Although Tony Bradshaw, former Holbrook Gaskell Professor of Botany in the University of Liverpool, was a long-standing member of the B.S.B.I., he was little known to most members; his principal involvement was as B.S.B.I. taxonomic Referee for both *Crataegus* and *Agrostis*. In the wider environmental community, he was best known for his contributions to restoration ecology; but most of all he was an outstanding evolutionary scientist whose work on the development of metal-tolerance in grasses earned him an international reputation.

Born in Kew in 1926, he read botany at Cambridge before taking up a research position in Aberystwyth; he then moved to a lectureship in Bangor, which allowed him ready access to a natural laboratory in the form of metalliferous mine-waste on Parys Mountain, Anglesey. There, he pioneered the study of how native grasses adapted to tolerate heavy metal contamination, work which led to a wide range of applications in re-vegetating polluted soils. He was, indeed, a consultant on the restoration of china clay quarries in Cornwall, techniques which greatly benefitted the Eden Project.

On becoming Professor of Botany in Liverpool in 1968, he greatly expanded his team of researchers and established an Environmental Advisory Unit which undertook commercial consultancies. Several of his former students now occupy senior positions in academia and environmental agencies. He was also involved with the management of Ness Botanic Gardens,

owned by the University, and in 1982 was made a Fellow of the Royal Society. In 1986, after the abolition of Merseyside County Council, he became a trustee of the National Museums & Galleries on Merseyside, and his wise counsel was much appreciated by the then director, Richard Foster.

An indication of the breadth of Tony's botanical and evolutionary interests was that he became a Fellow of the Linnean Society of London in 1988; in 2002 he introduced and chaired their symposium on metallophytes. He also served as President of the British Ecological Society, and helped to establish the Institute of Ecology and Environmental Management in 1991; it now has over 3,500 members.

Tony had a most engaging personality; nothing was too much trouble for him, whether answering enquiries on Hawthorn identification or travelling to India and China to advise on major landscape restoration projects. Latterly, he threw much of his energy into the restoration of a semi-derelict cemetery close to Liverpool's Anglican Cathedral: he was one of the most active members of the Friends of St. James' Gardens, a community group. Chairing the trustee board of the National Wildflower Centre in Knowsley was another of his achievements. Tony will be remembered not only for his highly productive academic career, but also for sharing his enthusiasm for botany with people in all walks of life.

JOHN EDMONDSON

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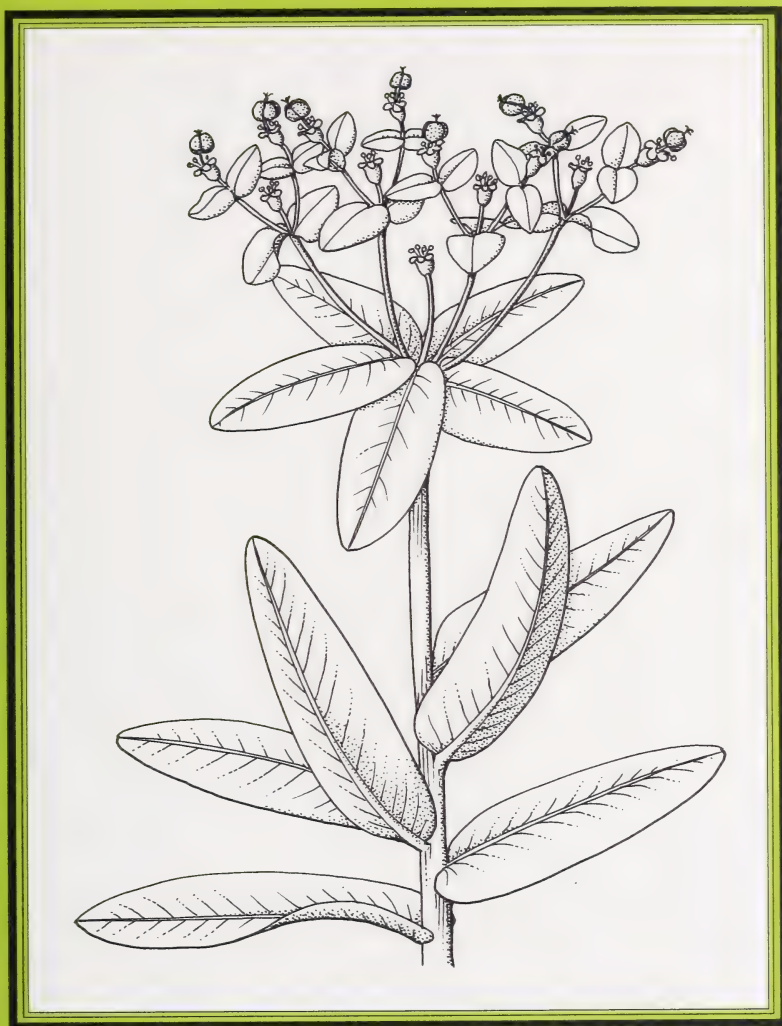
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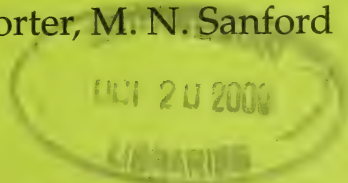
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The cover illustration of *Euphorbia hyberna* L. (Irish Spurge) was drawn by Rosemary Wise.

An account of the Whitebeams (*Sorbus* L., Rosaceae) of Cheddar Gorge, England, with description of three new species

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ABSTRACT

An account of the Whitebeams (*Sorbus* L., Rosaceae) of Cheddar Gorge, Somerset, England is given. *Sorbus aria* is abundant, and variable. *Sorbus anglica* and *S. eminens* are quite widespread, but *S. porrigentiformis* is rarer. Three new polyploid species endemic to the gorge are described supported by DNA analysis: *S. cheddarensis*, *S. eminentoides* and *S. rupicoloides*. The gorge is one of the most important sites for *Sorbus* in Britain. Browsing is affecting significant numbers of *Sorbus* trees, and grazing is affecting regeneration.

KEYWORDS: Endemic, goats, microsatellites, Somerset.

INTRODUCTION

Cheddar Gorge in the Mendips, Somerset, is Britain's largest gorge and one of its best known limestone features. The Carboniferous Limestone cliffs tower up to c. 120 m above the gorge bottom on the south side, with extensive screes, slopes and smaller cliffs on the north side. The gorge is part of the Cheddar Complex Site of Special Scientific Interest (SSSI) (which includes the former Cheddar Gorge SSSI), designated for a suite of rare plants, animals and communities and the geological interest. The north side is owned by the National Trust, the south side by the Longleat Estate.

Cheddar Gorge has been known for many years as a rich botanical site with nationally rare plants such as *Dianthus gratianopolitanus* Vill., *Galium fleurotii* Jord. and the Cheddar endemic *Hieracium stenolepiforme* (Pugsley) P. D. Sell & C. West, and other uncommon species such as *Geranium purpureum* Vill., *Cerastium pumilum* Curtis and *Sedum forsterianum* Sm. The gorge is also home to

rare *Sorbus* species, but there is relatively little data on them compared to other Cheddar rare plants. In their review of the rare plants in Cheddar, FitzGerald & McDonnell (1997) pointed out that the gorge was of great importance for *Sorbus* and recommended a full audit of the species present.

The common and widespread *Sorbus aria* (L.) Crantz has been known in Cheddar Gorge for many years and is abundant. *Sorbus anglica* Hedl. was first recorded in 1901 by A. Ley (Roe 1981), and has always been regarded as rare. *Sorbus porrigentiformis* E. F. Warb. was first confirmed in 1966 from material collected by A. W. Gravestock, and is also rare (Green *et al.* 1997). Surprisingly, *S. eminens* E. F. Warb., now known to be the second commonest species in the gorge, was only first reported by Proctor & Groenhof (1992), though it had been previously collected without a name by E. C. Wallace in 1935 and by F. Rose in 1948. *Sorbus aucuparia* L. and *S. torminalis* (L.) Crantz are known in the Cheddar area, but neither has been recorded from the gorge itself (Roe 1981; Green *et al.* 1997).

Cheddar Gorge and the surrounding area were grazed for many centuries by cattle, sheep and goats, when trees and scrub were largely confined to the cliffs. After the Second World War, stock grazing decreased and scrub species such as *Cornus sanguinea* L., *Crataegus monogyna* Jacq., *Rhamnus cathartica* L., *Taxus baccata* L., *Viburnum lantana* L. and *Sorbus aria* began to invade the grasslands, the scrub eventually developing locally into secondary woodland. The whitebeams, especially *S. aria*, benefited during this time and spread into the grasslands. Scrub clearance has been carried out to maintain open grasslands for the rare herbaceous species, but as rare whitebeams

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were known to be present, few *Sorbus* trees were cleared, and soon small groves of whitebeams were quite frequent in the gorge. To enable some *S. aria* trees to be cleared without affecting the rare *Sorbus* species, L. Houston was commissioned to survey the rare whitebeams by the National Trust in 2005 and by the Longleat Estate in 2006. Full details are given in Houston (2006, 2009) and the results are summarized here with descriptions of three new species found during the surveys.

METHODS

DNA MICROSATELLITES

Bud samples were collected for DNA analysis from ten *S. aria*, six *S. anglica*, six *S. eminens* and ten *S. cheddarensis* during the autumn of 2005 and from a single *S. eminentoides* and a single *S. rupicoloides* in 2006. They were placed in separate bags that were sealed and stored at 4°C for four days after which they were transferred to a freezer and stored at -20°C until needed. DNA was extracted using Qiagen® DNeasy® Plant Mini Kit 2004 protocol. Four nuclear microsatellite loci were amplified using two sets of primers developed for *Malus × domestica* (Gianfranceschi *et al.* 1998) and two pairs developed for *Sorbus torminalis* (Oddou-Muratorio *et al.* 2001). Each of these primer-pairs were redesigned, from sequences deposited in Genbank, to facilitate amplification of a wide range of *Sorbus* taxa (Table 1). Forward primers were labelled with fluorescent dyes. Reverse primers were tailed with a non-target-specific sequence to overcome allele-sizing problems associated with the primer sequence dependant

adenylation of PCR products by most *Taq* polymerases (Brownstein *et al.* 1996). PCR reaction mixtures (20 µl total volume) contained the following components/concentrations: one unit of Hotstart *Taq* DNA polymerase (Qiagen), 2 µl of 10× reaction buffer (Qiagen), 2 mM of each dNTP (Bioline), with 0.2 µM of each forward and reverse primer and 20–50 ng of genomic DNA. PCR reactions were performed in a MJ-Research PTC-200 Peltier Thermal Cycler. The following programme was used: 1 step at 95°C for 15 minutes followed by 35 cycles of 1 minute at 94°C, 1 minute at 55°C, 1 minute and 30 seconds at 72°C, and a 10 minute extension step of 72°C. PCR amplification products from the labelled primers were separated on a laser based capillary electrophoresis instrument, the ABI 3730xl. Alleles were sized relative to an internal size standard and resulting electropherograms were analysed using GeneMarker genotyping software. Each individual electropherogram was scored manually.

DATA ANALYSIS

The most appropriate measure to study genetic diversity for apomictic taxa is to compile and compare multilocus genetic phenotypes (Gornall 1999). Therefore, for each individual analysed in this study, microsatellite allele phenotypes were determined for each of the four amplified loci. These data were combined to construct the multilocus phenotypes of each sample. The numbers of individuals belonging to each multilocus phenotype were determined for each species. Ploidy level estimates were based on the maximum number of displayed alleles at a single locus. For example for *S. cheddarensis*, three alleles were displayed at

TABLE 1. NUCLEOTIDE SEQUENCES OF NUCLEAR AND CP DNA PRIMERS USED IN THIS STUDY

Locus	Dye	Primers	Repeat	Na
CH01F02 ^I	6-Fam	Forward CCACATTAGAGCAGTTGAGGATGA Reverse ATAGGGTAGCAGCAGATGGTTGT	(GA) ₂₂	9
CH02D11 ^I	Vic	Forward AAATAAGCGTCCAGAGCAACAG Reverse GGGACAAAATCTCACAAACAGA	(AG) ₂₁	10
MSS5 ^{II}	6-Fam	Forward CCCCAACAACATTTTCTCC Reverse CCTCTCGTCTTTGCCCTT	(GA) ₁₉	12
MSS16 ^{II}	Vic	Forward ATGTCACATCTCTCCCTTGTGT Reverse TTTTGCCCTCAAAGAATGCCTTA	(GA) ₂₈	5

^IMicrosatellite Primers derived from *Malus × domestica* DNA (Gianfranceschi *et al.* 1998)

^{II}Microsatellite Primers derived from *S. torminalis* (Oddou-Muratorio *et al.* 2001).

Na = the number of alleles amplified across all taxa.

locus F02 suggesting it is at least triploid. Each multilocus phenotype was transformed into binary code and metric distances were computed between them using Dice similarity coefficients (Dice 1945) with NTSYSPC version 2.11a software (Rohlf 2002). The relationships among the multilocus phenotypes were visualised using Principal Coordinate Analysis (PCO) with NTSYSPC software (Rohlf 2002).

MORPHOLOGY AND DESCRIPTIONS OF NEW SPECIES

Broad leaves from the short, vegetative shoots in sunlit situations, excluding the oldest and youngest leaf (Aas *et al.* 1994), were measured on herbarium material of the three new taxa in NMW. Fruits were measured on fresh material, and the colours matched against the Royal Horticultural Society colour charts (Royal Horticultural Society 1966).

POLLEN STAINABILITY

Pollen stainability, an estimate of potential pollen viability (Rich 2009), was investigated using Alexander's Stain (Alexander 1969) on the flowering collections available. Anthers were removed from herbarium specimens with tweezers under a low-power binocular microscope, and placed on a slide with a drop of Alexander's Stain, warmed briefly on the hotplate, then broken up with the tweezers. The preparation was then covered with a cover-slip

and replaced on the hotplate to improve the uptake of the stain. The slides were then examined under a high-power compound microscope for areas of dense pollen grains. Potentially viable grains were counted as those which were large and rounded-triangular with cell walls which stained green and with cytoplasm inside which stained uniformly bright red. Small deformed grains or those staining green only with very little or no red staining inside (i.e. no cytoplasm) were considered infertile. The numbers of pollen grains counted are cited for individual trees.

SOIL PH

Soil samples were collected from around the roots of a few trees in 2007, and air-dried. The pH was subsequently measured on a 50 soil:50 distilled water mixture with a calibrated pHep2 Hanna pocket-sized pH meter.

FIELD SURVEY

Field surveys were mainly carried out by L. Houston during the period 14 July to 10 August 2005, and 24 August to 27 October 2006, with extra visits with T. Rich during 2005, 2006 and 2007. Existing records were also used to direct surveys (e.g. M. C. F. Proctor unpublished 1989 data held at NMW; FitzGerald & McDonnell 1997; T. Rich unpublished data 2001–2004). Figure 1 shows the areas of the gorge searched;

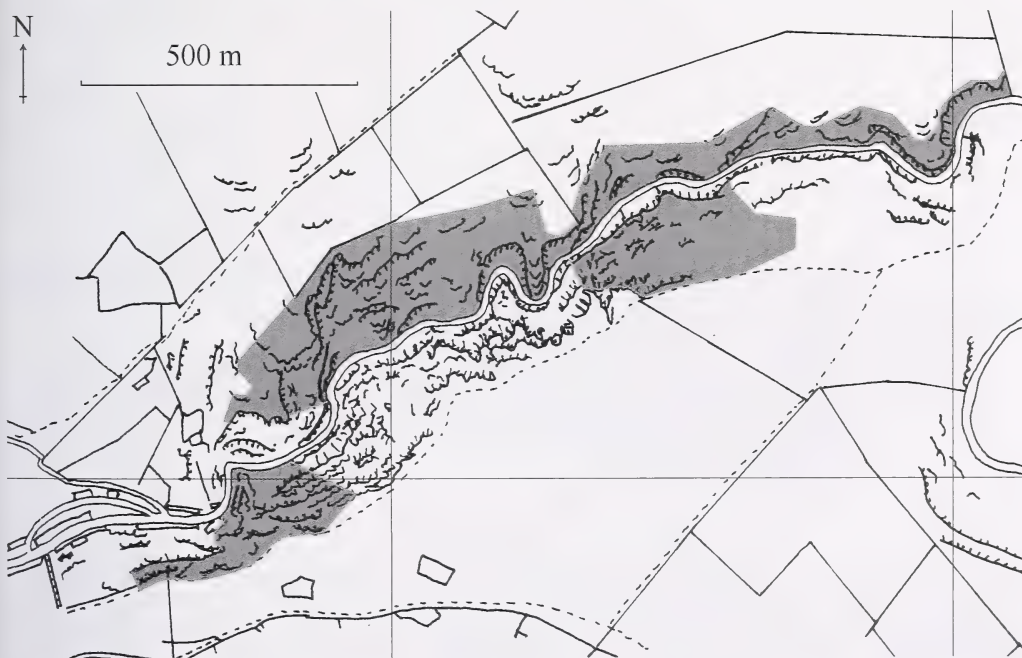


FIGURE 1. Areas of Cheddar Gorge surveyed for *Sorbus*.

the sheer size and scale of the gorge meant that it was not possible to survey it comprehensively, and thus the coverage shown in Figure 1 must be borne in mind when interpreting the distribution maps.

All locations and details of the rarer taxa were recorded, but for *S. aria* which is frequent throughout the site usually only brief details were noted. For the rarer trees, GPS grid references were recorded using a Garmin Etrex hand-held unit where possible. Tree height was estimated in metres, and the girth of accessible trees measured with a tape measure at 1.3 m. Notes were made on the growth form (maiden or coppice), and damage by goats, from conservation management work or from landscape work was noted. Numerous photographs were taken.

Most trees were named in the field. Trees on cliffs or with leaves high in the canopy were either sampled using a long-handled pruner or identified as far as possible with binoculars. No abseiling or climbing with or without ropes was undertaken. It was not possible to name with certainty many trees which were inaccessible on cliffs or trees which had lost leaves. Voucher specimens for some rarer trees or those requiring a second opinion were collected

and named in consultation with T. Rich; the vouchers have been deposited in NMW.

RESULTS

NUCLEAR MICROSATELLITE ANALYSIS

In total, 36 alleles from four microsatellite loci were amplified from 34 adult *Sorbus* individuals. The number of alleles amplified at each locus across all taxa ranged from five at locus MSS16 to 12 at locus MSS5 (Table 1). The total number of different alleles displayed by each taxon ranged from nine for *S. cheddarensis* to 15 for *S. rupicoloides* (Tables 2 and 3). When data from all loci were combined, the total number of detectable multilocus phenotypes scored across all taxa was 15. *Sorbus anglica* and *S. eminens* each consisted of just a single multilocus phenotype, as would be expected of a clonally reproducing species (Table 3). Similarly each of the *S. cheddarensis* individuals shared the same multilocus phenotype, supporting the hypothesis that *S. cheddarensis* is a novel *Sorbus* species that, like *S. anglica* and *S. eminens*, reproduces apomictically (Table 3). In contrast, each *S. aria* individual had a unique

TABLE 2. GENETIC DIVERSITY MEASURES FOR THE CHEDDAR GORGE *SORBUS* TAXA

Taxon	Ni	Xo	Xe	A'	Ng
<i>S. aria</i>	10	2	2	14	10
<i>S. anglica</i>	6	3	4	12	1
<i>S. cheddarensis</i>	10	3		9	1
<i>S. eminens</i>	6	4	4	12	1
<i>S. eminentoides</i>	1	4		13	
<i>S. rupicoloides</i>	1	4		15	

Ni = number of individuals sampled; Xo = observed ploidy, based on the maximum number of displayed alleles at a single locus; Xe = expected ploidy, based on published cytological work; A' = total number of different alleles seen across all loci; Ng = number of multilocus phenotypes detected.

TABLE 3. MULTILOCUS PHENOTYPES FOR THE CHEDDAR POLYPLOID *SORBUS* TAXA AND THE TOTAL ALLELE POPULATION FOUND AT EACH LOCUS FOR *S. ARIA*

Taxon	Alleles at locus:			
	F02	MSS5	D11	MSS16
<i>S. aria</i>	196,198,200,206	126,132,134,144,146	163,177,193	166,172
<i>S. anglica</i>	192,202,206	126,136,142	157,159,205	162,166,170
<i>S. cheddarensis</i>	196,206,208	132,140	159,193	166,178
<i>S. eminens</i>	196,202,206	120,126,140,142	159,163,169	166,178
<i>S. eminentoides</i>	196,202,208	120,132,136,140	159,161,205	166,168,178
<i>S. rupicoloides</i>	200,204,208,214	126,132,138,180	159,169,175,189	166,168,170

multilocus genotype, as would be expected of an obligate out-crossing diploid species. All individuals genotyped for *S. aria* displayed either one or two alleles at each locus, confirming them to be diploid. In contrast, each individual genotyped among *S. anglica*, *S. cheddarensis*, *S. eminens*, *S. eminentoides* and *S. rupicoloides* displayed more than two alleles (usually three or four) at a minimum of one locus, confirming that they were all polyploid (Table 3). The triploid ploidy level of *S. anglica* and the tetraploid ploidy level of *S. eminens* indicated by these alleles are supported by existing chromosome counts from Cheddar (Bailey *et al.* 2008). The alleles suggest that *S. cheddarensis* is at least triploid, and *S. eminentoides* and *S. rupicoloides* tetraploid, which require cytological confirmation.

Genetic similarity among the 15 multilocus phenotypes was calculated and the subsequent similarity matrix was used as the input for

Principal Coordinate Analysis (PCO). In addition to the 15 multilocus phenotypes found during the current study the multilocus phenotypes of *S. porrigentiformis* and *S. rupicola*, found during a previous study of *Sorbus* taxa (Robertson *et al.* 2009), were included in the PCO analysis. These two taxa were included as they are possible putative parents of *S. cheddarensis*, *S. eminentoides* and *S. rupicoloides*, and samples of these two taxa were not readily available from the sampled area of the current study. The PCO analysis revealed that the 17 multilocus phenotypes were divided clearly into two groups, group 1 consisting of *S. aria* and group 2 consisting of *S. cheddarensis*, *S. eminentoides* and *S. rupicoloides* and the other four polyploid apomicts (Fig. 2). The widespread nature of the *S. aria* group shows clearly the genetic diversity found among the individuals while the close grouping of the seven polyploid taxa

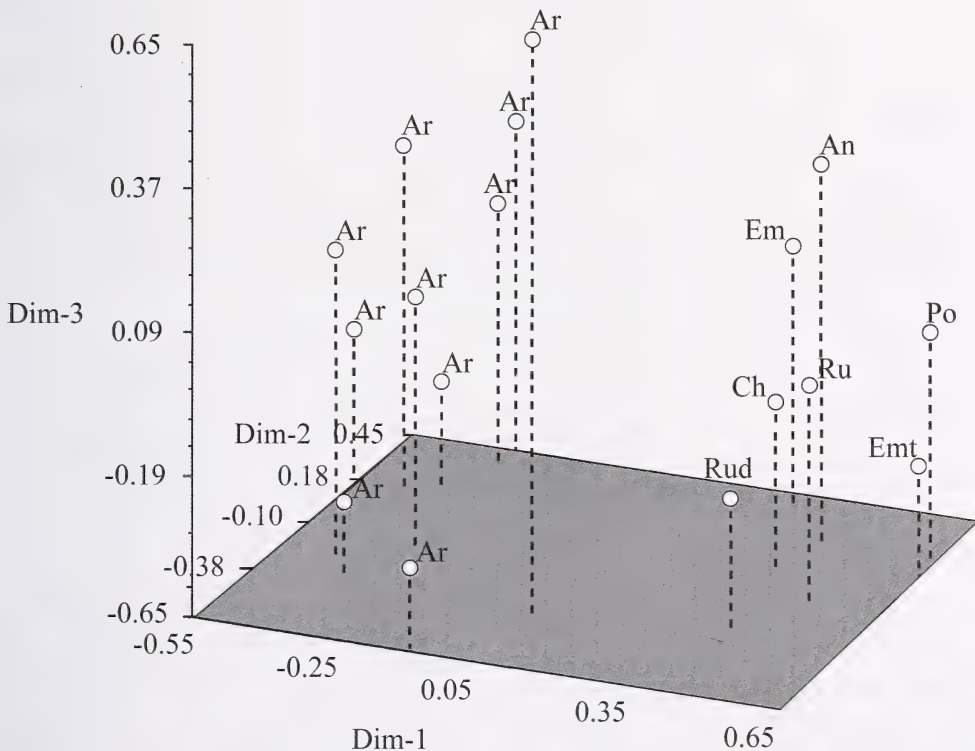


FIGURE 2. Principal Coordinate Analysis of the similarity relationships among the 15 Cheddar Gorge and two Avon Gorge *Sorbus* multilocus phenotypes, showing the first three dimensions. Two major groupings are easily identified; the grouping to the left of the figure consists solely of *S. aria*, and the grouping to the right consists solely of *Sorbus* polyploids. These three dimensions account for 57.44% of the total variation found among the phenotypes. Ar = *S. aria*, An = *S. anglica*, Ch = *S. cheddarensis*, Em = *S. eminens*, Emt = *S. eminentoides*, Po = *S. porrigentiformis*, Ru = *S. rupicola* and Rud = *S. rupicoloides*.

demonstrates how closely related they are and how likely it is that they share similar origins. Further sampling is required to determine the exact parentage of the new taxa.

DESCRIPTIONS OF NEW SPECIES

Sorbus cheddarensis L. Houston & Ashley Robertson, **sp. nov.**

HOLOTYPE: Cheddar Gorge, v.c. 6, North Somerset, England, ST472544, 19 September 2007, T. C. G. Rich & L. Houston, Cheddar survey number 601 (NMW, accession number V.2007.1.130).

Vernacular name: Cheddar Whitebeam

Frutex vel arbor parva ad 7 m ut minimum. Gemmae ovoideae, virides, ad apicem pilis albidis pilosae. Folia lata brachyblastorum (8.5–)9.0–12.0(–12.5) × 6.0–8.0 cm, (1.35–)1.4–1.7(–1.8)plo longiora quam latiora, elliptica, ad longitudinis suae 48–58(–60) partes centensimas latissima, apice acuto vel obtuso, basi cuneata, in centro laminae (0–)2–11(–13) partibus centensimis ad costam plerumque leniter lobata, marginibus uniserratis dentes parvos acutos prorsum projectos ferentibus vel leniter biserratis, sed 1–2 centimetris infimis prope petiolum fere integris; pagina superior viridis glabra; pagina inferior viridula tomentosa, venis (19–)20–24 ad angulum (24–)27–37° a costa tentis. Petioli 13–24 mm. Inflorescentia ad 8 cm lata, ramulis viridialbis tomentosis instructa. Flores 15–17 mm lati, fragrantis. Sepala anguste triangularia, viridula sed ad basin tomentosa, in marginibus glandibus nullis vel paucis. Petala 7–10 × 5–7 mm, anguste elliptica, cupulata, alba. Antherae cremeae, nonnunquam dilutissime roseotinctae. Styli 2, in triente infimo colligati, virides, basi pilosa. Fructus maximi (10–)10.5–13.5(–14) × (10–)11–13 mm, 0.9–1.1(–1.2)plo longiores quam latiores, plerumque aspectu globosi, in medio latissimi, in maturitate rubri, lenticellis paucis parvis vel mediocribus praediti.

Shrub or small tree to at least 7 m. Buds ovoid, green, pilose at tip with whitish hairs. Broad leaves of short shoots (8.5–)9.0–12.0(–12.5) × 6.0–8.0 cm, (1.35–)1.4–1.7(–1.8) times as long as wide, elliptic, widest at 48–58(–60)% along leaf length, with apex acute to obtuse and base cuneate, usually shallowly lobed (0–)2–11(–

13)% of way to midrib at centre of leaf; margins uniserrate with small acute, forwardly-directed teeth to weakly biserrate, but with the lowest c. 1–2 cm near the petiole nearly entire; upper surface green, glabrous; lower surface greenish tomentose, with (19–)20–24 veins held at an angle of (24–)27–37° to the midrib. Petioles 13–24 mm. Inflorescence to 8 cm across, with branchlets greenish-white tomentose. Flowers 15–17 mm across, fragrant. Sepals narrowly triangular, greenish but tomentose at base, without or with a few glands on margins. Petals 7–10 × 5–7 mm, narrowly elliptic, cupped, white. Anthers cream, sometimes with vaguest hint of pink. Styles 2, joined for the lowest third, green, hairy at base. Largest fruits (10–)10.5–13.5(–14) × (10–)11–13 mm, 0.9–1.1(–1.2) times as long as wide and usually looking globose, widest at the middle, red at maturity (RHS colour 42A, 44A, 45B), with a few small to medium-sized lenticels.

Sorbus cheddarensis is a difficult species to characterize in words, but is distinct in the field once known. It has elliptic leaves which are widest just above the middle (but not enough to be regarded as obovate), which curve to the base and apex symmetrically in the shape of an eye, with the shallow lobes on the margins cutting in to join the lamina at right angles, small, neat, acute, forward-directed teeth, and greenish-tomentose underneath with the prominent, parallel, whitish veins standing out noticeably (Fig. 3). It is a member of *Sorbus* subgenus *Aria* Pers.

Sorbus cheddarensis differs from *S. aria* in the greener underside to the leaves, the regular, neat toothing, and globose fruits (white undersides to the leaves with variable teeth and lobing, and fruits usually longer than wide in the very variable *S. aria*). *Sorbus porrigentiformis* differs in having obovate leaves and fruits wider than long. *Sorbus cheddarensis* is readily separated from all other Cheddar taxa; *S. anglica* and *S. intermedia* have deeply lobed leaves, *S. eminentoides* has broadly elliptic leaves with large, coarse toothing, and *S. rupicoloides* has much narrower leaves.

Two plants collected in 2001 by T. Rich and reported as *S. aria* and *S. porrigentiformis*, now redetermined as *S. cheddarensis*, had the widespread *Aria* group 'A' chloroplast type (Chester *et al.* 2006). The pollen stainability of the type tree was 71% (82 grains counted;

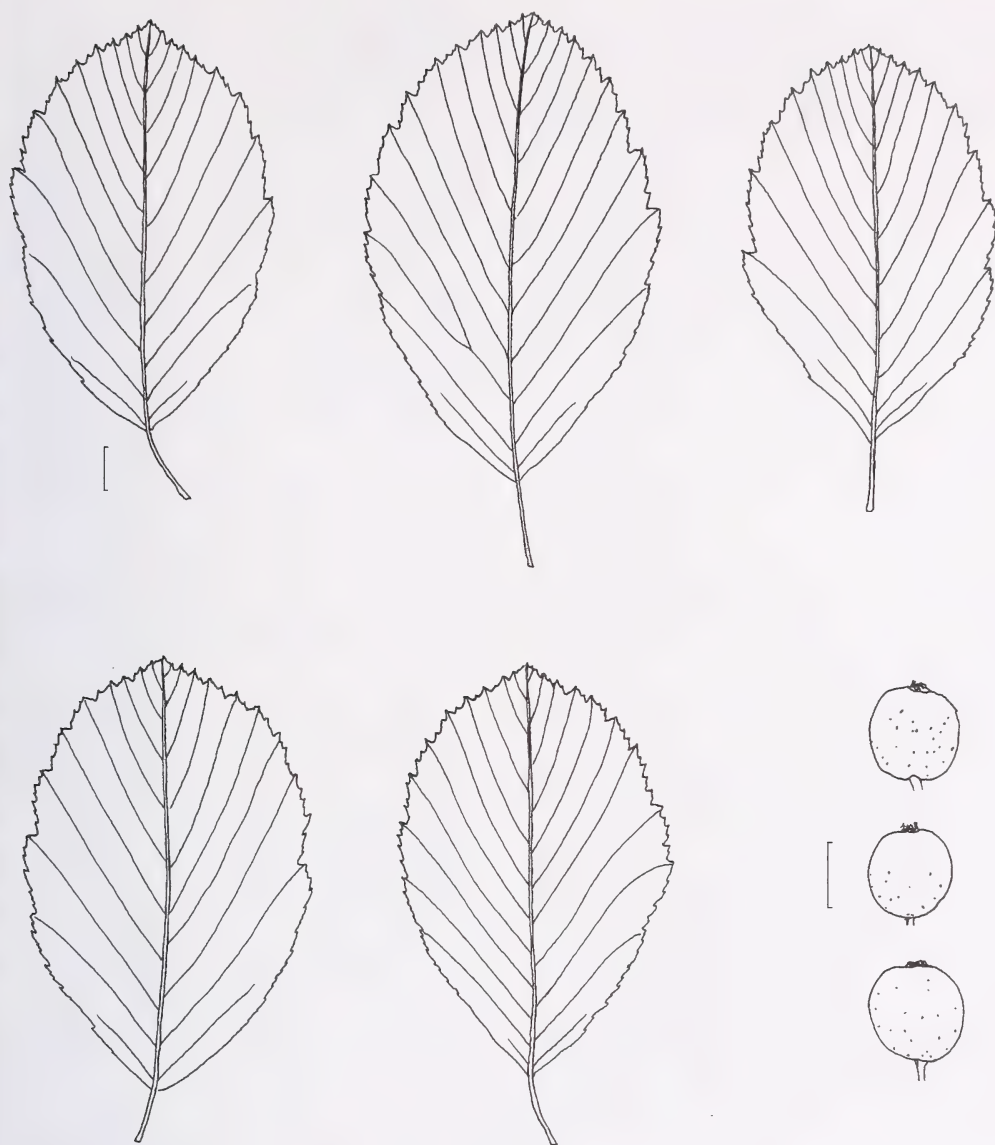


FIGURE 3. Leaves and fruits of *Sorbus cheddarensis*. Scale bars 1 cm.

A. Patto, pers. comm. 2007). Fruit set in 2006 varied between trees. Acute leaf lobes in *S. aria* may be a sign of introgression from *S. torminalis* in the Wye Valley (Price & Rich 2007), but there is no evidence of *S. torminalis* in this species.

Sorbus cheddarensis occurs on Carboniferous Limestone slopes and rocks in Cheddar

Gorge, Somerset (v.c. 6), England. Soil from under the type tree was pH 7.2. It was first recognised as a distinct taxon by L. Houston in 2005 whilst surveying the whitebeams, and was given the nickname 'Pinstripe' on account of the prominent parallel veins as seen against the greenish lower surface of the leaf. It mainly grows associated with *S. aria*.

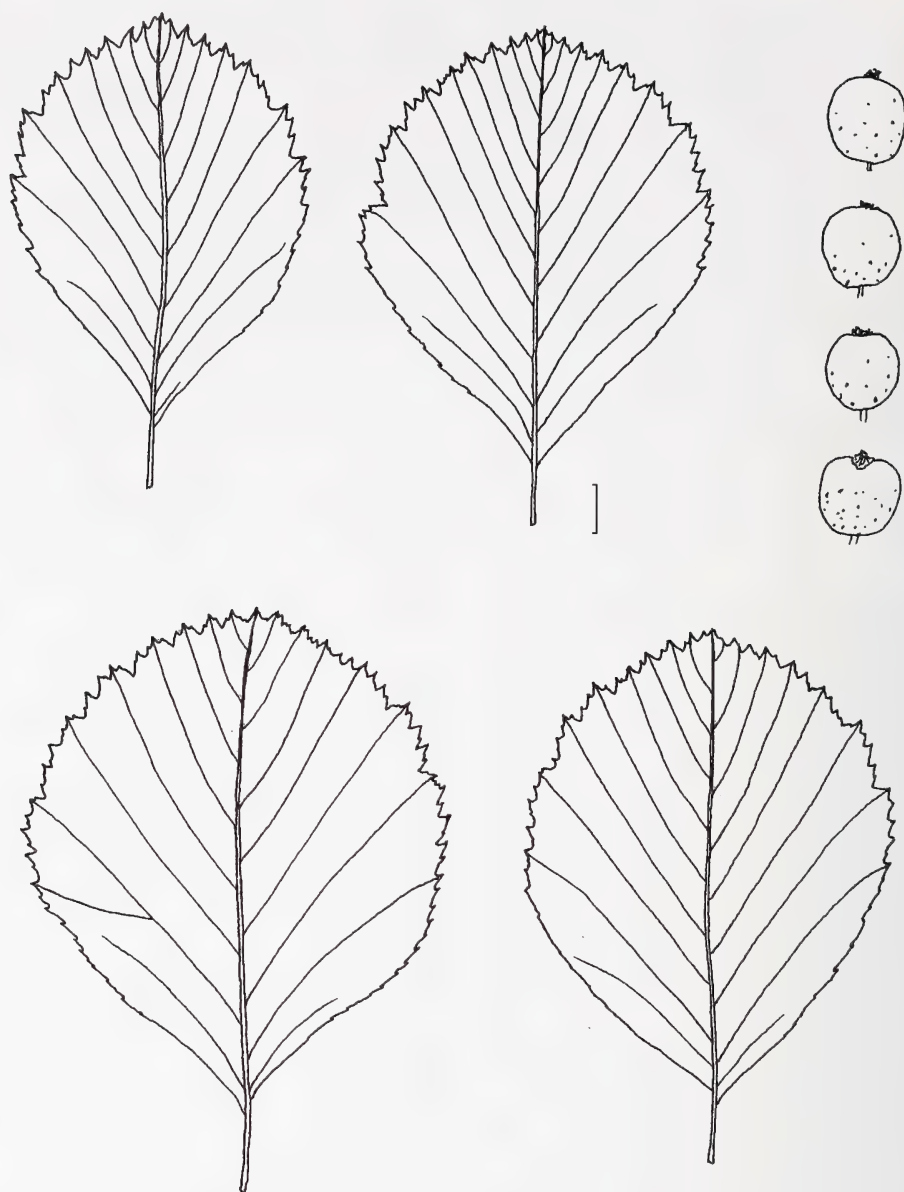


FIGURE 4. Leaves and fruits of *Sorbus eminentoides*. Scale bars 1 cm.

Sorbus eminentoides L. Houston, **sp. nov.**

HOLOTYPE: Cheddar Gorge, v.c. 6, North Somerset, England, ST466539, 19 September 2007, T. C. G. Rich & L. Houston, Cheddar survey number 261 (NMW, accession number V.2007.1.127).

ISOTYPUS: BM, CGE, E, OXF.

Vernacular name: Twin Cliffs Whitebeam

Frutex vel arbor parva ad 9(–15) m ut minimum; cortex cinereobrunneus. Gemmae ovoideoconicae, virides, ad apicem pilis albidis pilosae. Folia lata brachyblastorum (7.0–)8.0–11.0(–11.5) × 5.5–8.5(–9.0) cm, (1.1–)1.2–1.4 (–1.5) plo longiora quam latiora, late elliptica,

raro late ovata, ad longitudinis suae (35–)41–58(–68) partes centensimas latissima, apice acuto vel raro acuminato, basi cuneata vel raro margine extrorsus arcuato, 11 partibus centensimis ad costam leniter lobata vel dentibus longis (c. 2–3 mm) latis acuminatis exstantibus valde biserrata, sed 2–3 centimetris infimis prope petiolum fere integris; pagina superior viridis glabra; pagina inferior cinereoviridis tomentosa, venis 16–24 ad angulum 30–40(–41)° a costa tentis. Petioli 10–19 mm. Inflorescentia ad 8 cm lata, aggregata, leniter tholiformis, ramulis viridialbis tomentosis instructa. Flores 16–20 mm lati, fragrantis. Sepala anguste triangularia, viridula sed ad basin tomentosa, in marginibus sine glandibus. Petala 8–10 × 6.5–8 mm, late elliptica, cupulata, alba. Antherae cremeae, lenissime roseotinctae. Styli 2(–3), usque ad basin discreti, virides, basi pilosa. Fructus maximi (11.5–)12–14.5(–15) × 12–15(–15.5) mm, 0.9–1.1plo longiores quam latiores, plerumque aspectu globosi vel longiores quam latiores, in maturitate rubri, lenticellis paucis parvis vel mediocribus praediti.

Shrub or small tree to at least 9(–15) m; bark greyish–brown. Buds ovoid–conical, green, pilose at tip with whitish hairs. Broad leaves of short shoots (7.0–)8.0–11.0(–11.5) × 5.5–8.5(–9.0) cm, (1.1–)1.2–1.4(–1.5) times as long as wide, broadly elliptic, rarely broadly ovate, widest at (35–)41–58(–68)% along leaf length, with apex obtuse or rarely acuminate and base cuneate or rarely with its margin arching outwards, weakly lobed to 11% of way to midrib or strongly biserrate with long (c. 2–3 mm) broad acuminate teeth directed outwards, but with the lowest c. 2–3 cm near the petiole nearly entire; upper surface green, glabrous; lower surface greyish–green tomentose, with 16–24 veins held at an angle of 30–40(–41)° to the midrib. Petioles 10–19 mm. Inflorescence to 8 cm across, crowded, weakly domed, with branchlets greenish–white tomentose. Flowers 16–20 mm across, fragrant. Sepals narrowly triangular, greenish but tomentose at base, without glands on margins. Petals 8–10 × 6.5–8 mm, broadly elliptic, cupped, white. Anthers cream with a hint of pink. Styles 2(–3), split to base, green, hairy at base. Largest fruits (11.5–)12–14.5(–15) × 12–15(–15.5) mm, 0.9–1.1 times as long as wide and usually looking globose or longer than wide, red at maturity (RHS colour 44A, 45A, 46B), with a few small to medium-sized lenticels.

Sorbus eminentoides is characterised by the large, broadly elliptic to roundish leaves with large teeth or weak lobes (the point at which strongly biserrate becomes weak lobing is debatable) and the large fruits which are about as long as wide (Fig. 4). It is a member of *Sorbus* subgenus *Aria*.

The broadly elliptic leaves separate it from most other British taxa with the exception of *S. eminens* and *S. aria*. It most closely resembles *S. eminens* in leaf shape (hence the specific epithet) but has large, coarse tooothing whereas in *S. eminens* the teeth are fine and regular. *Sorbus aria* differs in having narrower, often ovate leaves with whitish undersides and fruits usually longer than wide. *Sorbus eminentoides* is readily separated from all other Cheddar taxa; *S. anglica* and *S. intermedia* have deeply lobed leaves, *S. cheddarensis* has elliptic leaves with fine tooothing, *S. porrigentiformis* has obovate leaves and fruits wider than long, and *S. rupicoloides* has much narrower leaves.

Sorbus eminentoides occurs on Carboniferous Limestone cliffs at the south-west end of Cheddar Gorge, Somerset (v.c. 6), England. It was first found and collected in 2006 by L. Houston whilst surveying the Whitebeams. It grows associated with *S. anglica*, *S. aria*, *S. eminens*, *S. porrigentiformis* sensu lato and *S. rupicoloides*. The soil under the type tree had pH 7.6. The pollen fertility of the type tree assessed using Alexander's Stain was 94% (54 grains counted) and of another tree, no. 138, 88% (77 grains counted).

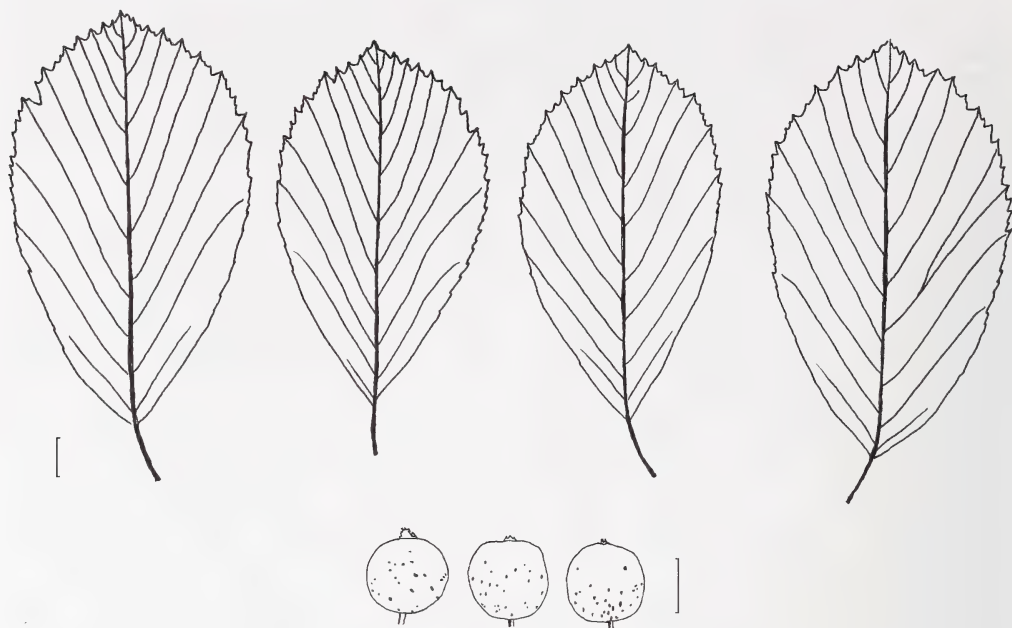
Sorbus rupicoloides L. Houston & T. C. G. Rich, **sp. nov.**

HOLOTYPE: Cheddar Gorge, v.c. 6, North Somerset, England, ST467539, 19 September 2007, T. C. G. Rich & L. Houston, Cheddar survey number 254 (NMW, accession number V.2007.1.131).

ISOTYPE: BM.

Vernacular name: Gough's Rock Whitebeam

Frutex vel arbor parva ad 7 m ut minimum, ramis saepe deorsum arcuatis; cortex cinereobrunneus. Gemmae ovoideoconicae, virides, ad apicem pilis albidis pilosae. Folia lata brachyblastorum (6.5–)7.0–12.0(–12.5) × (4.0–)4.5–7.5(–8.5) cm, (1.5–)1.6–1.8plo longiora quam latiora, obovata, ad longitudinis suae 55–65 partes centensimas latissima, apice acuto vel acuminato, basi cuneata, plerumque non lobata, marginibus apicem versus leniter biserratis

FIGURE 5. Leaves and fruits of *Sorbus rupicoloides*. Scale bars 1 cm.

dentes exstantes ferentibus, sed triente infimofere integro; pagina superior atroviridis glabra, grosse rugosa, convexa; pagina inferior cinereoviridis tomentosa, venis 16–21 ad angulum 25–35° a costa tentis. Petioli 10–21 mm, crassi. Inflorescentia aggregata, leniter tholiformis, ramulis albis tomentosis, ubi fructiferis glabrescentibus, instructa. Flores 15–18 mm lati, fragrant. Sepala anguste triangularia, tomentosa, in marginibus sine glandibus. Petala 8–10 × 6–8 mm, late elliptica vel magis minusve orbicularia, cupulata, alba. Antherae dilutissime roseae. Styli 2, in triente infimo colligati, virides, basi pilosa. Fructus maximi 11–14(–15) × (12–)13–17(–18) mm, 0.73–0.97plo longiores quam latiores, plerumque aspectu latiores quam longiores, in medio latissimi, in maturitate rubri sed inaequaliter maturescentes, lenticellis paucis vel aliquot parvis vel magnis praediti, lenticellis magnis praecipue fructus basin versus locatis.

Shrub or small tree to at least 7 m, with branches often arching downwards; bark greyish-brown. Buds ovoid-conical, green, pilose at tip with whitish hairs. Broad leaves of short shoots (6.5–)7.0–12.0(–12.5) × (4.0–)4.5–7.5(–8.5) cm, (1.5–)1.6–1.8 times as long as wide, obovate, widest at 55–65% along leaf

length, with apex acute to acuminate and base cuneate, usually unlobed, with the margins towards the apex weakly biserrate with teeth directed outwards, but with the lowest third nearly entire; upper surface dark green, glabrous, coarsely rugose, convex; lower surface greyish-green tomentose, with 16–21 veins held at an angle of 25–35° to the midrib. Petioles 10–21 mm, stout. Inflorescence crowded, weakly domed, with branchlets white tomentose, glabrescent in fruit. Flowers 15–18 mm across, fragrant. Sepals narrowly triangular, tomentose, without glands on margins. Petals 8–10 × 6–8 mm, broadly elliptic to more or less orbicular, cupped, white. Anthers very pale pink. Styles 2, joined for lowest third, green, hairy at base. Largest fruits 11–14(–15) × (12–)13–17(–18) mm, 0.73–0.97 times as long as wide and usually looking wider than long, widest at the middle, red at maturity (RHS colour 44A, 45A, 46A) but ripening unevenly, with a few to a moderate number of small to large lenticels, the large lenticels mainly towards the base of the fruit.

Sorbus rupicoloides is characterized by the narrow, obovate, acute leaves which are greenish-white underneath and the large, broad fruits (Fig. 5), which distinguish it from most other British taxa with the exception of the

narrow-leaved *S. rupicola* (Syme) Hedlund, *S. vexans* E. F. Warb. and *S. margaretae* M. C. F. Proctor (Taxon D sensu Proctor *et al.* 1989). It is a member of *Sorbus* subgenus *Aria*.

At first glance, *S. rupicoloides* looks like *S. rupicola* (hence our epithet) but differs in having acute leaves with biserrate toothing (obtuse, oblong-obovate and with more or less uniserrate teeth which curve towards the leaf apex in *S. rupicola*), and has generally larger fruits (average 12.8×15 mm in *S. rupicoloides*, and 12.1×13.6 mm in *S. rupicola*) though there is much variation in *S. rupicola*. *Sorbus rupicoloides* differs from *S. vexans* in having larger fruits and obovate, acute leaves (obovate-oblong, obtuse leaves in *S. vexans*), and from *S. margaretae* in having fruits usually more or less globose (markedly wider than long in *S. margaretae*).

Sorbus rupicoloides occurs on and below a Carboniferous Limestone cliff on the south side at the west end of Cheddar Gorge, Somerset (v.c. 6), England. It was first found and collected in 2006 whilst L. Houston was carrying out a survey of the whitebeams. It grows associated with *S. anglica*, *S. aria*, *S. eminens* and *S. eminentoides*.

FIELD SURVEY

A total of 3622 *Sorbus* trees belonging to at least eight taxa were recorded in the areas surveyed. 71 trees were dead, or probably dead, but still recognizable to genus. 256 living plants could not be identified to species, mainly either because they were inaccessible, had lost their leaves or been so eaten by goats that they were not recognizable.

SORBUS ANGLICA

112 *S. anglica* trees were recorded (Table 4), with another six possible trees, scattered throughout the site but especially concentrated at the west end (Fig. 6). Given that *S. anglica* had been regarded as rare, the number of trees found was very pleasing. It is the most widespread of the polyploids in the gorge.

Two puzzling trees with leaves somewhat intermediate between *S. aria* and *S. anglica* were noted, which might be hybrids; hybrids of this parentage have not been recorded before, and these trees merit further investigation.

SORBUS ARIA

Sorbus aria trees were noted throughout the site (data not presented), with 2803 positively

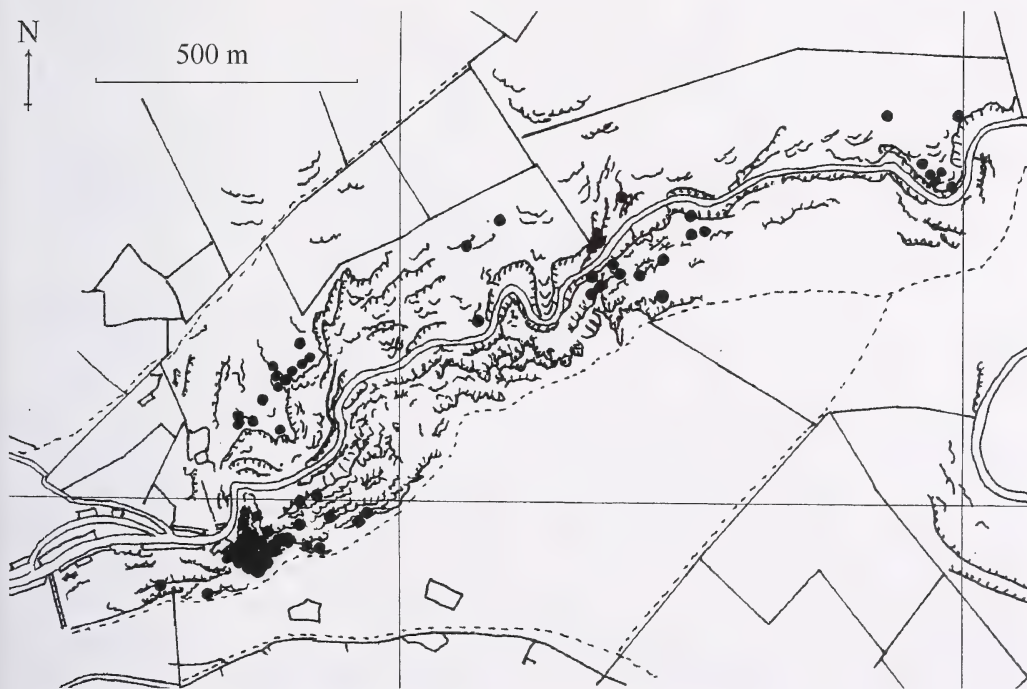


FIGURE 6. Distribution of *Sorbus anglica* at Cheddar Gorge in areas surveyed.

TABLE 4. NUMBERS OF *SORBUS* INDIVIDUALS RECORDED WITH DAMAGE TO TREES BY BROWSING

Species	Total no. trees	No. trees recorded for goat damage	Trees damaged	% damaged
<i>S. anglica</i>	112	99	31	31%
<i>S. aria</i>	2803	1785	175	10%
<i>S. cheddarensis</i>	19	13	6	46%
<i>S. eminens</i>	200	152	62	41%
<i>S. eminentoides</i>	15	14	2	14%
<i>S. intermedia</i>	1	1	0	0%
<i>S. porrigentifformis</i>	32	29	7	24%
<i>S. rupicoloides</i>	12	12	3	25%
<i>Sorbus</i> of uncertain identity	355	315	188	60%
			Overall average	20%

identified trees recorded (Table 4) and another 15 probably best attributed to *S. aria*. The total Cheddar Gorge population including unsurveyed areas is likely to be closer to 10,000.

Sorbus aria is very variable in Cheddar, possibly second only to the Avon Gorge in diversity of forms, and there are many trees with leaves varying towards those of other taxa.

Two *S. aria* trees were noted with acute lobes to the leaves which might be introgressed hybrids with *S. torminalis* (L.) Crantz (cf. Price & Rich 2007). The only sample of *S. aria* with a *torminalis* chloroplast type recorded by Chester *et al.* (2007) was from Cheddar, possibly a result in chloroplast capture as reported for France by Oddou-Muratorio *et al.* (2001).

SORBUS CHEDDARENSIS

19 trees of this new taxon were noted with 15 trees which may also be this species (Table 4). These occur mainly around the centre of the site above the horseshoe bend on the northern side (Fig. 7).

SORBUS EMINENS

200 *S. eminens* trees were recorded with another possible 42 whose identification requires confirmation (Table 4). These were concentrated at the western end of the gorge on the larger cliffs (Fig. 8).

Seven trees with leaves intermediate between *S. aria* and *S. eminens* were found which could be the hybrid *S. × robertsonii* T. C. G. Rich; these require confirmation from DNA.

SORBUS EMINENTOIDES

15 trees of *S. eminentoides* were noted (Table 4), with another four possible trees, all in the area of cliffs above Gough's Cave at the west end of the gorge (Fig. 9).

SORBUS INTERMEDIA

One 5 m tree was noted towards the east end of the gorge on the south side (Table 4). *Sorbus intermedia* has presumably spread from the mature trees planted in Cheddar village, but it is perhaps surprising that this species, which naturalizes readily on limestone soils elsewhere, is not more widespread in the gorge.

SORBUS PORRIGENTIFORMIS

This species was surprisingly rare and often difficult to separate from the variation in the other taxa. Only 18 trees were regarded as *S. porrigentifformis sensu stricto* (Table 4), with another 14 as *S. porrigentifformis sensu lato* and another eight possible trees. These occurred scattered along the gorge (Fig. 10).

One plant seen may have been referable to *S. aria × S. porrigentifformis* = *S. × avonensis* T. C. G. Rich but requires confirmation by DNA analysis.

SORBUS RUPICOLOIDES

Twelve trees of this new taxon were recorded (Table 4), all within a small area of the cliffs around Gough's Cave (Fig. 11).

EFFECTS OF GOATS

Damage by goats is used in a general way here to include browsing of leaves, shoots and twigs, and barking of small trees. Some damage may have been caused by Soay sheep, deer or other mammals which occur at Cheddar, but the bulk of the damage was clearly attributable to, and is in areas frequented by, goats.

The damage caused by goats was recorded for all the *Sorbus* species (Table 4). The large number of trees damaged by goats to one

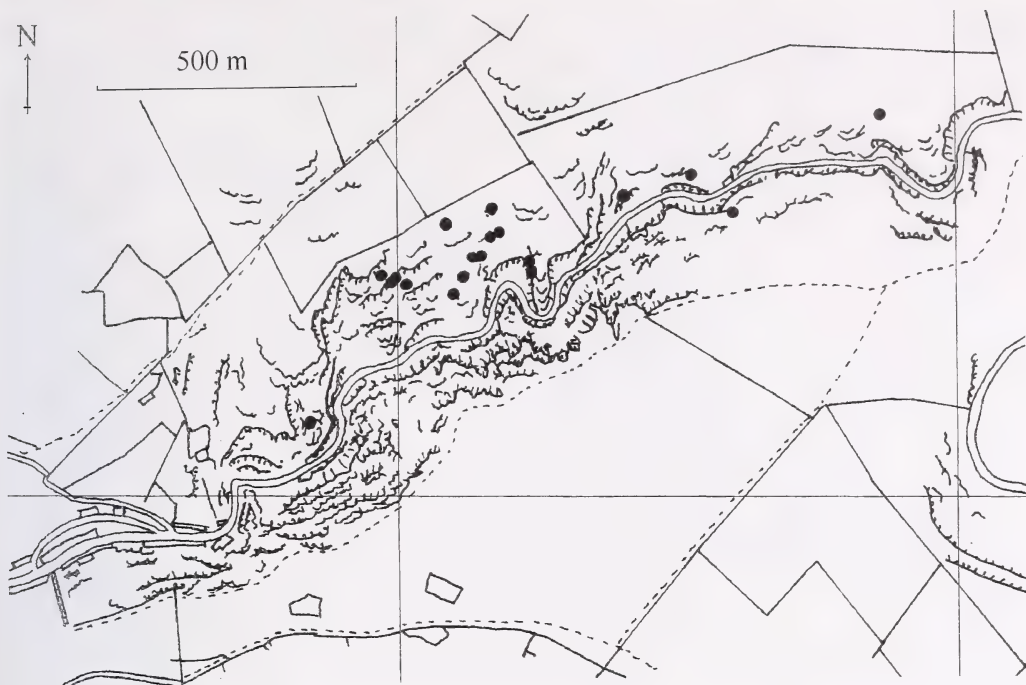


FIGURE 7. Distribution of *Sorbus cheddarensis* at Cheddar Gorge in areas surveyed.

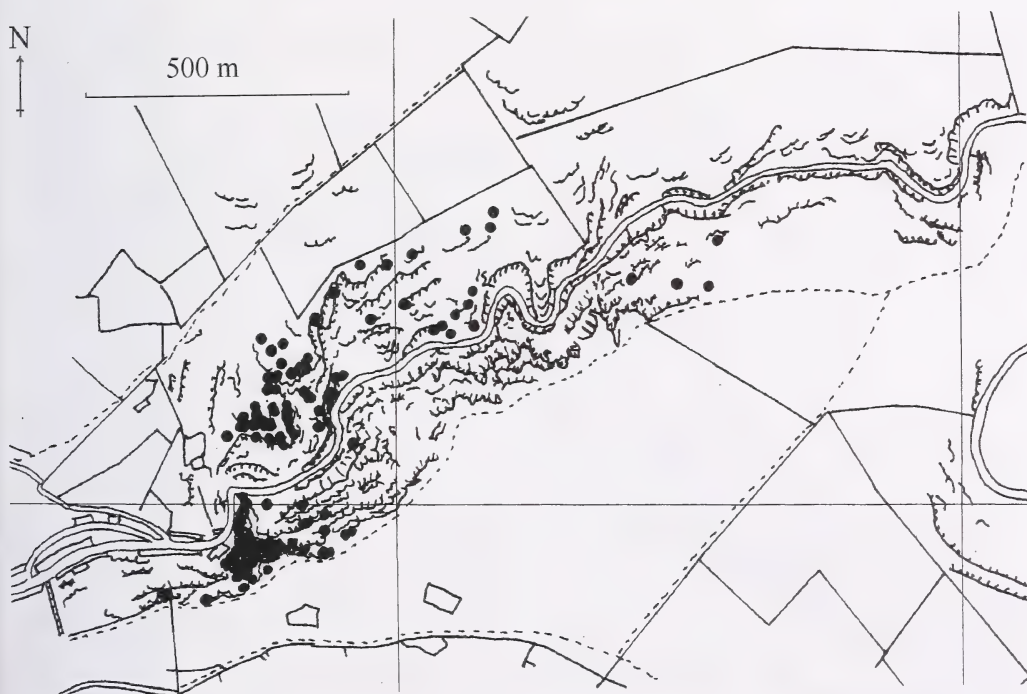


FIGURE 8. Distribution of *Sorbus eminens* at Cheddar Gorge in areas surveyed.

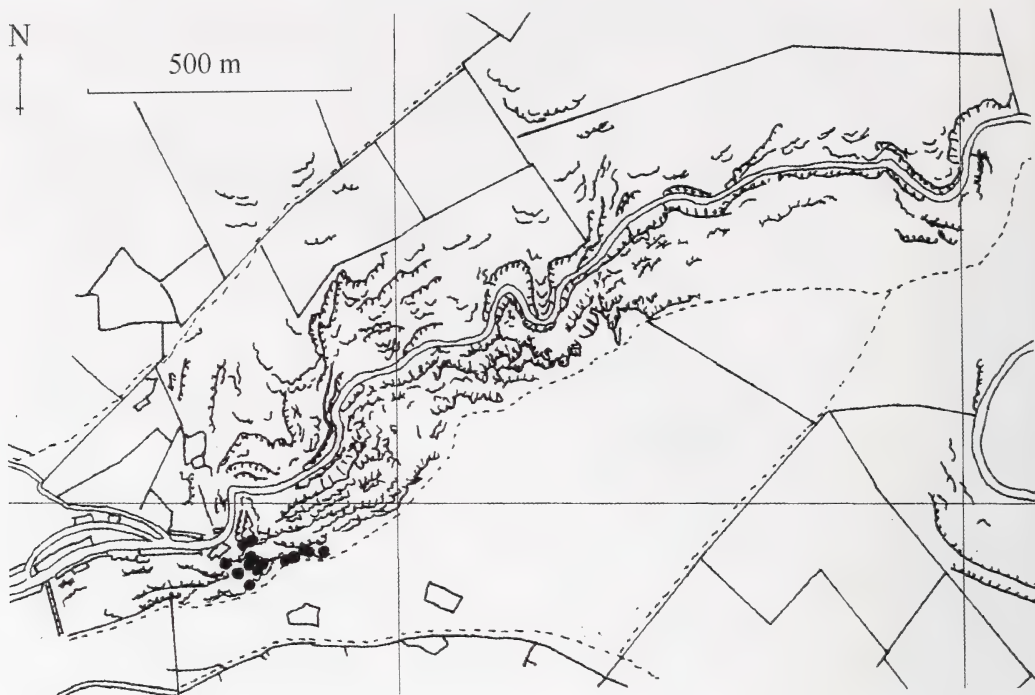


FIGURE 9. Distribution of *Sorbus eminentoides* at Cheddar Gorge in areas surveyed.

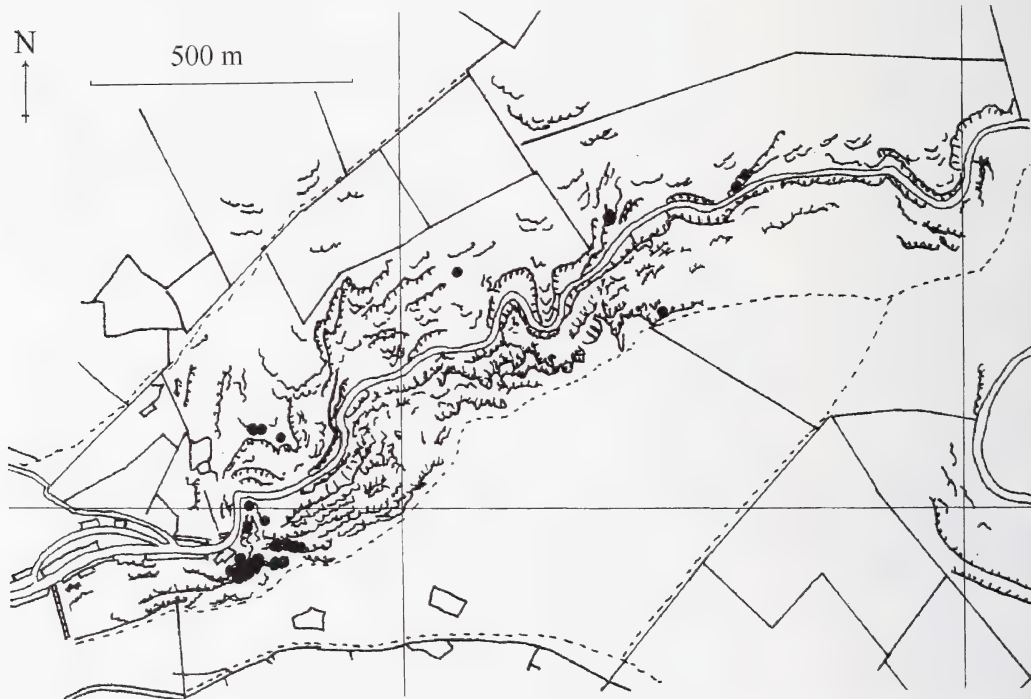


FIGURE 10. Distribution of *Sorbus porrigentiiformis sensu lato* at Cheddar Gorge in areas surveyed.

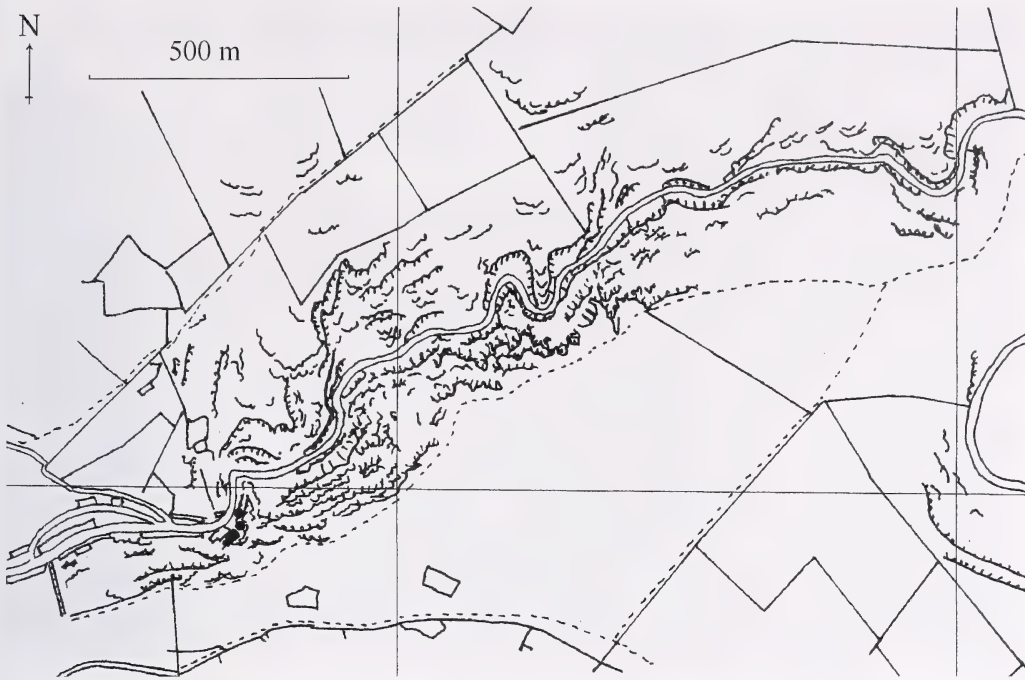


FIGURE 11. Distribution of *Sorbus rupicoloides* at Cheddar Gorge in areas surveyed.

extent or another (20% overall), and the high proportion of dead trees recorded on the National Trust side which were due to goat browsing (7 out of 9 trees), indicate the scale of the problem. It is not certain if the relatively high damage to *S. cheddarensis* and *S. eminentis* (Table 4) is due to selective browsing of these species, or is related to their occurrence in areas the goats frequent; a specific study is required. Trees particularly affected are those beside the paths regularly used by goats, and the effects are most marked on the sunnier, more open slopes on the National Trust side, at Commoners' Spur and Heart Leaf Bluff, where the goats prefer to reside. The main impact of animals on the Longleat side appears to be prevention of regeneration, which may be due to a combination of goats and Soay sheep.

The goats have proved capable of destroying some small trees altogether, in a gradual process, by breaking off branches and crown to leave the remains of the stem as a moribund stick. Young shoots produced at the base have then been vulnerable to selective browsing. Smith (2005) reported that goats will browse to a height of up to 2 m in woodland, and we noted that in more open areas trees with slender stems up to 3 m tall were vulnerable to being

pulled or broken down. Some goats were even observed climbing in trees. One *S. anglica* tree at Horseshoe Bend cut down during conservation work in 2002 did survive initially by re-sprouting from the base, but the young shoots were selectively browsed and it was dead by 2005. In a few cases, photographs taken by T. Rich in 2001 provide clear evidence of damage to individual trees (e.g. *S. anglica* no. 76), and other trees watched between 2005 and 2007 were seen to become progressively more damaged.

DISCUSSION

Eight *Sorbus* species were recorded in Cheddar Gorge, of which the three new taxa *S. cheddarensis*, *S. eminentoides* and *S. rupicoloides* are endemic to the gorge, and *S. eminentis* and *S. porrigentiformis* are endemic to Britain. This is clearly a nationally important site for *Sorbus*, ranking with the Avon Gorge, Wye Valley, Craig-y-Cilau and the north Devon-Somerset coast as centres of diversity. It is perhaps surprising that the importance of Cheddar for *Sorbus* has been so relatively poorly known, though this reflects the difficulties both of surveying the gorge and of identifying *Sorbus*



FIGURE 12. Photographs showing scrub invasion and woodland development at Cheddar. A. Old postcard, pre-Second World War. B, Approximate same view, 2005.

(the recognition of the new taxa here aided by DNA), but it is possible that the post-war removal of grazing has allowed the rarer taxa to spread onto the scree and slopes so that they are now more easily found in accessible places. The survey has also shown many more individuals of the rarer species than had previously been known. Many of the rarer trees are also concentrated around the massive cliffs and slopes at the west end of the gorge, but not exclusively so. The conservation statuses of *S. cheddarensis*, *S. eminentoides* and *S. rupicola* are 'Critically Endangered' following the IUCN (2001) guidelines.

The diversity in Cheddar, as in the Avon Gorge (cf. Robertson *et al.* 2009), is partly attributed to presence of *S. aria* and the ease with which it hybridizes with *S. porrigentiformis*. The genetic and morphological diversity within *S. aria* is also important, this site containing one of the more morphologically variable populations of *S. aria* seen by T. Rich.

Our survey data show that there is damage to the *Sorbus* populations by goats and other animals. Goats were introduced to Cheddar to control scrub, at which they are very effective and an important conservation tool (Smith &

Bullock 1993). The National Trust herd is currently five, free-ranging, neutered males whose preference is for the north side of the gorge at the west end. The goats were initially confined to an enclosure, but soon escaped and continued to do so when corralled back into the enclosure. On the Longleat Estate side of the gorge, a large breeding herd has been introduced recently to an extensive enclosure, but these have also escaped. While some goats have been reported from as far away as Hutton, near Weston-super-Mare 20 km to the west (D. Bullock, pers. comm. 2008), others have crossed to the sunnier north side of the gorge; there were 25 feral goats in the gorge by 2007 (D. Bullock, pers. comm., 2008). Smith & Bullock (1993) found that goats selectively targeted *Sorbus* species in summer, and Smith (2005) noted that it may be the bark stripping during the winter which actually kills the trees. Goats tend to prefer sheltered, sunny, open areas, and will browse in some areas more than others, locally affecting the vegetation; this may cause problems where it coincides with the occurrence of rare species. The herd of feral Soay sheep have been in the gorge since 1992; their population has varied between 34 and 124

between 2000 and 2007 (D. Bullock, pers. comm. 2008). The sheep also browse saplings, and have an impact on the *Sorbus* species. A recent study of the impact of sheep and goats in Cheddar by Wheatley (2009) has confirmed that significant damage to the whitebeams is taking place.

There is a nature conservation dilemma at Cheddar Gorge. On the one hand, it is important to maintain the open grassland for rarities such as *Dianthus gratianopolitanus*; on the other hand, it is important to conserve the *Sorbus* which prefers the intermediate stages of scrub succession to woodland. A comparison of modern day views with those shown in old photographs shows the extent of scrub recolonization in the gorge (Fig. 12). Allowing further development to closed woodland will not be acceptable for either rare grassland species or *Sorbus*, but continued heavy grazing would probably result in restriction of most of the *Sorbus* species to cliffs or places inaccessible to animals. Quite how all these conflicting

priorities can be resolved remains to be seen, but clearly both need accommodating perhaps by compartmentalization of parts of the gorge.

Finally, we strongly advise anyone wishing to see these whitebeams to take extreme care due to the number of loose rocks on the slopes and cliffs, and the large number of people who visit the gorge. Many of the *Sorbus* taxa can be seen safely from the public paths, but permission must be obtained to access the area of Gough's Cave where *S. rupicoloides* occurs as it is above buildings in an area with restricted public access.

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The diversity of *Sorbus* L. (Rosaceae) in the Lower Wye Valley

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ABSTRACT

The diversity of *Sorbus* in the Lower Wye Valley on the border between England and Wales is described. Sixteen *Sorbus* taxa occur in the Lower Wye Valley, including two new species which are described as *S. parviloba* T. C. G. Rich and *S. saxicola* T. C. G. Rich. Diverse, important sites include the Symonds Yat to Great Doward area, and the Pen Moel to Shorn Cliff area. Overall, the Lower Wye Valley is the second most diverse site for *Sorbus* in the British Isles. There is evidence of a minor decline in diversity of a few species at a few sites.

KEYWORDS: England, Wales, new species.

INTRODUCTION

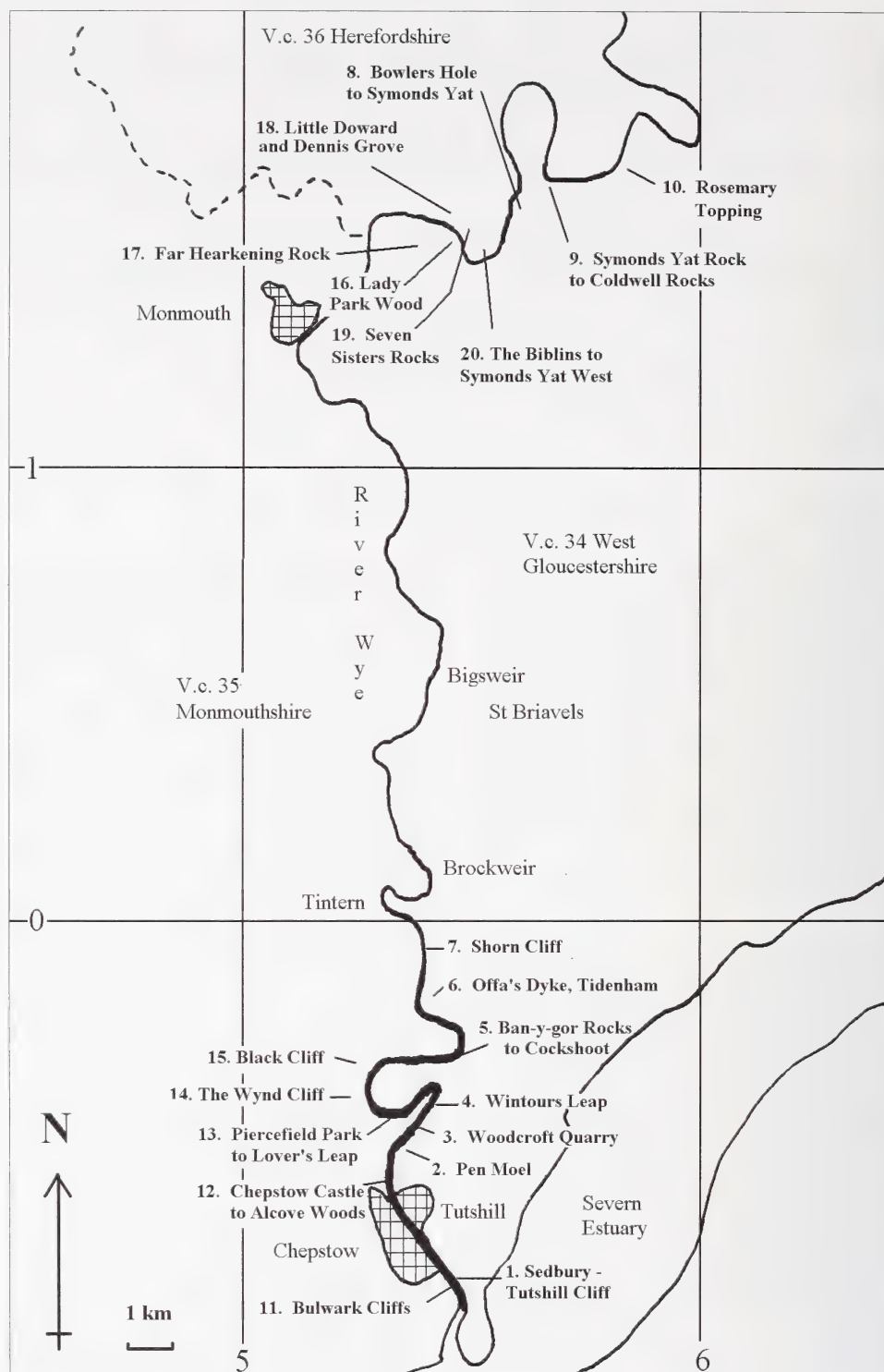
Britain, southern Scandinavia and the mountains of south-east to central Europe are the three main centres of diversity of *Sorbus* L. (Rosaceae) in Europe. Within Britain, the six key areas of diversity are the North Devon and North Somerset coast, Cheddar Gorge, Avon Gorge, the Lower Wye Valley, the Brecon Beacons and Arran. A few other areas such as Morecambe Bay, the Mendips and South Devon also support some endemics. In this paper an account of the diversity and distribution of taxa within one of these, the Lower Wye Valley, is given based on surveys carried out between 1999 and 2006, with the description of two new species. The data contribute towards Target 1 'Understanding

and documenting plant diversity' under the Global Plant Conservation Strategy (Secretariat for the Conservation of Biodiversity 2002).

The Lower Wye Valley is a large, meandering, north-south orientated valley c. 40 km long situated on the border between England and Wales extending from Ross-on-Wye to the Severn Estuary (Fig. 1). At the north end in the Symonds Yat area between English Bicknor and Monmouth, the river meanders between spectacular, large, wooded Carboniferous Limestone cliffs. The river then straightens running south through a broad valley over sandstones, before entering a second series of meanders through another wooded Carboniferous Limestone gorge between Tintern and Bulwark. Three vice-counties are represented in the Lower Wye Valley; v.c. 34 West Gloucestershire and v.c. 36 Herefordshire in England, and v.c. 35 Monmouthshire in Wales. The natural history of the valley has recently been described by Peterken (2008). Significant sites are protected as Sites of Special Scientific Interest and Special Areas for Conservation, and it is an Area of Outstanding Natural Beauty.

In 1999, T. Rich began a project looking at diversity and evolution in *Sorbus* and visited many areas in the Wye Valley. In 2000, the Wye Valley was included in the European Ravine Wood Life Project as part of the Natura 2000 initiative, and English Nature (now Natural England) commissioned abseil access

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FIGURE 1. Location of *Sorbus* sites surveyed in the Lower Wye Valley.

surveys of *Sorbus* on the major cliffs to provide information for conservation and management (Houston *et al.* 2001, 2002, 2003, 2004). These abseil surveys provided a wealth of new *Sorbus* material, which significantly augmented what could be collected from cliff tops. The data from both these studies are combined in this paper to give an overview of the diversity of *Sorbus* in the Wye Valley.

METHODS

MORPHOLOGY AND DESCRIPTIONS OF NEW SPECIES

Broad leaves from the short, vegetative shoots in sunlit situations, excluding the oldest and youngest leaf (Aas *et al.* 1994), were measured on herbarium material of the two new taxa in NMW. Fruits were measured on fresh material, and the colours matched against the Royal Horticultural Society colour charts (Royal Horticultural Society 1966).

Conservation status assessments were made for the new species following the IUCN (2001) guidelines.

HISTORICAL INFORMATION AND SURVEYS

Historical information was compiled from herbaria (**BM**, **BRISTM**, **GLR**, **K**, **NMW**), the voucher material of Proctor & Groenhof (1992) now held at **NMW**, and from the literature (e.g. Evans 2007; Riddelsdell *et al.* 1948).

Surveys were carried out between 1999 and 2008, mainly in the autumn when fruits were present helping identification. Two main methods were used:

1. 'Look-see' surveys (Rich *et al.* 2005) were carried out by walking along cliff tops and sometimes cliff bottoms, and noting taxa seen without consistently counting exact numbers of each species. Some material was collected using a long-handled pruner.
2. Abseil or rope access surveys were carried out by abseiling down rock-faces in a series of 'drops' along the cliffs at intervals of 3–10 m according to the frequency of *Sorbus* or presence of hazards such as loose rock. Samples were collected directly from the ropes, or sometimes using a long-handled pruner. Numbers of each species were counted, but due to practicalities of identification some counts are minima. In certain areas only quicker cliff-top or cliff-base 'look-see' surveys were carried out. Full details are given in the survey reports (Houston *et al.* 2001, 2002, 2003, 2004).

Collection of voucher specimens concentrated on the rarer or more difficult to identify taxa. Identifications of voucher material were confirmed by T. Rich, with other material determined in the field. The 755 specimens collected are deposited in the National Museum of Wales (**NMW**).

Most of the taxa found during the surveys were allocated to existing taxa, but the situation with the *S. eminens* E. F. Warb. group and *S. porrigentiformis* E. F. Warb. group was more complex (see also Proctor & Groenhof 1992). In the *S. eminens* group, plants with orbicular leaves matching the widespread Avon Gorge-Mendips form were called *S. eminens* sensu stricto, and plants with leaves subrhombic in outline with deeper teeth as *S. eminentiformis* T. C. G. Rich, following Rich & Proctor (2009). Proctor & Groenhof (1992) noted that these two species probably belonged to separate taxa, and regarded all the Wye Valley *S. 'eminens'* as belonging to *S. eminentiformis*. Our more extensive collections coupled with analysis of the plastid DNA (Chester *et al.* 2007) indicate both taxa are present throughout the valley. Warburg's type specimen was collected from Offa's Dyke, Tidenham, v.c. 34 West Gloucester-shire (**BM**; Warburg 1952, 1957) but is a poor specimen which is not clearly referable to either form, but he stated that the description related to plants from the Avon Gorge and Lower Wye Valley. However, an unusual feature of Warburg's description was that his *S. eminens* had fruits up to 2 cm long which were longer than wide; this does not equate to either our observations of *S. eminens* as currently interpreted, or those of Proctor & Groenhof (1992). Searches of Offa's Dyke at Tidenham have failed to reveal any plants with such long fruits, but several plants were found at Shorn Cliff immediately below Offa's Dyke with long fruits which had leaves like *S. eminens* but not identical (**NMW**); this problem is best dealt with by amending the description of *S. eminens* sensu stricto to having fruits wider than long.

Warburg (1952, 1957) also described *S. porrigentiformis* from Offa's Dyke at Tidenham, and this probably represents the widespread, lowland form (Proctor & Groenhof 1992). Again we have failed to find any plants which clearly match the type, though at least one tree remains with relatively narrow leaves on the banks of Offa's Dyke (this does not have leaves as narrow as *S. saxicola* described below however). As Warburg (1957) pointed out, plants from different locations differ, and we

have recorded plants with small, obovate leaves and fruits wider than long as *S. porrigentiformis* sensu stricto, and similar plants with larger leaves of more variable shape as *S. porrigentiformis* sensu lato.

With both the *S. eminens* group and *S. porrigentiformis* group we suspect that there are a significant number of hybrids with *S. aria* in the Wye Valley, as also recently reported for the Avon Gorge (Rich *et al.* 2009); confirmation of these will have to await DNA analysis. Plants from Symonds Yat discussed as similar to *S. graeca* (Spach) Kotschy by Proctor & Groenhof (1992) are here included in *S. porrigentiformis* sensu lato, and are probably also locally derived apomictic hybrids of *S. aria* and *S. porrigentiformis*.

The sites surveyed are as follows, ordered first by vice-county and second from south to north with approximate grid references (Fig. 1):

1. Sedbury – Tutshill Cliff (ST541939), v.c. 34
These 20–40 m high, W- to SW-facing cliffs are about 1 km long and fall directly to the River Wye with private gardens above. There are scattered *S. aria* trees visible with binoculars, but they have not been surveyed in detail due to difficult access.
2. Pen Moel (ST539955), v.c. 34
Pen Moel cliffs form a series of WNW-facing crags about 30–50 m high and 300 m long above the River Wye, and much, except the very top of the cliffs, has been quarried below and is wooded to the top edge and from below on the old quarry workings. The top has been landscaped in places as a garden.
The cliffs were surveyed by walking in autumn 2003 (Houston *et al.* 2004) and using ‘look-see’ in 2006.
3. Woodcroft Quarry (ST541959), v.c. 34
Northwards from Pen Moel, Woodcroft Quarry has an inner section of W-facing, 40 m high quarried cliffs c. 100 m long, behind a WNW-facing out section of 30–50 m cliff (‘Fly Wall’) which drops down to secondary woodland and quarry spoil below. The top part of the outer cliffs has been completely removed, and what remains seems to be the only section of this line of cliffs left unquarried.
The quarried inner section and part of the outer sections were surveyed by rope drops and parts by walking in autumn 2003 (Houston *et al.* 2004) and using ‘look-see’ in 2006.
4. Wintour’s Leap (ST542964), v.c. 34
The huge, quarried, 100 m high, NW- to SW-facing cliffs of Wintour’s Leap continue north for c. 500 m from Woodcroft Quarry to Lancaut. They have secondary woodland over quarry spoil below, and private gardens above with a short section of public footpath. The cliffs and woods are part of Gloucestershire Wildlife Trust’s Lancaut Nature Reserve.
The cliffs were surveyed in a series of rope drops in autumn 2003 (Houston *et al.* 2004) and using ‘look-see’ in 2006.
5. Ban-y-gor Rocks – Cockshoot (ST547972), v.c. 34
Ban-y-gor Rocks and Cockshoot form a series of crags about 1 km long with a N- to WNW-aspect. The western crags are 15–20 m high and dip slightly eastwards to give increasingly shaded wooded slopes above until the obvious break of ‘Ladder Gully’. A clear path follows their base. The c. 60 m high eastern crags are crossed by a wide vegetated ledge (‘The Terrace’) with most botanical interest above, and are bounded at the top by private gardens.
Nine days were spent surveying the cliffs in autumn 2000 by a systematic series of vertical rope drops (Houston *et al.* 2001). Several subsequent visits were made in 2002 to collect further material.
6. Offa’s Dyke, Tidenham
(including Plumweir Cliff and Devil’s Point) ST547985 to 542001, v.c. 34
Offa’s Dyke, an ancient earthwork c. 2–5 m high, has a series of small, SW- to NW-facing limestone crags (such as Pulpit Rock) and rocky slopes associated with it in the Tidenham area, but most is in woodland and some in conifer plantation. Both *S. eminens* and *S. porrigentiformis* were originally described from this area, but it is not known exactly where the type trees were.
Offa’s Dyke has been surveyed using ‘look-see’ in 2001 noting interesting taxa.
7. Shorn Cliff (ST541992), v.c. 34
The Shorn Cliff is an unquarried, natural, 20–35 m high, WNW-facing limestone crag about 600 m long overlooking Tintern Abbey. There is a series of open buttresses and rock faces with more forested sections between. There is dense woodland below the crag with some climbers’ paths up from the forest track, and a very steep, wooded slope above the crag below Offa’s Dyke.

- Four days were spent surveying the cliff in a series of rope drops in autumn 2001 (Houston *et al.* 2002). One subsequent visit was also paid in 2002.
8. Bowler's Hole – Symonds Yat (SO562158), v.c. 34
This WNW-facing, 20–50 m high series of cliffs and rocky outcrops is about 500 m long. It is very popular with climbers and tourists and is partly fenced. There is steep woodland on scree below, and woodland above.
The cliffs and rocks were surveyed by 'look-see' surveys in autumn 2002 (Houston *et al.* 2003), and have been visited many times using 'look-see' in 1999–2006.
 9. Symonds Yat Rock – Coldwell Rocks (SO566158), v.c. 34
This E- to N-facing broken cliff above a meander in the River Wye is about 1 km long, and contains a series of small (10 m) to large (25 m) and massive (50 m) cliffs, spurs and pinnacles. Parts have been quarried (Quarry Rock) and there was a popular Victorian walk along the top, 'Coldwell Walks', which is still visible in places. There is mainly secondary woodland below and tall, dense woodland above. Some cliff top scrub is cut back around Symonds Yat Rock to maintain views.
The cliffs were surveyed in detail in autumn 2002 using abseil drops (Houston *et al.* 2003) and several 'look-see' visits 1999–2006.
 10. Rosemary Topping (SO579163), v.c. 34
There are a series of small, poorly accessible, mostly shaded, E- and N-facing cliffs above English Bicknor in dense woodland, in total about 100 m long.
The cliffs were visited using 'look-see' in 2003, but little was found.
 11. Bulwark Cliffs (ST538927), v.c. 35
This is a small series of ENE-facing, partly wooded, limestone crags about 400 m long and 20–30 m tall, which have been quarried away on their west side to form the railway cutting, leaving thin, upright slabs of limestone. The east side drops directly into the River Wye. Access is very limited.
The crags have been visited several times using the 'look-see' approach, including once in 2001 with T. G. Evans who has visited them regularly for over 30 years.
 12. Chepstow Castle – Alcove Woods (ST532942), v.c. 35
The NE to NW-facing crags below Chepstow Castle are c. 400 m long and c. 30–40 m tall, and fall directly into the River Wye. They are partly vegetated.
One 'look-see' visit in 2005 indicated only *S. aria* was present, so no further surveys were carried out. The record for *S. domestica* L. in Wade (1970) refers to *S. torminalis* (Evans 2007).
 13. Piercefield Cliffs – Lover's Leap (ST537963 to 522968), v.c. 35
The NW to E-facing cliffs and very steep wooded slopes of Piercefield Cliffs rise from their low eastern end by the River Wye where they are from 5–20 m tall, to larger cliffs mid-slope, and then 40 m cliffs over woodland at their east end at Lover's Leap, c. 2 km to the west. There are large areas of woodland with relatively limited open areas and a few outcrops.
The cliffs have been surveyed using a 'look-see' approach on four occasions between 2000 and 2005.
 14. The Wynd Cliff (ST528974), v.c. 35
This dramatic, mainly S-facing cliff c. 100 m high and 500 m long stands out above the river valley, with woodland below and woodland sloping down to the cliffs at the top.
The cliffs were surveyed using a 'look-see' approach in 2001.
 15. Black Cliff (ST532983), v.c. 35
This ENE-facing cliff is about 10–30 m high and 400 m long above the road. Parts have been quarried.
The cliffs were surveyed using a 'look-see' approach in 2001; little of interest was found.
 16. Lady Park Wood (SO546145), v.c. 35
The E-facing cliffs of Lady Park Wood are c. 20 m high and 300 m long above the old railway line and the River Wye. At the top the cliffs are fairly accessible but are heavily wooded with *Fagus*. Some areas at the bottom have secondary woodland over old quarry spoil. The woodland is a National Nature Reserve.
The cliffs were surveyed using systematic rope drops in autumn 2003 (Houston *et al.* 2004), and were visited again in 2005 using the 'look-see' method.

17. Far Harkening Rock (SO941151), v.c. 35
Far Harkening Rock is the highest of a series of small (to 5 m) NW-facing rock outcrops about 100 m long in mature woodland, with very limited open rock.

The crags were surveyed in autumn 2005 using the 'look-see' method.

18. Little Doward and Dennis Grove (SO541158), v.c. 36

These low outcrops to c. 5 m high face SW to NE and total about 400 m long. They are mainly set in woodland, with open areas and forestry on the top of the Little Doward.

The crags were surveyed from the top, with one abseil drop in 2002 (Houston *et al.* 2003), and further visits in 2004 and 2005.

19. Seven Sisters Rocks (SO545153), v.c. 36

These SW-facing, 10–35 m high crags form a series of outcrops about 400 m long, above steep wooded scree down to the River Wye, and with woodland above.

The crags have been visited many times between 1999 and 2006, and most of them were systematically surveyed by abseil drops in autumn 2002 (Houston *et al.* 2003).

20. The Biblins – Symonds Yat West (SO555150), v.c. 36

These crags form a series of S-, SE- and ESE-facing cliffs above the Wye about 1 km long, which vary from c. 5 to 25 m in height. Within this length there are a few outcrops with open cliffs, and much partly wooded cliff, and the cliffs have one to three levels.

The cliffs were surveyed using abseil drops at the south end and 'look-see' methods in autumn 2002 (Houston *et al.* 2003) and 'look-see' in 2003.

RESULTS

DESCRIPTIONS OF NEW SPECIES

Sorbus parviloba T. C. G. Rich, *sp. nov.*

HOLOTYPE: Ship Rock, Coldwell Rocks, Symonds Yat, v.c. 34 West Gloucestershire, SO571.156, 4 October 1999, T. Rich & L. Houston (NMW, accession number V.1999.33.523).

Vernacular name: Coldwell Whitebeam

Arbor parva ad 8 m ut minimum, non rhizomatosa; cortex cinerebrunneus. Gemmae ovoideae, acutae. Folia lata brachyblastorum (6.0–)7.0–12.0 × (5.0–)5.5–10.0 cm, (1.05–)1.15–1.5(–1.58) plo longiora quam latiora, late elliptica vel elliptica, ad longitudinis suae (44–)47–63(–68) partes centensimas latissima, apice obtuso vel acuminato, basi cuneata (angulo 42–60°), in parte supra lobos manifestos sed non profundos (3–)5–14 partibus centensimis ad costam sectos praebentia vel valde biserrata, dentes longos (circa 3–4 mm) acutos vel acuminatos exstantes ferentia, sed parte infima prope petiolum circa 2–3 cm fere integra; pagina superior atroviridis glabra; pagina inferior cinereiviridis tomentosa, venis 17–23(–24) ad angulum 29–38° a costa tentis. Petioli (8–)10–18(–21) mm. Inflorescentia ad 10 cm lata, aggregata, leniter tholiformis, ramulis viridialbis tomentosis instructa. Sepala anguste triangularia, viridula sed ad basin tomentosa, in marginibus sine glandibus. Petala 9–11.5 × 5–7 mm, elliptica, alba. Antherae cremeae, lenissime roseotinctae. Styli 2(–3), discreti vel ad medium conjuncti, ad basin pilosi. Fructus maximi 9–13 × (10.5–)11–14 mm, 1.0–1.22 plo latiores quam longiores, aspectu latiores quam longiores vel ut videtur subgloboso, in maturitate rubri, lenticellis paucis dispersis parvis vel mediocribus praediti.

Small tree to at least 8 m, not rhizomatous; bark greyish-brown. Buds ovoid, acute. Broad leaves of short shoots (6.0–)7.0–12.0 × (5.0–)5.5–10.0 cm, (1.05–)1.15–1.5(–1.58) times as long as wide, broadly elliptic to elliptic, widest (44–)47–63(–68)% along leaf length, with apex obtuse or acuminate and base cuneate (angle 42–60°), with distinct shallow lobes (3–)5–14% of way to midrib in upper part to strongly biserrate with long (c. 3–4 mm), acute or acuminate teeth directed outwards, but with the lowest c. 2–3 cm near the petiole nearly entire; upper surface dark green, glabrous; lower surface greyish-green tomentose, with 17–23(–24) veins held at an angle of 29–38° to the midrib. Petioles (8–)10–18(–21) mm. Inflorescence to 10 cm across, crowded, weakly domed with branchlets greenish-white tomentose. Sepals narrowly triangular, greenish but tomentose at base, without glands on margins. Petals 9–11.5 × 5–7 mm, elliptic, white. Anthers cream with a hint of pink. Styles 2(–3), free or joined to middle, pilose at base. Largest fruits 9–13 × (10.5–)11–14 mm, 1.0–1.22 times as wide as long and looking

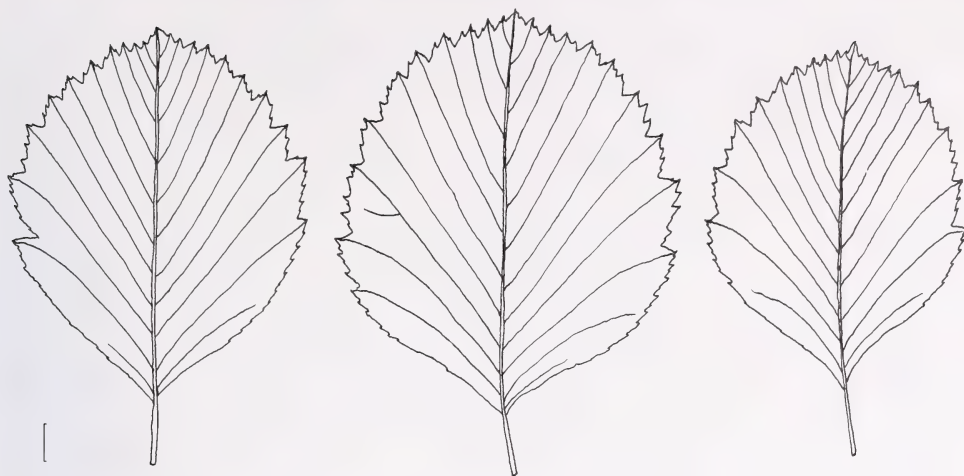


FIGURE 2. Broad leaves of short shoots of *Sorbus parviloba*. Scale bar 1 cm.

wider than long to subglobose, red at maturity (RHS colour 42a), with a few, scattered small to medium lenticels.

Sorbus parviloba is characterized by the broadly elliptic to elliptic leaves with shallow but distinct acute lobes in the upper part of the leaf, a cuneate base and greyish-green undersides, and the small red fruits just wider than long (Fig. 2). It is a member of the *S. aria* group.

Sorbus parviloba is a distinctive species, first found and collected in September 1999 by T. Rich and M. Kitchen. Further trees were found in 2002 (Houston *et al.* 2003). It is endemic to Coldwell Rocks, Gloucestershire (v.c. 34), England, where it occurs from Quarry Rock to Ship Rock on Carboniferous Limestone cliffs and cliff edges in open deciduous woodland with *Fagus sylvatica* L., *Fraxinus excelsior* L. and at least five other *Sorbus* taxa. The altitudes range from c. 100 to 125 m. Only eight trees of this species are currently known (Houston *et al.* 2003), but it is likely that more occur on the cliffs and in the woodlands. The provisional IUCN (2001) conservation status is 'Critically Endangered'.

A similar-looking plant from the Wynd Cliff requires DNA investigation to see if it belongs to the same clone.

***Sorbus saxicola* T. C. G. Rich, sp. nov.**

HOLOTYPE: cliffs on west side of Symonds Yat, v.c. 34 West Gloucestershire, SO562.157, 21 May 2004, T. C. G. Rich (NMW, accession number V.2004.3.116).

Vernacular name: Symonds Yat Whitebeam

Frutex ad 5 m ut minimum, non rhizomatosus; cortex dilute cinereibrunneus. Gemmae ovoideae, acutae. Folia lata brachyblastorum 7.0–11.0 × (4.5–)5.0–7.0 cm, (1.47–)1.5–1.85 (–2.05) plo longiora quam latiora, anguste obovata, ad longitudinis suae (53–)55–61 (–65) partes centenas latissima, apice acuminato vel aliquando acuto, basi cuneata (angulo 30–43°), in parte supera lobos non profundos obtusos 0–15 (–17) partibus centenis ad costam sectos praebentia vel non praebentia, marginibus dentes parvos acutos leniter biserratos prorsum projectos ferentibus, sed parte infima prope petiolum circa 1–4 cm fere integra; pagina superior atroviridis glabra; pagina inferior cinereialba tomentosa, venis 15–22 ad angulum 23–32 (–36)° a costa tentis. Petioli (7–)9–17 (–21) mm. Inflorescentia ad 9 cm lata, aggregata, leniter tholiformis, ramulis viridialbis tomentosis instructa. Sepala triangularia, viridula sed ad basin inque marginibus tomentosa, in marginibus sine glandibus. Petala 6–9 × 5–6 mm, elliptica vel late elliptica, cupulata, alba, ad basin pilosa. Antherae roseintactae. Styli 2–3, fere ad basin fissi, ad basin pilosi vel glabri. Fructus maximi (8)9–11 (–12) × (9.0–)9.5–11.5 mm, 0.9–1.05 plo longiores quam latiores, aspectu globoso, in medio latissimi, in maturitate rubri vel atrorubri, lenticellis paucis dispersis parvis vel mediocribus praecipue prope basin praediti.

Shrub to at least 5 m, not rhizomatous; bark light greyish-brown. Buds ovoid, acute. Broad leaves of short shoots 7.0–11.0 × (4.5–)5.0–7.0 cm, (1.47–)1.5–1.85 (–2.05) times as long as wide, narrowly obovate, widest (53–)55–61

TABLE 1. SUMMARY OF RECORDS OF *SORBUS* IN WYE VALLEY

	<i>S. anglica</i>	<i>S. aria</i>	<i>S. aucuparia</i>	<i>S. emineus s.s.</i>	<i>S. eminentiformis</i>	<i>S. intermedia</i>	<i>S. parviflora</i>	<i>S. porrigentiformis sensu lato</i>	<i>S. porrigentiformis sensu stricto</i>	<i>S. rupicola</i>	<i>S. saxicola</i>	<i>S. torminalis</i>	<i>S. whiteana</i>	<i>S. x thuringiaca</i>	<i>S. x tomentella</i>	<i>S. aria</i> backcrosses	Number of extant species
1. Sedbury - Tutshill Cliff		P						8(+4?)	4			P	(1?)	[P]		P	1
2. Pen Moel	[P]	37+						1	5								5
3. Woodcroft Quarry		66				7		1(1+3?)	3			7+			21	4	4
4. Wintour's Leap		257+	1	1 (+3?)	1 (+1?)												9
5. Ban-y-gor Rocks - Cockshoot		308		5	5+			11+	19+			50+	15	1	2		10
6. Offa's Dyke, Tidenham		LA			P			P	[P]			P	53+	1	P		5
7. Shorn Cliff	15	120+	16	3+	6			10(+2?)	10			2+					10
8. Bowlers Hole - west of Symonds Yat Rock	9	25+	1	4 (+3?)	P			6	1 (+1?)	2	13	LA			8+	3	12
9. Symonds Yat Rock - Coldwell Rocks	16	67+			11 (+2?)		8	15	1 (+1?)	3 (+3?)	2	LA			22+	5+	11
10. Rosemary Topping		P														P	2
11. Bulwark Cliffs	9	P							1	P		LA					5

TABLE 1. SUMMARY OF RECORDS OF *SORBUS* IN WYE VALLEY CONT...

	<i>S. anglica</i>	<i>S. aria</i>	<i>S. aucuparia</i>	<i>S. eminus s.s.</i>	<i>S. eminentiformis</i>	<i>S. intermedia</i>	<i>S. parviflora</i>	<i>S. porrigentiformis sensu lato</i>	<i>S. porrigentiformis sensu stricto</i>	<i>S. rupicola</i>	<i>S. saxicola</i>	<i>S. terminalis</i>	<i>S. whiteana</i>	<i>S. x thuringiaca</i>	<i>S. x tomentella</i>	<i>S. aria</i> backcrosses	Number of extant species
12. Chepstow Castle – Alcove Woods		LA										P					2
13. Piercefield Cliffs – Lover's Leap	P	LA	P		P		(1?)	1				LA		P	P		7
14. The Wynd Cliff	[P]	LA			1							P			[P]		4(+1?)
15. Black Cliff		P										P					2
16. Lady Park Wood		38	1	4	5+			1	1			LA	(1?)		2+		8(+1?)
17. Far Harkening Rock		P			1					P	1						4
18. Little Doward and Dennis Grove	1	16+			4 (+3?)			1			4	4+					6
19. Seven Sisters Rocks	1[+P]	31+			LA			13		4	3 (+2?)	LA				2	8
20. The Biblins –Symonds																	
Yat West		90+	3 (+2?)	1 (+1?)	13	1	1	1	4 (+5?)	7	5	LA	2(+2?)	1	4	5	10
Number of extant sites	8	20	5	6	13	1	1	13	10	6	5	16	2(+2?)	4	8	7	

The table is a mixture of qualitative and quantitative data. 1, 2 etc. = number of confirmed plants. (1?, 2?, etc) = number of unconfirmed plants. P=present. [] = historic records not seen recently. + =more present but not counted. LA = locally abundant. The location of the sites is shown in Figure 1.

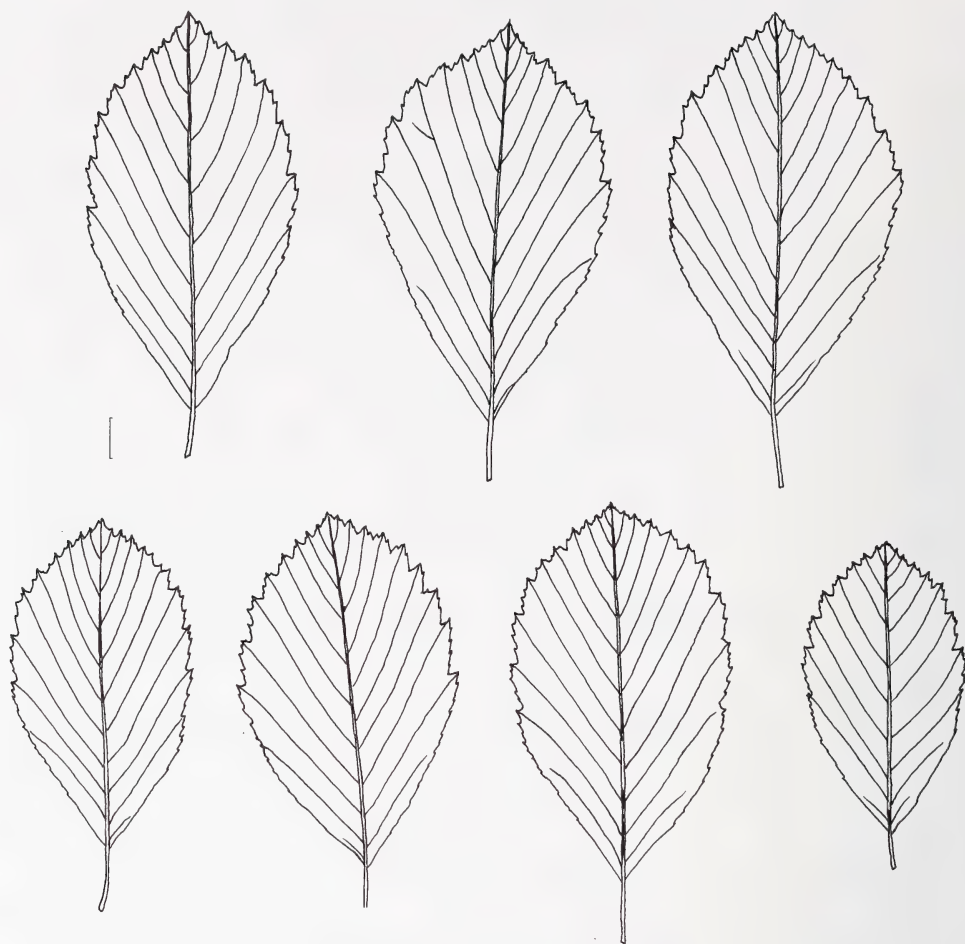


FIGURE 3. Broad leaves of short shoots of *Sorbus saxicola*. Scale bar 1 cm.

(–65)% along leaf length, with apex acuminate or sometimes acute and base cuneate (angle 30–43°), with or without shallow, obtuse lobes 0–15(–17)% of way to midrib in upper part; margins with small, acute, weakly biserrate teeth directed forwards, but with the lowest *c.* 1–4 cm near the petiole nearly entire; upper surface dark green, glabrous; lower surface greyish-white tomentose, with 15–22 veins held at an angle of 23–32(–36)° to the midrib. Petioles (7–)9–17(–21) mm. Inflorescence to 9 cm across, crowded, weakly domed with branchlets greenish-white tomentose. Sepals triangular, greenish but tomentose at base and on margins, without glands on margins. Petals 6–9 × 5–6 mm, elliptic to broadly elliptic, cupped, white, pilose at base. Anthers pink-flushed. Styles 2–3, split nearly to the base,

pilose at base or glabrous. Largest fruits (8)9–11(–12) × (9.0–)9.5–11.5 mm, 0.9–1.05 times as long as wide and looking globose, widest at the middle, red to dark red at maturity (RHS colour 45a), with a few, scattered small to medium lenticels mainly near base.

Sorbus saxicola is characterized by the narrowly obovate leaves with or without shallow obtuse lobes in the upper part of the leaf, a usually acuminate apex and a cuneate base, greyish-green underneath with 15–22 veins, and the small, globose, red fruits (Fig. 3). It is a member of the *S. aria* group. *Sorbus rupicola* has larger leaves with fewer veins and obtuse apices, and larger fruits wider than long. *Sorbus porrigentiformis* has broader leaves 1.25–1.65 times as long as wide, and fruits wider than long.

Sorbus saxicola was first found and collected in September 1999 by T. Rich and L. Houston, and has since been more widely found in surveys in the Symonds Yat and Doward areas (Houston *et al.* 2003).

Sorbus saxicola is endemic to the Wye Valley around Symonds Yat and the Great Doward, in Gloucestershire (v.c. 34), Monmouthshire (v.c. 35) and Herefordshire (v.c. 36), England. It has been recorded from Dennis Grove (4 plants), Seven Sisters Rocks and King Arthur's Cave (4, possibly 6, plants), Far Harkening Rock (1 plant), on the cliffs above the west side of Symonds Yat (at least 9 plants), the Yat Rock area (at least 3 plants) and at Coldwell Rocks (1 plant). It occurs on Carboniferous Limestone cliffs and cliff edges in open, deciduous woodland with *Fagus sylvatica*, *Fraxinus excelsior* and many other *Sorbus* taxa. The altitudinal range is *c.* 75 to 175 m.

Only 23 trees of this species are currently known (Houston *et al.* 2003, with updates), but there are probably more on the extensive cliffs in this area. The provisional IUCN (2001) conservation status is 'Critically Endangered'.

SURVEYS

The results of the surveys are summarized in Table 1. Collecting vouchers of the rare taxa, or those difficult to identify in the field, from parts of the cliffs not previously surveyed has resulted in a much more detailed knowledge about the distribution and frequency of each taxon, and allowed recognition of new taxa. The number of sites for each species, and number of species for each site, are still dependent on the quality and detail of the survey which is inconsistent between sites, but these are the best available data which are unlikely to be bettered in the foreseeable future.

The commonest and most widespread species are the diploids *S. aria* and *S. torminalis*, the former often the commonest species present. The diploid *S. aucuparia* is much rarer on the limestone cliffs and thus infrequent in our surveys, but is common in the associated woodlands on sandstone (Peterken 2008). Their hybrids *S. × thuringiaca* (Ilse) Fritsch (= *S. aria* × *S. aucuparia*) and *S. × tomentella* Gand. (= *S. vagensis* Wilm., *S. aria* × *S. torminalis*) are both scattered through the valley, the latter locally frequent in the

Symonds Yat area where it backcrosses with *S. aria* (Price & Rich 2007).

The next most widespread taxon is *S. eminentiformis* which is most abundant at the northern end of the Lower Wye Valley, but also occurs more locally at the southern end. *Sorbus eminens* sensu stricto is also scattered through the valley but is rare at the northern end. *Sorbus porrigentifformis* sensu stricto is quite rare with only small numbers of plants, whilst plants attributed to *S. porrigentifformis* sensu lato are more frequent and also more widespread.

Sorbus anglica Hedl. is quite widespread, though it has not been recorded recently in two sites and has declined at another, and *S. rupicola* (Syme) Held. and *S. whiteana* T. C. G. Rich & L. Houston occur in a few sites. *Sorbus parviloba* and *S. saxicola* are both restricted to the northern end of the Lower Wye Valley as described above. The alien *S. intermedia* has only been recorded in one site, not too far from Tutshill where it grows as a street tree.

The sites vary in diversity, which is only partly related to their size (Table 1). The two richest sites are site 8 Bowler's Hole – Symonds Yat, and site 9 Symonds Yat Rock – Coldwell Rocks (Fig. 1) which have extensive cliffs with good populations. Site 20 The Biblins – Symonds Yat West immediately west of this area on the opposite north side of the River Wye is also very rich with ten taxa, though the whitebeams are more scattered. Site 16 Lady Park Wood and site 19 Sevens Sister's Rocks are very diverse for small areas. At the southern end of the Lower Wye Valley, site 4 Wintour's Leap, site 5 Ban-y-gor Rocks and site 7 Shorn Cliff are diverse with ten taxa each. Not all cliffs are rich in species, for example Rosemary Topping and Black Cliff are poor, perhaps due to limited outcrops, tall woodland or quarrying.

Both the northern area around Symonds Yat and the Doward, and the southern end from Chepstow to Shorn Cliff, have 14 *Sorbus* taxa recorded.

DISCUSSION

It is inevitable given the large areas of the Lower Wye Valley investigated, the scale of the cliffs and the difficulty of access to the cliffs with or without ropes, that the surveys are incomplete. It is also often difficult to see

the trees for the wood. Nonetheless 16 *Sorbus* taxa have been recorded, of which three are endemic to the Lower Wye Valley (*S. eminentiformis*, *S. parviloba* and *S. saxicola*) and three endemic to Britain (*S. eminens* sensu stricto, *S. porrigentiformis* and *S. whiteana*). Both the northern area around Symonds Yat and the Doward, and the southern end from Chepstow to Shorn Cliff have 14 taxa recorded. Overall, the Lower Wye Valley is the second most diverse site for *Sorbus* in the British Isles, second only to the Avon Gorge which hosts about 22 taxa. If hybrids and alien species are excluded from the comparison (the former are much better studied in the Avon Gorge), both the Wye Valley and Avon Gorge support 12 species.

The key factor for the diversity is the presence of extensive areas of open or partly shaded, limestone rocks and cliffs with little disturbance or grazing. These open rocks provide ideal habitat for members of the *S. aria* group such as *S. rupicola* and *S. porrigentiformis* which are small, light-demanding trees and shrubs. Historically the woodlands were managed to the cliff edges by coppicing as high forest, as shown in old photographs (Helme 1989; Rainsbury 1989; Peterken 2008), and this may have provided conditions for colonization along the cliff edges. Other areas were managed as wood pasture, the grazing probably limiting the regeneration except on the cliffs. Plantations rarely affected the cliffs directly. In some places these cliff edges are now overgrown, forcing normally small trees such as *S. anglica* to grow to 10 m or more tall to keep their leaves in sunlight. As these edges become shaded by trees once more, the whitebeams may become more restricted to the

cliff faces. The exception to this is *S. eminentiformis*, which grows readily in closed woodland as well as on open rocks; for example, there are extensive colonies on the east side of the Great Doward in the wood around the old mines (not surveyed here).

There are only minor threats to maintenance of the *Sorbus* diversity. Most sites are protected by legislation as Sites of Special Scientific Interest or Special Areas for Conservation, and specific conservation management is neither required nor practical in most sites. At Symonds Yat, whitebeams are regularly cut back to maintain scenic views, but the trees regrow from the base. At least two whitebeam trees have been damaged and lost in an area heavily used by outdoor educational groups at Symonds Yat.

In general there is little evidence from historical records for anything other than a minor decline in diversity of sites or species. Some losses have occurred at Pen Moel and Wintour's Leap, probably due to the extensive quarrying. Losses at the Wynd Cliff may be due to increased shading by tall woodland. The failure to refind *S. eminens* on Offa's Dyke could be due to forestry operations replacing broad-leaved woodland with conifers, but the location of the type tree is not known.

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The decline of Lady's-mantles (*Alchemilla vulgaris* L. agg.) and other hay-meadow species in Northern England since the 1950s

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ABSTRACT

In Teesdale (v.cc. 65, 66 & 70) and Weardale (v.c. 66), a considerable decline in the status of five species of the *Alchemilla vulgaris* L. aggregate, together with three other species of herbs characteristic of northern England hay-meadows, has been revealed by repeat surveys of meadows, and road and rail verges first visited between 1950 and 1967. As a consequence, these five *Alchemilla* species and the three herbs should be considered threatened and in urgent need of conservation action.

KEYWORDS: Teesdale, meadows, conservation, agricultural changes, grassland management.

INTRODUCTION

Max Walters (Walters 1949), in his paper '*Alchemilla vulgaris* L. agg. in Britain', clarified the identity of the various British species within the aggregate, thereby establishing some order out of the chaos created during the last century by the Swiss botanist, Firmin Jaquet. In 1951, Walters suggested that the author might like to look for them in Teesdale (v.cc. 65, 66 & 70) where he had seen several interesting species himself. It soon became clear that in Northern England there were eleven native agamospecies of the *Alchemilla vulgaris* aggregate (Lady's-mantles) and nine of these were subsequently found in the north Pennine valleys of Teesdale and Weardale (lat. 54° 40' N, long. 2° 15' W). It is now known that three: *A. acutiloba* Opiz ('Starry Lady's-mantle'), *A. monticola* Opiz (Velvet Lady's-mantle) and *A. subcrenata* Buser (Large-toothed Lady's-mantle) are almost restricted to these two dales and that two more – *A. glomerulans* Buser (Clustered Lady's-mantle) and *A. wichurae* (Buser) Stefansson (Rock Lady's-mantle) are here at the southern fringe

of their distribution and known to be centred in Scotland (Preston *et al.* 2002).

The North Pennines is considered to contain approximately 40% of the surviving upland herb-rich hay meadows (National Vegetation Classification MG3 *Anthoxanthum odoratum*-*Geranium sylvaticum* grassland) in the U.K. These grasslands are characterised by boreal species such as *Trollius europaeus* L. (Globeflower), *Geranium sylvaticum* L. (Wood Crane's-bill) and *Cirsium heterophyllum* (L.) Hill (Melancholy Thistle) as well as more typical grassland species such as *Alchemilla* spp., *Rhinanthus minor* L. (Yellow-rattle), *Conopodium majus* (Gouan) Loret (Pignut), *Sanguisorba officinalis* L. (Great Burnet) and *Leontodon hispidus* L. (Rough Hawkbit).

It was fortuitous that the survey of the *Alchemilla* spp. took place in the early 1950s, shortly after the Second World War and about the time that farming in the dales was becoming mechanised and with artificial fertilisers readily available. In 1967 the author directed a survey of three other characteristic northern hay-meadow species, namely *Trollius europaeus*, *Geranium sylvaticum* and *Cirsium heterophyllum* in Teesdale. By this time, restriction to field margins and riversides of species such as *Trollius europaeus* indicated that a change in the diversity of the meadow flora had already begun. On the author's return to Teesdale, a survey was carried out in the year 2000 to determine the status of these *Alchemilla* species after a fifty-year period, whilst in 2003 and 2004 the Upper Teesdale Botany Group searched the original fields for the three meadow species. This paper now describes the results of these two surveys, the causes of the observed declines, and the prospects for the future conservation of northern hay-meadow species.

¹See APPENDIX p. 321 for Vernacular names

METHOD

RESULTS

The five species of the *Alchemilla vulgaris* aggregate originally surveyed were the northern-montane meadow species: *A. acutiloba*, *A. monticola* and *A. subcrenata* together with the arctic-alpine species *A. glomerulans* and the arctic-subarctic species *A. wichurae*. The fine-scale distributions of these five species were mapped in the early 1950s as 'dots' on the Ordnance Survey 1: 25,000 maps, with a 'dot' representing one or more plants (Bradshaw 1962). Where a species was abundant the whole field was coloured-in on the maps and any contiguous presence on road verges was marked as a solid line. In the year 2000, approximately 80% of these sites were re-visited and the findings marked on similar maps and in a similar way. Since then, many of the remaining 20% of sites have also been inspected. A summary of these results is given in Table 1.

In 1967 the three hay-meadow species, *Trollius europaeus*, *Geranium sylvaticum* and *Cirsium heterophyllum*, were surveyed in the hay-fields, roadsides, and river margins in two main areas: (i) the Newbiggin-in-Teesdale and Holwick area (altitude c. 260 m) to the west of Middleton-in-Teesdale, and (ii) Forest-in-Teesdale (altitude c. 380 m) to the west of the High Force Hotel (Bradshaw 2001). These sites were then re-surveyed in 2003 and 2004 (Bradshaw 2006).

ALCHEMILLA SPECIES

In the fifty-five year period since the first survey, the status of each of the five species of the *A. vulgaris* aggregate was found to have changed from being apparently stable (although in some species rare) to endangered, even in the most abundant species, *A. monticola* and *A. acutiloba*. A detailed assessment of each species is given below, see also Table 1.

Alchemilla subcrenata

A. subcrenata is the scarcest of the four Northern Montane Lady's-mantles in Britain. It was first collected in 1951 by the author near Newbiggin-in-Teesdale and identified by Walters (1952). Its main area of distribution is restricted to the Newbiggin-Holwick area but in 2007/2008 a few plants were also found in each of three meadows near Allendale, in Northumberland (v.c. 67), a considerable distance from its centre in Teesdale.

Since the first survey, the number of fields in which *A. subcrenata* has been recorded in Teesdale has fallen from 22 to 10 (49 to 25 dots) and now there is only a single road verge site. Most populations are confined to meadows where it is a scarce species and to two pastures. Plants found in the 1950s in two fields in Weardale, north of Stanhope, were not re-found in 2000 nor in 2002, both fields having been agriculturally 'improved'.

TABLE 1. CHANGES IN THE FREQUENCY OF THE 'DOT' RECORDS FOR FIVE SPECIES OF THE *ALCHEMILLA VULGARIS* AGGREGATE IN TEESDALE AND WEARDALE MADE IN THE 1950S AND BETWEEN 2000 AND 2007

Species	Area	'Dots' in 1950s	'Dots' visited 2000-2007	'Dots' found 2000-2007	% lost	Comment
<i>A. acutiloba</i>	Teesdale	27	20	16	20	
	Weardale	195*	164*	82	50	plus 10 fields*
<i>A. monticola</i>	Teesdale	498*	380*	56	85	plus 33 fields*
	Weardale	36	36	1	97	
<i>A. subcrenata</i>	Teesdale	49	49	25	49	
	Weardale	4	4	0	100	
<i>A. glomerulans</i>	Teesdale	81	74	14	81	
	Weardale	2	2	1	50	
<i>A. wichurae</i>	Teesdale	34	27	15	44	

* In the 2000-2007 survey neither species was found to be as frequent in any of the fields as they were in the original survey, nor were either of them frequent along contiguous lengths of road-verge. Finds in these places were recorded as 'dots'.

Only one site, a pasture, occurs within the perimeter of the Moor House-Upper Teesdale National Nature Reserve although several populations in fields on the south side of the River Tees are under 'agri-environment' agreements. On the north side of the Tees, the field where the species was discovered is not currently under any conservation management scheme, another field has a non-statutory agreement between the landlord and the tenant, whilst a third is in the Higher Level Stewardship Scheme (Natural England). *A. subcrenata* is classified as 'endangered' in the new Red List (Table 3) (Cheffings & Farrell 2005). The current population probably comprises no more than 300 plants.

Alchemilla acutiloba and *A. monticola*

A. acutiloba has been known from Teesdale since 1946, but was not collected in Weardale until 1951 when the author found a dense colony on disturbed ground near the new Burnhope Reservoir dam. In the 1950s it was found to be very frequent in meadows and on road- and rail-verges in Weardale but not as common in similar habitats in Teesdale. It has also been recorded from a scattering of sites, mostly on roadsides, to the east and north of the area. It was only in 2006 that it was found to occur south of the Tees with the location re-confirmed in 2008.

A. monticola was first recorded in Teesdale in 1922. Walters (1949) found it to be frequent in meadows and on roadsides in 1947 and this was also the case in the 1950s. It is rare in upper Weardale where the author found only one colony on a verge in a side valley. Many plants were also found to the east of this site growing around Hamsterley village green on the south side of the valley.

Since the 1950s both species have become much scarcer in both dales. In Teesdale the number of meadow populations of *A. acutiloba* has fallen by 20% from 20 visited-sites (of the 27 originally identified) to 16; in Weardale the decline has been much greater (50%) from 164 (of the 195 originally identified) to 82. In Teesdale the number of *A. monticola* populations has fallen by 80% from 330 (of the 448 originally identified) to 63 and in Weardale all the 35 'records' at Hamsterley have been destroyed due to the 'tidying-up' of the village green. However, the very small colony of roadside plants in the upper Dale was still present in 2008.

There have been even greater losses of both species from road- and rail-side habitats and from certain meadows. No longer are there long stretches of verge where one or both species are frequent as they were in the 1950s². *A. acutiloba* has been lost from a 2.9 km length of verge in Teesdale and from a 2.1 km length in Weardale, whilst *A. monticola* has disappeared from a 4.8 km length of verge in Teesdale; this is a total length of 9.7 km (i.e. almost 6 miles). Of the thirty-three small fields² near Middleton where *A. monticola* was formerly very frequent, about half of them are now built on with houses and a school whilst, in the remainder, the species have been reduced to individual 'dots'. Similarly, *A. acutiloba* is now scarce in the fields in Weardale where it was formerly very frequent.

Alchemilla glomerulans and *A. wichurae*

Alchemilla glomerulans and *A. wichurae* are respectively arctic-alpine and arctic-subarctic species which, in the UK, occur mainly above 615 m in Scotland. Populations of *A. wichurae* in northern England are at the southern limit of their UK distribution and also of their world distribution (Kurto *et al.* 2007) and are unusual in occurring at the relatively low altitude of 250 m. Walters (1949) discovered *A. glomerulans* when visiting Teesdale in 1947 and it is now known to occur in meadows, meadow-type vegetation near the Tees, and in well-drained and flushed hill grasslands extending up to 676 m on the Pennine escarpment in v.c. 69 (Westmorland). It has also been recorded on a road verge and a bank in a meadow in v.c. 70 (Cumberland). In Weardale it was discovered by the author in the 1950s growing in a single meadow and in a nearby railway cutting. *A. wichurae* was collected by Walters in 1946 on Ingleborough (v.c. 64) and in Teesdale in 1947 (v.cc. 66 & 69). It has been found to be very thinly scattered, usually occurring as single plants, in a few meadows, upland pastures, and on limestone outcrops. Several records occur by waterfalls over the whinsill (dolerite) rock.

In Teesdale, by 2007, the number of *A. glomerulans* populations has declined by 82% from 74 (of the original 81) 'dots' in the 1950s to 14 (including 4 recent finds). Some of the losses have been from meadows; one of these was due to ploughing but the majority have been of isolated single plants in close-grazed hill pastures. In Weardale it has been lost from its meadow site leaving just one plant by 2007.

In Teesdale, the number of 'dots' for *A. wichurae* has declined by 44% from 27 (of the original 34) to 15, most losses having been from meadow sites. In hill pastures, *A. wichurae* has survived better than *A. glomerulans* but is still vulnerable to extinction where only single plants remain. Nowadays, the only concentration of plants of *A. glomerulans* is in four meadows near Middleton-in-Teesdale.

SPECIES CHARACTERISTIC OF NORTHERN HAY-MEADOW

The survey of three hay-meadow species, *Cirsium heterophyllum*, *Geranium sylvaticum* and *Trollius europaeus*, has revealed a decrease in the numbers of fields in which each species can now be found (the slight increase of *Geranium sylvaticum* in Forest-in-Teesdale is very likely due to the more thorough search made in 2004) (Table 2). In the Newbiggin-Holwick area, *Trollius europaeus* is now almost exclusively confined to the banks of the Tees. *Geranium sylvaticum* is the only species that is widely dispersed throughout any individual fields and is most frequent in Forest-in-Teesdale. It is clear that these characteristic and conspicuous species are less common than they once were and that there has been a general decrease in the species diversity of the hay meadows. This is supported by an observable change in general colour of most dales meadows which at one time were mauve, white and shades of yellow to nowadays being only buttercup-yellow, white and brown. In 2006–2007, John O'Reilly searching for herb-rich meadows in the North Pennines Area of Outstanding Natural Beauty found that only 8% of the 388 fields examined could be classified as species-rich and that even this figure might be an over-estimate when considering the total number of meadows in existence (pers. comm., J. O'Reilly, 2008).

CAUSES OF DECLINES

The decline of the five species of *Alchemilla* and the other meadow species probably began in the 1960s and, based on the author's experience, most had occurred by the 1980s. The primary causes in meadow habitats have been due to changes in farm management and animal stocking. Heavy continental-cross suckler cows have replaced the dairy cows and larger numbers of sheep are being 'wintered' in the meadows. Artificial fertilisers have supplemented farmyard manure, which itself has changed from a sweet-smelling dung to an acrid, ammonia-laden, semi-raw compost created from bought-in straw used for bedding; this most probably has had a significant effect on the soil micro-flora and fauna as well. At the same time, there has been a decrease in the application of lime and/or basic-slag. Some hill farms stocked with fell-sheep continue to make small bales of hay, but large-bale silage and haylage has generally become the norm and a surer way of conserving the grass for winter feed.

Although during the second half of the last century, a few fields had been ploughed and re-seeded or slot-seeded with more productive rye-grass/clover (*Lolium/Trifolium*) mixtures, the recent relaxation of Environmental Impact Assessment (Agriculture) (England) Regulations 2006 has resulted in several herb-rich meadows being destroyed. The sum of all these developments has been a marked loss in species-diversity formerly evident in herb-rich meadows.

Road verge habitats have also been affected. There has been a great increase in the amount and weight of motorised traffic which has necessitated strengthening the road-edges by the addition of imported ballast. As a result, seeds and parts of weedy plants have accidentally been introduced onto the verges and become established. Eutrophication,

TABLE 2. NUMBER OF FIELDS CONTAINING THE THREE MEADOW SPECIES IN THE SURVEYS OF 1967 AND 2003–2004

	Nos. fields resurveyed in 2003/2004	Nos. fields with		Nos. of fields with		Nos. of fields with	
		<i>Trollius europaeus</i>		<i>Geranium sylvaticum</i>		<i>Cirsium heterophyllum</i>	
		1967	2003/2004	1967	2003/2004	1967	2003/2004
Newbiggin / Holwick	80	26	12	52	44	22	15
Forest in Teesdale	59	36	15	28	36	26	25

TABLE 3. CONSERVATION STATUS OF THE RARE *ALCHEMILLA VULGARIS* AGGREGATE SPECIES IN TEESDALE

Species	(1) Red List GB	(2) Scarce	(3) DRPR	(4) BAP
<i>Alchemilla acutiloba</i>	VU A2c	RD	V	+
<i>Alchemilla monticola</i>	EN A2c	RD	E	+
<i>Alchemilla subcrenata</i>	EN A2c B1ab(v) + 2ab(v) C2a(I) 4 <800 individuals	RD	E	+
<i>Alchemilla glomerulans</i> *	VU A2c		E	
<i>Alchemilla wichurae</i> *	EN A2c	SPIB	E	

(1) *Vascular Plant Red Data List for Great Britain*. (Cheffings & Farrell 2005).

(2) *Scarce Plants in Britain*. (Stewart *et al.* 1994).

(3) *Durham Rare Plant Register* (Durkin, unpublished) (pers. comm. 2008).

(4) *Biodiversity Action Plan UK BAP List 2007*

* Natural England Common Standards Monitoring of Rare Plant Species, Local Distinctiveness Attributes (LDA), e.g. scarce in England but frequent in Scotland or at edge of the species range.

caused by exhaust fumes, spray and salt from the roads, and seepage of nutrients from adjacent fields, have also had an adverse effect. Successive changes in road verge management have involved the use of herbicides; mowing by County Council machines with wide flails which create a heavy mulch has favoured the stronger, coarser grasses, broad-leaved plants and imported weeds. In addition, re-alignment of, and other work on, many minor roads has added to the toll. Collectively these changes have decimated the colourful meadow plant community.

Pacha (2004) found a similar decline over the last two decades in the distribution of *Geranium sylvaticum* in the meadows within the Yorkshire Dales National Park. This species has disappeared from 40% of meadows where it was known to exist in the 1980s with surviving populations having become increasingly isolated over the survey period. Also, even fields managed under agri-environment schemes have become more impoverished with a general decrease in diversity and richness, especially among species characteristic of MG3 *Anthoxanthum-Geranium* meadows. The survey results also highlighted the increasingly important role that road verges and river margins play for the survival of northern hay-meadow species such as *G. sylvaticum*, especially in areas where the species has disappeared from the adjacent meadow habitats.

CONSERVATION

All five species of the *Alchemilla vulgaris* aggregate mentioned in this paper are classified as 'endangered' or 'vulnerable' in the new Red

List for Great Britain (Cheffings & Farrell 2005), and the three meadow species (*A. acutiloba*, *A. monticola*, *A. subcrenata*) are included in the new Biodiversity Action Plan (BAP) List of priority species (Table 3). At the time of writing, in 2008, all of these species are very vulnerable to further reductions in their numbers. This is particularly so because of the uncertainties in the future of farming and of the management of the upland meadows and fells for food production, game birds and recreation. Already, more sheep as well as cattle are housed in winter on imported straw, thus producing larger quantities of straw-based manure (see earlier) which will have unknown effects on the meadow biota. Other changes, for example, might include the reduction in the numbers of cattle and hence their availability for the desirable autumn grazing of the meadows; also a possible increase in the number of sheep, including breeds with different fodder requirements, followed by an increase in winter grazing of the meadows; these would all have an effect. On the fells, the reduction in the number of sheep that has already begun might prove beneficial in the short-term by allowing heavily grazed plants to flower (and so be identified) at least in those areas where rabbits are absent or controlled. In the longer term, under-grazing could produce a different threat, especially to light-demanding plants. Of the five *Alchemilla* species, *A. wichurae* would be the most likely to be adversely affected by this.

Finally, it should be remembered that global warming is predicted to affect many more species than the *Alchemilla* species and meadow plants covered in this paper.

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APPENDIX

VERNACULAR NAMES FOR *ALCHEMILLA VULGARIS* S.L. SPECIES

The following vernacular names are proposed for the agamospecies of the *Alchemilla vulgaris* aggregate found in Britain. In non-scientific papers it is recommended that the English name be followed by the Latin in brackets.

<i>A. glabra</i>	Smooth	Lady's-mantle	(belongs to the 'Sub-glabrae' and can have hairs and so belie the name <i>glabra</i> and confuse learner botanists)
<i>A. acutiloba</i>	Starry	Lady's-mantle	
<i>A. micans</i>	Shining	Lady's-mantle	
<i>A. filicaulis</i> ssp. <i>filicaulis</i>	Slender	Lady's-mantle	as used in Scandinavia
<i>A. filicaulis</i> ssp. <i>vestita</i>	Hairy	Lady's-mantle	
<i>A. wichurae</i>	Rock	Lady's-mantle	as used in Scandinavia, the species frequently grows on rocky outcrops in the UK
<i>A. glaucescens</i>	Silky	Lady's-mantle	
<i>A. xanthochlora</i>	Pale	Lady's-mantle	
<i>A. subcrenata</i>	Large-toothed	Lady's-mantle	
<i>A. glomerulans</i>	Clustered	Lady's-mantle	
<i>A. monticola</i>	Velvet	Lady's-mantle	I frequently describe the upper surface of the leaf as looking like 'velvet'—dense, short erect hairs
<i>A. minima</i>	Least	Lady's-mantle	
<i>A. alpina</i>			Alpine Lady's-mantle is already in use
<i>A. conjuncta</i>			Silver Lady's-mantle is already in Stace (1997)
<i>A. tythantha</i>	Crimean	Lady's-mantle	
<i>A. mollis</i>	Soft	Lady's-mantle	
<i>A. venosa</i>	Crisp	Lady's-mantle	



Studies in the floristic diversity of Durham walls, 1958–2008

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ABSTRACT

A study of the flora of the walls of Durham City over the period 2006–2008 indicated that the floristic diversity had increased by between 39% and 42% since a survey undertaken fifty years ago by Woodell & Rossiter (1959). In addition, the increased frequency of occurrence of twenty-four of the thirty-four key species from the first survey is apparent and there is group of seven species not recorded in the first survey that has become especially prevalent. The increases may be interpreted in terms of the amelioration of the atmospheric environment which has offset any potential reduction of diversity associated with gentrification of the city. An influx of native species has been mainly responsible for the rise in diversity, though the number of neophytes has increased by almost a third of the original total. The floristic diversity of the urban wall habitat is higher than that of rural settlements of the Durham Dales, emphasising the importance of the former as a refuge for many species which have been perceived as declining at the national scale. The walls of each rural settlement have a distinct floristic signature, but the main chasmophyte communities show close phytosociological affinities with the alliance Cymbalariaion-Asplenion.

KEYWORDS: floristic diversity, walls, urban, rural, Durham City, Durham Dales.

INTRODUCTION

This paper takes its stimulus from an article by Woodell & Rossiter (1959) published in the *Proceedings of the Botanical Society of the British Isles* which reported the findings of a survey of the flora of the walls of Durham City in the period 1955–1958. Their study was based upon a survey of Cambridge walls by Risbeth (1948) and in turn, stimulated extensive research on the flora of the urban walls of Middlesex (Kent 1961), and more specific projects such as surveys of the churchyard walls in Middlesex (Kent 1964) and Norfolk (Silverwood 1965). Woodell continued his interest in urban habitats and became recognised as a leading authority in the genre (Woodell 1979). In the meantime, Segal (1969) published his classic volume on the ecology of

European wall vegetation and this encouraged rural research projects such as those of Holland (1972) on the old walls of western Ireland, and Payne (1978) in south-eastern Essex. As interest in urban ecology increased, so did an appreciation of the importance of walls as modified cliff-like habitats with a special group of ecological characteristics. The popular text by Darlington (1981) entitled *Ecology of walls* brought the value of the habitat to public attention and the subject area was admirably developed by Gilbert (1989, 1996), through to the work of Larsen *et al.* (2000). Related studies of ruderality in a variety of urban habitats (Crowe 1979; Kent *et al.* 1999; Hill *et al.* 2002; Lundholm & Marlin 2006, *inter alia*) have all shown the value of walls in terms of microhabitat preference of certain species in the context of an environment which is subject to frequent disturbance. Other studies have placed a greater emphasis on the cryptogamic flora of walls, with examples ranging from a transect across County Durham by Wright (1984) to the recent *Flora of Dry Stone Walls* conservation project (Presland 2007, 2008a, b). As a result of various ecological investigations, the recognition of the ecological value of the built environment and walls has led to their inclusion in several Local Biodiversity Action Plans (*vide* those of Surrey County Council (2001) and Hull (2002), for example).

The history of the construction of the defences of the key military and ecclesiastical site of Durham, on its peninsula formed by the River Wear, is well known (Page 1928). Probable Anglo-Saxon walls surrounding the cathedral and castle were rebuilt by Bishop Flambard (1099–1128) and the defensive walls extended to encompass most of the peninsula in 1173–1174. In 1315 and again in 1337, the townsfolk petitioned the King for murage grants to construct walls to protect the market place, the focal trading point of the Bishop's Borough. The key aspect of these early details is that the wall habitat may be viewed as a relatively ancient artificial ecosystem and that, although many of the defences from the early historical periods do not survive, their

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continual alteration and augmentation have provided a constant sequence of mural habitats for populations of species to colonise. The greater proportion of the walls in the city, the heirs of this long history of urban evolution, are of eighteenth and nineteenth century origin and this fact is implicit in the statement by Woodell & Rossiter (1959) that 'factors contributing to the high number of species present are the great age of many of the buildings and walls in the city, and the present state of neglect of many of them.'

In the half century since this statement, there have been many aspects of urban development which would appear to have caused subtle ecological changes to the city environment and thus, the flora of Durham walls. The full effects of the Clean Air Act 1956 would not have been realised at the time of the 1955–1958 survey and atmospheric conditions have been further ameliorated by the Smoke Control Area provisions of the 1968 Act, reinforced by the Clean Air Act 1993. The Rivers (Prevention of Pollution) Act 1951 was in force and its repeal by the Control of Pollution Act 1974, no doubt contributed to increases in the floristic diversity of the riverside retaining walls. To a certain extent, these increases may have been negated by the construction of new flood defences of a structure less amenable to plant colonisation. Further, the perceived general gentrification of the city in association with the designation of the Cathedral and Castle environs as a World Heritage Site in 1986 (extended 2008) would seem to suggest a means for the potential rectification of the neglect described by Woodell & Rossiter. The basic hypothesis for this resurvey of the flora of Durham walls fifty years later, is that the combination of a variety of general environmental change and urban developmental processes have had a cumulative effect to reduce the floristic diversity of this particular habitat.

SURVEY AND METHODOLOGY

The methods of the investigation undertaken by Woodell & Rossiter were difficult to replicate based on the rather minimal information published in their 1959 paper. They 'listed the flora of 66 walls from Durham City and its environs' on 'a series of visits over the whole year'. The walls were mainly of the simple type, but the survey also included bridges, old

buildings and stone buttresses. The composition and aspect of each wall and its function was recorded, but such data not included in the paper. Details are also lacking on the criteria by which the sample walls were chosen or what was the size of the sample. Some enlightenment was provided to the author by Dr Stan Woodell through personal communications in 1968, but unfortunately much of the raw data had been discarded at that time. Some original data was lodged with the Durham Colleges Natural History Society, founded by Woodell in 1953, to which the author had access as editor of the society journal in 1967–1968. These sources indicated that the survey was unstructured in terms of geography and that a wall was sampled initially when it had a complement of more than eight species in a fifteen metres length, and thereafter, whenever a new or different species not previously listed was noted. The walls chosen fell mainly within the urban core of the city around the castle and cathedral, radiating out to the Victorian terraces to the south of the city, perhaps within 'a radius of one mile from the castle'. Out-of-town sites at Shincliffe village, Old Durham and Finchale Priory, which fell within the purview of Durham City Council, were included in the survey on account of their age and heritage importance. The lists included only those species rooted in the fabric of the wall and the archive provided records of the occurrence of all the species recorded in four broad groups, i.e. the 14 species with 15 or more records (published in Woodell & Rossiter and identified in this paper as 'Category 1 species'); the 8 species recorded between 10 and 14 times ('Category 2 species'); the 21 between 5 and 9 times ('Category 3 species'); and the 129 species recorded less than 5 times ('Category 4 species').

The recent research began with a feasibility study in September 2006 on the variety of fabric types and potential differences in floristic complement due to aspect and shade. This study indicated that all the walls were mortared, that the greater proportion was of local sandstone and that little significant difference between the floras of brick as opposed to sandstone fabric could be determined. Similarly, few variations due to either aspect or shade were apparent within the context of the selection of samples by the minimum species number criterion. The preliminary survey also concentrated on determining the general

potential for replication of the survey by Woodell & Rossiter, particularly the identification of potential sites for analysis, with attempts to identify specific sites mentioned in their paper and archive. Direct comparisons with a few sites were possible. For example, their 'brick kiln, in large meadow near river' is in fact the grain/root vegetable silo at Kepier Farm (site 66, NZ284434). Other sites could be identified as the only locality for a particular species in both surveys, such as *Campanula rotundifolia* on the wall opposite the Seven Stars Inn, Shincliffe (67, NZ293406), *Milium effusum* on Cathedral Banks, Pimlico (20, NZ271419) and *Stellaria holostea* in Margery Lane, Durham School (4, NZ268420). It soon became apparent that it would be possible to find a similar number of sites, with eight or more species in a minimum required length of fifteen metres, in a similar geographical spread, for analysis through 2007 and 2008. The 68 sites (cf 66 of Woodell & Rossiter) fell unevenly within ten monads with a concentration of 29 in NZ 2742, the World Heritage Site and old urban core of the city (see Appendix 3 for details). Each site was visited on three occasions in both 2007 and 2008 during the last fortnight of April, the last week of June/first week of July, and in the first fortnight of September. The total complement of chasmophytes actually rooted in the fabric of the wall was recorded.

Mention was also made in Woodell & Rossiter (1959) of the wall flora of towns and villages to the west of the city in Weardale and Teesdale, though with little specificity of locality. As a second part of the present survey, it was decided to attempt an overall comparison of urban/rural wall floras and feasibility studies were undertaken in the period from September 2007 to January 2008. Their aims were twofold. The first sought to examine the potential for the generation of a comparative data set from the towns and villages of Weardale (Frosterley & Wolsingham and Stanhope) and Teesdale (Barnard Castle and Middleton-in-Teesdale). Thirty sample sites were selected from four localities, two in each dale, from a total of thirteen monads in relatively close comparison with the similar number in the city (see Appendix 3 for details). The methods used and the frequency of visit during 2008 were the same as for the urban survey.

RESULTS

A. INDICATIONS OF URBAN FLORISTIC CHANGE, 1958–2008

After nomenclatural corrections since 1958, the total complement of species recorded in the two surveys in Durham City was 260, though this figure would certainly have been higher had identification of the microspecies of *Taraxacum officinale* and *Rubus fruticosus* been attempted. On the advice of Dr A.J. Richards, the former was recorded as *Taraxacum* Section *Ruderalia*, since most urban dandelions fall into this group and many may be identified to either *T. exacutum* or *T. ekmanii*. The mature specimens of *Rubus fruticosus* which were encountered usually keyed out to *R. dasyphyllus*, but most were too immature to be positively identified. A similar situation applied to many seedlings of *Cotoneaster* – *C. simonsii* and the *C. × wateri* complex – but *C. horizontalis* was usually distinct. No attempt was made to distinguish taxa and hybrids in *Rosa* Section *Caninae*, Subsection *Caninae*. The full list of species is presented in Appendix 1 in which three categories are recognised: those species recorded in both surveys; those recorded in 1959, but not seen as chasmophytes in 2006–2008; and those not recorded in 1959 but noted in 2006–2008. Of the 159 species of pteridophyte, gymnosperm and angiosperm recorded in the 1959 paper, 34 were not noted as chasmophytes in 2006–2008, but all, with the exception of *Deschampsia flexuosa*, *Galium saxatile* and *Genista rigida*, were recorded in a variety of other habitats, notably wall bases and in overhanging garden shrubbery. The 2006–2008 survey recorded 226 species, including 86 chasmophyte species that were not recorded in the original 1959 paper. The primary indication of change from comparison of the two data sets is thus that the overall diversity of the urban wall flora has not been reduced in the intervening fifty years, rather, that it has increased by between 39% and 42% using the total species difference between Woodell & Rossiter and the 226 species of the 2006–2008 survey, and the 260 total recorded species for the two surveys.

A second indication of the nature of change may be derived from a closer look at the patterns of distribution of the 226 species in the

2006–2008 survey. Basically, the following data indicate that the mural vegetation has become more prominent, better developed and that the likelihood of encountering a species-rich community is far greater in 2008 than in 1958.

- a. the range of species number was from 12 to 46 with a mean number of 22.4 per sample; thirty-eight samples had 20 or more species;
- b. 68 species occurred in seven (>10%) or more samples and 29 species in 17 (25%) or more samples;
- c. 35 species occurred in 15 or more samples compared with 14 of Woodell & Rossiter (see Table 1);
- d. 85 species occurred in five or more samples compared with 45 of Woodell & Rossiter;
- e. 137 species occurred in four samples and less, 75 of these in only one sample; the relative numbers from Woodell & Rossiter were 129 and 74; the two surveys had only 72 and 39 species in common respectively in these two categories (see Appendix 2 for details).

Reference to Table 1 provides an insight into the changes in percentage frequency of individual species in the four categories recognised by Woodell & Rossiter. Of the fourteen species in Category 1 (Table 1a), only four (*Senecio jacobaea*, *Rubus fruticosus*, *Taraxacum* Section *Ruderalia* and *Epilobium montanum*) have increased in frequency. *Dactylis glomerata* and *Senecio vulgaris* are the two of the remaining ten species which show the greatest decline. Direct comparisons with species falling into Categories 2, 3 and 4 are not possible due to the lack of detail in the 1959 paper, but taking the maximum possible percentage frequency for each category (i.e. 21, 14 and 6) it is possible to see that none of the species achieving an overall frequency >20% in 2008 has declined. Category 2 is notable for the increase of *Hedera helix* and *Urtica dioica*, in Category 3 *Cymbalaria muralis*, *Galium aparine* and *Geum urbanum* stand out, whilst the three fern species *Phyllitis scolopendrium*, *Dryopteris filix-mas* and *Asplenium ruta-muraria* are of interest in Category 4.

The final group of seven species in Table 1e, those not recorded in the earlier survey, are of particular interest. Neophyte species such as *Epilobium ciliatum*, *Centranthus ruber*, *Cotoneaster horizontalis* and *Senecio squalidus* would fall into the common perception of invasive weed species, but perhaps not so the other three native species. In this context, an analysis of the status categories of the total complement of species, as defined by Preston, Pearman & Dines (2002) – native, archaeophyte and neophyte – provides some indication of the types of invading species since 1958. This must be viewed with a certain latitude for species such as *Clematis vitalba*, *Euphorbia amygdaloides* and *Meconopsis cambrica*, *inter alia*, considered native in a part of their range are clearly of horticultural origin on the city walls. With this reservation in mind, it is interesting to note that the main increase in diversity has been due to the addition of an increment of 54 native species in contrast with a mere ten neophytes.

B. A COMPARISON OF URBAN AND RURAL FLORAS AND THE NATURE OF RURAL SIGNATURES

	W & R	2006–2008	Both
Total	159	226	260
Native	106	160	173
Archaeophyte	17	20	23
Neophyte	36	46	64

Perhaps the most interesting feature of the Durham Dales data set from 120 samples of rural walls was the lower diversity when compared to that of Durham City, specifically, a total of 162 species as opposed to 226. The Durham Dales data set had 135 species in common with that of Durham City and also a total of 27 species not recorded on the urban walls. The difference may in part be explained by the absence of samples from riverside retaining walls in all rural localities except Barnard Castle. This locality did, however, have the lowest total of the four sub-sets, totals for which ranged between 95 and 107 species. Other differences may be seen in the summary data presented below, particularly in that the range and mean number of species per sample are considerably lower in the rural situation.

TABLE 1. SIGNIFICANT CHANGES IN PERCENTAGE FREQUENCY OF KEY SPECIES,
1958–2008
[1957/58 (a) and 2006–2008 (b)]

a. Changes in the Percentage Frequency of 1958 Category 1 species (>15 records/>23%)

	a		b		+/-%
	n	%	n	%	
<i>Taraxacum</i> Section <i>Ruderalia</i>	42	64	54	79	+15
<i>Chamerion angustifolium</i>	35	53	34	50	-3
<i>Sambucus nigra</i>	27	41	22	32	-9
<i>Dactylis glomerata</i>	26	39	14	21	-18
<i>Poa annua</i>	26	39	16	24	-15
<i>Epilobium montanum</i>	25	38	31	46	+8
<i>Acer pseudoplatanus</i>	23	35	17	25	-10
<i>Senecio vulgaris</i>	18	27	6	9	-18
<i>Lolium perenne</i>	15	23	9	13	-10
<i>Plantago lanceolata</i>	15	23	15	22	-1
<i>Poa pratensis</i> agg.	15	23	12	18	-5
<i>Rubus fruticosus</i>	15	23	29	43	+20
<i>Rumex obtusifolius</i>	15	23	9	13	-10
<i>Senecio jacobaea</i>	15	23	35	51	+28

b. 1958 Category 2 species (10–14 records/15–21%) achieving >20% frequency in 2008 (5 species)

<i>Hedera helix</i>	14	21	42	62	+41
<i>Urtica dioica</i>	14	21	36	53	+32
<i>Agrostis stolonifera</i>	14	21	22	32	+11
<i>Festuca rubra</i>	14	21	19	28	+7
<i>Ranunculus repens</i>	14	21	16	24	+3

c. 1958 Category 3 species (5–9 records/8–14%) achieving >20% frequency in 2008 (10 species)

<i>Cymbalaria muralis</i>	9	14	34	50	+36
<i>Galium aparine</i>	9	14	30	44	+30
<i>Geum urbanum</i>	9	14	30	44	+30
<i>Fraxinus excelsior</i>	9	14	28	41	+27
<i>Lapsana communis</i>	9	14	27	40	+26
<i>Sonchus oleraceus</i>	9	14	25	37	+23
<i>Arrhenatherum elatius</i>	9	14	23	34	+20
<i>Geranium robertianum</i>	9	14	21	31	+17
<i>Sonchus asper</i>	9	14	19	28	+14
<i>Sisymbrium officinale</i>	9	14	14	21	+7

d. 1958 Category 4 species (1–4 records/max 6%) achieving >20% frequency in 2008 (5 species)

<i>Phyllitis scolopendrium</i>	4	6	21	31	+25
<i>Buddleia davidii</i>	4	6	19	28	+22
<i>Dryopteris filix-mas</i>	4	6	18	26	+20
<i>Tanacetum parthenium</i>	4	6	18	26	+20
<i>Asplenium ruta-muraria</i>	4	6	15	22	+16

e. Percentage frequency of species not recorded in 1958, >20% in 2008 (7 species)

<i>Epilobium ciliatum</i>	-	-	42	62	-
<i>Holcus lanatus</i>	-	-	28	41	-
<i>Cotoneaster horizontalis</i>	-	-	24	35	-
<i>Centranthus ruber</i>	-	-	19	28	-
<i>Senecio squalidus</i>	-	-	17	25	-
<i>Hieracium vulgatum</i>	-	-	16	24	-

	a	b	c	d	e	f	g
Durham City 2008	226	7	37	68	158	12–46	22.40
Durham Dales 2008	162	4	22	42	120	8–33	15.00
Barnard Castle	95	7	26	38	47	10–24	14.00
Middleton-in Teesdale	98	5	29	49	49	10–23	14.75
Stanhope	103	4	26	45	58	9–26	14.00
Fosterley & Wolsingham	107	4	26	61	46	8–33	16.26

[a. Total number of species; b. number of species in >50% samples; c. number of species in >20% samples; d. number of species in >10% samples; e. number of species in <10% samples; f. range of species numbers per sample; g. mean species number per sample.]

The differences in frequency of individual species recorded in >20% samples in either data set between the urban and rural situations are shown in Table 2 in which three groups are recognised: a. species more common on urban walls by >20% difference; b. species more common on urban walls by 10–19% difference; and c. species more common on rural walls. The greater proportion of species falling into categories a and b is the most interesting immediate feature of the table, whilst the percentage difference may be interpreted as a simple index of urbanity or rurality. This latter concept is rather tenuous when applied to the data set as a whole for the four data sub-sets provide an implication of specific floristic signatures for the dale villages. Reference to Table 3, in which the number of records for those species achieving an overall frequency >10% are presented for the four sub-sets, indicates local concentrations of certain indicator species combinations. The key species of the signatures are as follows:

Barnard Castle

Linaria purpurea, *Phyllitis scolopendrium*,
Centranthus ruber

Middleton-in-Teesdale

Geranium lucidum, *Geranium robertianum*,
Dryopteris filix-mas, *Poa pratensis*

Stanhope

Erinus alpinus, *Poa nemoralis*, *Arabis caucasica*, *Aubretia deltoidea*, *Mycelis muralis*, *Ceastium tomentosum*

Fosterley/Wolsingham

Cotoneaster horizontalis, *Alliaria petiolata*,
Tanacetum parthenium, *Fraxinus excelsior*,
Arabis caucasica, *Aubretia deltoidea*

DISCUSSION AND CONCLUSIONS

Four major discussion points emerge from the results presented above. First, the overall floristic diversity of the walls of Durham City

has increased by between 39% and 42% in the period 1958–2008, suggesting that the prime factors of the amelioration of atmospheric conditions has enabled the colonization of the mural habitat with an increasing number of mainly native, as opposed to neophyte species. The hypothesis that general urban gentrification has had a deleterious effect on biodiversity would thus seem to be unfounded. As a corollary to these findings, it is interesting to note that a comparison of urban and rural walls indicates that the flora of the former is more diverse than the latter, although the proviso must be made that the rural data set did not include samples from riverside retaining walls, whereas the urban sample did. Both these features provide a strong case for the integration of biodiversity into urban planning, a major field of largely theoretical research and development for the past twenty years which has begun to manifest itself in the twenty-first century mainly through the agency of Local Urban Biodiversity Action Plans.

A second discussion topic concerns the importance of urban walls as a refuge habitat for certain groups of species which have been suggested to be in decline on a national scale. Indices for change in the national distribution of individual species have been generated in recent times by Preston, Pearman & Dines (2002) and by Braithwaite, Ellis & Preston (2006), the latter providing strong evidence that many species of their category BH17 (Built-up areas and gardens) have increased their frequency in recent times. The authors point out (p. 228) that 'plants with low fertility requirements and those of climates characterised by low rainfall and warm summers have done especially well.' The species in this category are those from a variety of urban habitats, not specifically those growing on walls, and conversely, many of those found on the walls of Durham City are more typical of other broad habitat types as defined by

TABLE 2. A COMPARISON OF SPECIES FREQUENCIES IN THE URBAN (DC) AND RURAL (DD) DATA SETS
(species with >20% frequency in one or both data sets)

	DC	DD	Diff
a. Species more common in urban walls			
(>20% difference)			
<i>Lapsana communis</i>	40	9	31
<i>Geum urbanum</i>	44	15	29
<i>Holcus lanatus</i>	41	13	28
<i>Chamerion angustifolium</i>	50	23	27
<i>Arrhenatherum elatius</i>	34	7	27
<i>Fraxinus excelsior</i>	42	15	27
<i>Galium aparine</i>	44	18	26
<i>Epilobium montanum</i>	46	23	23
<i>Rubus fruticosus</i>	43	21	22
<i>Acer pseudoplatanus</i>	25	3	22
<i>Senecio squalidus</i>	25	4	21
<i>Epilobium ciliatum</i>	62	42	20
<i>Buddleia davidii</i>	28	8	20
b. Species more common in urban walls			
(10–19% difference)			
<i>Cotoneaster horizontalis</i>	37	18	19
<i>Agrostis stolonifera</i>	32	13	19
<i>Phyllitis scolopendrium</i>	31	12	19
<i>Sonchus asper</i>	28	10	18
<i>Sisymbrium officinale</i>	20	3	17
<i>Ranunculus repens</i>	24	7	17
<i>Senecio jacobaea</i>	51	35	16
<i>Plantago lanceolata</i>	22	6	16
<i>Hieracium vulgatum</i>	24	9	15
<i>Taraxacum</i> Section <i>Ruderalia</i>	79	67	12
<i>Sambucus nigra</i>	32	20	12
<i>Centranthus ruber</i>	28	16	12
<i>Hedera helix</i>	62	51	11
<i>Dryopteris filix-mas</i>	26	15	11
<i>Sonchus oleraceus</i>	37	28	9
<i>Urtica dioica</i>	53	45	8
<i>Geranium robertianum</i>	31	23	8
<i>Tanacetum parthenium</i>	26	22	4
c. Species more common on rural walls			
<i>Asplenium ruta-muraria</i>	22	62	40
<i>Sedum acre</i>	4	28	24
<i>Cardamine hirsuta</i>	22	45	23
<i>Asplenium trichomanes</i>	16	36	20
<i>Poa annua</i>	24	36	12
<i>Cymbalaria muralis</i>	50	60	10
<i>Dactylis glomerata</i>	20	29	9
<i>Poa compressa</i>	12	20	8
<i>Poa pratensis</i>	18	21	3
<i>Festuca rubra</i>	28	30	2

TABLE 3. CHARACTERISTICS OF RURAL DATA SETS: FLORISTIC SIGNATURES FOR INDIVIDUAL SETTLEMENTS

[numbers of records for species achieving >10% total frequency for T (Total), BC (Barnard Castle), MT (Middleton-in-Teesdale), S (Stanhope), FW (Frosterley and Wolsingham)]

	T	BC	MT	S	FW
<i>Taraxacum</i> Section <i>Ruderalia</i>	80	17	18	20	25
<i>Asplenium ruta-muraria</i>	74	22	12	22	18
<i>Cymbalaria muralis</i>	72	23	18	18	13
<i>Hedera helix</i>	61	20	8	11	22
<i>Cardamine hirsuta</i>	54	15	16	8	15
<i>Urtica dioica</i>	54	11	10	13	20
<i>Epilobium ciliatum</i>	50	16	15	7	12
<i>Poa annua</i>	44	7	17	9	11
<i>Asplenium trichomanes</i>	43	11	13	13	6
<i>Senecio jacobaea</i>	42	16	9	4	13
<i>Senecio vulgaris</i>	40	13	13	8	6
<i>Festuca rubra</i>	36	7	10	10	9
<i>Dactylis glomerata</i>	35	8	8	9	10
<i>Sedum acre</i>	34	3	14	9	8
<i>Sonchus oleraceus</i>	34	10	6	10	8
<i>Epilobium montanum</i>	28	5	13	4	6
<i>Geranium robertianum</i>	28	3	14	7	4
<i>Chamerion angustifolium</i>	28	3	8	8	9
<i>Tanacetum parthenium</i>	26	8	3	5	10
<i>Poa pratensis</i>	25	5	10	5	5
<i>Rubus fruticosus</i>	25	9	6	6	4
<i>Poa compressa</i>	24	4	3	9	8
<i>Sambucus nigra</i>	24	7	2	6	9
<i>Alliaria petiolata</i>	23	6	5	2	10
<i>Erinus alpinus</i>	23	3	0	16	4
<i>Linaria purpurea</i>	23	10	3	5	5
<i>Cotoneaster horizontalis</i>	22	1	4	6	11
<i>Galium aparine</i>	21	6	4	3	8
<i>Poa nemoralis</i>	21	1	5	14	1
<i>Centranthus ruber</i>	19	8	2	4	5
<i>Geranium lucidum</i>	19	1	14	2	2
<i>Dryopteris filix-mas</i>	18	4	10	4	0
<i>Fraxinus excelsior</i>	18	2	4	1	11
<i>Geum urbanum</i>	18	5	7	1	5
<i>Agrostis stolonifera</i>	16	4	4	5	3
<i>Arabis caucasica</i>	16	0	1	7	8
<i>Digitalis purpurea</i>	16	6	6	3	3
<i>Aubretia deltoidea</i>	15	0	3	7	5
<i>Holcus lanatus</i>	15	3	6	1	5
<i>Ulmus glabra</i>	15	6	4	3	2
<i>Polypodium vulgare</i>	14	2	9	2	1
<i>Phyllitis scolopendrium</i>	14	9	2	2	1
<i>Arabidopsis thaliana</i>	13	0	8	2	3
<i>Cerastium tomentosum</i>	12	1	4	6	1
<i>Mycelis muralis</i>	12	2	0	7	3

TABLE 4. TYPES OF NATIONAL CHANGE INDICES AND URBAN CHANGE FREQUENCIES FOR SELECT SPECIES

[CI – Change Index from Preston, Pearman & Dines (2002); CF – Change Factor from Braithwaite, Ellis & Pearman (2006); %C – Durham City data 1958–2008]

a. All 3 measures positive

	CI	CF	%C
<i>Buddleia davidii</i>	+3.73	+70	+22
<i>Agrostis stolonifera</i>	+3.66	+77	+11
<i>Festuca rubra</i>	+2.96	+22	+7
<i>Sonchus asper</i>	+0.78	+28	+14
<i>Phyllitis scolopendrium</i>	+0.45	+33	+25
<i>Tanacetum parthenium</i>	+0.23	+47	+20
<i>Asplenium ruta-muraria</i>	+0.15	+5	+16
<i>Senecio jacobaea</i>	+0.11	+4	+28

b. One national change index negative, urban positive

<i>Ranunculus repens</i>	+0.55	-51	+3
<i>Arrhenatherum elatius</i>	+0.37	-2	+20
<i>Urtica dioica</i>	+0.28	-27	+32
<i>Dryopteris filix-mas</i>	+0.03	-13	+20
<i>Cymbalaria muralis</i>	-0.10	+10	+36
<i>Sisymbrium officinale</i>	-0.21	+6	+7
<i>Geranium robertianum</i>	-0.41	+13	+17
<i>Sonchus oleraceus</i>	-0.42	+18	+23
<i>Lapsana communis</i>	-0.47	+2	+26
<i>Geum urbanum</i>	-0.53	+11	+30

c. Both national change indices negative, urban positive

<i>Galium aparine</i>	-0.09	-16	+30
<i>Rubus fruticosus</i>	-0.29	-19	+20
<i>Epilobium montanum</i>	-0.39	-10	+8
<i>Hedera helix</i>	-0.65	-26	+41
<i>Fraxinus excelsior</i>	-0.73	-12	+27

d. One national change index positive, urban negative

<i>Plantago lanceolata</i>	+1.35	-75	-1
<i>Poa annua</i>	+0.83	-68	-15
<i>Rumex obtusifolius</i>	+0.66	-8	-10
<i>Poa pratensis</i>	+0.60	-28	-5
<i>Acer pseudoplatanus</i>	-0.40	+2	-10

e. All three measures negative

<i>Chamerion angustifolium</i>	-0.01	-17	-3
<i>Dactylis glomerata</i>	-0.06	-19	-18
<i>Lolium perenne</i>	-0.29	-11	-10
<i>Sambucus nigra</i>	-0.75	-4	-9
<i>Senecio vulgaris</i>	-1.08	-9	-18

Braithwaite, Ellis & Pearman. In spite of these differences in the two categories, some comparisons are possible. Using the change index (CI) of Preston, Pearman & Dines (2002) and the Change Factor (CF) from Braithwaite, Ellis & Pearman (2006), Table 4 categorises the Durham City wall species into five groups: those with positive or negative values (a and e) for all three indices; those with conflicting national indices, positive for urban wall habitats (b); those with negative national values, positive for urban wall habitats (c); and those with conflicting national indices and negative values for urban walls (d). Many interpretations of these data are possible, but the over-riding impression that emerges is the importance of urban wall habitats as refuges for species which have been otherwise viewed as being in decline.

The third aspect of the research concerns the general representativeness of the data at the regional and national scales, the primary indication of which must come from plant sociological considerations. The accepted classification of rock crevice and wall vegetation in western Europe is that published in Rodwell (2000) and Rodwell *et al.*, (2000), and it is into the two alliances Centrantho-Parietarium Rivas-Martinez 1960 and Cymbalaria-Asplenion Segal 1969 that most chasmophyte wall communities of Great Britain and Ireland may be classified. The city and county data for Durham indicate that stands of the former thermophilous communities are poorly represented and although indicator species such as *Centranthus ruber*, *Parietaria judaica*, *Antirrhinum majus* and *Erysimum cheiranthoides* are generally uncommon, it would seem to be of importance to flag these species as potential indicators of future climatic amelioration. Thus, the data primarily reflect the geographical realm of the Cymbalaria-Asplenion. Whilst the combination of *Cymbalaria muralis* with either or both *Asplenium ruta-muraria* and *A. trichomanes* is a sound indication of such communities, combinations which are to be found quite commonly in both urban and rural data sets, it is important to realise that many wall samples do not fall into this typical wall community. Many stands combine species typical of weedy vegetation dominated by phospho-nitrophilous perennials (Galio-Urticetea, e.g. *Galium aparine* and *Urtica dioica*) with disturbance indicators such as *Chamerion angustifolium* (Epilobietea angustifolii) and, falling into the category of 'communities of open habitats', await closer

definition. In terms of evidence for the boreal influence and the presence of stands referable to the alliance Cystopteridion fragilis Richard 1972, the presence of *Cystopteris fragilis* alone, or in combination with *Polypodium vulgare* and species of *Asplenium* is also a fringe feature, the type species being found in only ten of the Durham Dales samples, notably in the more humid atmosphere of Middleton-in-Teesdale.

The fourth point concerns the identification of potential climate change indicators as a basis for future monitoring. In addition to the group of Centrantho-Parietarium species and *Cystopteris fragilis* mentioned above, two other species are worthy of interest, namely *Ceterach officinarum* and *Erinus alpinus*. The former was not recorded in either data set, but was formerly known in one site, in Durham City (Graham 1988, Dr M. Smith pers. comm.). It was seen during the present survey in two rural localities in Weardale and one in lower Teesdale and appears to have spread since the publication of the County Flora in 1988. This member of the Submediterranean-Subatlantic element (Preston & Hill 1997) is presently known in only five tetrads, but may be following the trend noted by Rumsey (2002) of benefiting from the built environment in its spread in eastern England. According to *The Flora of North-east England* (2009), *Erinus alpinus* is only known in two tetrads post-2000. The present survey, however, added a further two tetrads to the east in Weardale and the first record for Teesdale at Barnard Castle. Being a plant of Subatlantic-Montane distribution, its liking for the cooler climates of northern England and Scotland was noted by Ellis (1993), whilst Horsfall (2002) records a change index of +1.52. It is a chasmophyte which is capable of colonizing the smallest of mortared cracks in walls wherein the small seeds germinate freely. It has a strong association with both *Asplenium ruta-muraria* and *Cymbalaria muralis* and the stands of wall vegetation in which it is dominant may be viewed as a humid, northern variant of the widespread OV42 community. The basic question to be posed in this context is whether changes in the distribution of representative species from these and other geographical elements, involving their spread into urban wall habitats, is a reliable reflection of a reaction to general climate change, or whether spread is encouraged by the peculiar microclimatic characteristics of the built environment?

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APPENDIX 1. FLORA OF DURHAM CITY WALLS, 1959–2008

[regular – recorded in both the 1959 and 2006–2008 surveys; *italic* – recorded in the 1959 survey but not noted as a chasmophyte in the 2006–2008 survey; ***bold/italic*** – not recorded in the 1959 survey but recorded as a chasmophyte in 2008; * nomenclature changes 1959–2008]

001 <i>Acer plat</i>	002 <i>Acer pseu</i>	003 <i>Achi mill</i>	004 <i>Aego poda</i>	005 <i>Aeth cyna</i>	006 <i>Agro capi*</i>
007 <i>Agro stol</i>	008 <i>Alch moll</i>	009 <i>Alli peti</i>	010 <i>Alli ursi</i>	011 <i>Alnu glut</i>	012 <i>Alop prat</i>
013 <i>Alys saxa</i>	014 <i>Ange sylv</i>	015 <i>Anis ster*</i>	016 <i>Anth odor</i>	017 <i>Anth sylv</i>	018 <i>Anti maju</i>
019 <i>Aqui vulg</i>	020 <i>Arab thal</i>	021 <i>Arct minu</i>	022 <i>Arrh elat</i>	023 <i>Arte vulg</i>	024 <i>Aste lanc</i>
025 <i>Aste novi</i>	026 <i>Athy fili</i>	027 <i>Atri patu</i>	028 <i>Aspl adia</i>	029 <i>Aspl ruta</i>	030 <i>Aspl tric</i>
031 <i>Ball nigr</i>	032 <i>Bell pere</i>	033 <i>Betu pube</i>	034 <i>Brac sylv</i>	035 <i>Brom ramo*</i>	036 <i>Brom hord</i>
037 <i>Budd davi</i>	038 <i>Cale offi</i>	039 <i>Caly sepi</i>	040 <i>Caly silv</i>	041 <i>Camp patu</i>	042 <i>Camp port</i>
043 <i>Camp rapu</i>	044 <i>Camp rotu</i>	045 <i>Caps burs</i>	046 <i>Card flex</i>	047 <i>Card hirs</i>	048 <i>Care pend</i>
049 <i>Care remo</i>	050 <i>Cata rigi</i>	051 <i>Cent nigr</i>	052 <i>Cent rube</i>	053 <i>Cera font*</i>	054 <i>Cera glom</i>
055 <i>Cera tome</i>	057 <i>Chae temu</i>	056 <i>Cham angu*</i>	058 <i>Chel maju</i>	059 <i>Clem vita</i>	060 <i>Cirs arve</i>
061 <i>Cirs vulg</i>	062 <i>Conv arve</i>	063 <i>Cory avel</i>	064 <i>Coto frig</i>	065 <i>Coto hori</i>	066 <i>Coto spec</i>
067 <i>Coto sple</i>	068 <i>Crat mono</i>	069 <i>Cruc laev</i>	070 <i>Cymb mura</i>	071 <i>Cyno cris</i>	072 <i>Cyst scop*</i>
073 <i>Dact glom</i>	074 <i>Dauc caro</i>	075 <i>Desc cesp</i>	076 <i>Desc flex</i>	077 <i>Dian cary</i>	078 <i>Digi purp</i>
079 <i>Dips full</i>	080 <i>Dryo fili</i>	081 <i>Elym cani</i>	082 <i>Elyt repe*</i>	083 <i>Epil cili</i>	084 <i>Epil hirs</i>
085 <i>Epil mont</i>	086 <i>Epil parv</i>	087 <i>Equi arve</i>	088 <i>Erys chei*</i>	089 <i>Euph amyg</i>	090 <i>Euph heli</i>
091 <i>Euph pepl</i>	092 <i>Fagu sylv</i>	093 <i>Fall bald*</i>	094 <i>Fall conv*</i>	095 <i>Fall japo*</i>	096 <i>Fest ovin</i>
097 <i>Fest prat</i>	098 <i>Fest rubr</i>	099 <i>Ficu cari</i>	100 <i>Fili ulma</i>	101 <i>Foen vulg</i>	102 <i>Frag vesp</i>
103 <i>Frag xana*</i>	104 <i>Frax exce</i>	105 <i>Gali apar</i>	106 <i>Gali palu</i>	107 <i>Gali saxa</i>	108 <i>Geni radi</i>
109 <i>Gera luci</i>	110 <i>Gera robe</i>	111 <i>Geum urba</i>	112 <i>Glec hede</i>	113 <i>Hebe xlew</i>	114 <i>Hede heli</i>
115 <i>Hera mant</i>	116 <i>Hera spho</i>	117 <i>Hesp matr</i>	118 <i>Hier saba*</i>	119 <i>Hier vulg</i>	120 <i>Holc lana</i>
121 <i>Holc moll</i>	122 <i>Hord muri</i>	123 <i>Hype andr</i>	124 <i>Hype caly</i>	125 <i>Hype perf</i>	126 <i>Hypo radi</i>
127 <i>Iber semp</i>	128 <i>Ilex aqui</i>	129 <i>Impa glan</i>	130 <i>Iris germ</i>	131 <i>Labu anag</i>	132 <i>Lami albu</i>
133 <i>Lami purp</i>	134 <i>Laps comm.</i>	135 <i>Lath odor</i>	136 <i>Leon autu</i>	137 <i>Leon hisp</i>	138 <i>Leyc form</i>
139 <i>Ligu vulg</i>	140 <i>Lina purp</i>	141 <i>Loli mult</i>	142 <i>Loli pere</i>	143 <i>Loni peri</i>	144 <i>Lupi noot</i>
145 <i>Lyci barb</i>	146 <i>Lycy euro</i>	147 <i>Lysi vulg</i>	148 <i>Maho aqui</i>	149 <i>Malv sylv</i>	150 <i>Matr disc</i>
151 <i>Meco camb</i>	152 <i>Medi lupu</i>	153 <i>Meli offi</i>	154 <i>Ment aqua</i>	155 <i>Ment spic</i>	156 <i>Merc pere</i>
157 <i>Mili effu</i>	158 <i>Myce mura</i>	159 <i>Myos sylv</i>	160 <i>Myrr odor</i>	161 <i>Oena croc</i>	162 <i>Oxal corn</i>
163 <i>Papa rhoe</i>	164 <i>Papa somn</i>	165 <i>Pari juda</i>	166 <i>Pent semp</i>	167 <i>Peta hybr</i>	168 <i>Phal arun</i>
169 <i>Phyl scol</i>	170 <i>Pilo aura</i>	171 <i>Pilo offi*</i>	172 <i>Pisu sati</i>	173 <i>Plan lanc</i>	174 <i>Plan majo</i>
175 <i>Plan medi</i>	176 <i>Poa annu</i>	177 <i>Poa comp</i>	178 <i>Poa nemo</i>	179 <i>Poa prat</i>	180 <i>Poa triv</i>
181 <i>Poly avic</i>	182 <i>Poly seti</i>	183 <i>Pote anse</i>	184 <i>Prun vulg</i>	185 <i>Prun aviu</i>	186 <i>Prun padu</i>
187 <i>Prun spin</i>	188 <i>Pseu lute</i>	189 <i>Pter aqui</i>	190 <i>Quer petr</i>	191 <i>Ranu acri</i>	192 <i>Ranu repe</i>
193 <i>Rese lute</i>	194 <i>Rhod pont</i>	195 <i>Ribe rubr</i>	196 <i>Ribe uvac</i>	197 <i>Rosa cani*</i>	198 <i>Rubu frut</i>
199 <i>Rubu idae</i>	200 <i>Rume acet</i>	201 <i>Rume acel</i>	202 <i>Rume cris</i>	203 <i>Rume long</i>	204 <i>Rume obtu</i>
205 <i>Rume sang</i>	206 <i>Sagi apet</i>	207 <i>Sagi proc</i>	208 <i>Sali capr</i>	209 <i>Sali cine*</i>	210 <i>Sali vimi</i>
211 <i>Samb nigr</i>	212 <i>Saxi xumb*</i>	213 <i>Sedu acre</i>	214 <i>Sedu albu</i>	215 <i>Sedu refl</i>	216 <i>Semp tect</i>
217 <i>Sene cine</i>	218 <i>Sene jaco</i>	219 <i>Sene squa</i>	220 <i>Sene visc</i>	221 <i>Sene vulg</i>	222 <i>Sile vulg</i>
223 <i>Sina arve</i>	224 <i>Sisy offi</i>	225 <i>Sola dulc</i>	226 <i>Soli cana*</i>	227 <i>Sonc aspe</i>	228 <i>Sonc oler</i>
229 <i>Sorb aucu</i>	230 <i>Sorb inter</i>	231 <i>Stac sylv</i>	232 <i>Stel holo</i>	233 <i>Stel medi</i>	234 <i>Stel nemo</i>
235 <i>Symp albu</i>	236 <i>Symp offi</i>	237 <i>Tana part*</i>	238 <i>Tana vulg</i>	239 <i>Tara rude</i>	240 <i>Taxu bacc</i>
241 <i>Trag prat</i>	242 <i>Trif dubi</i>	243 <i>Trif prat</i>	244 <i>Trif repe</i>	245 <i>Trip inod*</i>	246 <i>Tuss farf</i>
247 <i>Ulm glabr</i>	248 <i>Urti dioi</i>	249 <i>Urti uren</i>	250 <i>Vale offi</i>	251 <i>Verb thap</i>	252 <i>Verb virg</i>
253 <i>Vero arve</i>	254 <i>Vero cham</i>	255 <i>Vero serp</i>	256 <i>Vici crac</i>	257 <i>Vici hirs</i>	258 <i>Vici sati</i>
259 <i>Vici sepi</i>	260 <i>Vinc mino</i>				

APPENDIX 2. RECORDS OF SPECIES OCCURRING IN LESS THAN 20% (14) SAMPLES IN DURHAM CITY

(Species only recorded in 2006–2008 denoted in **bold italic**)

No. Species

- 13 *Epilobium hirsutum* (1)
- 12 *Alliaria petiolata*, *Poa pratensis*, *Rosa canina*, *Ulmus glabra* (4)
- 11 *Artemisia vulgaris*, *Asplenium trichomanes*, *Plantago major* (3)
- 10 *Betula pubescens*, *Heracleum sphondylium*, *Stellaria media* (3)
- 9 *Cirsium vulgare*, *Lolium perenne*, *Rumex obtusifolius* (3)
- 8 *Anisantha sterilis*, *Digitalis purpurea*, ***Linaria purpurea***, ***Meconopsis cambrica***, *Poa compressa* (5)
- 7 *Alnus glutinosa*, *Anthriscus sylvestris*, *Capsella bursa-pastoris*, ***Cardamine flexuosa***, *Cotoneaster* spp, *Elymus caninus*, *Festuca ovina*, *Myosotis sylvatica*, *Poa trivialis*, ***Sagina procumbens***, *Taxus baccata*, *Trifolium repens* (12)
- 6 *Antirrhinum majus*, *Cirsium arvense*, *Hypochaeris radicata*, *Impatiens glandulifera*, ***Prunus avium***, *Senecio vulgaris*, *Stachys sylvatica*. (7)
- 5 *Achillea millefolium*, ***Arabidopsis thaliana***, *Crataegus monogyna*, *Hieracium sabaudum*, ***Hypericum androsaemum***, ***Ilex aquifolium***, *Papaver rhoeas*, *Phalaris arundinacea*, ***Rumex sanguineus***, *Veronica arvensis*. (10)
- 4 ***Aegopodium podagraria***, ***Athyrium filix-femina***, ***Brachypodium sylvaticum***, ***Chaerophyllum temulentum***, ***Euphorbia peplus***, *Fagus sylvatica*, *Festuca pratensis*, ***Filipendula ulmaria***, *Rumex longifolius*. (9)
- 3 *Ballota nigra*, ***Calystegia sepium***, *Cerastium fontanum*, *Elytrigia repens*, *Equisetum arvense*, *Fragaria vesca*, *Hebe* × *lewisii*, *Lamium album*, ***Oenanthe crocata***, ***Parietaria judaica***, *Poa nemoralis*, ***Pseudofumaria lutea***, ***Rhododendron ponticum***, *Salix capraea*, *Sedum acre*, ***Solanum dulcamara***, ***Trifolium dubium***, *Verbascum thapsus*, *Veronica chamaedrys*. (19)
- 2 *Aethusa cynapium*, *Agrostis capillaris*, *Arctium minus*, ***Asplenium adiantum-nigrum***, *Calystegia silvatica*, ***Campanula patula***, ***Campanula rapunculus***, ***Carex pendula***, ***Cotoneaster splendens***, *Dipsacus fullonum*, *Fallopia japonica*, ***Hesperis matronalis***, *Holcus mollis*, *Hypericum perforatum*, *Laburnum anagyroides*, *Lamium purpureum*, *Lolium multiflorum*, ***Malva sylvestris***, ***Mycelis muralis***, ***Oxalis corniculata***, ***Papaver somniferum***, *Pentaglottis sempervirens*, ***Polygonum aviculare***, *Ranunculus acris*, *Reseda luteola*, *Ribes uva-crispa*, *Sagina apetala*, *Sedum album*, *Senecio viscosus*, *Sorbus aucuparia*, *Sorbus intermedia*, ***Tanacetum vulgare***, ***Vicia cracca***, ***Vicia hirsuta***. (34)
- 1 ***Acer platanoides***, ***Alchemilla mollis***, ***Allium ursinum***, ***Alyssum saxatile***, ***Angelica sylvestris***, *Anthoxanthum odoratum*, *Aquilegia vulgaris*, *Aster novi-belgi*, *Bellis perennis*, *Bromopsis ramosa*, *Bromus hordaceus*, ***Campanula portenschlagiana***, *Campanula rotundifolia*, ***Carex remota***, ***Catapodium rigidum***, *Centaurea nigra*, ***Cerastium glomeratum***, *Cerastium tomentosum*, ***Chelidonium majus***, ***Clematis vitalba***, *Corylus avellana*, *Cotoneaster frigida*, ***Cruciata laevipes***, *Cynosurus cristatus*, *Cystisus scoparius*, ***Daucus carota***, *Erysimum cheiranthoides*, ***Euphorbia amygdaloides***, ***Euphorbia helioscopia***, *Fallopia baldschuanica*, ***Foeniculum vulgare***, ***Galium palustre***, *Geranium lucidum*, *Hordeum murinum*, ***Hypericum calycinum***, ***Iberis sempervirens***, *Leontodon autumnalis*, *Leontodon hispidus*, ***Leycesteria formosa***, *Ligustrum vulgare*, ***Lonicera periclymenum***, *Lycium barbarum*, ***Lycopus europaeus***, ***Lysimachia vulgaris***, ***Mahonia aquifolium***, ***Medicago lupulina***, ***Melissa officinalis***, *Mentha aquatica*, *Mentha spicata*, *Milium effusum*, *Myrrhis odorata*, *Petasites hybridus*, *Pilosella aurantiaca*, *Pilosella officinarum*, ***Polystichum setiferum***, ***Prunella vulgaris***, ***Prunus spinosa***, *Quercus robur*, ***Ribes rubrum***, *Rumex acetosa*, ***Rumex crispus***, *Salix cinerea*, *Salix viminalis*, ***Sedum reflexum***, *Sempervivum tectorum*, ***Senecio cinerea***, *Silene vulgaris*, *Solidago canadensis*, *Stellaria holostea*, ***Symphoricarpos albus***, ***Tragopogon pratensis***, *Tussilago farfara*, *Valeriana officinalis*, ***Verbascum virgatum***, *Veronica serpyllifolia*, ***Vicia sativa***. (75)

APPENDIX 3. SUMMARY OF MONAD DISTRIBUTION OF SAMPLE SITES

1 km grid square reference (number of samples); full details are available on request

DURHAM CITY

NZ2642 (12); NZ2643 (2); NZ2741 (8); NZ2742 (29); NZ2743 (1); NZ2841 (1); NZ2842 (7); NZ2843 (2); NZ2940 (2); NZ2946 (1)

DURHAM DALES

Barnard Castle: NZ0416 (15); NZ0516 (15); **Middleton-in-Teesdale:** NY9425 (23); NY9426 (2); NY9525 (5).

Stanhope: NY9940 (5); NZ9839 (3); NZ9939 (22); **Frosterley & Wolsingham:** NZ0236 (12); NZ0336 (2); NZ0736 (2); NZ0737 (12); NZ0837 (2)

APPENDIX 4. FLORA OF DURHAM DALES WALLS, 2006–2008

(bold/italic – flora of Durham Dales walls; italic – flora of Durham City walls 1958–2008)

001 <i>Acer plat</i>	002 <i>Acer pseu</i>	003 <i>Achi mill</i>	004 <i>Aego poda</i>	005 <i>Aeth cyna</i>	006 <i>Agro capi*</i>
007 <i>Agro stol</i>	008 <i>Alch moll</i>	009 <i>Alli peti</i>	010 <i>Alli ursi</i>	011 <i>Alnu glut</i>	012 <i>Alop prat</i>
013 <i>Alys saxa</i>	014 <i>Ange sylv</i>	015 <i>Anis ster*</i>	016 <i>Anth odor</i>	017 <i>Anth sylv</i>	018 <i>Anti maju</i>
019 <i>Aqui vulg</i>	020 <i>Arab thal</i>	021 <i>Arct minu</i>	022 <i>Arrh elat</i>	023 <i>Arte vulg</i>	024 <i>Aste lanc</i>
025 <i>Aste novi</i>	026 <i>Athy fili</i>	027 <i>Atri patu</i>	028 <i>Aspl adia</i>	029 <i>Aspl ruta</i>	030 <i>Aspl tric</i>
031 <i>Ball nigr</i>	032 <i>Bell pere</i>	033 <i>Betu pube</i>	034 <i>Brac sylv</i>	035 <i>Brom ramo*</i>	036 <i>Brom hord</i>
037 <i>Budd davi</i>	038 <i>Cale offi</i>	039 <i>Caly sepi</i>	040 <i>Caly silv</i>	041 <i>Camp patu</i>	042 <i>Camp port</i>
043 <i>Camp rapu</i>	044 <i>Camp rotu</i>	045 <i>Caps burs</i>	046 <i>Card flex</i>	047 <i>Card hirs</i>	048 <i>Care pend</i>
049 <i>Care remo</i>	050 <i>Cata rigi</i>	051 <i>Cent nigr</i>	052 <i>Cent rube</i>	053 <i>Cera font*</i>	054 <i>Cera glom</i>
055 <i>Cera tome</i>	057 <i>Chae temu</i>	056 <i>Cham angu*</i>	058 <i>Chel maju</i>	059 <i>Clem vita</i>	060 <i>Cirs arve</i>
061 <i>Cirs vulg</i>	062 <i>Conv arve</i>	063 <i>Cory avel</i>	064 <i>Coto frig</i>	065 <i>Coto hori</i>	066 <i>Coto spec</i>
067 <i>Coto sple</i>	068 <i>Crat mono</i>	069 <i>Cruc laev</i>	070 <i>Cymb mura</i>	071 <i>Cyno cris</i>	072 <i>Cyst scop*</i>
073 <i>Dact glom</i>	074 <i>Dauc caro</i>	075 <i>Desc cesp</i>	076 <i>Desc flex</i>	077 <i>Dian cary</i>	078 <i>Digi purp</i>
079 <i>Dips full</i>	080 <i>Dryo fili</i>	081 <i>Elym cani</i>	082 <i>Elyt repe*</i>	083 <i>Epil cili</i>	084 <i>Epil hirs</i>
085 <i>Epil mont</i>	086 <i>Epil parv</i>	087 <i>Equi arve</i>	088 <i>Erys chei*</i>	089 <i>Euph amyg</i>	090 <i>Euph heli</i>
091 <i>Euph pepl</i>	092 <i>Fagu sylv</i>	093 <i>Fall bald*</i>	094 <i>Fall conv*</i>	095 <i>Fall japo*</i>	096 <i>Fest ovin</i>
097 <i>Fest prat</i>	098 <i>Fest rubr</i>	099 <i>Ficu cari</i>	100 <i>Fili ulma</i>	101 <i>Foen vulg</i>	102 <i>Frag vesc</i>
103 <i>Frag xana*</i>	104 <i>Frax exce</i>	105 <i>Gali apar</i>	106 <i>Gali palu</i>	107 <i>Gali saxa</i>	108 <i>Geni radi</i>
109 <i>Gera luci</i>	110 <i>Gera robe</i>	111 <i>Geum urba</i>	112 <i>Glec hede</i>	113 <i>Hebe xlew</i>	114 <i>Hede heli</i>
115 <i>Hera mant</i>	116 <i>Hera spho</i>	117 <i>Hesp matr</i>	118 <i>Hier saba*</i>	119 <i>Hier vulg</i>	120 <i>Holc lana</i>
121 <i>Holc moll</i>	122 <i>Hord muri</i>	123 <i>Hype andr</i>	124 <i>Hype caly</i>	125 <i>Hype perf</i>	126 <i>Hypo radi</i>
127 <i>Iber semp</i>	128 <i>Ilex aqui</i>	129 <i>Impa glan</i>	130 <i>Iris germ</i>	131 <i>Labu anag</i>	132 <i>Lami albu</i>
133 <i>Lami purp</i>	134 <i>Laps comm</i>	135 <i>Lath odor</i>	136 <i>Leon autu</i>	137 <i>Leon hisp</i>	138 <i>Leyc form</i>
139 <i>Ligu vulg</i>	140 <i>Lina purp</i>	141 <i>Loli mult</i>	142 <i>Loli pere</i>	143 <i>Loni peri</i>	144 <i>Lupi noot</i>
145 <i>Lyci barb</i>	146 <i>Lycu euro</i>	147 <i>Lysi vulg</i>	148 <i>Maho aqui</i>	149 <i>Malv sylv</i>	150 <i>Matr disc</i>
151 <i>Meco camb</i>	152 <i>Medi lupu</i>	153 <i>Meli offi</i>	154 <i>Ment aqua</i>	155 <i>Ment spic</i>	156 <i>Merc pere</i>
157 <i>Mili effu</i>	158 <i>Myce mura</i>	159 <i>Myos sylv</i>	160 <i>Myrr odor</i>	161 <i>Oena croc</i>	162 <i>Oxal corn</i>
163 <i>Papa rhoe</i>	164 <i>Papa somn</i>	165 <i>Pari juda</i>	166 <i>Pent semp</i>	167 <i>Peta hybr</i>	168 <i>Phal arun</i>
169 <i>Phyl scol</i>	170 <i>Pilo aura</i>	171 <i>Pilo offi*</i>	172 <i>Pisu sati</i>	173 <i>Plan lanc</i>	174 <i>Plan majo</i>
175 <i>Plan medi</i>	176 <i>Poa annu</i>	177 <i>Poa comp</i>	178 <i>Poa nemo</i>	179 <i>Poa prat</i>	180 <i>Poa triv</i>
181 <i>Poly avic</i>	182 <i>Poly seti</i>	183 <i>Pote anse</i>	184 <i>Prun vulg</i>	185 <i>Prun aviu</i>	186 <i>Prun padu</i>
187 <i>Prun spin</i>	188 <i>Pseu lute</i>	189 <i>Pter aqui</i>	190 <i>Quer petr</i>	191 <i>Ranu acri</i>	192 <i>Ranu repe</i>
193 <i>Rese lute</i>	194 <i>Rhod pont</i>	195 <i>Ribe rubr</i>	196 <i>Ribe uvac</i>	197 <i>Rosa cani*</i>	198 <i>Rubu frut</i>
199 <i>Rubu idae</i>	200 <i>Rume acet</i>	201 <i>Rume acel</i>	202 <i>Rume cris</i>	203 <i>Rume long</i>	204 <i>Rume obtu</i>
205 <i>Rume sang</i>	206 <i>Sagi apet</i>	207 <i>Sagi proc</i>	208 <i>Sali capr</i>	209 <i>Sali cine*</i>	210 <i>Sali vimi</i>
211 <i>Samb nigr</i>	212 <i>Saxi xumb*</i>	213 <i>Sedu acre</i>	214 <i>Sedu albu</i>	215 <i>Sedu refl</i>	216 <i>Semp tect</i>
217 <i>Sene cine</i>	218 <i>Sene jaco</i>	219 <i>Sene squa</i>	220 <i>Sene visc</i>	221 <i>Sene vulg</i>	222 <i>Sile vulg</i>
223 <i>Sina arve</i>	224 <i>Sisy offi</i>	225 <i>Sola dulc</i>	226 <i>Soli cana*</i>	227 <i>Sonc aspe</i>	228 <i>Sonc oler</i>
229 <i>Sorb aucu</i>	230 <i>Sorb inter</i>	231 <i>Stac sylv</i>	232 <i>Stel holo</i>	233 <i>Stel medi</i>	234 <i>Stel nemo</i>
235 <i>Symp albu</i>	236 <i>Symp offi</i>	237 <i>Tana part*</i>	238 <i>Tana vulg</i>	239 <i>Tara rude</i>	240 <i>Taxu bacc</i>
241 <i>Trag prat</i>	242 <i>Trif dubi</i>	243 <i>Trif prat</i>	244 <i>Trif repe</i>	245 <i>Trip inod*</i>	246 <i>Tuss farf</i>
247 <i>Ulm glabr</i>	248 <i>Urti dioi</i>	249 <i>Urti uren</i>	250 <i>Vale offi</i>	251 <i>Verb thap</i>	252 <i>Verb virg</i>
253 <i>Vero arve</i>	254 <i>Vero cham</i>	255 <i>Vero serp</i>	256 <i>Vici crac</i>	257 <i>Vici hirs</i>	258 <i>Vici sati</i>
259 <i>Vici sepi</i>	260 <i>Vinc mino</i>	135 <i>in common</i>			

Species recorded on Durham Dales walls and not in Durham City

001 <i>Alli oler</i>	002 <i>Arab cauc</i>	003 <i>Arab hirs</i>	004 <i>Aren serp</i>	005 <i>Aubr delt</i>	006 <i>Camp pers</i>
007 <i>Coni macu</i>	008 <i>Crep capi</i>	009 <i>Cyst frag</i>	010 <i>Erig karv</i>	011 <i>Erin alpi</i>	012 <i>Erop vern</i>
013 <i>Euph esul</i>	014 <i>Leuc vulg</i>	015 <i>Orig vulg</i>	016 <i>Poly vulg</i>	017 <i>Pote ster</i>	018 <i>Ranu bulb</i>
019 <i>Ribe nigr</i>	020 <i>Ribe sang</i>	021 <i>Sedu spur</i>	022 <i>Sher arve</i>	023 <i>Sile dioi</i>	024 <i>Symp orie</i>
025 <i>Syri vulg</i>	026 <i>Vero hede</i>	027 <i>Vinc majo</i>			

APPENDIX 5. RECORDS OF SPECIES OCCURRING IN LESS THAN 10% (12)
SAMPLES IN THE DURHAM DALES

- | No | Species |
|----|--|
| 11 | <i>Cotoneaster</i> sp., <i>Rosa canina</i> , <i>Sedum album</i> |
| 10 | <i>Cystopteris fragilis</i> , <i>Meconopsis cambrica</i> , <i>Pseudofumaria lutea</i> , <i>Ribes uva-crispa</i> , <i>Taxus baccata</i> |
| 9 | <i>Hieracium vulgatum</i> , <i>Veronica arvensis</i> |
| 8 | <i>Ranunculus repens</i> |
| 7 | <i>Myosotis sylvatica</i> , <i>Plantago lanceolata</i> |
| 6 | <i>Anthriscus sylvestris</i> , <i>Capsella bursa-pastoris</i> , <i>Leucanthemum vulgare</i> , <i>Sempervivum tectorum</i> |
| 5 | <i>Antirrhinum majus</i> , <i>Cerastium fontanum</i> , <i>Cirsium vulgare</i> , <i>Crataegus monogyna</i> , <i>Erophila verna</i> , <i>Euphorbia peplus</i> , <i>Parietaria judaica</i> , <i>Ribes sanguineum</i> , <i>Sagina procumbens</i> |
| 4 | <i>Achillea millefolium</i> , <i>Arenaria serpyllifolia</i> , <i>Erysimum cheiranthoides</i> , <i>Sagina apetala</i> , <i>Sedum spurium</i> , <i>Stellaria media</i> , <i>Symphoricarpos albus</i> |
| 3 | <i>Agrostis capillaris</i> , <i>Alchemilla mollis</i> , <i>Anisantha sterilis</i> , <i>Cardamine flexuosa</i> , <i>Elytrigia repens</i> , <i>Euphorbia esula</i> , <i>Lolium perenne</i> , <i>Medicago lupulina</i> , <i>Pilosella aurantiaca</i> , <i>Plantago major</i> , <i>Rubus idaeus</i> , <i>Rumex obtusifolius</i> , <i>Senecio viscosus</i> , <i>Trifolium repens</i> , <i>Veronica hederifolia</i> |
| 2 | <i>Alyssum saxatile</i> , <i>Aquilegia vulgaris</i> , <i>Asplenium adiantum-nigrum</i> , <i>Betula pubescens</i> , <i>Bromus hordaceus</i> , <i>Calystegia sylvatica</i> , <i>Campanula persicifolia</i> , <i>Campanula portenschlagiana</i> , <i>Conium maculatum</i> , <i>Crepis capillaris</i> , <i>Centaurea nigra</i> , <i>Fragaria vesca</i> , <i>Lamium album</i> , <i>Poa angustifolia</i> , <i>Prunella vulgaris</i> , <i>Ribes nigrum</i> , <i>Rumex acetosa</i> , <i>Salix capraea</i> , <i>Sorbus aucuparia</i> , <i>Symphytum orientale</i> , <i>Syringa vulgaris</i> , <i>Verbascum thapsus</i> , <i>Veronica chamaedrys</i> , <i>Veronica serpyllifolia</i> , <i>Vinca major</i> |
| 1 | <i>Allium oleraceum</i> , <i>Anthoxanthum odoratum</i> , <i>Arabis hirsuta</i> , <i>Asplenium adiantum-nigrum</i> , <i>Athyrium filix-femina</i> , <i>Bromopsis ramosa</i> , <i>Catapodium rigidum</i> , <i>Cerastium glomeratum</i> , <i>Chaerophyllum temulentum</i> , <i>Cirsium arvense</i> , <i>Dipsacus fullonum</i> , <i>Elytrigia canina</i> , <i>Equisetum arvense</i> , <i>Erigeron karvinskianus</i> , <i>Euphorbia amygdaloides</i> , <i>Fagus sylvatica</i> , <i>Ilex aquifolium</i> , <i>Laburnum anagyroides</i> , <i>Leycesteria formosa</i> , <i>Lonicera periclymenum</i> , <i>Malva sylvestris</i> , <i>Myrrhis odorata</i> , <i>Origanum vulgare</i> , <i>Papaver rhoeas</i> , <i>Pilosella officinarum</i> , <i>Potentilla sterilis</i> , <i>Prunus avium</i> , <i>Prunus laurocerasus</i> , <i>Prunus spinosa</i> , <i>Ranunculus bulbosus</i> , <i>Reseda luteola</i> , <i>Sherardia arvensis</i> , <i>Silene dioica</i> , <i>Stachys sylvatica</i> , <i>Stellaria graminea</i> , <i>Trifolium dubium</i> , <i>Trifolium pratense</i> , <i>Vicia sepium</i> |

Distribution, status and ecology of *Blysmus compressus* (L.) Panz. ex Link on the Sefton Coast sand-dunes, Merseyside

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ABSTRACT

This paper describes a 2008 survey of the nationally declining *Blysmus compressus* on the Sefton Coast sand-dunes (v.c. 59), where it has been known since 1801. The plant was recorded in 18 sites, occupying over 3000 m², with an estimated total population of 15,000–20,000 individuals. Evidence suggests *B. compressus* has increased here in recent decades, relatively few known sites having been lost. The plant was mainly found in calcareous wet-slacks, though three sites were described as damp grassland. Most localities are of fairly recent origin and have a history of recreation disturbance and grazing, especially by rabbits. A few are winter-grazed by livestock and some are mown annually. Ninety associated vascular taxa were recorded. NVC analysis gave mainly poor to very poor fits to known dune-slack communities (SD15, SD16 and SD17) and two mesotrophic grassland types (MG8 and MG11). The conservation requirements for *B. compressus* are discussed.

KEYWORDS: communities, conservation management, dune-slacks, Ellenberg's indicator values, history, National Vegetation Classification, mowing, population, rabbit-grazing, trampling.

INTRODUCTION

Blysmus compressus (L.) Panz. ex Link (Flat-sedge) (Cyperaceae) is a far-creeping rhizomatous perennial of open vegetation in marshes and fens and in short, sedge-rich, damp grassland, calcareous flushes and stream borders that are subject to flooding, especially on base-rich rocks. The plant is a hemi-cryptophyte and a member of the European temperate flora with a continental distribution in Western Europe, extending as far north as southern Scandinavia and east to Central Asia (Foley & Porter 2002; Hill *et al.* 2004; Jermy *et al.* 2007; Walker 2008). Ellenberg's indicator values in Hill *et al.* (2004) show that this species is a light-loving plant (L = 8), associated with constantly moist to wet soils (F = 8) that are base-rich (R = 8) and relatively infertile (N = 3) and that the plant is absent from saline sites (S = 0).

DISTRIBUTION IN BRITAIN

B. compressus is widespread but localised in Britain. It is recorded for most English counties but in abundance only in the north and west, reaching a maximum elevation of 490 m in Co. Durham (v.c. 66). It is rare in lowland England, though there are still large populations on the Rivers Kennett and Thames. In Wales, this species is confined to a single site in Brecon (v.c. 42), while Scotland has no populations north of the Central Belt. *B. compressus* does not occur in Ireland (Foley & Porter 2002; Walker 2008).

This is one of the most rapidly declining vascular plants in Britain, having been lost from more than half its pre-1930 hectads by 1962 and, subsequently, from 40% of its post-1930 hectads. Its change index since 1962 is -1.28 (Foley & Porter 2002); as a consequence, it is a Red Data listed species in Britain, classified as Vulnerable (Cheffings & Farrell 2005). The plant has become extinct in South Devon (v.c. 03), Kent (v.c. 15; 16), Surrey (v.c. 17), Middlesex (v.c. 21), West Suffolk (v.c. 26), Staffordshire (v.c. 39), Shropshire (v.c. 40), Leicestershire (v.c. 55) and Nottinghamshire (v.c. 56). Similar declines have been reported elsewhere in Europe, for example, in Croatia and Finland (Walker 2008).

DISTRIBUTION IN NORTH WEST ENGLAND

There are no records of *B. compressus* for Cheshire (v.c. 58) (Newton 1971, G. M. Kay *in litt.* 2009) but in South Lancashire (v.c. 59), Savidge *et al.* (1963) record the plant as "occasional, locally common" in dune-slacks and marshes, at intervals along the coast between Hightown and Southport. They mention only one site away from what is now the Sefton Coast; a pasture near the canal at Nelson in 1926, where the plant does not seem to have been recorded since.

The *New Flora of South Lancashire Project* (D. P. Earl *in litt.* 2008) has 23 records of

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B. compressus from 1851 onwards in hectads SD20, 21, 31 and 39, these being situated along the Merseyside coast from Liverpool to Southport, and SD83 which includes Nelson in eastern Lancashire. In addition, there are 18 sheets of gatherings in the Manchester Museum herbarium (**MANCH**) for localities between Liverpool and Southport, most from the 19th century, the earliest on 17 June 1840 at Bootle, collected by J. B. Wood. The Liverpool Museum herbarium (**LIV**) has two earlier sheets, from 1821, from near Rimrose Bridge, Seaforth (Mr Shepherd; ex. J. Shillito) and 1801, north shore opposite Bootle (ex Liverpool Botanic Garden collection). Both these sites have been destroyed and are in the modern borough of Sefton.

B. compressus has always been rare in West Lancashire (v.c. 60), being confined historically to two nearby sites on the bank of the R. Lune at Wrayton and at the junction of the R. Greta and the Lune. It was also found in dune-slacks at Lytham St. Anne's on the north shore of the Ribble Estuary (Wheldon & Wilson 1907). More recently, the plant has been found in small quantity near these historical localities; in 1980 on Lune ox-bows north of Melling and at two adjacent dune sites at Fairhaven, Lytham, in 1998, one of these being lost to erosion by 2003 (E. F. Greenwood *in litt.* 2008). In the northern part of this vice-county, Livermore & Livermore (1987) describe it as "rare in a wet meadow", where they found only two or three plants. It is not clear whether this is one of the Lune sites. There is also an un-localised record from the "Heysham Peninsula" in the north of the vice-county by G. W. Garlick in about 1957 (E. F. Greenwood *in litt.* 2008).

The Lancashire Biodiversity Action Plan (BAP) considers *B. compressus* to be critically endangered in v.c. 60, being threatened by nutrient enrichment, a lowered water-table and physical disturbance at its coastal locality and vulnerable to drainage, fertiliser run-off and river management works on the R. Lune (Greenwood 2002). The Lancashire Wildlife Trust's *Endangered Plants Project* (E. F. Greenwood *in litt.* 2008) recorded two colonies of the plant in 2003 on Lune ox-bows about 200 m apart, the total population being only about 60 spikes. Due to multiple private ownerships, this area is difficult of access and largely unexplored. Two small colonies were found on the dunes at Ansdell, Lytham St.

Anne's in 2003, the first being lost by 2005. The second site had three spikes in 2007 and 100–200 in 2008 (E. F. Greenwood *in litt.* 2008). This seems to be the one described by Skelcher (2008) as "a good stand" in dune-slack vegetation north of Fairhaven Lake.

B. compressus is much more widespread in Cumbria, with records for 69 tetrads, though Halliday (1997) states that it is nearly confined to a limited area of north Westmorland (v.c. 69), where it is quite frequent in calcareous flushes and marshes and by beck-sides, particularly on ground subject to flooding. A few sites elsewhere include the edge of a salt-marsh near Bowness-on-Solway where some degree of tolerance to salinity is implied, despite the plant having an Ellenberg salinity (S) score of 0.

OCCURRENCE ON THE SEFTON COAST (V.C. 59)

B. compressus has been known from slacks in the Sefton Coast sand-dune system for over 200 years, 19th century herbarium records having already been mentioned. The earliest relevant flora is by Hall (1838) who states: "There are specimens of *B. compressus* in the Herbarium at the Botanic Gardens from the north shore of Liverpool, but I am not aware of it having been found there recently by any botanist." However, only 13 years later, Dickinson (1851) remarks: "Grassy spots on Crosby sandhills, and near Bootle Land Marks, abundant. Also at Formby and Southport". Despite the plant's unassuming appearance, McNicholl (1883) writes in his *Handbook for Southport*: "In parts of the sandhills there are tracts such as are congenial to semi-amphibious plants. Here may be gathered the *Blysmus compressus*." More recently, it is described by Smith (1978) as a plant almost confined to dune slacks within this vice-county and listed as "very local, wet slacks" in a species list for Ainsdale Sand Dunes National Nature Reserve (NNR) (Payne 1982). In the early 1980s, *B. compressus* was known from under 10 sites in the dune system (Smith 1983). Edmondson *et al.* (1993a) mention its presence in a few slacks at Birkdale Sandhills Local Nature Reserve (LNR), Lifeboat Road and Cabin Hill NNR. In a more detailed study of 26 dune-slacks at Birkdale LNR, Smith (2006a) found *B. compressus* in ten of these slacks in 2003, an increase in occurrence from only two slacks twenty years earlier (Smith 1983).

SURVEY RATIONALE

Reflecting its declining national status, *B. compressus* was added to the list of UK Biodiversity Action Plan (BAP) species in 2007 and highlighted for special study in the *BSBI Threatened Plants Project* in 2008 (Walker 2008). It is also listed as a Species of Conservation Importance in North West England (Regional Biodiversity Steering Group 1999). However, recent observations (e.g. Smith 2006a) suggest that, far from declining, this species may actually be increasing on the Sefton Coast. It was therefore thought opportune to investigate its status here in a comprehensive survey. As *B. compressus* is not mentioned in the UK National Vegetation Classification (NVC) and relatively little seems to be known in detail about its habitat requirements (Walker 2008) it was also decided to collect relevant floristic and habitat data.

METHODS

Based on detailed personal knowledge of the dune system and previous reports of survey, all known and likely sites for *B. compressus* were visited in June, July and August 2008. Populations were marked out using bamboo canes, their approximate areas measured by pacing and numbers of plants estimated. National Grid References of locations were determined using a hand-held GPS device. Distribution maps were prepared using the Sefton Coast Geographic

Information System (GIS). For each site, depending on its size, between one and eight samples of representative vegetation were recorded in 2 m × 2 m quadrats using NVC methodology (Rodwell 1991). These were analysed using a modified TABLEFIT programme to determine the degree of fit to known NVC communities and sub-communities (Hill 1996). Notes were also taken on habitat type, condition and current management. The origin and past management of sites was investigated using literature sources, maps and aerial photographs. Details of recently lost sites were investigated through contacts with local botanists and reference to the literature.

RESULTS

DISTRIBUTION OF SITES

Eighteen sites for *B. compressus* were recorded in the dune system (Figure 1). They are highly localised, falling into three distinct groupings; four at Altcar Rifle Range and Cabin Hill NNR in the south, five at Ainsdale-on-Sea, about 8 km to the north, and nine sites in the Birkdale sandhills (including Royal Birkdale Golf Course), another 2.5 km further north (Table 1). They occupy only three tetrads: SD20X, SD31B and SD31C. Despite extensive searches in 2008, no plants of this species were found in ostensibly suitable habitat elsewhere in the dunes, though a few additional historical sites are known and three came to light after the field work was completed (see below).

TABLE 1. *BLYSMUS COMPRESSUS* SITES ON THE SEFTON COAST, 2008

Site	Central Grid Reference (SD)	Habitat	Date of origin (where known)	Area of Colony (m ²)	Estimated population
Altcar Rifle Range "I" range	2888 0462	Damp grassland	After 1924	52	1000+
Cabin Hill NNR Slack 1	2828 0524	Wet-slack	1970/71	1192	10,000
Slack 3	2835 0529	Wet-slack	1970/71	54	100+
Slack 20	2826 0520	Wet-slack	1945-50	336	1000+
Sands Lake, Ainsdale	3013 1282	Damp grassland	After 1911	23	100
Ainsdale frontals Slack 49	3009 1330	Wet-slack	Early/mid 1970s	145	1000+
Slack 50	3007 1315	Wet-slack	Early/mid 1970s	384	100s
Slack 51	3002 1309	Wet-slack	Early/mid 1970s	24	100
Slack 52	3008 1309	Wet-slack	Early/mid 1970s	5	10s
Royal Birkdale pond	3159 1529	Marshy pond edge		6	10s
3rd fairway	3162 1528	Damp grassland		180	100
Birkdale Sandhills Slack 26	3143 1537	Wet-slack	1929	7	100+
Birkdale frontals Slack 27	3134 1524	Wet-slack	Early/mid 1970s	58	100s
Slack 28	3142 1555	Wet-slack	Early/mid 1970s	162	1000+
Slack 30	3202 1631	Dry-slack	Pre-1970	56	100+
Slack 31	3196 1619	Wet-slack	Pre-1969	100	100
Slack 32	3191 1614	Dry-slack	Mid 1970s	63	100s
Slack 33	3193 1614	Dry-slack	1976	170	100s

TABLE 2. WEIGHTED ELLENBERG'S INDICATOR VALUES FOR ASSOCIATES OF
BLYSMUS COMPRESSUS

Taxon	Occ. in 51 quadrats	%	F	R	N	wF	wR	wN
<i>Carex flacca</i>	44	86.3	5	6	2	220	264	88
<i>Trifolium repens</i>	41	80.4	5	6	6	205	246	246
<i>Agrostis stolonifera</i>	36	70.6	6	7	6	216	252	216
<i>Salix repens</i>	35	68.6	7	6	3	245	210	105
<i>Mentha aquatica</i>	30	58.8	8	7	5	240	210	150
<i>Hydrocotyle vulgaris</i>	29	56.9	8	6	3	232	174	87
<i>Festuca rubra</i>	27	52.9	5	6	5	135	162	135
<i>Holcus lanatus</i>	27	52.9	6	6	5	162	162	135
<i>Rubus caesius</i>	24	47.1	7	7	6	168	168	144
<i>Juncus articulatus</i>	21	41.2	9	6	3	189	126	63
<i>Dactylorhiza incarnata</i> ssp. <i>coccinea</i>	17	33.3	9	6	2	153	102	34
<i>Carex arenaria</i>	16	31.4	3	5	2	48	80	32
<i>Equisetum palustre</i>	16	31.4	8	6	3	128	96	48
<i>Prunella vulgaris</i>	16	31.4	5	6	4	80	96	64
<i>Ranunculus repens</i>	16	31.4	7	6	7	112	96	112
<i>Cirsium arvense</i>	15	29.4	6	7	6	90	105	90
<i>Ranunculus acris</i>	15	29.4	6	6	4	90	90	60
<i>Plantago lanceolata</i>	14	27.5	5	6	4	70	84	56
<i>Eleocharis palustris</i>	13	25.5	10	6	4	130	78	52
<i>Galium palustre</i>	13	25.5	9	5	4	117	65	52
<i>Ranunculus flammula</i>	13	25.5	9	5	3	117	65	39
<i>Salix cinerea</i>	13	25.5	8	6	5	104	78	65
<i>Lathyrus pratensis</i>	12	23.5	6	6	5	72	72	60
<i>Carex hirta</i>	11	21.6	7	7	6	77	77	66
<i>Eleocharis quinqueflora</i>	11	21.6	9	7	2	99	77	22
<i>Leontodon autumnalis</i>	11	21.6	6	6	4	66	66	44
<i>Lotus corniculatus</i>	11	21.6	4	6	2	44	66	22
<i>Senecio jacobaea</i>	11	21.6	4	6	4	44	66	44
<i>Potentilla anserina</i>	10	19.6	7	7	6	70	70	60
<i>Rhinanthus minor</i>	10	19.6	5	6	4	50	60	40
<i>Vicia cracca</i>	10	19.6	6	7	5	60	70	50
<i>Bellis perennis</i>	9	17.6	5	6	4	45	54	36
<i>Juncus inflexus</i>	9	17.6	7	7	5	63	63	45
<i>Trifolium pratense</i>	9	17.6	5	7	5	45	63	45
<i>Epipactis palustris</i>	8	15.7	8	7	3	64	56	24
<i>Euphrasia nemorosa</i>	8	15.7	5	6	4	40	48	32
<i>Cardamine pratensis</i>	7	13.7	8	5	4	56	35	28
<i>Lotus pedunculatus</i>	7	13.7	8	6	4	56	42	28
<i>Lythrum salicaria</i>	7	13.7	9	7	5	63	49	35
<i>Taraxacum officinale</i>	7	13.7	5	7	6	35	49	42
<i>Anthoxanthum odoratum</i>	6	11.8	6	4	3	36	24	18
<i>Glaux maritima</i>	6	11.8	7	7	5	42	42	30
<i>Plantago major</i>	6	11.8	5	6	7	30	36	42
<i>Potentilla reptans</i>	6	11.8	5	7	5	30	42	30
<i>Equisetum variegatum</i>	5	9.8	8	8	3	40	40	15
<i>Lolium perenne</i>	5	9.8	5	6	6	25	30	30
<i>Poa pratensis</i>	5	9.8	5	6	5	25	30	25
<i>Cerastium fontanum</i>	4	7.8	5	5	4	20	20	16
<i>Cerastium semidecandrum</i>	4	7.8	3	6	3	12	24	12

TABLE 2 CONTINUED

Taxon	Occ. in 51 quadrats	%	F	R	N	wF	wR	wN
<i>Cynosurus cristatus</i>	4	7.8	5	6	4	20	24	16
<i>Parnassia palustris</i>	4	7.8	8	7	3	32	28	12
<i>Trifolium fragiferum</i>	4	7.8	7	7	6	28	28	24
<i>Triglochin palustre</i>	4	7.8	9	6	2	36	24	8
<i>Carex disticha</i>	3	5.9	8	6	4	24	18	12
<i>Centaurea nigra</i>	3	5.9	5	6	5	15	18	15
<i>Elytrigia repens</i>	3	5.9	5	7	7	15	21	21
<i>Equisetum arvense</i>	3	5.9	6	6	6	18	18	18
<i>Iris pseudacorus</i>	3	5.9	9	6	6	27	18	18
<i>Juncus balticus</i>	3	5.9	8	5	2	24	15	6
<i>Juncus gerardii</i>	3	5.9	7	7	6	21	21	18
<i>Poa humilis</i>	3	5.9	6	6	4	18	18	12
<i>Pulicaria dysenterica</i>	3	5.9	7	7	4	21	21	12
<i>Veronica scutellata</i>	3	5.9	9	5	3	27	15	9
<i>Bolboschoenus maritimus</i>	2	3.9	10	8	7	20	16	14
<i>Carex nigra</i>	2	3.9	8	4	2	16	8	4
<i>Carex viridula</i> ssp. <i>viridula</i>	2	3.9	7	7	3	14	14	6
<i>Centaureum erythraea</i>	2	3.9	5	6	3	10	12	6
<i>Dactylorhiza fuchsii</i>	2	3.9	8	7	3	16	14	6
<i>Epilobium hirsutum</i>	2	3.9	8	7	7	16	14	14
<i>Leontodon saxatilis</i>	2	3.9	5	6	3	10	12	6
<i>Pastinaca sativa</i>	2	3.9	4	7	5	8	14	10
<i>Phragmites australis</i>	2	3.9	10	7	6	20	14	12
<i>Poa annua</i>	2	3.9	5	6	7	10	12	14
<i>Sagina procumbens</i>	2	3.9	6	6	5	12	12	10
<i>Tussilago farfara</i>	2	3.9	6	6	6	12	12	12
<i>Agrostis capillaris</i>	1	2.0	5	4	4	5	4	4
<i>Calystegia silvatica</i>	1	2.0	5	7	6	5	7	6
<i>Cirsium vulgare</i>	1	2.0	5	6	6	5	6	6
<i>Dactylis glomerata</i>	1	2.0	5	7	6	5	7	6
<i>Dactylorhiza praetermissa</i>	1	2.0	8	7	3	8	7	3
<i>Epilobium obscurum</i>	1	2.0	8	5	5	8	5	5
<i>Epilobium palustre</i>	1	2.0	8	5	3	8	5	3
<i>Equisetum fluviale</i>	1	2.0	10	6	4	10	6	4
<i>Eriophorum angustifolium</i>	1	2.0	9	4	1	9	4	1
<i>Filipendula ulmaria</i>	1	2.0	8	6	5	8	6	5
<i>Glechoma hederacea</i>	1	2.0	6	7	7	6	7	7
<i>Lycopus europaeus</i>	1	2.0	8	7	6	8	7	6
<i>Rosa rugosa</i>	1	2.0	3	6	3	3	6	3
<i>Sonchus arvensis</i>	1	2.0	6	7	6	6	7	6
Totals	798					5144	4905	3394
Means			6.25	6.25	4.37	6.45	6.15	4.25

F = moisture; R = reaction; N = nitrogen; w = weighted



FIGURE 1. Locations of *Blysmus compressus* on the Sefton Coast, 2008.

POPULATION SIZES

Estimated areas of colonies range from 1192 m² at Cabin Hill slack 1 to 5 m² at Ainsdale slack 52, the total extent being 3017 m² (Table 1). Due to time limitations, only approximate estimates were made of plant numbers. These range from under 100 spikes at Ainsdale slacks 51 and 52 to about 10,000 at Cabin Hill slack 1. Other large populations, with 1000 or more spikes, were recorded at Altcar Rifle Range, Ainsdale slack 50, Ainsdale slack 49 and Birkdale slack 28 (Table 1). Overall, a conservative estimate for the total Sefton Coast population of *B. compressus* is 15,000–20,000 plants.

HABITATS

Most Sefton Coast sites for *B. compressus* are dune slacks that have formed secondarily by wind-erosion or by sand-winning and have a seasonally fluctuating water-table. Following Ranwell's (1972) criteria, 11 are considered to be wet-slacks, flooded during the winter, and three dry-slacks, rarely holding water. All seem to accord with the Type B slack of Davy *et al.* (2006), this being a precipitation-fed slack in which water is lost by evaporation. A small colony at Royal Birkdale Golf Course is associated with the edge of a pond, while three sites (at Altcar Rifle Range, Ainsdale Sands Lake and Royal Birkdale) were categorised as damp grassland (Table 1).

The ground profile of dune-slacks often leads to different degrees of wetness from dry around the edges to semi-aquatic in the centre; at some sites this seemed to influence the distribution of *B. compressus*. For example, at Cabin Hill slack 1, the plant occupies a zone between damp conditions to the north, with much *Salix repens*, and semi-aquatic vegetation to the south dominated by *Equisetum fluviatile*. It was also noted that, within several sites, *B. compressus* plants were often concentrated in areas where the vegetation was somewhat suppressed or altered by recreational trampling or rabbit (*Oryctolagus cuniculus*) -grazing or both; for example, on the surfaces or along the edges of lightly-used informal footpaths. Such areas often show a reduced frequency of *S. repens*, a dominant plant in many Sefton Coast dune-slacks (Gateley & Michell 2004). The flower spikes of *B. compressus* were often seen to stand proud of grazed vegetation, suggesting that rabbits may avoid the plant. At a few of the more heavily trampled sites, *B. compressus* plants were suppressed, being only a few cm

tall; however, in most wet-slacks, the populations consisted of vigorous, strongly flowering individuals, some stems attaining a height of 50 cm at Birkdale slack 28, compared to the 45 cm maximum cited in Jermy *et al.* (2007).

Soil characteristics have been documented for some of the *B. compressus* sites. Smith (1983; 1984) studied soil profiles at eight of the Ainsdale-Birkdale slacks. Two are described as peaty-gleys, the others being ground-water gleys. pH values range from 7.0 to 8.8 at 3–5 cm depth and 6.9 to 8.9 at 10–15 cm, reflecting the base-rich nature of the parent material which has about 5% calcium carbonate derived from intertidal mollusc shells (Smith 2009). Such slack soils throughout this dune system have been included in the Greatstone Series defined by the Soil Survey of England & Wales, a general account of their characteristics on the Sefton Coast being given by James (1993).

ORIGIN AND MANAGEMENT OF SITES

At the southernmost site on Altcar Rifle Range, *B. compressus* is confined to wet grassland at the northern edge of 'T' range, where it was first found in 2008. 'T' range seems to have been laid out when the ranges were rebuilt in 1923/24 (Cook 1989). This area was added to the Altcar Sand Dunes & Foreshore Site of Special Scientific Interest (SSSI) in 1986 and subsumed into the Sefton Coast SSSI in 2000. It has been managed by mowing, this being delayed until late summer (after 15 July) since SSSI designation. Some limited rabbit-grazing may occur but this species is controlled and has low populations at Altcar.

At Cabin Hill, the slacks occupied by *B. compressus* are of fairly recent origin. Slack 20 was created by sand-winning, during the 1940s and early 1950s, which removed the largest sand-dune on this part of the coast down to the water-table. Because of a perceived threat to coast protection, a planning application for further sand removal was refused in 1952 (Crosby 2007). Slacks 1 and 3, the former now supporting the largest colony of *B. compressus* found during the study, were formed in 1970/71 when the then Mersey & Weaver River Authority constructed a 780 m-long barrier bank to act as a secondary sea-defence. The slacks are shallow borrow-pits, in the earlier sand-quarry floor, from which material to build the bank was extracted (Smith 2007a). *B. compressus* was first recorded at Cabin Hill in July 1979 in slack 20, from which it has apparently spread to the adjacent sites, being

noted in slack 1 in July 2003 and slack 3 in June 2008 (personal observations). Edmondson *et al.* (1988/89) also mention its presence in a Target Note for slack 20 in their comprehensive NVC survey of the dune system.

This area was leased as a National Nature Reserve in 1984 (declared 1991). During the 1970s and 1980s, sporadic grazing by small numbers of cattle and horses took place but, since 1992, the reserve has been managed by extensive winter-grazing using Herdwick sheep. There is also a large rabbit population, though only slack 3 is heavily rabbit-grazed. Slack 1 was mowed on four occasions in the 1990s and willow (*Salix*) scrub was removed in 1989 and 1990 (Smith 2007b).

The Sands Lake, Ainsdale site is difficult to date accurately but this dune area developed after the Southport & Cheshire Lines Extension Railway was built along the foreshore in 1884 (Smith 1983). The lake itself was dug by hand in 1911, the surrounding area being subject to high levels of recreational disturbance thereafter. The *B. compressus* site, of which the current population is a small relict, was first recorded in July 1979 as "a large colony of *Blasmus* at the north end of the lake" (personal observations). It was also documented in a 1988 Target Note as "Rich strip along well-used area between Sands Lake and tall mixed scrub to east. Short, dense sward has *Carex flacca*, *Blasmus compressus*, *Lolium perenne*, *Trifolium repens* etc." (Edmondson *et al.* 1988/89). Since then, dense scrub, especially of *Hippophae rhamnoides*, together with a tall herbaceous sward of *Epilobium hirsutum* etc., has overtaken much of the site, *B. compressus*, being restricted to a 1 m-wide zone of short, weedy turf on the edge of a carpark. Here, it is subject to trampling and, probably, some rabbit-grazing. There is no formal conservation management.

To the west and north-west of Sands Lake, slacks 49, 50, 51 and 52 were formed by wind-erosion as recently as the mid 1970s when the water-table was exceptionally low and levels of recreational trampling high. Thus, they were not mapped as wet-slacks by Smith (1978) during a comprehensive survey of dune wetlands. However, by 1983, they were well-established and mapped as "incipient" (i.e. immature) wet-slacks (Smith 1983). Twenty years later, they were listed as "mature wet-slacks" (Smith 2006a). *B. compressus* has been known in slack 50 since the 1990s and was recorded in slacks 49, 51 and 52 during Smith's (2006a) study. In slacks 51 and 52 and, to a lesser

extent in slack 50, *B. compressus* is largely confined to lightly-used informal footpaths.

This area of dunes was added to the Birkdale Sandhills LNR in 1983. Conservation management has concentrated on control of *H. rhamnoides* which spread rapidly through the slacks in the late 1980s and 1990s. From 1995, this invasive shrub was progressively removed by cutting and stump treatment, followed by herbicide spraying of young regrowth. In addition, slack 49 has been mown annually since 1996, with removal of arisings. There is no livestock grazing but rabbits are present in moderate numbers.

Royal Birkdale Golf Course was established in the sand-dunes in 1889, the pond on the southern edge of which *B. compressus* is currently found, has been present since at least 1945 (Smith 1983; 2009). The plant was first recorded here in a permanent 2 m × 2 m quadrat established in 1998 at site "I" "east of an open water-body in a damp area with lush vegetation", being still present in 2006 (Butcher *et al.* 2006). The damp grassland east of the pond, which supports most of the *B. compressus* colony, was scrub-cleared in November 1996 and has been managed since by annual mowing in September using a tractor-mounted flail-mower with all arisings removed (C. Whittle *in litt.* 2009). There is little or no rabbit-grazing as this species is controlled on the course.

Recently, P. S. Gateley (*in litt.* 2009) drew attention to the discovery of *B. compressus* at another site on Royal Birkdale Golf Course (site "K", SD31061528), a large wet hollow on the western side of the course between the tee and green of the 12th hole. The plant was identified for the first time in July 2008 in a permanent quadrat that had been recorded several times since 1998 using NVC methodology. This site has received the same management as slack "I".

Just to the west of the golf course, Birkdale slack 26 was formed after the above mentioned railway line was built in 1884, Smith (1984) suggesting that it probably dates to about 1929. Aerial photographs show that it was mature and fully vegetated in 1945. *B. compressus* was first noted here in 1982 during a study of *Juncus balticus* (Smith 1984). At that time, it was more abundant in the northern part of the slack than at present, the plant now being restricted to lightly-used footpaths through the generally rank vegetation, which is not grazed by rabbits (personal observations). This slack is within the Birkdale Sandhills LNR and was subject to scrub-control in 1987 and 2001 (Smith 2007b).

Also at the northern end of the Birkdale Sandhills is a series of six frontal-dune slacks (nos. 27, 28, 30, 31, 32, 33) all of which have *B. compressus* colonies. Most of them were dated by Smith (1984) to the early/mid 1970s, though slacks 30 and 31 were thought to be a few years older. *B. compressus* was originally found here in July 1980, growing in slack 31 with *Juncus balticus*, etc. (personal observations). During the period 1978–1982, most of these slacks were churned up by illegal motor-cycle scrambling (Smith 1984) but, in 1983, the frontal-dunes were added to the Birkdale Sandhills LNR and wardening introduced to control this activity. Edmondson *et al.* (1988/89) include Target Notes indicating the occurrence of *B. compressus* in slacks 27 and 31. By 2003, the plant was present in all six slacks (Smith 2006a).

Conservation management of these slacks has mainly concentrated on the control of *H. rhamnoides* which became increasingly dominant during the 1980s and early 1990s. The slacks were scrub-cleared progressively from no. 27 in 1996 to no. 30 in 2003, with subsequent annual control of regrowth (Smith 2006a; 2007b). All the slacks have well-used informal footpaths, many of which support *B. compressus*. Slack 32, in particular, is heavily trampled and rabbit-grazed, with a very short sward.

LOST SITES

Herbarium records suggest that *B. compressus* was much more widespread on the Merseyside coast in the nineteenth and early twentieth centuries; however, building development in north Liverpool, Bootle, Crosby, Formby, Ainsdale, Birkdale and Southport destroyed about 40% of the dune system (Smith 2009) and no doubt many sites were lost. Within recent memory, only three dune sites for *B. compressus* are known to have disappeared, either wholly or in large part. One was a small wet-slack at Lifeboat Road, Formby Point (SD277066), created by post-Second World War sand-winning, where the plant was recorded as “abundant” in 1978. This site was soon lost to dense poplar (*Populus*) scrub (personal observations). The Ainsdale Sand Dunes NNR archive contains a “Rare Plant Species Location Map” drawn up by K. R. Payne in 1976. It records *B. compressus* in slack 4 (SD284105), part of the Massams Slack complex near the sea, this having been subsequently lost to coastal erosion and sand-blow (A. Kimpton *in litt.* 2008). Finally, the

Sands Lake, Ainsdale site (SD302129), described above, has largely been destroyed by vegetation maturation, including the development of dune-scrub and a tall herbaceous sward.

Literature searches following the completion of field work identified two additional sites for *B. compressus* recorded in Target Notes by Gateley & Michell (2004). These are at slack 8, Altcar Rifle Range (SD285050), and slack 13, Birkdale Sandhills LNR (SD305135), in wet-slack vegetation on the margins of scrapes dug for nature conservation purposes in 1976 and 1977 respectively (Smith 1978). While both these sites have been visited since 2004 for purposes of biological recording, the presence of *B. compressus* was not suspected and it may therefore have been overlooked. Therefore, the continuing presence of the plant cannot be entirely ruled out.

ASSOCIATED VASCULAR PLANTS

Ninety vascular taxa were found associated with *B. compressus* in the 51 quadrats recorded for NVC analysis. These are listed, together with their frequency of occurrence and Ellenberg’s indicator values in Table 2. *Equisetum* × *litorale*, with eight occurrences, is omitted from the Table as no Ellenberg values are available for this taxon (Hill *et al.* 2004). The most ubiquitous species (with over 20 occurrences) are *Agrostis stolonifera* (36 occurrences), *Carex flacca* (44), *Festuca rubra* (27), *Holcus lanatus* (27), *Hydrocotyle vulgaris* (29), *Juncus articulatus* (21), *Mentha aquatica* (30), *Rubus caesius* (24), *Salix repens* (35) and *Trifolium repens* (34). All these taxa are characteristic of dune slacks on the Sefton Coast (Smith 2009; 2006a). Ten of the associates are notable, two (*Dactylorhiza incarnata* ssp. *coccinea* and *Juncus balticus*) being Nationally Scarce and eight (*Carex disticha*, *C. viridula* ssp. *viridula*, *Eleocharis quinqueflora*, *Epipactis palustris*, *Equisetum variegatum*, *Parnassia palustris*, *Trifolium fragiferum* and *Triglochin palustre*) ranked as Species of Conservation Importance in North West England (Regional Biodiversity Steering Group 1999).

Table 2 gives Ellenberg’s indicator values for moisture (L), reaction (R) and nitrogen (N) for vascular taxa associated with *B. compressus*. These have been weighted to take into account their frequency of occurrence. The weighted mean values (6.51, 6.21 and 4.30 respectively) indicate that the taxa favour constantly moist soils that are weakly acid to

TABLE 3. TABLEFIT ANALYSIS OF QUADRAT SAMPLES

Site (no. of samples)	NVC code	Community	Sub-community	% fit	Match
Altcar (3)	MG11a	<i>Festuca rubra</i> - <i>Agrostis stolonifera</i> - <i>Potentilla anserina</i> grassland	<i>Lolium perenne</i>	57	Poor
Cabin Hill 1 (8)	SD15	<i>Salix repens</i> - <i>Calliargon cuspidatum</i> dune slack		46	Very poor
Cabin Hill 3 (3)	SD17	<i>Potentilla anserina</i> - <i>Carex nigra</i> dune slack		49	Very poor
Cabin Hill 20 (3)	SD15	<i>Salix repens</i> - <i>Calliargon cuspidatum</i> dune slack		51	Poor
Sands Lake (3)	MG11a	<i>Festuca rubra</i> - <i>Agrostis stolonifera</i> - <i>Potentilla anserina</i> grassland	<i>Lolium perenne</i>	52	Poor
Ainsdale 49 (3)	SD16d	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack	<i>Agrostis stolonifera</i>	55	Poor
Ainsdale 50 (3)	SD15	<i>Salix repens</i> - <i>Calliargon cuspidatum</i> dune slack		47	Very poor
Ainsdale 51	No sample				
Ainsdale 52 (1)	SD16b	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack	<i>Rubus caesius</i>	58	Poor
Royal Birkdale pond	No sample				
Royal Birkdale fairway (3)	MG8	<i>Cynosurus cristatus</i> - <i>Caltha palustris</i> grassland		60	Fair
Birkdale 26 (3)	SD16b	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack	<i>Rubus caesius</i>	41	Very poor
Birkdale 27 (3)	SD16d	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack	<i>Agrostis stolonifera</i>	52	Poor
Birkdale 28 (3)	SD16d	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack	<i>Agrostis stolonifera</i>	47	Very poor
Birkdale 30 (3)	SD17b	<i>Potentilla anserina</i> - <i>Carex nigra</i> dune slack	<i>Carex flacca</i>	27	Very poor
Birkdale 31 (3)	SD16b	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack	<i>Rubus caesius</i>	54	Poor
or	SD16d	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack	<i>Agrostis stolonifera</i>	54	Poor
Birkdale 32 (3)	SD17b	<i>Potentilla anserina</i> - <i>Carex nigra</i> dune slack	<i>Carex flacca</i>	36	Very poor
Birkdale 33 (3)	SD16	<i>Salix repens</i> - <i>Holcus lanatus</i> dune slack		31	Very poor

weakly basic in reaction and have intermediate fertility (Hill *et al.* 2004). Recalculation of weighted means, for ubiquitous taxa only, gives closely similar values (6.41, 6.29 and 4.36).

NVC COMMUNITIES

Table 3 lists TABLEFIT results for 51 quadrats supporting *B. compressus*. In almost all cases, the statistical fits to known NVC communities are "poor" to "very poor", only one (Royal Birkdale Golf Course) having a "fair" level of agreement with MG8 (*Cynosurus cristatus*-*Caltha palustris* grassland).

As expected, vegetation at most sites equates to dune-slack communities, seven being SD16 (*Salix repens*-*Holcus lanatus* dune-slack), three SD15 (*Salix repens*-*Calliargon cuspidatum* dune-slack) and three SD17 (*Potentilla anserina*-*Carex nigra* dune-slack). The *Salix*-*Holcus* community is characteristic of older and dryer calcareous dune slacks, rarely flooded to any great extent, and often subject to grazing by livestock and/or rabbits. Two sub-communities, SD16d (*Agrostis stolonifera* sub-community) and SD16b (*Rubus caesius* sub-community) were indicated by the analysis, the

former being found in wetter conditions (Gateley & Michell 2004; Rodwell 2000). SD15 also occurs in older slacks but is associated with more prolonged flooding. As in the case of SD16, it is widely distributed nationally and is frequent on the Sefton Coast (Gateley & Michell 2004; Rodwell 2000). Being especially associated with northern dune systems, SD17 is found in damp or wet slacks in which the water is less base-rich, perhaps due to accumulation of organic matter. This slack type is relatively rare on the Sefton duneland (Gateley & Michell 2004; Rodwell 2000).

Three sites apparently support mesotrophic grassland communities, two MG11 (*Festuca rubra*-*Agrostis stolonifera*-*Potentilla anserina* grassland) (at Altcar Rifle Range and Sands Lake) and one MG8 (*Cynosurus cristatus*-*Caltha palustris* grassland) (at Royal Birkdale Golf Course). A rare community on the Sefton sand-dunes, MG11 is a damp grassland type that seems to take the place of slack vegetation in a few disturbed and nutrient rich areas (Gateley & Michell 2004). MG8 is species-rich vegetation characteristic of periodically inundated land, usually managed as pasture and often associated with traditional water-meadows (Rodwell 1992). This community seems out of place here and was not recorded during Gateley & Michell's (2004) NVC survey of the Sefton dunes. Indeed, the Royal Birkdale site was recorded as the rather similar MG5 (*Cynosurus cristatus*-*Centaurea nigra* grassland) or MG5a (*Lathyrus pratensis* sub-community) by Butcher *et al.* (2006). This is a typical grassland of traditionally grazed hay-meadows on heavy textured lowland soils (Rodwell 1992) and is also an unlikely community to find on sand-dunes.

DISCUSSION

It seems clear that the status of *B. compressus* on the Sefton sand-dunes has changed in recent decades. It was recorded in 18 sites during the present study, having been known from under 10 sites in the early 1980s. This is, of course, a species that is easily overlooked but the fact that Smith (2006a) found an increase in occurrences from two to ten dune-slacks in careful studies at Birkdale over a 20-year period suggests that this apparent change is genuine. A continuing increase is suggested by the discovery of *B. compressus* for the first

time in 2008 in a permanent quadrat on Royal Birkdale Golf Course that has been recorded regularly since 1998. In view of the plant's rapid national decline, these are encouraging findings. Furthermore, only two known sites have been completely lost since the 1970s, one to coastal erosion and another to scrub development, while another (at Sands Lake) has shown a major decline in *B. compressus* due to maturation of the vegetation.

Most sites for, and the largest colonies of, *B. compressus* are in calcareous wet-slacks (*sensu* Ranwell), soils being gleys or peaty gleys with a fairly high pH. This accords with habitat descriptions in the rather limited literature on the ecology of this species (e.g. Burkmar 2008; Foley & Porter 2002; Halliday 1997; Walker 2008). Marshy, seasonally-flooded, base-rich sites are said to be favoured, conditions which apply in these slacks. However, small to medium-sized populations were also found in dry-slacks and damp grassland, most surprisingly in the heavily disturbed, weedy fringe of a carpark at Sands Lake, Ainsdale, suggesting that the plant can persist for some time under sub-optimal conditions.

There is a tendency for *B. compressus* populations to be associated with informal footpaths through slack basins, where vegetation height is much reduced, perhaps as a consequence of mechanical damage and, probably, enhanced rabbit-grazing. Plant composition may also be altered; for example, *S. repens* is often reduced in frequency or eliminated from such footpaths, a fact that may well be important for the survival of *B. compressus*, since dominance by *S. repens* is considered to reduce plant species richness (Edmondson *et al.* 1993b). These findings also imply that *B. compressus* is tolerant of grazing and trampling damage.

A majority of the Sefton Coast sites for *B. compressus* appears to be of recent origin. This applies particularly to the wetland supporting the largest population at Cabin Hill and the slacks in the Ainsdale and Birkdale frontal dunes, all of which are less than 40 years old (Table 1). In some cases, it has been possible to date the first appearance of *B. compressus* to about 10 years after slack formation. There are a few ostensibly older sites but here the plant is favoured either by human trampling, grazing or mowing, these maintaining a shorter, more open sward. This supports the suggestion that the plant is a poor competitor (Walker 2008) and is therefore likely to decline, in the absence

of management, as slacks age and become colonised by ranker vegetation (Davy *et al.* 2006; Smith 2009). It is interesting that *B. compressus* survived and even increased in the northern Birkdale frontal slacks after these were severely damaged by motor-cycling in the late 1970s and early 1980s; this activity created large areas of bare ground and provided sites for colonisation, not only by *B. compressus* but also *Juncus balticus* at what was, by then, its only English location. Smith (1984; 2006b) concludes that *J. balticus* is a good coloniser of young, sparsely vegetated wet-slacks and may then persist for many years before declining as the habitat becomes dryer and more heavily vegetated. These conclusions seem also to apply to *B. compressus*.

Although, *B. compressus* is currently well-established and locally abundant on the Sefton sand-dunes, its populations are highly localised, confined to only three tetrads and therefore vulnerable. Bearing in mind that this dune system is particularly well-endowed with wet-slacks (Smith 1978) and supports about 39% of all the dune-slack vegetation in England (Radley 1994), it is perhaps surprising that the plant is not more widespread here. Thus, the large expanses of Ainsdale Sand Dunes NNR (339ha) and Ainsdale Sandhills LNR (88ha), both with extensive slack habitat, appear to be devoid of *B. compressus* populations. However, many of the large slacks in these areas originated over a century ago (Smith 1978) and are densely clothed in *S. repens*. Such habitat seems to be unsuitable for *B. compressus* which is mainly found in young and/or disturbed sites.

B. compressus grows here with a high diversity of associated vascular plants (90 taxa), many being characteristic of wet-slacks. However, analysis of Ellenberg's indicator values shows that, on average, the associates are adapted to slightly dryer, less basic and more fertile sites than *B. compressus*. This suggests that requirements for the latter species may be more taxing than for other wet-slack vascular plants, a finding which may also help to account for its restricted distribution in the dune system.

B. compressus is not mentioned by Rodwell (1991; 1992; 2000) and there is little published information on plant communities favoured by this species, though Walker (2008) gives some examples. Thus, in vice counties 80 (Roxburghs.) and 81 (Berwicks.), most colonies occur in a distinct habitat of short turf on a shelf below the level of stream banks. Here typical

associates include *Agrostis capillaris*, *Anthoxanthum odoratum*, *Cirsium palustre*, *Cynosurus cristatus*, *Eleocharis palustris*, *Festuca rubra*, *Bellis perennis*, *Geum rivale*, *Lychnis flos-cuculi*, *Poa* sp., *Ranunculus repens* and *Trifolium repens*; nine of these also being associated with *B. compressus* in Sefton. A typical NVC community of *B. compressus* sites in the uplands of northern England is M10 (*Carex dioica*-*Pinguicula vulgaris* mire) (Walker 2008), a calcareous flush vegetation in which small sedges predominate and which is often maintained in an open condition by grazing and trampling of large herbivores (Rodwell 1991). In southern and eastern England, *B. compressus* occurs in species-rich fen meadows, including MG8 (*Cynosurus cristatus*-*Caltha palustris* grassland) and M23 (*Juncus effusus*-*acutiflorus*-*Galium palustre* rush-pasture) (Walker 2008). The former is found on seasonally-flooded, flat or slightly sloping land by rivers and streams and was managed traditionally as pasture for cattle and horses, sometimes as water-meadow (Rodwell 1992). MG8 was unexpectedly recorded at the Royal Birkdale site during the present study. The *Juncus*-*Galium* community is especially characteristic of ill-drained and relatively unimproved or reverted pasture in the cool and rainy lowlands of western Britain; here it is maintained by grazing or, much more rarely, by mowing (Rodwell 1991). Typical associates in both these types include *Carex acutiformis*, *C. flacca*, *C. disticha*, *C. panicea*, *Cirsium dissectum*, *Dactylorhiza incarnata*, *D. praetermissa*, *Eleocharis uniglumis*, *Filipendula ulmaria*, *Lychnis flos-cuculi* and *Persicaria hydropiper* (Walker 2008), five of these being listed as associates of *B. compressus* on the Sefton Coast (Table 2).

Almost all the samples taken during this study are poor or very poor fits to known NVC communities. Similar results were reported for several of the Birkdale sites by Smith (2006b). Samples taken in 1981/82 in slacks 26, 27, 30, 31 and 33 show mostly poor to very poor levels of fit, while those recorded in 2004 for slack 27 range from very poor to fair. Similarly, Butcher *et al.* (2006) report very poor to fair fits to MG5 at the Royal Birkdale site (their slack 'T') between 1998 and 2006. A possible explanation is that the vegetation of these and most other Sefton sites for *B. compressus* has a recent origin and has been disturbed by several factors, including recreational activities, grazing, mowing and scrub removal. This might result in samples failing to match known

NVC communities because the vegetation is still maturing with respect to species ingress. However, low matches are likely to be as spurious as useful (P. S. Gateley *in litt.* 2009). For example, slack "I" at Royal Birkdale is clearly neither a traditional water-meadow nor a hay-meadow but a form of dune-slack, albeit somewhat atypical.

CONSERVATION

All current sites for *B. compressus* on the Sefton Coast are protected by SSSI/Natura 2000 designations. Those at Cabin Hill lie within a National Nature Reserve, while apart from Royal Birkdale Golf Course, the Ainsdale and Birkdale sites benefit from Local Nature Reserve status. The plant is proposed for inclusion in the North Merseyside BAP.

The present study reinforces opinion (e.g. Burkmarr 2007) that habitat management favouring the plant will include maintaining the hydrology of sites, avoiding eutrophication and preventing the over-maturation and coarsening of swards. The fact that the plant seems to have increased recently suggests that current Sefton Coast conservation management, including late-summer mowing (Altcar Rifle Range, Ainsdale slack 49 and Royal Birkdale), livestock-grazing (Cabin Hill) and scrub control (most sites) is being successful. Additionally, light to moderate recreational trampling and rabbit-grazing seem to be important in helping to maintain open swards and reduce dominance of slack vegetation by *S. repens*. Scrub control on the duneland has concentrated mainly on *H. rhamnoides* but attention may also need to be given to the larger willows, such as *S. cinerea*, which are slowly colonising some of the *B. compressus* sites.

Long-term studies of Sefton dune hydrology provide no convincing evidence of water-table decline, though modelling the impact of climate change suggests adverse impacts could be seen within a few decades (Clarke & Sanitwong-Na-Ayutthaya 2006). Also of concern is eutrophication by aerial deposition of nitrogen. Gateley & Michell (2004) report recent reductions in

the areas of oligotrophic vegetation types on the Sefton duneland, implying enrichment is taking place, perhaps partly from this source. Over the last 30–40 years, many British dune systems, including the Sefton Coast, have become more stable and heavily vegetated. Meanwhile, atmospheric N deposition in Europe has approximately doubled (Jones *et al.* 2004). The latter authors show a positive relationship between N inputs and above-ground biomass and a negative relationship with plant species-richness in mobile and fixed dunes, though the trends are less clear in dune-slacks. They suggest a critical load range of 10–20 kgNha⁻¹yr⁻¹ for coastal dunes in the UK.

As *B. compressus* seems to be largely absent from mature dune-slacks, management that promotes dune dynamics, including dune formation and localised blow-out development will assist the creation of suitable new habitat in the medium to long-term. The recent development of Birkdale Green Beach, a 60ha strip of salt-marsh, sand-dune, dune-slack and swamp communities on the foreshore between Birkdale and Ainsdale (Smith 2007c), provides potential future habitat for *B. compressus*, although only the related *B. rufus* has been recorded there to date.

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Some localised early plant records from North-west England: then and now

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ABSTRACT

The plant records of three late sixteenth/early seventeenth-century collectors made in two localised areas of north-west England are examined and the relevant plants' continued survival there, or otherwise, is discussed. Apart from what at that time were already scarce plants or were aesthetically attractive and therefore over-collected, most of them still survive.

KEYWORDS: Craven limestones, Great Harwood, botanical history, Thomas Hesketh, Thomas Penny, Thomasin Tunstall.

INTRODUCTION

In the late sixteenth and early seventeenth century, plants growing locally in north-west England were recorded in contemporary herbals, especially those prepared and published by John Gerard (1545–1612), John Parkinson (1567–1650) and Charles L'Ecluse (Clusius) (1526–1609). The latter were compilers of information but the detail came from local botanists who variously sent them specimens, drawings, descriptions, and locality details of any plants they considered interesting. In this particular area of the country at that time, the three most important and prolific were Thomas Penny (c. 1530–1588), Thomas Hesketh (1560–1613) and Thomasin Tunstall (fl. 1620–1630) but, understandably, their areas of activity were usually close to their respective homes.

Two limited geographical areas in which these three were active are considered here. The first is that part of the botanically-rich Craven limestone area (v.c. 64) which includes Ingleborough hill and the woods and ghylls on its south-west side close to the villages of Ingleton and Clapham (grid reference: SD67/77). This region was visited at different times by all three botanists. The second area appears to have been the sole preserve of Hesketh. This was close to his home near Great Harwood, Lancashire (v.c. 59), and included the nearby region around the confluences of the

rivers Ribble, Calder and Hodder (v.cc. 59/60; SD63/73). Additional scattered records by Hesketh from elsewhere in northern England are also known including the west Lancashire (v.c. 59) moss-land near Rufford and Mawdesley (SD41) where he owned a second property, as well as Rosgill, Crosby Ravensworth and Walney Island (the latter three, all in Cumbria, v.cc. 69 & 70). These dispersed records are not discussed here.

THE LOCAL BOTANISTS

Thomas Penny was born in the small Lancashire village of Gressingham north-east of Lancaster within easy reach of Ingleborough hill. He apparently spent his early years in the area but, after graduating at Cambridge University, took up holy orders and moved to London. Later, between 1565 and 1569, he travelled on the continent, mainly to avoid the religious hostility present in England at that time and whilst abroad spent most of this period pursuing field botany and medical training. Despite having moved away from northern England, he nevertheless retained close links with his birthplace, returning there on occasion and visiting the Ingleborough area. In his will, he made a bequest to the poor of Gressingham "to be distributed at the discretion of Mr Fawcett minister.....". In St John's Church, Gressingham, there is, to this day, a plaque listing previous ministers which includes the said John Fawcett, the incumbent during the period 1562–1590. Penny's interest in botany presumably originated from these early years in north Lancashire whereon some of his local finds were recorded by the contemporary herbal authors of the day, especially Gerard and Clusius. Later, during his time on the continent, he became an expert on the flora of the region around Geneva and was known to other eminent naturalists such as Conrad Gesner, Matthew de l'Obel and Joachim Camerarius. On his return to England, he took up medical practice and also became an

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eminent entomologist. He was a co-author, along with Thomas Mouffett and others, of the posthumously-published *Insectorum sive minimorum Animalium Theatrum* (Mouffett 1634), a very early work on entomology. An account of Penny's botanical work abroad together with additional details of his background, are given in Foley (2006).

By coincidence, another person with a great interest in plants, but born rather later than Penny, lived within a mere five kilometres of Penny's Gressingham birthplace. This was a lady, Thomasin Tunstall, whose plant collecting virtues were extolled by John Parkinson, herbalist to James I. In his book *Paradisi in sole paradisus terrestris* Parkinson (1629) described her as "a courteous Gentlewoman.....who dwelleth at Bull-banke, neare Hornby castle in those parts...". Bull Bank, although now rebuilt, still exists as a farm, situated close to the River Greta, and with the village of Tunstall (as in her name) and Thurland Castle, little more than a kilometre away. The castle was once owned by the Tunstall family and it is possible that she was born there. An earlier Thomasin Tunstall, born around 1544, was the daughter of the then owner Marmaduke Tunstall and could have been Thomasin's mother or grandmother, whilst Francis Tunstall, who sold Thurland Castle around 1605, was of an age to have possibly been her father. Little else is known of her background but there is a record in St John's Parish Church register in the village of Tunstall, dated September 29, 1632, which may relate to her. This lists the marriage between Thomasin Smythies de Tunstall and Thomas Smyth. Also, Farrer & Brownbill (1914) state that, in 1629, Thomasin Tunstall and Alice Clopton, both of this area, compounded for two thirds of their estates liable to sequestration for recusancy and were each fined £2 10s. a year. This also may refer to her. She was apparently very familiar with the Ingleborough area (as was Penny) and sent plants collected there to John Parkinson in London.

The third person under consideration is Thomas Hesketh who was born at Martholme Hall, Great Harwood, in 1560. An extant record in the local parish register for 15 May of that year records his baptism: *Thomas Hesketh filius secundus Thome Hesketh militis* (i.e. second son of the knight, also called Thomas Hesketh). On his father's death in 1588, Thomas was left property at the village of

Mawdesley in west Lancashire. Until that time, his early life would have been spent at Martholme, but he now moved to his inherited property whilst his widowed mother continued to live on at Martholme Hall. However, in 1593 he returned there to live with his mother again. This is confirmed by an entry into the Great Harwood parish records for October that year because, as a non-conforming catholic, he was considered to be a recusant, a penalty for which was the necessity to register his current place of residence. This entry, also extant, states: *Thomas Hesketh gent a Recusant did /notifie/ his Cominge to the martholme to dwele /wth his mother/ to me Wm Herris Cur' of the Chappell of moch Harwood the fowrte day of october A^o Regni Elizabeth nunc Regine xxxv^o 1593*. So, for much of his life prior to the publication of Gerard's "Herball" (Gerard 1597), he lived at Martholme making excursions into the surrounding countryside as well as to the Ingleborough area. Around the turn of the century, he moved to nearby Clitheroe where he practised as a doctor, Parkinson (1640) referring to him as "a painefull Chirurgion [surgeon] and Simplist [plant collector] of Lancashire". He was held in high regard by Gerard who considered him "a diligent searcher of Simples [plants]" who had discovered many plants "likewise, never before his time remembered or found out". Also that he was "a curious [enquiring] gentleman in the searching forth of Simples ... [and] ...in the knowledge of plants". It is quite possible that Gerard, prior to the publication of his Herbal in 1597, visited Hesketh at Martholme and met his mother (Lady Alice) as he refers to Martholme as "my Lady Heskiths house" (see *Tragopogon porrifolius* below); they may also have made an excursion together to Walney Island (Barrow-in-Furness, Cumbria). Matthias de L'Obel (1538–1616), the king's 'botanographer', also recorded some of Hesketh's finds and Hesketh must have met both Gerard (see *Narthecium ossifragum*, below) and de L'Obel (see L'Obel 1655) in London since both of them record his having brought plants to them.

(A) THE CRAVEN LIMESTONES/INGLEBOROUGH AREA
(V.C. 64)

At the time of these early records, this area was variously considered to be either in Yorkshire or in Lancashire and Gerard, especially, was

notoriously inconsistent in regards to geography. However, nowadays this area is firmly within the former county.

CARDAMINE PRATENSIS L.

Thomasin Tunstall sent a double-flowered plant of this to John Parkinson in London (Parkinson 1629: 389): “Cardamine flore pleno. Double Cuckow flowers in Lancashire, from whence I received a plant, which perished, but was found by the industrie of a worthy Gentlewoman, dwelling in those parts heretofore remembred, called Mistresse Thomasin Tunstall, a great lover of these delights”. *C. pratensis* is still very frequent here in damp grassland and elsewhere in the north although, understandably, the double variety appears to be ignored nowadays.

CARDUS HETEROPHYLLUM (L.) HILL

This thistle, of quite striking appearance, was known to, and had been sketched by, Penny prior to 1581 where he must have seen it in the fields around Ingleborough. Clusius (1583: 655–657) stated “... cuius descriptionem & iconem mihi anno 1581. Londini communicavit C.V. Thomas Pennaeus Londin-ensis medicus”....”in pratis ad radices montis Englebrow totius Angliae celsissimi in Comitatu Eboracensi. Floret Iulio & Augusto”. It is still a frequent plant in these parts.

CEPHALANTHERA LONGIFOLIA (L.) FRITSCH

Parkinson (1629: 348) stated that “The second [i.e. *C. longifolia*] growth in many places of England, and with the same Gentlewoman [i.e. Thomasin Tunstall] also before remembred, who sent one plant of this kinde [this would be from Helks Wood, Ingleton] with the others [*Cypripedium calceolus*, see below]”. However, due to extravagant over-collecting, it appears to have met the same fate there as did the *Cypripedium*. In the early days it was also known from other woods within the area around Settle, Clapham and Ingleton and there is a localised reference to its presence near Brackenbrow, Ingleton in the eighteenth century. It appears to have persisted at the latter for some time and was seen there by F A Lees in 1869 (Lees 1888). However, no further records have been traced, from either there or elsewhere in this area. More recently it was known until the 1930s from a hazel coppice at Far Arnside (v.c. 69) but this locality is c. 25 kilometres to the west of the Helks Wood and the other Craven sites. The nearest occurrence for *C. longifolia* nowadays lies well to the

north in Cumbria (v.c. 69/70) where it occurs at a few sites in open *Fagus* woodland

COCHLEARIA PYRENAICA DC

This plant of damp, bareish places on upland limestone was sent to Parkinson by Tunstall (Parkinson (1640: 286): “It has also been found growing upon Ingleborough hill in Lancashire, assured me by a worthy Gentlewoman Mrs Thomasin Tunstall remembred in my former booke for many things, found growing in those parts by her meanes which were not known to be growing in England, and thereof shee sent to me up some for a manifestation of the truth.”. It is still widespread here and common in suitable habitats.

CYPRIPEDIUM CALCEOLUS

Parkinson (1629: 348) recorded that the plant “...groweth likewise in Lancashire, neare upon the border of Yorkshire, in a wood or plece called the Helkes [Helks Wood], which is three miles from Ingleborough, the highest hill in England, and not farre from Ingleton, as I am informed by a courteous Gentlewoman, a great lover of these delights, Mistris Thomasin Tunstall, ...and who hath often sent mee up the rootes to London, which have borne faire flowers in my Garden”. Nowadays long since extinct both at Ingleton and virtually everywhere else in England, it has been the victim of deplorable over-collection, especially in those early days. Its spectacular appearance and value as a garden plant meant that it was highly coveted. A letter noted by Curtis (1941) which was written in 1781 mentioned a man having brought about forty wild plants to sell at Settle market; plants also were on sale at nearby Ingleton. It appears to have survived at Helks Wood until the late-eighteenth century. Withering writing in 1798 quoted a Mr Thornbeck, an Ingleton surgeon, who told him that it had been “lost in Helks Wood for some years” and Dawson Turner in 1805 recorded that he had searched there for it in vain, “a gardener of Ingleton having eradicated every plant for sale” (see also Lees 1888). It lingered on in a few other parts of Craven into the twentieth century but was eventually reduced to a single, currently surviving, plant. However, re-introductions have recently taken place at some former sites and so eventually it may again become a more familiar sight.

PINGUICULA VULGARIS L.

Gerard (1597: 645) recorded “Pinguicula sive Sanicula Eboracensis – Butterwort” in “...a

field called Crag-Close, and upon Ingleborow fels.....". The Crag-Close locality is thought to be in the Settle area where Hesketh is known to have operated (see *Primula vulgaris* × *P. veris*, below). This will be a Hesketh record. Rocky ground, of which there is a great deal in the area, is sometimes referred to as a "close". The Ingleborough record, however, is probably Penny's. The plant still survives in many such localities in the area.

POLYGONATUM ODORATUM (MILLER) DRUCE

Unlocalised, but this must be a Hesketh record from Clapham since it was from precisely these woods that he also recorded the hybrid *Primula* (see below), Gerard (1597: 758) stating: "that sort.....with broad leaves groweth in certaine woods in Yorkshire called Clapdale woods, three miles from a village named Settle". *P. odoratum* still occurs on nearby scars from where it was recorded quite recently (P. Abbott, pers. comm., 2008).

PRIMULA FARINOSA L.

On a return visit to the area in 1581, this was recorded by Penny as "Primula veris flore rubro", Clusius (1583: 342) stating: "Anno verò 1581, dum Londini essem, de C.V.D. Pennaeo intellexi copiosè admodum nasci in Angliae Septentrionalibus locis pratis humidis & pascuis, atq;". Although only localised to northern England, this will be from this area of Craven where, even nowadays, it is still frequent in damp areas over limestone. Hesketh also knew it near to his Lancashire home (see below).

PRIMULA VULGARIS HUDSON × *P. VERIS* L.

Recorded by Hesketh (Gerard 1597: 637): *Primula veris Heskethi* – Mr Hesketh's Primrose. "the Primrose found by Mr Hesketh growes in a wood called Clap-dale [near Clapham], three miles from a towne in Yorkshire called Settle". It appears to be this hybrid and is the first British record. A later comment in the appendix to Johnson's revision (Gerard 1633) seems to suggest a cultivar: "if Mr Hesketh found it there, it was some extraordinary luxurious floure, for now I am well assured no such is there to be seene". The hybrid often occurs where the parents grow close together and is not uncommon in the area and is probably still present at Clapham. Hesketh's record is also acknowledged by de L'Obel (1655: 118).

RUBUS CHAMAEMORUS L.

Recorded by both Clusius and Gerard, although that of the former is almost certainly the earlier of the two. Clusius attributed the discovery to Penny who had sent him a description and an excellent drawing, both of which he reproduced in his book. He stated (Clusius 1583: 117–119): "De Chamaemoro: iconem & descriptionem nobis communicavit c.v. Thomas Pennaeus suprà memoratus, atque Chamaemorum appellare placuit...../..... aperta loca amat, summósque montes, & magna copia inter Ericas provenit monte Ingleborrow totius Angliae celsissimo, duodecim miliaribus à Lancastria. Later, Gerard (1597:1386) under *Vaccinia nubis* (Cloud-berrie) said it had been found on two high mountains, one "in Yorkshire called Ingleborough, the other in Lancashire called Pendle....", the latter locality being referred to Hesketh as the finder (see below). *R. chamaemorus* still occurs on Ingleborough and other high hills within the area.

SEDUM ROSEA (L.) SCOP.

As with *Rubus chamaemorus*, this was first found first by Penny who had sent it to Joachim Camerarius prior to 1588. He (Camerarius 1588: 139) recorded it as "Rhodia radix" as found "in Anglia in monte Ingleborreno [Ingleborough] dicto,ubi flores & semen producit, ut ad me scripsit Doctiss. & rerum naturalium peritiss. Medicus D. Thomas Pennaeus Anglus". Gerard (1633: 532) also noted that "Rhodia radix"... "groweth very plentifully in the North part of England, especially in a place called Ingleborough Fels", whilst Parkinson (1640: 739–740) recorded what appears to be the same plant (*Sedum laciniatus* foliis Small Houseleek with divided leaves) "on the Mountaines of Lancashire with us as Mr Hesketh told us". However, there is no precise reference to Hesketh having found it on Ingleborough. *Sedum rosea* was reported as rare in Yorkshire by Lees (1888), occurring on high exposed grit or slate rocks. However, it is still known from Ingleborough from where Penny certainly knew it.

OTHER POSSIBLE RECORDS

Clusius (1601: 237) recorded *Trollius europaeus* L. [as *Trollius flos*] in mountains in northern England: "ex septentrionalibus Angliae montibus erutum recenter Londini

anno octuagesimo primo supra millesimu & quingentesimus conspiciebam” but without a finder. Even earlier he (Clusius 1583: 372), using the name “Trollius flos”, had commented on it having been known in England growing amongst *Primula farinosa*: “...in Anglia inter primulas flore rubro”. Knowing of the Penny-Clusius connection in relation to *P. farinosa* and other plants, these references very probably originate from Penny and from this area where it still survives in small populations.

Gerard also gave a few additional northern England plant records, but without direct attribution but these almost certainly will have originated from Hesketh. He reported that *Hypericum tetrapterum* Fries “... Square S. Johns Grasse”... “groweth plentifully in the North part of England, especially in Landsdale and Craven” (Gerard 1633: 542). Again, this is the first record for Britain. He also described *Digitalis purpurea* L. “Fox-Gloves....in Landesdale [Lonsdale, north-east of Lancaster], and Craven, in a field called Cragge-close [see *Pinguicula vulgaris*, above], in the north of England” (Gerard 1633: 791) and also *Parnassia palustris* L. “Grasse of Parnassus....in Landsdall [Lonsdale] and Craven, in the North parts of England” (Gerard 1633: 840). These plants are all still present in the area in suitable habitats.

To these may be added *Valeriana officinalis* (“Mountaine Setwall, or Nardus”, Gerard 1633:1081) also at Crag-close, and both this and *Phyllitis scolopendrium* (“Harts tongue”) on Ingleborough (Gerard 1633:1139), both of which may also be relevant here.

(B) NORTH-EAST LANCASHIRE (MAINLY V.C. 59)

All the records from here are attributable to Hesketh (some possibly jointly with his mother). Other than his discoveries in Craven (given above) and those near his inherited property in west Lancashire, most of the remainder are from a limited area within a few kilometres of his Great Harwood home. Both his birth-place, Martholme Hall, and its associated gate-house, still survive. Into the stonework are carved the letters “T H” and the dates 1561 and 1577 commemorating the renovation work carried out there by his father. Hesketh must have spent much time wandering the local countryside and would have known this area in detail. Most of his records are provided by Gerard who possibly also visited Martholme.

LATHRAEA SQUAMARIA L.

This remarkably localised record was given by Gerard (1597: 1388) as “Dentaria maior Mathioli – Great Toothwort, or Lungwort [which] groweth likewise neere Harwood in Lancashire, a mile from Whanley [Whalley], in a wood called Talbot banke”. This wood is on the bank of the Calder about three kilometres downstream from Hesketh’s home at Martholme. The plant was seen around 1827 at what is probably Hesketh’s original locality: “George Ward....informs me that....that he had found this plant about 35 years ago [i.e. c.1827] between Whalley and Harwood, about a mile from the former place and near to the river Calder” (Ashfield 1862). This wood is now very overgrown, a recent search for the plant being unsuccessful but it could still survive there. It still occurs nearby at Mitton (pers. obs. 2006) and is also known elsewhere in the vicinity.

LEPIDUM LATIFOLIUM L.

This was recorded by Parkinson (1640: 856) for Sawley further to the north but this may be a mis-spelling for Whalley which is closer to Hesketh’s home. In either case it is most likely to originate from him. It is normally a plant of coastal areas but is sometimes naturalised inland and there are modern records from as close as 3 km to the south-east of Martholme (S. Bungard, pers. comm., 2005).

MAIANTHEMUM BIFOLIUM (L.) F. W. SCHMIDT

Gerard (1597: 330) lists “Monophyllon – One Blade” as occurring “.... in Lancashire in Dingley [Dinckley] Wood, six miles from Preston in Aundernesse; and in Harwood [Great Harwood], neere to Blackburne”. Both of these localities are very close to Hesketh’s home and although he is not specifically named, there can be little doubt these are his records. Nowadays, Dinckley Wood is much reduced and modern searches have been unsuccessful. The plant was probably only doubtfully native there in those days and is now long since gone, as it is from Great Harwood.

NARTHECIUM OSSIFRAGUM (L.) HUDSON

According to Gerard (1597: 89) “Asphodelus Lancastriae verus – The true Lancashire Asphodil” was found by Hesketh at “Martom” [Martholme] and that he “... brought the plants thereof unto me for the increase of my garden”. Hesketh also found the plant at Mawdesley, near his other property.

TABLE 1. PAST AND PRESENT OCCURRENCE OF PLANTS RECORDED BY PENNY, HESKETH AND TUNSTALL

Species	Source	Finder	Recorded prior to:	Locality	Current status
(a) Craven/Ingleborough area					
<i>Cardamine pratensis</i>	Parkinson (1629: 389)	Tunstall	1629	Near Ingleborough	Still very frequent
<i>Carduus heterophyllus</i>	Clusius (1601 exlviii)	Penny	1581	Below Ingleborough	Frequent
<i>Cephalanthera longifolia</i>	Parkinson (1629: 348)	Tunstall	1629	Helks Wood, Ingleton	Long extinct; was known nearby until at least 1859
<i>Cochlearia pyrenaica</i>	Parkinson (1640: 286)	Tunstall	1640	Ingleborough	Still frequent
<i>Cypripedium calceolus</i>	Parkinson (1629: 348)	Tunstall	1629	Helks Wood, Ingleton	Extinct since the late eighteenth century
<i>Digitalis purpurea</i>	Gerard (1633: 791)	Hesketh (probably)	1597	Ingleton area	Frequent off the limestone
<i>Hypericum tetrapterum</i>	Gerard (1633: 542)	Hesketh (probably)	1597	"Craven area"	Still present
<i>Parnassia palustris</i>	Gerard (1633: 840)	Hesketh (probably)	1597	"Craven area"	Still present
<i>Pinguicula vulgaris</i>	Gerard (1597: 645)	Penny; Hesketh	1597	Ingleborough and near Settle	Still present
<i>Polygonatum odoratum</i>	Gerard (1597: 758)	Hesketh	1597	Clapdale wood, Clapham	Still present on nearby scars
<i>Primula farinosa</i>	Clusius (1601: 301)	Penny	1588	Unlocalised but in the Ingleborough area	Still occurs
<i>Primula vulgaris</i> × <i>veris</i>	Gerard (1597: 637)	Hesketh	1597	Clapdale wood, Clapham	Probably still there but overlooked
<i>Rubus chamaemorus</i>	Gerard (1597: 1091 & 1386)	Penny; Hesketh	1597	Ingleborough	Still present
<i>Sedum rosea</i>	Camerarius (1588)	Penny; Hesketh	1588	Ingleborough	Still present
<i>Trollius europaeus</i>	Clusius (1601: 237)	Penny	1588	Unlocalised but in the Ingleborough area	Very local

TABLE 1. CONT...

Species	Source	Finder	Recorded prior to:	Locality	Current status
(b) North-east Lancashire					
<i>Lathraea squamaria</i>	Gerard (1597: 1388)	Hesketh	1597	Talbot Bank wood, Whalley- Great Harwood	Unconfirmed but nearby at Mitton and elsewhere
<i>Lepidium latifolium</i>	Parkinson (1640: 856)	Hesketh (probably)	1640	Sawley (but perhaps mis- spelled: Whalley?)	Not known but probably extinct.
<i>Maianthemum bifolium</i>	Gerard (1597: 330)	Hesketh	1597	Dinckley and Great Harwood	Whalley is near to Hesketh's home Extinct
<i>Narthecium ossifragum</i>	Gerard (1597: 89)	Hesketh	1597	Martholme (Great Harwood)	Occurs nearby of Wiswell Moor
<i>Paris quadrifolia</i>	Gerard (1597: 328)	Hesketh	1597	Dinckley and Martholme (Great Harwood)	Extinct. Recently recorded nearby at Clitheroe
<i>Pinguicula vulgaris</i>	Gerard (1597: 645)	Hesketh	1597	Great Harwood	Probably extinct but present nearby on Wiswell Moor
<i>Primula farinosa</i>	Gerard (1597: 639)	Hesketh	1597	Great Harwood	Extinct. Last record in 1907 *
<i>Prunus padus</i>	Gerard (1633: 1505)	Hesketh	1597	Martholme (Great Harwood)	Perhaps extinct but known from an adjacent tetrad
<i>Rubus chamaemorus</i>	Gerard (1597: 1091 & 1386)	Hesketh	1597	Pendle Hill	A shy flowerer, known there until the 1930s and probably still present.
<i>Rubus idaeus</i>	Gerard (1597: 1091)	Hesketh	1597	Great Harwood	Frequent
<i>Teucrium scordium</i>	Gerard (1597: 535)	Hesketh	1597	Great Harwood	Extinct (probably planted)
<i>Tragopogon porrifolius</i>	Gerard (1597: 596)	Hesketh	1597	Banks of the River Calder (Great Harwood)	Extinct but known some distance away near Nelson

* It was known at Great Harwood, possibly at Hesketh's precise site near Martholme, as recently as 1907 (*Lancashire Naturalist* 1: 80). The last record in the immediate area was at Hardhill Common between Whalley and Clitheroe, surviving there up to the middle of the twentieth century.

These appear to be the first British records. It may still be present in the vicinity of Martholme and certainly survives just a few kilometres to the north-west in the Wiswell Moor area (D Earle, pers. comm., 2005).

PARIS QUADRIFOLIA L.

"One-Berry, or Herbe True-love" was known "...in Blackburne at a place called Merton [Martholme] in Lancashire; [and]... in Dingley [Dinckley] wood, six miles from Preston in Aundernessee..." (Gerard (1597: 328). Both localities are at, or very close to, Hesketh's home and again, although he is not mentioned by name, they must undoubtedly originate from him. The more likely place for the plant to survive will be at Dinckley but there are no modern records from there. Savidge et al. (1963) gave a record for the plant in woods at Moreton Hall, Whalley, a locality only about one kilometre from Martholme. It was more recently recorded near Horrocksford Quarries, Clitheroe in 1964 approximately ten kilometres to the north of Martholme.

PINGUICULA VULGARIS L.

Gerard (1597: 645) recorded "*Pinguicula sine Sanicula Eboracensis* – Butterwort, or Yorkshire Sanicle. ...a field called Crag-Close, and at Crosby, Ravenswaith, in Westmerland, upon Ingleborow fels.....and in Harwood neere to Blackburne". The record for Great Harwood will certainly be Hesketh's. Currently not known precisely from here, it still survives in small numbers on Wiswell Moor, less than 4 kilometres to the north (S Bungard, pers. comm.).

The Crag-Close locality is in the Settle area where Hesketh had been known to operate (see *Primula vulgaris* × *P. veris*) and may be his record. It seems to be a local or vernacular name since rocky ground, of which there is a great deal there, is sometimes referred to as a "close". The plant still survives in such localities.

PRIMULA FARINOSA L.

Gerard (1597: 639) calls this "Birds-eine?" and that "...plants grow very plentifully in moist and squally grounds...in Harwood neere to Blackburne...".

This is one of the first British records for *P. farinosa*, a northern England plant of damp ground over base-rich substrates. Again, although not mentioned directly by name, the "Harwood" locality must originate from Hesketh; it is towards the plant's southern

British limit. It was "still to be foundat Great Harwood...", possibly at Hesketh's precise site near Martholme, as recently as 1907 (Anon, 1914). Close to Martholme there were several calcareous flushes (perpetuated by the locality name "Allsprings"). One such flush near to the bank of the Calder about a kilometre downstream of Martholme, still survives but, unfortunately, in the absence of the plant. *P. farinosa* was also frequently recorded in the general vicinity, especially around nearby Pendle Hill. The last record appears to have been on Hardhill Common between Whalley and Clitheroe where it survived until the middle of the twentieth century but drainage and agricultural activity has resulted in its loss nowadays.

PRUNUS PADUS L.

"*Cerasus avium nigra* & *racemosa* – Birds Cherry, and blacke Grape Cherry tree..... groweth likewise in Martome Park [Martholme], foure miles from Blackeburne, and in Harward [Great Harwood] neere thereunto; in Lancashire almost in every hedge...". Gerard (1633: 1505). Currently it is known from an adjacent tetrad to Martholme (D. Earle, pers. comm., 2005).

RUBUS IDAEUS L.

Gerard (1597: 1091) says that "*Rubus idaeus*" – Raspis, or Hinde-berry" is not wild "except in a fielede by a village in Lancashire called Harwood [Great Harwood] not farre from Blackburne [Blackburn]". Again, surely a Hesketh record from near Martholme and probably still present there as it is a common plant in the general area.

RUBUS CHAMAEMORUS L.

The source of the first British record is confused but there is little doubt that it was either from near the summits of Ingleborough or Pendle. Under *Vaccinia nubes* (Cloud-berry) Gerard (1597: 1386) stated it was found on two high mountains, one of which is "in Yorkshire called Ingleborough, the other in Lancashire called Pendle.....found there by a curious gentleman in the knowledge of plants, called Master Hesketh, often remembered". However, as remarked earlier regarding *Sedum rosea*, Thomas Penny who predated Hesketh by thirty years or so, probably first found it on Ingleborough although Hesketh's record for Pendle will be the first for that hill. At the latter locality it has always been a shy flowerer, but flowering plants were recorded there in 1934

(Turner 1934) and where it almost certainly still survives. Its very shy flowering on Pendle is unusual but this was also noted, even into the past (Dobson 1864; 1881), Leigh (1700). The distinctly crude illustration reproduced by Gerard will probably have originated from Hesketh. It appears to show a plant both in flower and in fruit and for that reason it is perhaps more likely to relate to one he saw on Ingleborough rather than Pendle.

TEUCRIUM SCORDIUM L.

"Scordium – Water Germander.... in a meadow by Harwood in Lancashire" Gerard (1597: 535). Although not named, this must be Hesketh's record from near his Martholme home. Presumably introduced and not now known there of course, this is a plant of calcareous soils, sometimes found on river banks. It is now extremely rare anywhere in the British Isles.

TRAGOPOGON PORRIFOLIUS L.

Gerard (1597: 596) states that "Tragopogon purpureum – Purple Goats-beard.....growes not wild in England that I could ever see or heare of, except in Lancashire upon the banks of the river Chalder [Calder], neere to my Lady Heskiths house, two miles from Whawley [Whalley]". This mainly Mediterranean plant can occur as a casual or is introduced for use as a vegetable. It is occasionally found within the area. Martholme Hall, where Thomas was born and his mother lived, is on the banks of the Calder close to this spot. This unusual direct reference to Lady Hesketh may mean that she had personally sent a specimen to him, or that Thomas had done so mentioning its presence near to his mother's home, or even that Gerard

had seen the plant there if he had visited them at Martholme. The most recent record appears to have been at Reedyford near Nelson (v.c. 59) in 1927 which is about 12 kilometres from Martholme (Savidge *et al.* 1963).

SUMMARY

Many of the plants recorded by the three early botanists still survive within the areas discussed. The Craven area, especially, is undeveloped commercially, although farmland will have come under much more intensive cultivation recently. Since Hesketh's day, the town of Great Harwood has grown and spread widely, and again, agriculture has intensified but, despite this, many of his plants survive locally. As expected, the major losses have been of the more attractive plants, the rare orchids, which were ravaged through over-collection even as early as the seventeenth century. The past and present occurrence of each of the plants discussed is summarised in Table 1.

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The Svalbard plant collection in the Arctic Herbarium at the University of Lancaster (LANC)

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ABSTRACT

A detailed examination (and cataloguing) has been made of material collected from the Svalbard archipelago which is currently held in the University of Lancaster herbarium, U.K. (LANC). This paper briefly outlines the background to its formation and to its collectors and contents. However, full details of the relevant specimens are available on the internet and can be accessed via the link: <http://biol.lancs.ac.uk/svalbard/data.pdf>

INTRODUCTION

The Lancaster University herbarium as a whole contains a wide range of preserved European plant specimens as well as an important specialised section loosely known as the 'Arctic Herbarium'. The latter is divided into geographical regions circumscribing the arctic: i.e. Alaska Yukon, Canada, Greenland (the largest section), Iceland, Fennoscandia, Svalbard, and northern Russia (in two sections, west & east). However, it is the Svalbard section of the herbarium upon which this paper is based.

The Svalbard archipelago lies well to the north of the Arctic Circle and has several months of permanent daylight each year. It comprises four main islands: Barentsøya, Edgeøya, Nordaustlandet and Spitsbergen, of which the latter is the largest and most widely known. Smaller islands include Bjornøya, Hopen, Kong Karl's Land, Kvitøya, Prinz Karl's Forland and the Sjuøyane group. Together, they lie between latitudes approximately 76° 30' N and 80° 30' N, well to the north of northern Norway and within 1000 kilometres of the North Pole. To the west of the archipelago the North Atlantic Current, a remnant of the warm Gulf Stream, favourably influences the climate but the eastern side with its southward-flowing cold Arctic Current is very adversely affected. A consequence is that the western coastal regions of Spitsbergen and especially the central parts, have a climate much warmer than would be expected at these high latitudes. Here, and especially in the inner

fjord areas, quite a rich flora has developed, such that in addition to monocotyledons such as grasses and sedges, there is a surprising variety of colourful flowering plants. The latter number more than one hundred species and need to make the most of the period of relative warmth and permanent daylight of high summer to complete their flowering and reproductive cycle. Elsewhere, and especially on the much colder north and east sides of the archipelago, the flora can be extremely sparse, much of the region comprising polar desert or even permanent ice-cap. To the south of the archipelago, the two principal coastal currents meet near the isolated island of Bjornøya and here again the climate is harsh, often with periods of persistent fog. In fact the name Svalbard means 'cold shores'.

It is sometimes thought that the discovery of Svalbard dates back to the twelfth century but it was the Dutchman, Willem Barents, who is more often credited with this when he sailed along the Spitsbergen coast in 1596. Thereafter, other nations paid visits and exploited the archipelago's waters by whaling until stocks were drastically depleted and the practice ceased. Later, early in the twentieth century, coal mining became a minor industry in some locations whilst others, especially in the north, became bases for expeditions participating in high arctic exploration either by boat or balloon.

Nowadays, apart from the settlement of Longyearbyen on Isfjord (Spitsbergen) with its population of around 2000 and a few other very minor settlements and research stations, Svalbard is completely uninhabited; most of it is designated as a strictly controlled National Park. Recently, the Norwegian government has capitalised on Svalbard's geographical isolation by constructing a 'doomsday' seed bank near Longyearbyen. This is designed to store seed from as many of the world's crop varieties and wild relatives as possible and is precautionary in preventing their genetic diversity being adversely affected by man-made or natural disasters.

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EARLY BOTANICAL EXPLORATION ON SVALBARD

Prior to the early twentieth century there was little serious botanical exploration carried out on Svalbard. What took place was very much a side-line to other seemingly more serious matters such as arctic exploration and whaling.

Probably the earliest to make any contribution to the flora was the Englishman, Constantine John Phipps (1744–1792). In 1773 he sailed north (a young Horatio Nelson was with him as a crew member) in an attempt to reach the North Pole. In doing so he reached the Seven Islands (Sjuøyane), which are the most northerly ones in Svalbard, but was turned back there by dense pack ice. One of the islands of this group was later named Phippsøya in his memory. He is thought to be the first European to provide a description of the polar bear and the ivory gull, both of which he saw on the voyage. As for plants, he is credited with the discovery of *Phippsia algida* (the genus being named after him by Daniel Solander). He also found *Ranunculus sulphureus*, also subsequently described by Solander, as well as four saxifrages and seven other flowering plants. All these together with other items of natural history are detailed in the Appendix to his book '*A Voyage towards the North Pole undertaken by His Majesty's command 1773*' (Phipps 1774).

At a much later date, around the turn of the nineteenth century, the Scotsman William Speirs Bruce made several visits to the archipelago. Bruce was essentially a naturalist and paid his first visit when invited to join Prince Albert of Monaco's exploratory oceanographic expedition in 1898; he also paid a further visit a year later. During his time there Bruce collected plants, several preserved specimens of which are retained in the Svalbard herbarium (see below). He also discovered the presence of coal and other minerals which, in 1909, led him to form the Scottish Spitsbergen Syndicate with the aim of exploiting these natural resources.

Prior to Bruce's first visit, the Swedish palaeo-botanist, Alfred Nathorst had visited several parts of the archipelago. His main interest, however, was plant fossils and the glacial plant flora of the region. He made several discoveries within his subject, publishing them in a paper titled "*Om vegetationen på Spetsbergens västkust*" (Nathorst 1871).

As the early twentieth century proceeded, interest in Svalbard's flora accelerated with botanists such as Dahl, Elton, Hoeg, Lid, Lynge, Mathery-Dupraz, Resvoll-Holmsen, Rudmose Brown, Summerhayes and Tolmatchew making visits there. These can be considered to be the first modern-era botanists to the islands. In the LANC Svalbard herbarium there are in fact specimens collected by Bruce, Dahl, Lid, and Lynge, but all subsequent additions originate from the 1960s onwards.

THE SVALBARD HERBARIUM

The formation of the Arctic Herbarium began in 1961 and was initiated by Geoffrey Halliday whilst on the staff of Leicester University (1958–1968). This followed his first expedition to East Greenland to study its flora. On leaving Leicester, Halliday transferred to Lancaster University and became a member of the academic staff there and was permitted to bring the arctic collection with him.

The total number of sheets in this collection now numbers several thousand, approximately 665 of which are from Svalbard with about 75% of the 165 known native species being represented by at least one sheet. In consequence, this provides a very useful base reference for anyone interested in, or wishing to learn more of, the specialised flora and is also a useful facility to aid identification.

Much of the material originates from university expeditions and, whilst parts of the archipelago are reasonably well covered, others are not covered at all. This is largely due to two factors: easier access such as to the Isfjorden region, and to the particular interests of various expeditions which have concentrated on limited areas such as Bellsund, van Mijenfjorden and Wijdefjorden. The total number of contributors to the herbarium is only twenty-one and several of these have contributed just a very few sheets. However, Derek Spicer (218 sheets), Alasdair Neilson (107) and Sven Manum (70) have been particularly prolific and their combined collections represent almost 60% of the overall total. Other collectors are mentioned below and of these Martin Halliday (no relation to Geoffrey Halliday), Robert Harper and Derek Spicer were Leicester University undergraduates at that time, Alasdair Neilson was a Cambridge graduate then at Glasgow University and K. Vaughton was at Oxford.

Of special historical interest are nineteen sheets collected in 1898 and 1899 by William Speirs Bruce (see above). Most of these are from the remote, and at that time relatively unexplored, islands of Bjørnøya, Barentsøya and Hopen, the two latter situated towards the eastern side of the archipelago. Bruce also made a few collections from Spitsbergen itself, i.e. at Recherchefjorden and Raudfjorden. At the Raudfjorden locality he collected *Cerastium arcticum* and *Luzula confusa*, the actual locality being quaintly described on the sheet as 'opposite the Princess Alice'. This is a reference to his ship (owned by Prince Albert 1 of Monaco) which ran aground on a submerged rock in Raudfjorden, north-west Spitsbergen in 1899 and close to a headland now known as Bruce Point. When the ship was finally floated clear, the expedition terminated as it was necessary to sail south to the mainland for repairs. Bruce's name is also commemorated in a remote abandoned settlement known as Brucebyen in Billefjorden which lies close to the impressive glacier front of the Nordenskjøldbreen. It still survives today and comprises four huts built by Bruce in the early twentieth century. It is still sometimes used by expeditions.

Some of the sheets in the Svalbard herbarium are duplicated in others such as the Botanical Museum, University of Oslo (O). Johannes Lid collected in Bellsund, Isfjorden and Wijdefjorden in 1920 and 1924 (represented here by 12 sheets), B Lyng in Bellsund in 1926 (13) and Eilif Dahl in Isfjorden and Dicksonfjorden in 1936 (4). Other than these early collections and those of Bruce and the occasional sheet from other botanists, by far the greatest amount of material derives from the period 1962–1970. This was the result of the combined efforts of several botanists. Listed chronologically these are, F. Hørl & J. Schweitzer who collected at Adventfjorden and Sassendalen in 1961 (4 sheets); A. H. Neilson mainly at Wijdefjorden and elsewhere in the north and north-east in 1962 (107); S. Manum at Isfjorden (especially Boheman on the northern shore) and Bellsund in 1962 & 1964 (70); A. Jenkinson at Reinsdyrflya in 1963 (7); D. P. Spicer mainly in north Spitsbergen (Wijdefjorden, Austfjorden, Ny Alesund) in 1964 & 1965 (218; of which 35% are Poaceae); M. B. W. Halliday at van Mijenfjorden and Isfjorden in 1965 (64); R. S. Harper at van Mijenfjorden and Adventdalen in 1965 (45); S. M. Cobb & C. Martell at Liefdefjorden in 1966

(15); H. Schweitzer on Bjørnøya in 1967 (7); K. Vaughton at van Mijenfjorden in 1968 (33) and J. W. Squier in Sassendalen (Isfjorden) in 1970 (32). With collecting nowadays limited, the present author has added a modest number of sheets (22) mainly of the commoner plants but including 6 sheets of *Draba*; all these were collected in the Isfjorden area in July 2007 & 2008. Other than these, no new material has been added within the last 35 years or so. A series worth commenting upon is Neilson's nine sheets of *Draba* collected on the remote, bleak island of Nordaustlandet along with one sheet of the scarce *Ranunculus pedatifidus* from Edgeøya. Neilson devoted much of his time to studying and collecting the plants of these two islands, later publishing an account of their flora (Neilson 1968, 1970). Spicer, who had a special interest in *Draba*, subsequently produced a dissertation on the Svalbard species (Spicer 1969). As stated above, scientific expeditions to the archipelago during the 1960s have been a major contributor, especially those from the University of Leicester in 1965 (collector M. B. W. Halliday) and from Oxford University in 1968 (K. Vaughton). J. Lid's small collection originated from the two earlier Norwegian Spitsbergen Expeditions of 1920 and 1924.

Of the total number of sheets in the herbarium, 3% are of pteridophytes (*Lycopodium*, *Equisetum* and *Cystopteris*) and 40% of monocotyledons (65% of these being Poaceae). Lower plants such as lichens are not represented.

A summary of all the details of each individual collection is available in an electronic document located at:

<http://biol.lancs.ac.uk/svalbard/data.pdf>

The information in that document is taken directly from the sheets and includes locality, date, collector and collection number, geographical coordinates (where known) and ecological notes. For non-critical species where the correct identification can be relied upon, these notes provide useful information on the distribution, phenology and ecology of the Svalbard flora without the necessity of having to physically examine each specimen. Where critical species have been determined or confirmed, this is also indicated. When consulting the document it should be borne in mind that a semi-colon [;] is used to separate each individual collection. The nomenclature used is that of the original collector(s) and/or herbarium compiler and, in only a few cases, has this been modified or updated. Locality

names are as given on the sheets and the systematic arrangement follows that currently in use in the herbarium.

Abbreviations used in the electronic document are as follows: N = north; S = south; E = east; W = west; c. = circa, det. = determined/

confirmed by: AOC. = A. O. Chater; ED = E. Dahl; AG = A. Game; MF = M. J. Y. Foley; GH = G. Halliday; EH = E. Hultén; KJ = K. Jacobsen; JL = J. Lid; BL = B. Lyngé; AM = A. Melderis; JAN = J. A. Nannfeldt; TP = T. Prestø; AJR = A. J. Richards; IR = I. Rønning; PDS = P. D. Sell.

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Notes

THREE MORE NEW COMBINATIONS IN THE BRITISH FLORA

Three further new combinations are required for the forthcoming third edition of *New Flora of the British Isles*.

1. *Poterium* L.

It has been shown that the earliest epithet at subspecific level for the introduced subspecies of *Sanguisorba minor* Scop., until recently known as subsp. *muricata* (Gremli) Briq., is *balearica*, and the combination *S. minor* subsp. *balearica* (Bourg. ex Nyman) Muñoz Garm. & C Navarro is available. However, molecular data indicate that the genus *Poterium* L. should now be re-segregated from *Sanguisorba* L., and the required combination under the latter genus appears to be unpublished:

Poterium sanguisorba* L. subsp. *balearicum (Bourg. ex Nyman) Stace, **comb. nov.**

BASIONYM: *Poterium spachianum* Coss. subsp. *balearicum* Bourg. ex Nyman, *Consp. Fl. Eur.* 1: 240 (1878)

SYNONYMS: *Sanguisorba minor* Scop. subsp. *balearica* (Bourg. ex Nyman) Muñoz Garm. & C Navarro, in Castrov., *Fl. Iberica* 6: 386 (1998)

S. minor subsp. *muricata* (Gremli) Briq., *Prodr. Fl. Corse* 2(1): 209 (1913)

S. minor subsp. *polygama* (Waldst. & Kit.) Cout., *Fl. Portugal* 296 (1913)

Poterium sanguisorba subsp. *muricatum* (Gremli) Bonnier & Layens, *Tabl. Syn. Pl. Vasc. France* 102 (1894)

2. *Malva* L.

Molecular data have shown that *Malva* L. and *Lavatera* L. are artificial genera based on a single character (fusion of epicalyx segments), and that their species form an interlocking mass

rather than two separate groups. The amalgamation of the two genera is preferable to the recognition of several groups of species as separate genera, when, confusingly, *Malva moschata* L. would fall into *Lavatera*, and *Lavatera cretica* L. into *Malva*. Combinations in *Malva* exist for all our species of *Lavatera*, except for the garden hybrid between *M. olbia* and *M. thuringiaca*:

***Malva olbia* (L.) Alef. (*Lavatera olbia* L.) × *Malva thuringiaca* (L.) Vis. (*Lavatera thuringiaca* L.)**

= ***Malva* × *clementii* (Cheek) Stace, **comb. nov.****

BASIONYM: *Lavatera* × *clementii* Cheek, *Kew Bull.* 55: 1013 (2000)

3. *Elytrigia* Desv.

The variants of *E. repens* (L.) Desv. ex Nevski and *E. atherica* (Link) Kerguélen with awned lemmas are best recognised at the level of forma. The combination *E. repens* f. *aristata* (Schum.) Beetle exists for the former; a new combination is needed for the latter:

Elytrigia atherica* Kerguélen forma *setigera (Dumort.) Stace, **comb. nov.**

BASIONYM: *Agropyron littorale* Dumort. var. *setigerum* Dumort., *Obs. Gram. Fl. Belg.* 97 (1824)

SYNONYM: *Elymus pycnanthus* (Godr.) Melderis var. *setigerus* (Dumort.) Melderis

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I am grateful to Christopher Davis for advice on the nomenclature of *Malva* and *Lavatera*.

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VALIDATION OF NAMES FOR NEW AVON GORGE *SORBUS* (ROSACEAE) TAXA

I am embarrassed to find that under section 8.2 of the International Code of Botanical Nomenclature (Greuter *et al.* 2000), the five new *Sorbus* names I published for the Avon Gorge (Rich *et al.* 2009) are invalid as more than one gathering was cited for each holotype. The names are republished below with corrected citation of their holotypes.

Sorbus* × *avonensis T. Rich, **hybr. nov.** (*Sorbus aria* (L.) Crantz × *S. porrigentifformis* E. F. Warb.).

HOLOTYPE: St Vincent's Rocks South, Avon Gorge, v.c. 34 West Gloucestershire, England, ST/565.730, 19 September 2007, T. C. G. Rich & L. Houston (NMW, accession number V.2007.1.132).

ISOTYPE: **BM, CGE**. Validating description in *Watsonia* 27: 218. 2009.

Sorbus* × *houstoniae T. Rich, **hybr. nov.** (*Sorbus aria* (L.) Crantz × *S. bristoliensis* Wilm.).

HOLOTYPE: rocks Stokeleigh Camp, v.c. 6 North Somerset, England, ST/561.732, 31 October 2004, T. C. G. Rich, A. Robertson & L. Houston (NMW, accession number V.2004.26.276).

Validating description in *Watsonia* 27: 220. 2009.

Sorbus leighensis T. Rich, **sp. nov.**

HOLOTYPE: Quarry 4, Leigh Woods, v.c. 6 North Somerset, England, ST/561.739, 19

September 2007, T. C. G. Rich & L. Houston (NMW accession number V.2007.1.180).

ISOTYPE: **BM, CGE**.

Validating description in *Watsonia* 27: 222–221. 2009.

Sorbus* × *robertsonii T. Rich, **hybr. nov.** (*Sorbus aria* (L.) Crantz × *S. eminens* E. F. Warb.).

HOLOTYPE: Great Fault, Avon Gorge, Bristol, v.c. 34 West Gloucestershire, England, ST/564.733, 19 September 2007, T. C. G. Rich & L. Houston (NMW, accession number V.2007.1.175).

ISOTYPE: **BM, CGE, OXF**.

Validating description in *Watsonia* 27: 224–225. 2009.

Sorbus* × *proctoriana T. Rich, **hybr. nov.** (*Sorbus aucuparia* L. × *S. scalaris* Koehne).

HOLOTYPE: Top edge of Quarry 2, Leigh Woods, v.c. 6 North Somerset, England, ST/557.743, 19 September 2007, T. C. G. Rich & L. Houston (NMW, accession number V.2007.1.125).

ISOTYPE: **BM, CGE, E, LIV, OXF**.

Validating description in *Watsonia* 27: 226. 2009.

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REINSTATEMENT OF THE NAME *DACTYLORHIZA KERRYENSIS* (WILMOTT)
P. F. HUNT & SUMMERH. FOR THE WESTERN MARSH ORCHID,
AND A NEW VARIETAL COMBINATION

Recent research has revealed that the taxon formerly known in Britain and Ireland as *Dactylorhiza majalis* is distinct from Continental populations of that species (Delforge *et al.* 1991), and further, that its former subspecies do not all belong to a single species (Delforge 2000; Foley & Clarke 2005; Bateman 2006).

Until recently, plants in Ireland and in North Uist had been classified under *Dactylorhiza majalis* subsp. *occidentalis* and all other populations were referred to subsp. *cambrensis* (Stace 1997). Recent work has argued that this last is better treated as a variety of *D. purpurella* (Foley & Clarke 2005; Bateman 2006), and that the North Uist plants are a species of hybrid origin, *D. ebudensis* (Wiefelspütz ex R.M. Bateman & Denholm) P. Delforge (Delforge 2000). This means that the Irish plants are referable to an endemic species for Ireland, which has been erroneously called *Dactylorhiza occidentalis* (Pugsley) P. Delforge (Delforge *et al.* 1991; Foley & Clarke 2005; Bateman 2006).

Whilst the broader taxonomy has been resolved for the present, the nomenclature of the species has become confused. The first description of the taxon was by Pugsley (1935), who described *Orchis majalis* var. *occidentalis*. The following year Wilmott (1936) published *Orchis kerryensis*, a species lacking spots on its leaves. Under the International Code of Botanical Nomenclature, names only have priority at the same rank (McNeil *et al.*; Art. 11.2). Pugsley's 1935 variety is therefore to be regarded as a synonym, as is the combination *Dactylorhiza occidentalis* published in 1991, and *Dactylorhiza kerryensis* should be adopted. Given that the combination *Dactylorhiza occidentalis* dates from 1991, and has not been extensively adopted into British or Irish literature, there is little cause for inconvenience with adopting the correct name.

Bateman and Denholm (1983) recognised two varieties of this taxon in Ireland, namely var. *occidentalis* with spotted leaves, and var. *kerryensis* with unspotted leaves. Baumann & Künkele (1988) made the correct combination, under *Dactylorhiza kerryensis*, but at the rank of subspecies: Whilst the two varieties are

distinctive, the leaf spotting and flower colour is variable, and the two forms are occasionally found in mixed populations. Varietal rank, however, seems justifiable. The full nomenclature is laid out below.

Dactylorhiza kerryensis (Wilmott) P. F. Hunt & Summerh., *Watsonia* 6: 131 (1965).

BASIONYM: *Orchis kerryensis* Wilmott, *Proceedings of the Linnean Society of London* 148, 126 (1936).

SYNONYMS: *Dactylorchis kerryensis* (Wilmott) Verm., *Studies on Dactylorchids* 67 (1947). *Orchis occidentalis* (Pugsley) Wilmott subsp. *kerryensis* (Wilmott) A. R. Clapham, in A. R. Clapham, T. G. Tutin & E. F. Warburg, *Flora of the British Isles*, p.1321 (1952).

Dactylorhiza majalis (Rchb.) P. F. Hunt & Summerh. var. *kerryensis* (Wilmott) R. M. Bateman & Denholm, *Watsonia*, 14: 368 (1983).

Dactylorhiza comosa (Scop.) P. D. Sell subsp. *occidentalis* (Pugsley) P. D. Sell forma *kerryensis* (Wilmott) P. D. Sell, in P. D. Sell & G. Murrell, *Flora of Great Britain & Ireland*, 5: 365 (1996).

Dactylorhiza occidentalis (Pugsley) P. Delforge var. *kerryensis* (Wilmott) R. M. Bateman & Denholm, *Watsonia* 27: 247 (2009).

HOLOTYPE: Ireland, Co. Kerry, v.c. H1, near Dingle, 23 June 1934, A. J. Wilmott (BM).

Dactylorhiza kerryensis (Wilmott) P. F. Hunt & Summerh. var. ***occidentalis*** (Pugsley) Jebb, **comb. nov.**

BASIONYM: *Orchis majalis* Rchb. var. *occidentalis* Pugsley, *Journal of the Linnean Society of London. Botany* 49: 586 (1935).

SYNONYMS: *Orchis occidentalis* (Pugsley) Wilmott, Report, *Botanical Exchange Club of the British Isles*, 11: 458, 551 (1938). *Dactylorchis occidentalis* (Pugsley) Verm., *Studies on Dactylorchids*, 67 (1947). *Dactylorchis latifolia* (L.) Rothm. subsp. *occidentalis* (Pugsley) Soó, *Nomina Novis Generis Dactylorhiza* 5 (1962).

Dactylorhiza majalis (Rchb.) P. F. Hunt & Summerh subsp. *occidentalis* (Pugsley) P. D. Sell, *Acta Facultatis Rerum Naturalium Universitatis Comenianae. Botanica. Bratislava*, **14**: 19 (1968).

Dactylorhiza majalis (Rchb.) P. F. Hunt & Summerh. subsp. *occidentalis* (Pugsley) E. Nelson, *Monographie und Ikonographie der Orchidaceen-Gattungen Dactylorhiza*, **90** (1976).

Dactylorhiza majalis (Rchb.) P. F. Hunt & Summerh. var. *occidentalis* (Pugsley) R. M. Bateman & Denholm, *Watsonia*, **14**: 368 (1983).

Dactylorhiza kerryensis (Wilmott) P. F. Hunt & Summerh. subsp. *occidentalis* (Pugsley) H. Baumann & Künkele, *Mitteilungsblatt, Arbeitskreis Heimische Orchideen Baden-Württemberg*, **20**(3): 629 (1988).

Dactylorhiza occidentalis (Pugsley) P. Delforge, *Naturalistes Belges*, **72**(3): 100 (1991).

Dactylorhiza comosa (Scop.) P. D. Sell subsp. *occidentalis* (Pugsley) P. D. Sell forma *occidentalis* (Pugsley) P. D. Sell, in P. D. Sell & G. Murrell, *Flora of Great Britain & Ireland*, **5**: 351 (1996).

HOLOTYPE: Ireland, Co. Clare, v.c. H9, Lisdoonvarna, 16–20 May 1935, H. W. Pugsley 514 (BM).

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A NEW NOTHOSPECIES IN *SYMPHYTUM* L. (BORAGINACEAE)

INTRODUCTION

This note describes and formally names a new nothospecies in *Symphytum* L., its putative parents being *Symphytum asperum* Lepech. and *S. orientale* L. This taxon was first recorded from Intwood, East Norfolk v.c. 27, England, in 1999 by R. M. Leaney. There appears to be

no record in the literature of *Symphytum asperum* × *S. orientale*, whether occurring naturally or as a result of experimental or horticultural crossing. Therefore an epithet is assigned in order that this taxon may receive full treatment in the forthcoming third edition of the *New Flora of the British Isles* (Stace 1997).

DISTRIBUTION & ORIGIN

This new taxon occurs in two metapopulations at eight localities in East Norfolk, with one metapopulation at three sites between 2 and 20 km south and south-east of Norwich, and the other over five sites between 17 and 25 km north-west of Norwich. The largest colonies at Intwood and Sustead cover around 150 m² with scattered seedlings extending over a further 50 m radius. Plants in all colonies are constant in morphological characters. The two metapopulations, represented by plants from the colonies at Intwood and Sustead, have the same chromosome number. This taxon is believed to originate from a horticultural selection, which has subsequently naturalised.

DESCRIPTION

The description below is based on fresh material. For corolla and calyx measurements, 20 flowers were measured by one author (R.M.L.) from the Intwood colony and 20 from the Sustead colony.

Symphytum* × *norvicense R. M. Leaney & C. L. O'Reilly ***hybrida nova*** (Boraginaceae) (putative parentage *Symphytum asperum* Lepech. $2n = 32 \times S. orientale$ L. $2n = 32$, ?64) Norfolk Comfrey

Herba perennis robusta, erecta vel decumbens, 50–150 cm alta, radice palari obliqua. Caules senescentes decumbentes saepe longiores quam 200 cm. Folia mediocriter viridia vel leviter griseiviridia, infra pallidiora, mollia vel aliquantum setosa, alis 1–7 mm sed non decurrentibus petiolata. Folia basalia anguste ovata vel late lanceolata, ad apicem leviter cuspidata subacuta vel acuta, ad basin truncata vel subcordata, ubi perhiemantia saepe valde cordata vel ad basin auriculata; folia caulina superiora late ovata, ad apicem acuta vel acuminata, ad basin truncata vel rotundata. Caulis indumentum ex setis longis crassis pilisque brevibus tenuibus uncinatis constans, in caule supero setis brevioribus sparsioribus rigidioribus curvatis subuncinatis, saepe basi bulbosa. Costae in laminae pagina abaxiali indumentum caulis superi indumento simile, sed setas basi bulbosa manifestius praebens. Calycis tubi indumentum ex setis latis curvatis uncinatis basi bulbosa numerosis, pilis brevibus tenuibus uncinatis abundantibus intermixtis, lorumque indumentum ex setis longioribus

tenuioribus non uncinatis. Inflorescentia et calyx et corolla sicut typice in *Symphyto* L. sed differentiis his peculiaribus: Calyx in gemma 6.8–9.0 mm longus. Calyx sub anthesi separatus complanatus 7.1–10.4 mm longus, ad 2/5–1/2(–3/5), plerumque paene ad dimidium, dissectus. Calycis lobi magis minusve triangulares (non linearioblongi), ad apicem acuti vel subacuti. Flos gemmis roseirubris corollaque variabiliter colorata, primo alba azureo purpureove diluto maculata vel striata, sub anthesi caerulescenti sed adhuc saepiuscule zonas albas saepeque strias longitudinales purpureas et/vel in lobis maculas praebenti. Corolla separata complanata 17.4–23.3 mm longa, quam calyx circiter duplo longior. Corollae squamae anguste triangulares, inclusae. Stamina quam corollae squamae breviora, filamentis antheras nonnunquam aequantibus vel plerumque excedentibus. Stylus multum exsertus. Nuculae 3.9–4.1 mm longae, curvatae, mediocriter brunneae, minute tuberculatae obscureque porcatae. Planta fertilis et seminibus propagata. Floret mense Maio usque ad Julium. $2n = 48$.

Robust, erect or decumbent perennial herb 50–150 cm tall with an oblique taproot. Decumbent senescent stems often exceeding 200 cm in length. Leaves mid green to slightly grey-green, paler beneath, soft or somewhat bristly to the touch, petiolate, with wings 1–7 mm but not decurrent. Basal leaves narrowly ovate to widely lanceolate, with slightly cuspidate subacute to acute apex and truncate to subcordate base, when overwintering often strongly cordate to auriculate-based; upper cauline leaves broadly ovate, with acute to acuminate apex and truncate to rounded base. Indumentum of stem of long, thick bristles and short, fine, uncinete hairs, with bristles on upper stem becoming shorter, sparser, stiffer, curved and subuncinate, often with bulbous base. Indumentum of midrib of abaxial surface of lamina similar to that of upper stem, but with bulbous-based bristles more pronounced. Indumentum of calyx tube of numerous broad, curved, uncinete, bulbous-based bristles intermixed with abundant short, fine, uncinete hairs, and of calyx-lobes of longer, finer, non-uncinate bristles. Inflorescence, calyx and corolla as typically found in *Symphytum* L. but with the key differences comprising: Calyx in bud 6.8–9.0 mm long. Detached, flattened calyx at anthesis 7.1–10.4 mm long, dissected to 2/5–1/2(–3/5), usually almost to half-way.

Calyx-lobes more or less triangular (not linear-oblong), with acute to subacute apices. Flower with pink-red buds and a variably coloured corolla, at first white blotched or streaked with pale blue or purple, becoming sky blue at anthesis but still often with white zones and frequently with purple longitudinal striations and/or corolla-lobe blotches. Detached, flattened corolla 17.4–23.3 mm long and about twice as long as calyx. Corolla scales narrowly triangular, included. Stamens shorter than corolla-scales, with filaments sometimes equalling or usually exceeding anthers. Style strongly exserted. Nutlets 3.9–4.1 mm long, curved, mid-brown, minutely tuberculate and obscurely ridged. Fertile and spreading by seed. Flowers May to July. $2n = 48$.

Colour photographs of plants from the Sustead colony can be seen on *BSBI News* 105 cover and front piece. The epithet is derived from *Norvicum*, the Latinized name for the city of Norwich.

HOLOTYPE: Roadside verge at Intwood, East Norfolk, v.c. 27, TG/1971.0414, 2 June 2006, R. M. Leaney Accession No. 2007.368.5 (NWH).

DISCUSSION

The Norfolk comfrey is referable to Section *Caerulea* Buckn. (Bucknell 1913; Sandbrick *et al.* 1990), but is distinguished from all other taxa in this Section, including *Symphytum savvalense* Kurtto (Sell & Murrell 2009), by

the combination of the indumentum type, the typically under half-dissected relatively large calyx, the shape of the calyx-lobes, corolla colour and size, and the strongly exserted style. The following morphological characters of the Norfolk Comfrey suggest intermediacy between a taxon of Section *Caerulea* and *S. orientale*: the soft indumentum with numerous uncinata hairs; the broadly ovate upper cauline leaves with truncate to rounded bases; the large half-dissected calyx; and the white coloration in the developing corolla. The chromosome number of $2n = 48$ suggests *S. asperum* ($2n = 32$) rather than a cytotype of *S. × uplandicum* as the other parent taxon. Either parent with $2n = 32$ may have produced unreduced gametes, or one parent may have been *S. orientale* with $2n = 64$, as unpublished results have shown $2n = 62, 63$ for *S. orientale*, which may represent a miscout of $2n = 64$ (T. W. J. Gadella, pers. comm., 2009). Resynthesis of the Norfolk Comfrey by experimental crossing of putative parent species should resolve this issue, with results expected in 2010, and allow publication of a full account of this plant.

ACKNOWLEDGMENTS

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Plant Records

Records for publication must be submitted to the appropriate Vice-county Recorder (see *BSBI Year Book 2008*), and not to the Editors. Following publication of the *New Atlas of the British & Irish Flora* and the *Vice-county Census Catalogue*, new criteria have been drawn up for the inclusion of records in *Plant Records*. (See *BSBI News* no. 95, January 2004 pp. 10 & 11). These are outlined below:

- First records of **all** taxa (species, subspecies and hybrids) included in the VCCC, designated as native, archaeophyte, neophyte or casual.
- First record since 1970 of the taxa above, except in the case of *Rubus*, *Hieracium* and *Taraxacum*.
- Records demonstrating the rediscovery of all taxa published as extinct in the VCCC or subsequently.
- Newly reported definite extinctions.
- Deletions from the VCCC (e.g. through the discovery of errors, the redetermination of specimens etc.) **NB** – only those errors affecting VCCC entry.
- New 10km square records for Rare and Scarce plants, defined as those species in the *New Atlas* mapped in the British Isles in 100 10km squares or fewer. (See *BSBI News* no. 95, January 2004 pp 36–43).

Records for the subdivisions of vice-counties will not be treated separately; they must therefore be records for the vice-county as a whole. However, records will be accepted for the major islands in v.cc. 100, 102–104, 110 and 113.

In the following list, records are arranged in the order given in the *List of Vascular Plants of the British Isles* and its supplements by D. H. Kent (1992), from which the species' numbers, taxonomy and nomenclature are taken. The Ordnance Survey national grid reference follows the habitat and locality. With the exception of collectors' initials, herbarium abbreviations are those used in *British and Irish Herbaria* by D. H. Kent & D. E. Allen (1984). Records are field records if no other source is stated. For all records 'det.' or 'conf.' appear after the herbarium if the determination was based on material already in an institutional herbarium, otherwise before the herbarium.

The following signs are used:

- * before the vice-county number: to indicate a new vice-county record.
- † before the species number: to indicate that the plant is an archaeophyte.
- ‡ before the species number: to indicate that the plant is a neophyte.
- © before the species number: to indicate that the plant is a casual.

The above 3 signs may also be used before the vice-county number to indicate the status of the plant in that vice-county.

® before the vice-county number: to indicate that this is an additional hectad for a Rare or Scarce plant.

Ø at end of entry: established taxon not in Vice-County Census Catalogue. Name of authority provided.

[] enclosing a previously published record: to indicate that that record should be deleted or changed.

Records are now published in two separate sections – 1) NATIVES (including archaeophytes) and 2) ALIENS (neophytes and casuals).

The following list contains the first set of records up to and including the year 2008. Further records including the year 2008 will be published in the next issue of *Watsonia*.

ARCHAEOPHYTES AND NATIVES

Diphasiastrum complanatum 1/4.2. *81, Berwicks.: Dirrington Little Law, Cattleshiel moor, NT6853, J. Hardy, 1892, det. E. S. Marshall, *Hist. Berw. Nat. Club* XIV p.17. Found first by Mrs Dodds of Bowden, formerly Miss Sibbald, collected for James Hardy by John Buckham, shepherd to Mr Craw, Rawburn, sent to W. B. Boyd who sent it on to Rev E. S. Marshall; his reply determines it as '*Lycopodium alpinum* var. *decipiens*, the *L. complanatum* of British authors'.

Equisetum ×dycei (*E. fluviatile* × *palustre*) 4/1.4×8. *17, Surrey, on metal enriched substrate by a small stream draining a boggy area, Pirbright Ranges, SU928579, F. J. Rumsey, 2008.

Equisetum sylvaticum 4/1.7. @14, E. Sussex: beside Bluebell railway, W of Tremaines, TQ374266, P. J. Acock, 2008.

Ophioglossum azoricum 5/1.2. *93, N. Aberdeen: dune slack, Sands of Forvie NNR, NK012260, D. Welch, 2007. Possibly previous records of *O. vulgatum* belong to *O. azoricum* which formerly was a subsp. of *vulgatum*. @110, Outer Hebrides: near building, Cnoc na Liana Moire, Uig, Lewis, NB042375, R. J. Pankhurst, P. A. Smith, J. W. McIntosh & E. Pilling, 2008.

Pilularia globulifera 9/1.1. 10, Wight: recently cleared pool, Bouldnor Copse, SZ380902, G. N. Toone, 2002, det. A. C. Jermy, *herb. G. N. Toone*. Last recorded 1923, from this area.

Dryopteris ×complexa (*D. filix-mas* × *affinis*) 17/3.2×3. *81, Berwicks.: dean, Nabdean Burn, NT931522, M. E. Braithwaite, 2008. Fronds 160cm, winter-green.

Dryopteris affinis (Lowe) Fraser-Jenk. subsp. **paleaceolobata** (T. Moore) Fraser-Jenk. 17/3.3.pal. *110, Outer Hebrides: road bank next to Loch Sgailier, NB0835, P. A. Smith & J. W. McIntosh, 2008, det. K. Trewren, E. Ø

Nuphar ×spenneriana (*N. lutea* × *pumila*) 26/2.1×2. *58, Cheshire: mere fringe, Hatchmere, SJ5472, S. J. Whild, 2001. Status uncertain.

Ranunculus bulbosus 28/13.3. *91, Kincardines.: riverside grassland, Crathes, NO734961, D. Welch, 2003. Omitted in error from VCCC.

Betula pubescens subsp. *tortuosa* 40/1.2b. *63, S. W. Yorks.: waste ground, Broomhill, SE4102, B. K. Byrne, 2008.

Suaeda maritima 43/7.2. *81, Berwicks.: Ramsheugh Bay, NT7772, anon, 1940, WFS Berwickshire County Botanical Record, as 'Cockburnspath', possibly casual only, recorder probably Mrs E. K. Swinton.

Minuartia hybrida 46/4.5. @8, S. Wilts.: disturbed ground, Stokehill North, ST967520, N. Cope, 2005. Common in nearby military training area.

Stellaria neglecta 46/5.4. *90, Angus: by path through swamp, Restenneth, NO4851, B. G. Hogarth, 2007.

Cerastium pumilum 46/7.11. @8, S. Wilts.: tracksides, Salisbury Plain ATE West, ST945456, S. Pilkington, 2006. Very local in disturbed ground.

Herniaria glabra 46/13.1. ‡64, Mid-W. Yorks.: neglected area of nursery garden, Scarcroft, Leeds, SE347409, J. Scott, 2008, det. N. Jardine. 1st record since 1970.

Spergularia marina 46/17.3. *‡8, S. Wilts.: roadside, A303 trunk road, SU24, S. Leach, 2005. Also recorded along major roads elsewhere in VC8 in 2005.

Rumex ×hybridus (*R. longifolius* × *obtusifolius*) 47/8.8×19. *90, Angus: arable field adjacent to river, near Pirn Brig, NO5768, B. G. Hogarth & P. Gaff, 2008.

Tilia platyphyllos 52/1.1. *‡91, Kincardines.: woodland in den, Durris House, NO798969, D. Welch, 2007.

Viola ×intersita (*V. riviniana* × *canina*) 57/1.4×6. *79, Selkirks.: hillside pasture, Tinnis Top, Yarrow, NT382290, R. W. M. Corner, 2008, *herb. R.W.M.C.*

Viola ×contempta (*V. tricolor* × *arvensis*) 57/1.12×13. 8, S. Wilts.: arable land, Bulford, SU198408, J. R. Moon, 2006. 1st record since 1945. Area supports many interesting arable species.

Viola tricolor subsp. *tricolor* 57/1.12a. @10, Wight: arable, Coppidhall Farm, Havenstreet, SZ564907, G. N. Toone, 2005, det. M. Hardman, *herb. G. N. Toone*. 1st confirmed record since 1926.

†**Salix ×mollissima** (*S. triandra* × *viminalis*) 61/2.4×9. *58, Cheshire: mere fringe, Knutsford, SJ755788, D. Woods & M. Woods, 2006, det. D. Wood.

- Salix cinerea* subsp. *cinerea* 61/2.11a. *17, Surrey: Merstham, Spynes Mere, TQ307524, B. W. Phillips, 2008. *58, Cheshire: marshy field, Mobberley, SJ800817, G. M. Kay, 2007.
- Arabis petraea* 62/15.1. 91, Kincardines.: silt by River Dee, Durris, NO801986, D. Welch, 2007. 1st record since 1970.
- Draba muralis* 62/21.4. *‡90, Angus: on rocky slabs in wooded den, Den of Airlie, NO293521, B. G. Hogarth & P. Gaff, 2007. 1st record in a natural habitat.
- Cochlearia officinalis* subsp. *scotica* 62/23.3b. @81, Berwicks.: six scattered plants on rocks behind beach, Horsecastle Bay, St Abbs Head, NT917685, M. F. Godfrey, 2007. Last seen here 1884.
- Cochlearia officinalis* × *danica* 62/23.3×5. *81, Berwicks.: one plant in turf behind beach, Horsecastle Bay, St Abbs Head, NT917685, M. F. Godfrey, 2007.
- Cochlearia danica* 62/23.5. *90, Angus: plants in natural habitat frequent along rocky coast north of Auchmithie, NO64, B. G. Hogarth & P. Gaff, 2006.
- Crambe maritima* 62/41.1. 81, Berwicks.: one large plant, not flowering, on shingle beach, Yellow Craig, NT921660, C. Dixon, 2008, conf. M. E. Braithwaite. 1st record since 1836.
- Raphanus raphanistrum* subsp. *maritimus* 62/42.1b. 110, Outer Hebrides: Bhatarsaigh, NL633940, R. J. Pankhurst, 2007. 1st record since 1970.
- Primula veris* 69/1.3. *110, Outer Hebrides: on machair, Eoligarry, Barra, NF709065, J. C. M. Alexander, 2005.
- Samolus valerandi* 69/8.1. *17, Surrey: small plants in South Nutfield Churchyard, TQ302487, G. Fookes, 2008.
- Crassula tillaea* 73/1.1. *‡90, Angus: track between arable and policy woodland, Panmure area, NO532381, P. Gaff, 2008.
- Umbilicus rupestris* 73/2.1. *60, W. Lancs.: Silverdale, SD459749, J. Webb, 2006.
- Rubus saxatilis* 75/8.3. 91, Kincardines.: woodland edge, Inchmarlo, NO653972, D. Welch, 2007, **herb. D. Welch**. 1st record since 1970.
- Rubus albionis* 75/8.34. *71, Man: cliff scrub above beach, Port Garwick, SC434814, D. E. Allen, 2008, **BM**.
- Rubus errabundus* 75/8.51. *91, Kincardines.: roadside by felled plantation, Garvock, NO748965, D. Welch, 2007, conf. A. L. Newton, **herb. D. Welch**.
- Rubus lasiodermis* 75/8.108. *10, Wight: relic heath scrub, roadside near Shorwell, SZ461822, D. E. Allen, 2008, det. A. L. Newton.
- Rubus pictoris* 75/8.116. *71, Man: hedge-top outside Union Mills, SC3477, D. E. Allen, 2008, **BM**.
- [*Rubus leucostachys* 75/8.156. 10, Wight. Delete record in *Watsonia* 27:177. On re-inspection in the field this has proved a misdetermination.]
- Rubus surrejanus* 75/8.161. *71, Man: hedgebank of garden, Croudle Old Road, Baldrine, SC427809, D. E. Allen, 2008, **BM**. Accidental introduction.
- Rubus vestitus* 75/8.163. *90, Angus: A90 Tealing, NO435419, D. Welch, 2004, conf. A. L. Newton. *‡110, Outer Hebrides: electricity substation, Carishader, NB102320, E. Pilling & R. J. Pankhurst, 2008, conf. G. H. Ballantyne, **E**.
- Rubus wirralensis* 75/8.174. *11, S. Hants.: roadside hedge, Chark Common, near Gosport, SU576019, D. E. Allen, E. J. Clement & J. A. Norton, 2007-8, conf. A. L. Newton, **BM**, **HCMS**.
- [*Rubus wirralensis* 75/8.174. 71, Man. Delete. All existing records (including 5 hectads in Atlas of British and Irish Brambles) relate to the subsequently described *R. cumbrensis*, det D. E. Allen, conf. A. L. Newton)]
- Rubus raduloides* 75/8.199. *71, Man: open roadside verge, Ballabeg to Grenaby road, SC257258, D. E. Allen, 2008, **BM**.
- Rubus anglofusus* 75/8.205. *11, S. Hants.: patch, old hedge line bordering recreation ground, near Eastleigh station, SU462195, D. E. Allen, 2005-6, **BM**, det. A. L. Newton.
- Rubus scabripes* 75/8.286. *10, Wight: trackside by edge of copse, Westover, SZ4186, E. J. Clement & P. D. Stanley, 2008, conf. D. E. Allen, **BM**.
- Rubus conjungens* 75/8.307. *71, Man: hedgebank, green lane near Grenaby, SC260722, D. E. Allen, 2008, **BM**.
- Potentilla* × *suberecta* (*P. erecta* × *anglica*) 75/9.13×14. *90, Angus: in dune slack, Barry Links, NO524322, B. G. Hogarth & P. Gaff, 2007.

- Potentilla ×mixta** (*P. anglica* × *reptans*) 75/9.14×15. *90, Angus: in dune slack, Barry Links, NO524322, B. G. Hogarth & P. Gaff, 2007.
- Crataegus ×media** (*C. laevigata* × *monogyna*) 75/35.7×8. *‡91, Kincardines.: streamside by playing field, Maryculter, NJ858002, D. Welch, 2007.
- Vicia parviflora** 77/14.7. @10, Wight: ex-arable land on chalk, Mersley Down, SZ551872, G. N. Toone, 2007.
- Ulex europaeus** × **gallii** 77/26.1×2. *58, Cheshire: heathland, Helsby Hill, SJ491753, M. O. Stead, 2006, det. P. M. Benoit.
- Epilobium ×limosum** (*E. parviflorum* × *montanum*) 84/1.2×3. *58, Cheshire: riverbank, Brooklands, Sale, SJ816919, G. M. Kay, 2008, det. G. D. Kitchener.
- Epilobium ×mutabile** (*E. montanum* × *roseum*) 84/1.3×7. *63, S. W. Yorks.: footpath, Park Drive, Heaton, Bradford, SE144360, M. Wilcox, 2008, conf. G. D. Kitchener.
- Epilobium ×nutantiflorum** (*E. roseum* × *ciliatum*) 84/1.7×8. *63, S. W. Yorks.: Fairweather Green, Bradford, SE133334, M. Wilcox, 2008, conf. G. D. Kitchener.
- Buxus sempervirens** 90/1.1. *‡91, Kincardines.: conifer plantation on edge of policies, Banchory, NO683967, D. Welch, 2007.
- Erodium maritimum** 103/2.1. 10, Wight: well established in cracks between cobbles in front of old house by coast, Sprinvale, Seaview, SZ618920, P. D. Stanley, 2008, det. E. J. Clement, **herb. C. R. Pope**. 1st record since 1955. Origin unknown.
- ‡**Smyrniololus** **olusatrum** 107/10.1. *90, Angus: East Haven, NO594364, B. G. Hogarth, 2005. Also at NO599368, by burn outflows.
- Crithmum maritimum** 107/17.1. *90, Angus: Rumness, NO691456, P. Gaff, 2005. 3 plants still there in 2008.
- ‡**Aethusa cynapium** subsp. **agrestis** 107/20.1b. @10, Wight: arable, Little Stenbury, Whitwell, SZ524796, G. N. Toone, 2003, det. C. R. Pope, **herb. G. N. Toone**. @10, Wight: arable, Cheverton Down, Shorwell, SZ4584, G. N. Toone, 2007. *‡64, Mid-W. Yorks.: waste ground, Shipley, SE151380, B. A. Tregale & M. Wilcox, 2008.
- Heracleum sphondylium** × **H. mantegazzianum** 107/41.1×2. *90, Angus: on steep slopes of coastal grassland adjacent to arable, N of Rumness, NO688452, B. G. Hogarth & P. Gaff, 2006.
- Gentianella germanica** 108/5.3. @8, S. Wilts.: chalk grassland, Martin Down NNR, SU057189, D. & M. Nesbitt, 2006, det. A. R. G. Mundell.
- ‡**Lamium confertum** 118/5.5. *© 63, S. W. Yorks.: heathland, Edge Moor, Huddersfield, SE104126, M. J. Lucas, 2004.
- Lycopus europaeus** 118/22.1. *81, Berwicks.: Bemersyde Moss, NT6133, C. O. Badenoch, 1973. Also recorded here 1982 & 2002.
- Salvia pratensis** 118/25.3. @©7, N. Wilts.: grassland, Stratton Woods, SU165893, A. Deakin, 2006, det. S. Pilkington. Single plant, thought to be introduced in wildflower seed in sown grassland.
- Callitriche truncata** 120/1.2. 15, E. Kent: in 2 ditches, Lydden Valley, Hacklinge, TR349564, C. J. Cadbury & A. Parker, 2008. Also at TR351564, TR080643, TR082642 & TR087643. Only East Kent records ever outside Dungeness area.
- Callitriche platycarpa** 120/1.4. *79, Selkirks.: inflow stream, Clearburn Loch, NT345156, T. J. Pankhurst, 1998, NMW. See Lansdown (2008) *Callitriche Species of Europe*, p. 170.
- Veronica hederifolia** subsp. **lucorum** 124/16.24b. *31, Hunts.: shady, disturbed ground, Alwalton, TL1396, D. Broughton, 2007.
- [**Hebe cupressoides** 124/17.cup. 63, S. W. Yorks.: waste ground, Huddersfield, SE1419, M. J. Lucas, 2007. Error - delete].
- Euphrasia rostkoviana** 124/20.1. *81, Berwicks.: near Gordon, NT6342, G. C. Druce, 1907, *Hist. Berw. Nat. Club* XXIII p.228, ex *Ann. Scot. Nat. Hist.* 1907 p.99.
- Euphrasia nemorosa** × **micrantha** 124/20.7×18. *81, Berwicks.: Penmanshiel Moor, NT8268, L. W. Frost, 1960, det. P. F. Yeo. BSBI party.
- Euphrasia marshallii** × **scottica** 124/20.15×19. *110, Outer Hebrides: rocky knoll on moorland, Little Bernera, NB138411, R. J. Pankhurst, 2008, det. A. J. Silverside, **E**.
- Euphrasia heslop-harrisonii** 124/20.20. @110, Outer Hebrides: sheep-mown coastal turf, Rubha Liath, Eriskay, NF8009, P. A. Smith, 2007, det. A. J. Silverside, **NMW**.
- Orobanche hederæ** 125/2.8. *14, E. Sussex: 5 spikes among *Hedera helix*, on bank of ditch in garden, Burgess Hill, TQ3119, E. Sears, 2008, det. A. G. Knapp. Confidential location.

Utricularia australis 128/2.2. *60, W. Lancs.: pool, Storrs Moss, Yealand Redmayne, SD485755, G. Lyons & M. Ausden, 2007, conf. E. F. Greenwood. Population explosion following sediment removal winter 2005/6.

Linnaea borealis 131/4.1. 91, Kincardines.: native Scots Pine woodland, Strachan, NO646899, E. Jensen, 2007. 1st record since 1970. Known here by F. Sheridan, former forester, since 1985.

†**Valerianella dentata** 133/1.4. @10, Wight: approx. 5 plants in set-aside arable field, Warren Farm, Totland, SZ315854, G. N. Toone, 2002, **herb. G. N. Toone**.

Carduus nutans 135/5.4. *‡110, Outer Hebrides: Newton, N Uist, NF885773, R. J. Pankhurst, 2006, **E**.

†**Centaurea cyanus** 135/11.3. 113(S), Channel Islands (Sark): rough grass near school/village hall, WV464761, S. Synnott, 2008, **herb. Société Sercquaise**. Garden escape. 1st record for Sark.

Centaurea ×moncktonii (*Centaurea nigra* × *jacea*), 135/11.7×jac. 14, E. Sussex: 5 - 10 plants in old car park entrance on north side of Warren Road, Brighton, TQ334056, A. Spiers, 2008. 1st record since 1970.

†**Cichorium intybus** 135/12.1. 91, Kincardines.: in policies - self-seeded from garden, Banchory House, NJ915023, D. Welch, 2007. 1st record since 1970.

Taraxacum subnaevosum 135/25.46. *110, Outer Hebrides: roadside verge A888, Grean, Barra, NF682034, R. J. Pankhurst, 1998, det. A. J. Richards & A. J. Dudman, **E**.

Taraxacum bracteatum 135/25.55. *31, Hunts.: damp grassy ride in ancient woodland, Archer's Wood, TL172812, D. Broughton, 2008, det. A. J. Richards.

Archer's Wood 135/25.66. *110, Outer Hebrides: rough grass by ruin, Boisdale, S. Uist, NF741191, R. J. Pankhurst, 2008, det. A. J. Richards, **E**.

[**Taraxacum hamatifforme** 135/25.87. 31, Hunts.: location as given in *Taraxacum* database is VC29.]

Taraxacum hamatum 135/25.89. *31, Hunts.: ancient woodland ride, Waresley Wood NNR, TL262545, D. Broughton, 2008, det. A. J. Richards.

[**Taraxacum hamiferum** 135/25.90. 31, Hunts.: location as given in *Taraxacum* database is VC29.]

Taraxacum hamiferum 135/25.90. *63, S. W. Yorks.: Kings Road, Bradford, SE167356, B. A. Tregale, 2000, det. A. J. Richards.

[**Taraxacum lamprophyllum** 135/25.92. 31, Hunts.: location as given in *Taraxacum* database is VC29.]

Taraxacum pseudohamatum 135/25.98. *110, Outer Hebrides: causeway verge, Creagorry, Benbecula, NF801506, R. J. Pankhurst, 2008, det. A. J. Richards, **E**.

Taraxacum quadrans 135/25.99. *110, Outer Hebrides: grassy meadow, Griminish, Benbecula, NF768518, R. J. Pankhurst, 2008, det. A. J. Richards, **E**.

Taraxacum spiculatum 135/25.100. *90, Angus: road from Kirriemuir - Glen Prosen, NO363579, R. Pankhurst, 2003, conf. A. J. Richards.

Taraxacum ekmanii 135/25.131. *110, Outer Hebrides: roadside by river bridge, Milton, S. Uist, NF744262, R. J. Pankhurst, 2008, det. A. J. Richards, **E**.

Gnaphalium luteoalbum 135/33.6. *©55, Leics.: in pavement cracks and on roadside, Gaol Street, Oakham, SK859087, A. Lear, 2009, conf. K. Walker. 23 flowering plants and up to 75 seedlings.

Arum maculatum × *italicum*, 147/5.1×2. 113(S), Channel Islands (Sark): N side of track at foot of hedge, E of Pilcher Monument, WV455755, R. A. Waterman & C. Helyar, 2007, det. R. A. Waterman. R. A. Waterman has decided that all Sark plants (except this one) previously considered hybrids are atypical *A. maculatum*.

Juncus ×surrejanus (*J. articulatus* × *acutiformis*) 151/1.13×14. 113(S), Channel Islands (Sark): wet parts of two adjoining fields, S of Eperquerie Common, WV464769, R. M. Veall, 2008, det. M. Wilcox, **herb. Société Sercquaise**. Numerous plants previously recorded as one of the parents. 1st record for Sark.

Juncus ×diffusus (*J. inflexus* × *effusus*) 151/1.25×26. *90, Angus: The Lurgies, Montrose Basin, NO675579, B. G. Hogarth, 2008.

Juncus ×kern-reichgeltii (*J. effusus* × *conglomeratus*) 151/1.26×27. *64, Mid-W. Yorks.: mire at 390m, Ingleborough, SD743759, M. Wilcox, 2008.

Luzula ×borreri (*L. forsteri* × *pilosa*) 151/2.1×2. **10**, Wight: ancient woodland, Nunney's Wood, Ningwood, SZ403895, P. D. Stanley, 2008, det. G. M. Kay, **herb. C. R. Pope**. Growing with both parents. 1st confirmed record since 1883.

Cyperus fuscus 152/11.3. ***8**, S. Wilts.: ditches and marsh, Breamore Marsh, SU1518, C. Chatters, 2002. Edge of New Forest but 1st record for VC8. Records have been passed to VC11 VCR since 1983. Much monitored population.

Carex muricata × **divulsa** 152/16.8×9. ***10**, Wight: roadside verge, Mottistone, SZ4083, P. D. Stanley, 2008, conf. M. S. Porter & M. J. Y. Foley, **herb. P. D. Stanley**. 1st record for England.

Carex maritima 152/16.14. **@110**, Outer Hebrides: Traigh na Clibhe, Lewis, NB083362, A. H. Wilson, R. J. Pankhurst & E. Pilling, 2008.

Carex lasiocarpa 152/16.24. **58**, Cheshire: fen, Wybunbury Moss NNR, SJ6950, I. Diack, 2008. Last seen here c. 1905. Only current site.

Carex pendula 152/16.31. ***90**, Angus: Backmuir Wood, NO340344, B. G. Hogarth, 2009. Has persisted for several years - probably garden escape.

Carex viridula subsp. **brachyrrhyncha** 152/16.46a. ***10**, Wight: small base-rich fen, Dolcoppice, Whitwell, SZ5093, J. Norton & D. E. Allen, 2008, det. A. O. Chater, **herb. J. Norton**. Remarkably, there are no historic records for this taxon.

Festuca gigantea 153/12.3. ***‡110**, Outer Hebrides: Carishader, Lewis, NB102320, R. J. Pankhurst & E. Pilling, 2008.

Festuca rubra subsp. **litoralis** 153/12.7c. ***©63**, S. W. Yorks.: marshy ground near supermarket, Waterloo, Huddersfield, SE178164, M. J. Lucas, 2000.

Festuca rubra subsp. **arctica** 153/12.7e. **110**, Outer Hebrides: gravelly slip on bank of river, Abhainn a' Bheannain, Lewis, NB050294, P. A. Smith & M. Teneva, 2008, conf. A. Copping, NMW. 1st record since 1970. AC describes this as a very convincing subsp. *arctica*. **@110**, Outer Hebrides: coastal turf, Pabaigh Mor, NB1038, P. A. Smith, 2008, conf. A. Copping, E.

×**Festulolium loliaceum** (*Festuca pratensis* × *Lolium perenne*) 153/12×13.1×1. ***90**, Angus: in arable field adjacent to The Lurgies, Montrose Basin, NO675572, B. G. Hogarth, 2008.

×**Festulolium holmbergii** (*Festuca arundinacea* × *Lolium perenne*) 153/12×13.2×1. ***10**, Wight: roadside verge, Barton's Corner, Shalfleet, SZ4189, P. D. Stanley, 2008, det. T. A. Cope.

Puccinellia distans 153/16.2. ***‡8**, S. Wilts.: roadside, Deptford A36, SU009384, S. Pilkington, 2006. Also recorded elsewhere in VC8 in 2006.

†**Briza minor** 153/17.2. **@10**, Wight: frequent along field margin, Stenbury Manor Farm, Whitwell, SZ520796, G. N. Toone, 2004, det. C. R. Pope, **herb. G. N. Toone**.

Poa infirma 153/18.1. **@13**, W. Sussex: several plants on low bank by cricket field, N of Broadbridge Heath, TQ149322, A. G. Knapp & A. G. Hoare, 2008, det. A. G. Knapp.

Poa compressa 153/18.9. ***‡81**, Berwicks.: garden wall, Swinton, NT8147, E. K. Swinton, 1952. (Accepted, but could have been *P. nemoralis*.)

Deschampsia setacea 153/32.2. **@110**, Outer Hebrides: unnamed lochan, Lewis, NA996218, P. A. Smith & M. Teneva, 2008.

Gastridium ventricosum 153/42.1. **@10**, Wight: set-aside arable land, Cridmore Farm, Rookley, SZ5080, G. N. Toone, 2002, det. C. R. Pope.

Polypogon monspeliensis 153/46.1. **©8**, S. Wilts.: arable land, Farley, SU214283, J. Ford, 2006, det. S. Pilkington. 1st record since 1970.

Bromus racemosus 153/50.3. ***‡81**, Berwicks.: Anton's Hill, NT7843, E. Bell, 1853, det. G. Johnston, *Nat. Hist. Eastern Borders*, G. Johnston, with four other records by three recorders. Wrongly excluded from VCCC.

Bromus hordaceus subsp. **thominei** 153/50.4c. **@10**, Wight: maritime cliffs, Watershoot Bay, Niton, SZ493754, G. N. Toone, 1999, det. L. Spalton, **herb. G. N. Toone**.

Molinia caerulea subsp. **arundinacea** 153/63.1b. ***31**, Hunts.: fen birch woodland, Holme Fen NNR, TL209889, D. Broughton, 2008.

Sparganium erectum subsp. **oocarpum** 154/1.1d. ***63**, S. W. Yorks.: Broomhill, Barnsley, SE4102, M. Wilcox, 2008.

[**Pontederia cordata** 157/1.1. **58**, Cheshire: pond, Marston, SJ664700, G. M. Kay, 1989. Delete. Error for *Calla palustris*]

Epipactis phyllanthus 162/3.7. **@64**, Mid-W. Yorks.: calcareous grassland, Ellington Banks MoD site, SE280735, Yorks. Nats. Union, 2008.

Spiranthes romanoffiana 162/7.3. *110, Outer Hebrides: Loch na Creige Glais, Benbecula, NF811485, F. Horsman, 2008. 1 flowering plant each side of the loch.

Gymnadenia borealis 162/16.1c. *110, Outer Hebrides: heath, Fuday, NF740083, F. Horsman, 2008, conf. R. M. Bateman.

Dactylorhiza fuchsii subsp. **hebridensis** × **traunsteinerioides** 162/18.1×7. *110, Outer Hebrides: Luskentyre, S. Harris, NG068998, F. Horsman, 2008.

Dactylorhiza fuchsii subsp. **hebridensis** × **ebudensis** 162/18.1×ebu. *110, Outer Hebrides: one plant Machair Robach, N. Uist, NF862757, F. Horsman, 2008, conf. R. M. Bateman. Ø This hybrid is new to science.

Dactylorhiza maculata × **traunsteinerioides** 162/18.2×7. *110, Outer Hebrides: Luskentyre, S. Harris, NG068998, F. Horsman, 2008.

Dactylorhiza incarnata subsp. **coccinea** 162/18.3b. *90, Angus: Easthaven - Elliot, NO610376, B. G. Hogarth & P. Gaff, 2005. Reported in 2004 but no details.

Dactylorhiza incarnata subsp. **coccinea** × **purpurella** var. **purpurella** 162/18.3b×5. @110, Outer Hebrides: Uig machair, Lewis, NB103356, F. Horsman, 2007. 2 plants.

Dactylorhiza incarnata subsp. **coccinea** × **traunsteinerioides** 162/18.3b×7. *110, Outer Hebrides: in series of calcareous flushes, Borve, S. Harris, NG031947, F. Horsman, 2008.

Dactylorhiza incarnata (L.) Soo subsp. **coccinea** (Pugsley) Sóo × **D. ebudensis** (Wief. ex R.M. Bateman & Denholm) P. Delforge 162/18.3b×ebu. *110, Outer Hebrides: Machair Robach, N. Uist, NF861757, F. Horsman, 2008, conf. R. M. Bateman. Ø

Dactylorhiza incarnata subsp. **pulchella** 162/18.3c. *90, Angus: unimproved damp pasture with scrub, Woodside, NO435541, L. Farrell, 2005.

Dactylorhiza traunsteinerioides 162/18.7. @110, Outer Hebrides: Machair Robach, N. Uist, NF868759, F. Horsman, 2008. Approx. 50 flowering plants in an isolated *Schoenus* flush. @110, Outer Hebrides: Luskentyre, S. Harris, NB069001, F. Horsman, 2008.

Orchis purpurea 162/20.5. *14, E. Sussex: one plant in chalk grassland, Beachy Head, Eastbourne, TV569954, J. Curson, 2008, det. D. C. Lang. Status uncertain but thought to be of continental origin.

NEOPHYTES AND CASUALS

‡**Pteris multifida** 8/1.mul. *17, Surrey: several plants on the wall of South Dock, Rotherhithe, TQ365790, N. H. Bertrand, 2008. Ø See *BSBI News* 73. p. 40.

‡**Matteuccia struthiopteris** 16/1.1. *91, Kincardines.: streamside, Durris House, NO7996, J. S. Murray, 1962, *ABD*. Not submitted in 1960s. Seen again 2007 - 1st record since 1970.

‡**Polystichum munitum** 17/1.mun. *58, Cheshire: dumped soil heap, Marple, SJ945886, P. Owen, 2007, det. F. J. Rumsey, **BM**.

‡**Abies grandis** 20/1.2. *©7, N. Wilts.: in layby, Savernake Forest, SU221672, J. Oliver, 2006.

‡**Abies procera** 20/1.3. *90, Angus: mosaic of native woodland and policy woodland, Den of Airlie, NO2950, B. G. Hogarth & P. Gaff, 2007.

‡**Picea glauca** 20/4.gla. *63, S. W. Yorks.: N. side of Underbank Reservoir, SK2499, J. P. Flanagan, 2007.

‡**Picea pungens** Engelm. 20/4.pun. *63, S. W. Yorks.: Wyming Brook, Sheffield, SK265870, Sheffield Wildlife Trust, 2001. Ø

‡**Thuja plicata** 21/3.1. *90, Angus: semi-wild policy in former wooded den, Mains of Auldbar, NO574583, B. G. Hogarth & P. Gaff, 2008.

‡**Araucaria araucana** 22/1.1. *90, Angus: semi-wild policy in former den woodland, Mains of Auldbar, NO573582, B. G. Hogarth & P. Gaff, 2008.

‡**Nymphaea marliacea** Wildsmith 26/1.mar. *©7, N. Wilts.: pond, Savernake Forest, SU221651, Wiltshire Botanical Society, 2006, det. S. Pilkington. Ø Extensive in Bitham Pond.

‡**Helleborus orientalis** 28/3.3. *80, Roxburghs.: one clump on wooded bank above river, Hornshole Bridge, Hawick, NT532368, P. R. Green, 2008.

‡**Helleborus argutifolius** 28/3.arg. 113(S), Channel Islands (Sark): verge of track near foot of wall, Valette de Bas, WV472760, R. M. Veall, 2008, **herb. Société Sercquaise**. Origin unknown. 1st record for Sark.

©**Nigella damascena**, 28/5.1. *31, Hunts.: railway track, Woodston, Nene Valley Railway, TL1898, D. Broughton, 2005.

- ‡*Actaea erythrocarpa* Fisch. 28/8.ery. *©81, Berwicks.: one plant in fruit on old road between Old Free Kirk and the bridge, Gavinton, NT7652, M. J. Long, 1965, det. A. G. Long. Ø
- ‡*Anemone apennina* 28/9.2. ©7, N. Wilts.: grassy embankment, Great Bedwyn, SU273647, J. Oliver, 2006. 1st recent record. One site for VC7 given in 1957 flora but not dated.
- ‡*Berberis darwinii* 29/1.9. *10, Wight: established small bush well away from gardens on railway embankment, Yarbridge, Brading, SZ607867, C. R. Pope, 2008.
- ‡*Eschscholzia californica* 30/6.1. *7, N. Wilts.: wall-road angles, West Overton, SU129679, J. Oliver, 2006. Also recorded at West Overton SU128680 same date.
- ‡*Dicentra formosa* 31/1.1. *90, Angus: survey of the Miley with SWT support group for Local Change, Dundee, NO33W, B. G. Hogarth, 2003. Also seen by BGH in Glen Prosen village at NO328658 in 2008.
- ‡*Dicentra spectabilis* Lem. 31/1.spe. *Mid-W. Yorks.: woodland, Gilstead, SE121396, B. A. Tregale & M. Wilcox, 2008. Ø
- ‡*Corydalis solida* 31/2.1. *©81, Berwicks.: Allanbank, Allanton, NT8554, A. Kelly, 1873, *Hist. Berw. Nat. Club* VII p.125. Omitted from VCCC.
- ‡*Nothofagus xodocaphleps* (*N. obliqua* × *alpina*) 39/2.1×2. *63, S. W. Yorks.: Heaton Woods, Shipley, SE13, B. K. Byrne, 2008.
- ‡*Betula lutea* Michx. 40/1.lut. *63, S. W. Yorks.: wooded valley, Quarmby, Huddersfield, SE114173, M. J. Lucas, 2007. Ø
- ‡*Corylus maxima* 40/4.2. *60, W. Lancs.: plantations, Brockholes Quarry, Preston, SD5830, G. Wilmore & M. Clapham, 2008. Details found in draft management plan.
- ‡*Bassia scoparia* 43/2.1. *7, N. Wilts.: along M4, Sutton Benger, ST98, S. Leach, 2006. *8, S. Wilts.: roadsides, A303 trunk road, SU04, S. Leach, 2006. Also recorded in other hectads along the same road.
- ‡*Amaranthus retroflexus* 44/1.1. *91, Kincardines.: by River Dee, Torry, NJ90, J. W. H. Trail, 1889, Source - *Trail Memorial Volume* (1923).
- ©*Amaranthus cruentus* 44/1.3. *31, Hunts.: reseeded area by newly laid track, Hinchingsbrooke Country Park, TL218717, K. Walker, 2006, det. J. Mason.
- ©*Amaranthus bouchonii* 44/1.4. *10, Wight: arable, Bathingbourne, Godshill, SZ5483, G. N. Toone, 2006, det. E. J. Clement, **herb. G. N. Toone**.
- ©*Amaranthus albus* 44/1.6. 10, Wight: arable, Cridmore Farm, Rookley, SZ5081, G. N. Toone, 2006, det. E. J. Clement, **herb. E. J. Clement**. 1st record since 1970. Surviving in herbicide-sprayed area.
- ‡*Lychnis flos-jovis* (L.) Desr. 46/18.flo. *64, Mid-W. Yorks.: riverside, Ilkley, SE110481, N. Vernon, 2008. Ø Area of riverbank where rubble had been tipped.
- ‡*Petrorhagia saxifraga* 46/24.3. *13, W. Sussex: small clump at back of verge, W side of road, Climping, TQ027013, R. J. Kemp, 2008.
- ‡*Dianthus carthusianorum* L. 46/25.car. *90, Angus: The Den, Kinpurney Hill, NO312416, B. G. Hogarth, 2008. Ø First seen 2007 but no flowers for ID. Very dull plant to be garden escape.
- ‡*Persicaria weyrichii* 47/1.4. *63, S. W. Yorks.: Crosland Edge, Huddersfield, SE1011, M. J. Lucas, 2008.
- ‡*Persicaria affinis* (D. Don) Ronse Decr. 47/1.aff. *64, Mid-W. Yorks.: woodland, Gilstead, SE121386, B. A. Tregale & M. Wilcox, 2008, det. E. J. Clement. Ø
- ‡*Muehlenbeckia complexa* 47/6.1. 113(S), Channel Islands (Sark): over a length of 5m on and near roadside wall, Rue de la Rade, WV464765, R. M. Veall, 2008, **herb. Société Sercquaise**. Spread from trees in nearby garden. 1st record for Sark.
- ‡*Rumex dentatus* 47/8.den. *90, Angus: big pheasant country, S of Round Loch, Lundie, NO299380, B. G. Hogarth & P. Gaff, 2008.
- ‡*Hypericum xnodorum* (*H. androsaemum* × *hircinum*) 51/1.3×4. *©63, S. W. Yorks.: demolition site, Manor, Sheffield, SK3885, K. Balkow, 2008.
- ‡*Hypericum forrestii* 51/1.for. *60, W. Lancs.: one bush on steep roadside bank, near Hole House Farm, Bentham, SD646659, E. F. Greenwood, 2008. *©63, S. W. Yorks.: riverbank, Bingley, SE104395, B. A. Tregale, 2008, conf. E. J. Clement.
- ‡*Malva alcea* 53/1.2. *58, Cheshire: rough grassland, Alderley Edge, SJ838783, G. M. Kay, 2004. Self-sown. *90, Angus: in former sand quarry, by Glamis, NO371485, B. G. Hogarth & P. Gaff, 2008. 1st of several records.

- ©*Lavatera cretica* 53/2.2. *10, Wight: manure heap in field, Hardingshute Farm, Brading, SZ5988, G. N. Toone, 2008, det. E. J. Clement, **herb. G. N. Toone**.
- ‡*Sidalcea malviflora* 53/5.1. *81, Berwicks.: waste ground, Longformacus, NT692575, M. E. Braithwaite, 2008. Established from throw-out.
- ‡*Salix ×ehrhartiana* (*S. pentandra* × *alba*) 61/2.1×3. *63, S. W. Yorks.: hedgerow, Hatfield Moor, SE7208, P. P. Abbott, 2008, conf. M. Wilcox.
- ‡*Sisymbrium irio* 62/1.2. *58, Cheshire: pavement cracks, Chester, SJ404662, A. M. Boucher, 2008, conf. G. M. Kay & T. C. G. Rich, **NMW**.
- ‡*Sisymbrium polyceratum* L. 62/1.poc. *©81, Berwicks.: paper mill, Chirnside, NT8556, C. I. Robson, 1960, det. T. C. G. Rich, **RNG. Ø**
- ‡*Sisymbrium runcinatum* Lag. ex DC. 62/1.run. *©81, Berwicks.: paper mill tip, Chirnside, NT8556, anon, 1961, det. T. C. G. Rich, **CGE. Ø** Recorder probably C. I. Robson.
- ©*Lunaria rediviva* L.62/17.red. *8, S. Wilts.: roadside, Bratton, ST924516, R. Duckett, 2006. Ø Not near houses.
- ‡*Carrichtera annua* (L.) DC. 62/CAR.ann. *©81, Berwicks.: paper mill and railway, Chirnside, NT8556, C. I. Robson, 1958, det. T. C. G. Rich, **E. Ø** As 'Duns, paper mill and railway', but Chirnside is where the mill was; further record 'Chirnside' 1961.
- ©*Eruca vesicaria* 62/ERC.ves. 10, Wight: well established on slumping maritime cliffs, Forelands, Bembridge, SZ650870, A. Campbell, 2008, det. E. J. Clement, **herb. C. R. Pope**. 1st record since 1925.
- ‡*Peltaria alliacea* Jacq. 62/PEL.all. *81, Berwicks.: shaded river bank, Tweedmill, NT863426, G. Hargreaves, 2006, det. D. R. McKean, **E. Ø** By 2008 vegetative spread to a large patch, 2m tall when flowering.
- ‡*Rhododendron luteum* 65/2.2. *90, Angus: semi-wild policy, Glamis, NO391491, B. G. Hogarth & P. Gaff, 2008.
- ‡*Gaultheria mucronata* 65/8.3. *90, Angus: Montreathmont, NO5355, B. G. Hogarth & P. Gaff, 2007. Becoming established in wild.
- ‡*Pieris japonica* (Thunb.) D. Don 65/PIE.jap. *63, S. W. Yorks.: Old Spring Wood, Northcliffe, Bradford, SE135370, B. A. Tregale, 2008, conf. E. J. Clement. Ø
- ‡*Cyclamen repandum* 69/3.rep. *©7, N. Wilts.: plantation picnic area, West Woods, SU161666, J. Oliver, 2006. 2nd record for Wiltshire.
- ‡*Ribes sanguineum* 72/2.4. *31, Hunts.: Hall Farm, TL1389, K. Walker, 2003.
- ‡*Crassula helmsii*, 73/1.3. *90, Angus: new ponds in former gravel quarry, Murton, NO495516, B. Ballinger, 2003, conf. B. G. Hogarth.
- ‡*Sedum spectabile* 73/5.4. *90, Angus: Loch Fithie track, NO4851, B. G. Hogarth & P. Gaff, 2008. Becoming established in wild.
- ©*Sedum hispanicum* 73/5.19. *63, S. W. Yorks.: Bolton Wood Quarry, Bradford, SE1636, B. A. Tregale & M. Wilcox, 2002.
- ‡*Chiasophyllum oppositifolium* (Ledeb. ex Nordm.) A. Berger 73/CHI.opp. *60, W. Lancs.: top of wall, Silverdale, SD459757, J. Clarke, 2008. Ø
- ‡*Saxifraga ×geum* (*S. umbrosa* × *hirsuta*) 74/5.8×10. *80, Roxburghs.: a very large stand in woodland, Hassendeanburn, Hawick, NT537183, P. R. Green, 2008.
- ‡*Saxifraga spathularis* 74/5.9. *90, Angus: conifer plantation - edge of track, Montreathmont, NO557530, P. Gaff, 2008.
- ‡*Tellima grandiflora* 74/8.1. *90, Angus: small wooded den east of Balgavies, NO539509, B. G. Hogarth, 2007. *91, Kincardines.: streamside in policies, Glenbervie, NO768805, D. Welch, 2007.
- ‡*Spiraea alba* 75/3.2. *91, Kincardines.: streamside, Glassel, NO668992, D. Welch, 2007, **ABD**. Well naturalised.
- ‡*Spiraea douglasii* subsp. *douglasii* 75/3.3a. *91, Kincardines.: streamside, Strachan, NO652921, D. Welch, 2007, **herb. D. Welch**. Known here for last 40 years but not included as subsp. in VCCC.
- ©*Rubus loganobaccus* 75/8.10. *10, Wight: waste ground, St Helen's Duver, SZ6388, C. R. Pope, 2008, det. E. J. Clement.
- ‡*Acaena anserinifolia* 75/18.2. *110, Outer Hebrides: Northton, car park of MacGillivray Centre, NF989894, R. J. Pankhurst, 2006, **E**.

- ‡*Acaena caesiiglauc* (Bitter) Bergmans 75/18.cae. *81, Berwicks.: wall, Duns Public School, NT782539, G. Grahame, 1954, det. P. F. Yeo, **HAMU**. Ø
- ‡*Rosa virginiana* 75/21.9. *©81, Berwicks.: two bushes in riverside wood, near Preston Bridge, NT788568, M. E. Braithwaite, 2008. Probably planted.
- ‡*Prunus domestica* subsp. *instititia* 75/22.5b. *91, Kincardines.: hedgerow, Marykirk, NO689661, D. Welch, 2007.
- ‡*Cotoneaster sternianus* 75/32.40. *©80, Roxburghs.: a single tree in wood, Bucklands, Hawick, NT519163, P. R. Green, 2008.
- ©*Acacia dealbata* A. Cunn. 76/1.dea. *10, Wight: 3 young plants at foot of wall, roadside, Sandown, SZ597847, G. N. Toone, 2008, det. C. S. Crook.
- ‡*Elaeagnus macrophylla* 78/2.mac. *63, S. W. Yorks.: Broomhill, Barnsley, SE4102, B. K. Byrne, 2008.
- ‡*Epilobium brunescens* 84/1.12. *7, N. Wilts.: scrubby open ground near Ashton Keynes, SU060939, S. Pilkington & J. Newton, 2006. 1st record for Wiltshire. Quite common in damp open silty ground near pits.
- ‡*Clarkia amoena* 84/CLA.amo. *64, Mid-W. Yorks.: riverbank, Ilkley, SE110481, N. Vernon, 2008. Area of riverbank where rubble had been tipped.
- ‡*Euonymus japonicus* 88/1.3. *63, S. W. Yorks.: disused railway, Thackley, Bradford, SE175386, B. A. Tregale & M. Wilcox, 2001.
- ©*Euphorbia cyparissias* 91/2.15. 10, Wight: roadside verge, Sandford, Godshell, SZ5381, G. N. Toone, 2007, det. C. R. Pope, **herb. G. N. Toone**. Not recorded since 1960 away from gardens.
- ‡*Euphorbia mellifera* Aiton, 91/2.mel. 113(S), Channel Islands (Sark): edge of road, La Valette, WV473762, R. M. Veall, 2008, det. J. Higham, **herb. Société Sercquaise**. Ø Seeding from mature plant in nearby garden. 1st record for Sark.
- ‡*Euphorbia thymifolia* L. 91/2.thy. *©7, N. Wilts.: plant nursery (Lowden Nursery), ST878657, P. R. Green, 2005. Ø Growing as a nursery weed.
- [*Acer saccharinum* 99/1.5. *62, N. E. Yorks.: many self-sown amongst planted trees and in adjacent wasteland N of A66 South Bank, NZ533209, V. Jones & W. A. Thompson, 2007, **herb. V. Jones**. Error. See *Watsonia* (Plant Records) Vol. 27 Part 3 p. 267. Delete *Acer saccharinum* and replace with *A. saccharum* 99/1.sac. Marshall, *. Ø]
- ‡*Rhus typhina* 100/1.1. *31, Hunts.: edge of gravel pit, Paxton Pits, TL198639, D. Broughton, 2008.
- ‡*Oxalis corniculata* 102/1.3. *110, Outer Hebrides: airport entrance, Balivanich, NF781554, M. J. Crawley, 2008.
- ‡*Geranium endressii* 103/1.1. *©110, Outer Hebrides: Little Loch Roag, Giosla, NB128257, P. A. Smith & R. J. Pankhurst, 2008. Escaping from planted strip.
- ‡*Geranium versicolor* 103/1.2. *93, N. Aberdeen: at 320m in grassland near house, Boganclogh, Clashindarroch, NJ434293, D. Welch, 2007.
- ‡*Geranium himalayense* 103/1.8. *©110, Outer Hebrides: roadside bank, N side of road at Carisiader, NB099331, R. J. Pankhurst, 2008, E.
- ‡*Hedera colchica* 106/1.1. *90, Angus: conifer plantation - edge of track, Middleton Woods, NO553516, P. Gaff, 2008.
- ‡*Aralia elata* 106/2.2. *58, Cheshire: several self-sown plants on trackside, Partington, SJ731917, G. M. Kay, 2008. First seen in 1990s.
- ‡*Levisticum officinale* 107/38.1. *17, Surrey: group of 6+ plants at base of wall near entrance to Oaks Farm, Little Woodcote, A2022, TQ273610, P. Wakeham, 2008.
- ‡*Hyoscyamus albus* L. 110/4.alb. 113(S), Channel Islands (Sark): in vegetable bed, S. of La Vaurocque, W side of Rue de la Coupée, WV461756, S. Synnott, 2008, det. E. J. Clement, **herb. Société Sercquaise**. Ø Unknown source. 1st record for Sark.
- ‡*Solanum sarachoides* 110/8.4. *90, Angus: 3 plants in rubble along shoreline by Fishtown of Usan, NO726547, B. G. Hogarth & P. Gaff, 2008.
- ©*Datura ferox* 110/9.fer. *58, Cheshire: potato field, Helsby, SJ501755, P. Llewellyn, 2006. *90, Angus: Paradise near RM Condor, NO6143, D. Balfour, 2006, conf. D. R. McKean.
- ©*Ichroma australe* 110/I0C.aus. *10, Wight: one established bush, waste ground by coast, Bembridge Point, SZ6488, C. R. Pope, 2008, det. E. J. Clement, **herb. C. R. Pope**. Ø Grown in gardens nearby.

‡**Calystegia pulchra** 111/3.3. *113(S), Channel Islands (Sark): neglected garden, The Arsenal, WV467758, R. M. Veall, 2008, det. R. K. Brummitt, **herb. Société Sercquaise**. 1st record for Sark.

‡**Calystegia silvatica** 111/3.4. *©79, Selkirks.: climbing fence on waste ground, Lingle Road, Selkirk, NT461290, R. W. M. Corner, 2008. 1st localised record.

‡**Symphytum 'Hidcote Blue'** (*S. officinale* × *asperum* × *grandiflorum*) 116/4.1×2×4. *91, Kincardines.: steep woodland policies, Glenbervie, NO768805, D. Welch, 2007, det. C. O'Reilly, **ABD**.

‡**Symphytum orientale** 116/4.6. *91, Kincardines.: roadside, Maryculter, NJ80, A. H. Sommerville, 1965, **ABD**. 91, Kincardines.: abandoned garden of cottage, Kingcausie, Maryculter, NJ861003, D. Welch, 2007, **ABD**. 1st record since 1970. Perhaps where seen in 1965.

©**Verbena bipinnatifolia** 117/1.bip. *13, W. Sussex: one plant on new gravel by canal bridge workings, Loxwood, TQ041311, S. M. Simkin, 2007, det. E. J. Clement. Ø

‡**Stachys byzantina** 118/1.2. *31, Hunts.: sparsely vegetated ground by gravel pit, Paxton Pits, TL193638, D. Broughton, 2009.

‡**Lamiastrum galeobdolon** subsp. *argentatum* 118/4.1c. *31, Hunts.: tall herb vegetation on urban fringe, Ramsey, TL2885, D. Broughton, 2008. *90, Angus: Miley, Dundee, NO3832, B. G. Hogarth, 2003. With SWT support group for Local Change. Also seen at West Wood of Ethie NO663458 by BGH and P. Gaff in 2008.

‡**Mentha ×rotundifolia** (*M. suaveolens* × *longifolia*) 118/23.4×lon. *81, Berwicks.: near Coldingham, NT913661, P. A. Green, 1954.

‡**Salvia verbenaca** 118/25.4. *81, Berwicks.: Cockburnspath, NT7771, anon, 1952, WFS Berwickshire County Botanical Record. Recorder probably E. K. Swinton.

‡**Forsythia suspensa** (Thunb.) Vahl 123/1.sus. *63, S. W. Yorks.: riverbank, Beckfoot Lane, Bingley, SE1138, B. A. Tregale, 2008. Ø

‡**Fraxinus ornus** L. 123/2.orn. *©81, Berwicks.: Duns Nursery Cottage, NT788532, G. Grahame, 1956. Ø

©**Verbascum pulverulentum** 124/1.11. *13, W. Sussex: on landfill on old pit, Adsdean, SU797090, M. M. Shaw, 2008, det. E. J. Clement.

‡**Scrophularia scorodonia** 124/2.4. *90, Angus: by Dean Water near Dean House near Glamis, NO378478, B. G. Hogarth & P. Gaff, 2008.

‡**Asarina procumbens** 124/10.1. *81, Berwicks.: self-seeded on two adjoining walls, Duns, NT789537, M. E. Braithwaite, 2008.

‡**Linaria pelisseriana** 124/13.7. *©7, N. Wilts.: one plant only on waste ground, Ogbourne St. George, SU203741, J. Newton, 2006.

‡**Linaria maroccana** 124/13.mar. *64, Mid-W. Yorks.: pavement weed, Woodhouse, Leeds, SE294339, G. Twigge, 2008, det. P. P. Abbott. ©113(S), Channel Islands (Sark): roadside, La Ville Farm, WV469762, R. M. Veall, 2008, **herb. Société Sercquaise**. Casual from nearby flower bed. 1st record for Sark.

‡**Veronica peregrina** 124/16.18. ©63, S. W. Yorks.: garden weed, Beaumont Park, Huddersfield, SE123145, M. J. Lucas, 2007. 1st record since 1970.

‡**Hebe ×lewisii** (*H. salicifolia* × *elliptica*) 124/17.1×ell. *81, Berwicks.: one self-seeded bush plus seedling on wooded bank, Eye Water near Netherbyres, NT941635, M. E. Braithwaite, 2008.

‡**Hebe albicans** Cockayne 124/17.alb. *63, S. W. Yorks.: seedlings on wall, Canal Road, Bradford, SE164344, B. A. Tregale, 2008. Ø

‡**Gratiola officinalis** L. 124/GRA.off. *14, E. Sussex: spreading around edge of pond, East Brighton Golf Course, TQ350041, A. D. Symon, 2008, det. A. G. Knapp. Ø Probably originally planted.

‡**Campanula alliariifolia** 129/1.6. *©63, S. W. Yorks.: side of Leeds-Liverpool Canal, Leeds, SE296328, M. Wilcox, 2008.

‡**Campanula portenschlagiana** 129/1.9. *81, Berwicks.: established on wall, Duns, NT788538, M. E. Braithwaite, 2008.

‡**Symphoricarpos ×chenaultii** (*S. orbiculatus* × *microphyllus*) 131/3.orb×mic. *31, Hunts.: roadside planting, New Fletton, A1139, TL1997, D. Broughton, 2008.

‡**Lonicera tatarica** 131/6.tat. *64, Mid-W. Yorks.: woodland on hillside, Otley Chevin, SE225445, B. N. Brown, 2008.

- ‡*Cephalaria gigantea* 134/2.1. *81, Berwicks.: one clump on roadside, Preston, NT788573, M. E. Braithwaite, 2008.
- ‡*Echinops bannaticus* 135/1.3. *90, Angus: by River Isla, NO301474, B. G. Hogarth & P. Gaff, 2008. Past records under a variety of names.
- ‡*Taraxacum aequilobum* 135/25.106. *110, Outer Hebrides: trackside in dunes, Nunton, Benbecula, NF761534, R. J. Pankhurst, 2008, det. A. J. Richards, E.
- ‡*Taraxacum horridifrons* 135/25.140. *110, Outer Hebrides: roadside verge, Balivanich, NF769554, R. J. Pankhurst, 2008, det. A. J. Richards, E.
- ‡*Taraxacum valens* 135/25.218. *31, Hunts.: improved verge on edge of arable, Lady Grove Wood, TL126675, D. Broughton, 2008, det. A. J. Richards.
- ‡*Erigeron glaucus* 135/43.1. *©63, S. W. Yorks.: well established garden escape on roadside verge, Norton, SE5315, G. T. D. Wilmore, 2008.
- ‡*Erigeron karvinskianus* 135/43.4. *60, W. Lancs.: wall of Penwortham Road Bridge, Broadgate, Preston, SD530283, N. Searles, 2008.
- ‡*Olearia paniculata* 135/45.1. *93, N. Aberdeen: abandoned garden on coast, Pennan, NJ847655, D. Welch, 1999. Although included in VCCC, no details have been published previously.
- ‡*Olearia macrodonta* 135/45.2. *113(S), Channel Islands (Sark): edge of scrubland, N. of Port à la Jument, WV460761, R. M. Veall, 2008, **herb. Société Sercquaise**. 1st record for Sark.
- ©*Anthemis austriaca* Jacq. 135/55.aus. *10, Wight: roadside verge, Mersley Farm, SZ5586, G. N. Toone, 2007, det. E. J. Clement, **herb. G. N. Toone**. Ø Possibly from flower seed mix.
- ‡*Senecio inaequidens* 135/62.3. *©7, N. Wilts.: waste ground, Chippenham, ST927739, S. Pilkington, 2006. Single plant, in area soon to be built on with housing. *©8, S. Wilts.: wall-pavement angles, Trowbridge, ST853573, S. Pilkington, 2006. Single large plant near newly built houses.
- ‡*Brachyglottis 'Sunshine' (B. compacta × laxifolia)* 135/66.comxlax. *93, N. Aberdeen: abandoned garden on coast, Pennan, NJ847655, D. Welch, 2008.
- ‡*Doronicum columnae* 135/69.3. *13, W. Sussex: in relict garden on south side of Harbour Road, Pagham Harbour, SZ886968, M. M. Shaw, 2008, det. E. J. Clement. Probably originally planted but now established and spreading.
- ‡*Ambrosia artemisiifolia* 135/74.1. *90, Angus: bird seed near easternmost hide, Loch of Kinnordy, NO362538, B. G. Hogarth & P. Gaff, 2008.
- ‡*Arum italicum* 147/5.2. *80, Roxburghs.: one clump on bank of river, Teviot Bank, Hawick, NT556184, P. R. Green, 2008.
- ‡*Arum italicum* subsp. *italicum* 147/5.2b. *31, Hunts.: plantation woodland on urban fringe, Hinchingsbrooke Country Park, TL222717, D. Broughton, 2009.
- ‡*Lemna minuta* 148/2.4. *80, Roxburghs.: abundant in pond, Cavers Wood, Hawick, NT541151, P. R. Green, 2008.
- ‡*Luzula luzuloides* 151/2.4. *60, W. Lancs.: garden escape in cultivated ground, Avenham Park, Preston, SD5328, P. Jepson, 2008.
- ‡*Carex comans* 152/16.com. *17, Surrey: a small but well-established tuft on Horsell Common, TQ012601, G. Hounsome, 2008. Ø Appears to be 1st record in the wild for British Isles.
- ‡*Pseudosasa japonica* 153/5.1. *8, S. Wilts.: common land, West Wellow, SU287184, R. Veall, 2002.
- ‡*Festuca heterophylla* 153/12.5. *13, W. Sussex: under beech trees on the south side of the metalled track to the Stansted House offices, Stansted, SU755104, M. M. Shaw, 2008, det. A. G. Knapp.
- ‡*Glyceria grandis* Wats. 153/24.gra. *63, S. W. Yorks.: marshy ground near supermarket, Waterloo, Huddersfield, SE178164, M. J. Lucas, 2000, det. E. J. Clement. Ø
- ©*Avena sativa* 153/28.5. *110, Outer Hebrides: fallow machair, A' Bheirigh, NB1034, R. J. Pankhurst, P. A. Smith & E. Pilling, 2008, det. R. J. Pankhurst, conf. A. O. Chater, NMW. Previously reported but the first confirmed record. Probable relic of cultivation.
- ‡*Agrostis lachnantha* 153/39.lac. *64, Mid-W. Yorks.: waste ground, Baildon, SE151380, B. A. Tregale & M. Wilcox, 2008, det. T. B. Ryves.
- ‡*Polypogon viridis* 153/46.2. *8, S. Wilts.: garden centre, Trowbridge, ST843566, S. Pilkington, 2004. Seems to be spreading in Trowbridge.

- ‡**Polypogon fugax** Nees ex Steud. 153/46.fug. *8, S. Wilts.: wall-pavement angles, Trowbridge, ST850577, S. Pilkington, 2006, det. T. B. Ryves. Ø
- ‡**Anisantha diandra** 153/52.1. *90, Angus: on edge of disused railway by arable field, Newtyle, NO298415, B. G. Hogarth, 2007. Persisted for 3 years.
- ‡**Cortaderia richardii** 153/62.ric. *©63, S. W. Yorks.: foot of wall, Wagon Lane, Bingley, SE1238, B. A. Tregale & M. Wilcox, 2008.
- ‡**Scilla liliohyacinthus** 158/19.5. *13, W. Sussex: becoming established in wild garden, Nymans wild garden, TQ264293, Sussex Botanical Recording Society, 2008, det. E. J. Clement.
- ‡**Chionodoxa forbesii** 158/22.1. *90, Angus: Ruthven, NO24, B. G. Hogarth & P. Gaff, 2007. Beginning to occur more frequently well away from gardens.
- ‡**Chionodoxa luciliae** 158/22.luc. *©63, S. W. Yorks.: verge, Beckfoot Lane, Bingley, 2008, SE111380, B. A. Tregale, 2008.
- ‡**Muscari latifolium** J. Kirk. 158/23.lat. *64, Mid-W. Yorks.: grass verge, Hirst Mill, SE131383, B. A. Tregale, 2008. Ø
- ©**Allium carinatum** 158/24.12. *10, Wight: amenity grassland, Freshwater, SZ3386, P. D. Stanley, 2008.
- ©**Allium ampeloprasum** var. **babingtonii**, 158/24.13. *10, Wight: field gateway, Sprinvale, Seaview, SZ6192, P. D. Stanley, 2008, det. E. J. Clement.
- ‡**Allium cepa** 158/24.cep. *‡64, Mid-W. Yorks.: woodland, Gilstead, SE121386, B. K. Byrne, B. A. Tregale & D. Mason, 2008.
- ‡**Nothoscordum borbonicum** 158/26.1. *©63, S. W. Yorks.: rough track behind houses, Birkby, Huddersfield, SE139171, M. J. Lucas, 2007.
- ‡**Leucojum aestivum** 158/31.1. *©81, Berwicks.: Milne Graden, NT8744, E. O. Pate, 1968.
- ‡**Leucojum aestivum** subsp. **aestivum** 158/31.1a. *©63, S. W. Yorks.: waste ground, Bingley, SE1039, B. A. Tregale & M. Wilcox, 2002.
- ‡**Galanthus woronowii** Losinsk. 158/32.wor. *©63, S. W. Yorks.: disused railway, Thackley, Bradford, SE175386, B. A. Tregale & M. Wilcox, 2008. Ø
- ‡**Ruscus aculeatus** 158/35.1. *80, Roxburghs.: scattered plants by woodland path, Hassendeanburn, Hawick, NT541184, P. R. Green, 2008.
- ‡**Sisyrinchium californicum** 159/2.3. *64, Mid-W. Yorks.: riverbank, Ilkley, SE110481, N. Vernon, 2008. Area of riverbank where rubble had been tipped.
- ‡**Crocus chrysanthus** 159/8.6. *©63, S. W. Yorks.: verge, Beckfoot Lane, Bingley, SE111380, B. A. Tregale, 2008.
- ‡**Crocsmia masoniorum** 159/13.2. *©63, S. W. Yorks.: waste ground, East Ardsley, SE2428, J. Martin, 2006.
- ‡**Schizostylis coccinea** 159/SCH.coc. *58, Cheshire: peat bog, Lindow, Wilmslow, SJ822808, B. T. Shaw, 2008. Present for several years.



Book Reviews

Fumitories of Britain and Ireland. R. J. Murphy. Pp. vi + 121. B.S.B.I. Handbook No. 12. Botanical Society of the British Isles, London. 2009. Paper covers. £12.50. ISBN 978-0-901158-40-6.

The B.S.B.I. handbook series is undergoing something of a resurgence at the moment: first, the much-expanded edition of *Sedges*, then last year the eagerly awaited *Water-starworts of Europe*, and now *Fumitories* and *Grasses* in quick succession. I used to steadfastly record water-starworts as ‘*Callitriche* agg’, and had always believed that many of the fumitories were probably best avoided as well. But this new handbook convinces me that these plants really do *matter*, and that they’re not quite as difficult as I had thought.

The handbook follows the usual format. A brief introduction to the genus is followed by an excellent chapter describing floral characters – with a helpful emphasis on those features used to distinguish between taxa – then identification keys, illustrated species accounts with distribution maps, glossary, references, lists of vice-counties in which the various taxa have been recorded, and an index (with synonyms) to the 12 species, seven subspecies, four hybrids and 20 varieties covered by the species accounts.

The text is a model of clarity, and the author’s enthusiasm for her subjects is infectious. “Fumitories are a fascinating group of plants”, she claims in the very first sentence of the introduction, and from then on you are left in no doubt about the truth of this assertion. The keys and species accounts are ‘two-tiered’, enabling beginners to confidently identify their fumitories to species level, while the more adventurous can revel in the delights of subspecies, varieties and forms. The identification keys seem to work admirably well and are based largely on the helpful key in *Plant Crib* (Sell 1998). Anyone tempted to have a go at infraspecific taxa will have a field day: in my own case, it took only a few minutes, with ×15 hand lens and ×10 scale loupe with graticule, to work out that my local *Fumaria muralis* was subsp. *boraei* (probably var. *britannica*) while, unsurprisingly, my *F. officinalis* was subsp. *officinalis* var. *officinalis*. A scale loupe is probably a wise purchase for the would-be fumitory aficionado, as successful use of the keys relies heavily on the accurate measuring of petals, sepals and fruits.

Aside from the text, what really sets this volume apart from other B.S.B.I. handbooks is the extensive use of colour illustrations. For each species, and for most subspecies, there are splendid full-page colour plates with images of flowers, sepals, lower petals and fruits, plus smaller close-up photographs of leaves, inflorescences, dried fruits, and portraits of plants in the wild. The scope of the illustrations is excellent, only *F. muralis* being let down by the fact that all the photographs are of subsp. *boraei*. The reason for this is presumably that neither subsp. *muralis* nor subsp. *neglecta* have been seen recently – indeed it is thought that *neglecta* may possibly be extinct – but without pictures to support the text it is unlikely that many of us will be skilled enough (or feel brave enough) to hunt them down in the future.

The species accounts include E. W. Hunnybun’s line illustrations originally drawn for the Cambridge British Flora (Moss 1920). These are lovely drawings, but much less useful than the author’s own illustrations comparing the flowers and fruits of easily confused species such as *F. capreolata* and *F. occidentalis* (p. 31), *F. capreolata* and *F. purpurea* (p. 73) and *F. muralis* subsp. *boraei* and *F. purpurea* (p. 65). The line drawings of flowers and sepals of the five *Fumaria* archaeophytes on p. 83 are especially helpful.

This small genus has many taxa of conservation importance, including several declining arable archaeophytes; and the handbook will be widely used by those involved, for example, in surveying farmland habitats and the targeting or monitoring of agri-environment schemes. *F. occidentalis* and *F. purpurea* are British-and-Irish endemics, while one subspecies, *F. capreolata* subsp. *babingtonii*, and two varieties, *F. bastardii* var. *hibernica* and *F. parviflora* var. *symei*, are also endemic to these islands. *F. parviflora* and *F. vaillantii* are listed as ‘Vulnerable’ in the Red Data List (Cheffings & Farrell 2005), and *F. purpurea* is a UK BAP Priority Species. *F. reuteri* is ‘Nationally Rare’ in Great Britain and listed on Schedule 8 of the Wildlife & Countryside Act 1981 (as amended), while four species – *F. occidentalis*, *F. purpurea*, *F. parviflora* and

F. vaillantii – are ‘Nationally Scarce’. However, contrary to the statement on p. 84, *F. densiflora* is no longer ‘Nationally Scarce’, having been recorded in more than 100 10-km squares in the 1987–1999 date class in the New Atlas.

The Cornish endemic *F. occidentalis* features on the old UK BAP list, but not the new, and the author is uneasy about it listed as being of ‘Least Concern’ in Cheffings & Farrell (2005), highlighting how difficult it is to assess long-term trends in this species. Nevertheless, she reports that “...it has disappeared from many arable fields on the Isles of Scilly... [and] there are also several Cornish pre-1987 tetrads where it has never been re-found. It may be that this plant requires a threat status that is more than of ‘Least Concern’” (p. 34). There are many in Cornwall who would agree with this assessment, and this species is clearly one we need to be keeping a close eye on.

In her preface, Rose Murphy thanks the B.S.B.I. for publishing this handbook. A nice thought, but surely it’s the Society that should be thanking *her* for writing it. In terms of design, the book certainly breaks new ground, and it will serve as a fine model for future handbooks on other relatively small but ‘difficult’ genera. What wouldn’t we give to have similar colour-guides to the broomrapes, glassworts, crowfoots, rock sea-lavenders and lady’s-mantles, to name but five? It is a lovely volume: written, illustrated, edited and printed to the highest standards, attractively priced, and a huge credit to the author and all those associated with its production. Anyone who, like me, has tended to struggle with these delightful little plants, should make sure they get hold of a copy and *use* it. And enjoy it, too!

S. J. LEACH

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- CHEFFINGS, C. M. & FARRELL, L. eds. (2005). *Species Status no. 7: The Vascular Plant Red Data List for Great Britain*. Joint Nature Conservation Committee, Peterborough.
 MOSS, C. E. (1920). *Cambridge British Flora*. Cambridge University Press, Cambridge.
 SELL, P. D. (1998). *Fumaria*. In Rich, T. C. G. & Jermy, A. C. *Plant Crib 1998*, pp. 67–72. Botanical Society of the British Isles, London.

Mabberley’s plant-book: a portable dictionary of plants, their classification and uses. D. J. Mabberley. Pp. xviii + 1021. Cambridge University Press, Cambridge. 2008. Pictorial hard covers. £50.00. ISBN 978-0-521-82071-4.

The origins of this book can be traced to J. C. Willis’s *Dictionary of the flowering plants and ferns*, whose title more accurately reflects the taxonomic scope of the present work which is still largely restricted to vascular plants. Despite this limitation, ‘Mabberley’ has become an essential adjunct to the working botanist’s library and the main question which might be posed by the owner of one of the previous editions is whether it provides sufficient by way of novelty and up-to-dateness to justify the expenditure.

As the previous edition was reviewed in *Watsonia* 22: 197–198 (1998) a detailed description of the format and contents is unnecessary; the various innovations are outlined in the introduction, which helpfully states that there are 169 humorous statements hidden among the definitions, following the tradition of Samuel Johnson. In casual use, I only spotted a couple. Those unfamiliar with the format will find the sample entries and their

expanded equivalents on pp. xvii–xviii useful, as in order to accommodate around 1650 new entries the definitions have been kept extremely terse. Despite this, the major families and genera often get half a page.

A noteworthy feature of the present edition is the effort that has been made to reposition families into their true relationships based on evidence from DNA studies. This affects both the classification, and the circumscription, of families and inevitably challenges conventional wisdom; but the author pleads “kindly don’t shoot the messenger”. The publication in the *Botanical Journal of the Linnean Society* of the third instar of the Angiosperm Phylogeny Group’s reclassification, accompanied by an internationally agreed linear sequence of orders and families suitable for use by herbarium curators and flora-writers, has in some respects superseded the treatment adopted by Mabberley, who acknowledges the not yet completed *The families and genera of vascular*

plants by Kubitzki (reviewed in *Watsonia* 20: 162–163, 1994) as a principal reference. But no doubt this will be corrected in a future edition. By hedging his bets in a number of instances (e.g. Apocynaceae in the Gentianales, which now encompasses the Asclepiadaceae) he still records the subfamilies and tribes to which a genus belongs in each constituent former family. Personally I find this confusing.

One notable improvement in the present version is the inclusion of a much larger number of vernacular names of cultivated and economic plants. Another more minor innovation is the inclusion of a few names of bryophytes, such as *Sphagnum*, though one looks in vain for any mention of *Bryum*,

possibly because it lacks economic value. Of great value as a point of reference is the Appendix on pages 927–938, which helpfully gives the former ordinal affiliation of families whose position has recently been changed. Occasionally, Mabberley's digressions are almost worthy of Eric Cantona: "A goldfish grazing green algae in its fishbowl is effectively a modern version of the ancestors of human vegetarians at home".

In conclusion, one cannot argue with the blurb on the rear cover which states that "*Mabberley's Plant-book* continues to rank among the most practical and authoritative botanical texts available".

JOHN EDMONDSON

The Vegetative Key to the British Flora. Poland, J. & Clement, E. Privately published by John Poland, Southampton, in association with the Botanical Society of the British Isles. 2009. Pp. 526. Price £25.00 ISBN 978-0-9560144-0-5.

One of the most successful strategies for identifying plants is to use a range of keys and guides depending on the state and stage it is in. The Vegetative Key appears to be an unusual and invaluable addition to the existing guides available. However, long before its publication it was hailed by many as a panacea for all identification problems, especially for consultants having to survey sites out of the field season – so does it live up to the hype?

The key covers over 3,000 species of vascular plants that are native or naturalized in Britain and follows an unusual format as identification is tackled using entirely artificial vegetative characters using polychotomous indented keys. Much of the information used in the keys appears to be original and this perhaps is the most remarkable aspect of this book, reflecting the extraordinary amount of field-work put in by John Poland over the last few years.

I was able to test the key over several weeks with different groups of students of varying abilities and it is worth noting some caveats to be observed before using the key. First of all, read the instructions! *Bupleurum rotundifolium* resolutely refused to be keyed out as it did not produce latex an hour after picking although the key insists it should have latex. There are several features that work only if the book is taken to the plant – and of course this is what is stated in the introduction. Latex and smell are two features that are used extensively and it is

difficult to extract latex if a specimen is left for a while after picking; similarly *Sison amomum* loses its distinctive smell very swiftly after collecting, so the point in the introduction about the book being an 'in situ' guide is an important one.

The best points of the Key are the speed at which it can be used – identification is very swift – and the grasses section, which is remarkable in its simplicity. The number of vascular bundles in the petioles of ferns as a diagnostic feature is a revelation. There is a comprehensive glossary, as there are many technical terms even for an experienced botanist and getting to grips with locating stomata and cartilaginous teeth is not a skill acquired immediately. The illustrations and colour plates are excellent – more in the next edition please.

Unusual features of the Key are the polychotomous options and the indentations – even if you are used to indented keys, they are often subtle so care should be taken in moving between rows. Try to avoid mis-reading leaflets for leaves as I and several others did in the main key. Printing the main key on the first page is an excellent idea as it can be turned to immediately if you are starting from scratch but it will be obscured in library copies as there are no blank pages for library stickers or stamps. The sections are clearly labelled with letter codes although it took two goes to realize that the genus groups are at the back (also

remedied by reading the instructions before using the key). A slight irritation is that the 'bibliography' should have been more comprehensive (and also should have been at the back).

There appear to be very few errors – the only one detected was in the *Myriophyllum* key which still relies on the number of leaves in a whorl rather than number of leaf segments and leaf to internode ratio. What cannot be identified? The usual suspects such as *Galeopsis tetrahit sensu lato* which remains s.l. in its vegetative state, and of course some of the Batrachian *Ranunculi*.

Is it a book for complete beginners? One of the main problems for novices is the use of technical keys that depend on diagnostic features based on (usually) reproductive parts of vascular plants. Dissection of flowering parts, deciding whether the ovary is inferior or superior, counting perianth segments and carpels often deters new botanists from progressing on to technical keys, but vegetative parts are generally regarded as more accessible and easier to define. However, using a key

based on taxonomic distinctions helps botanists to learn family characteristics and relationships between species and although there is much to be learnt from this book even by experienced botanists, it is probably not a suitable book for beginners, but every botanist should aspire to use the Key at some point in their botanical activities. Will all keys look like this in the future? Undoubtedly a lot of the new features will be incorporated into future taxonomic keys; the Vegetative Key will not replace them but, like the Plant Crib, will become a virtually indispensable adjunct to them.

So who should buy it? Anyone seriously interested in identifying British plants – the Key gives insights into vegetative features that are not present in most other texts so using it will undoubtedly teach most of us a lot about features that we tend to take for granted. For improvers and experienced botanists, this extraordinary book is essential reading. Will it be the consultants' panacea for winter identification? If the consultants are good enough botanists, then yes.

SARAH WHILD

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Plant Records: the appropriate vice-county recorder, who should then send them to Mike Porter, 5 West Avenue, Wigton, Cumbria CA7 9LG.

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