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Plate 1 Riffle and kingfisher bank

Plate 2 Shoal creation through gravel placement

Plate 3 Log jam bank

Plate **4** Restored ditch to give two-stage channel.

Plate **5** Reed-bed two years after planting.

Photographs by Rob Mungovan. See article on page 49

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Cover Illustration: *Ribautodelphax imitans*. Photograph by kind permission of Tristan Bantock. See article on Hemiptera of Coe Fen (page 32.)

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EDITORIAL

We have a larger than usual volume this year, with an interesting variety of topics covered.

Amongst the vertebrates we have a detailed appraisal of the Muntjac in the county, and a report on a recent survey of Otters, whilst Water Voles and their problems are discussed in a paper on the Bourn Brook.

In botany we cover Crested Cow-wheat, wetland plants at Kingfishers Bridge, lichens of west Cambridgeshire woodlands and Green-flowered Helleborine at a site in Cambridge. We welcome the return of an article on algae by Hilary Belcher and Erica Swale after they missed last year, for unavoidable reasons.

Amongst the invertebrate topics we cover the Diptera of the Devil's Ditch. The Hemiptera of Coe Fen and the Marsh Carpet moth at Wicken Fen.

This year we report two new species, new not only to Cambridgeshire, but new to Britain. Philip Oswald describes *Symphytum* x *perringianum* and Brian Eversham describes an as yet un-named flatworm.

We also have most of the regular contributions, but no report on Invertebrates. The weather was so inimical to most invertebrates this summer, that very few records were reported, and certainly not sufficient to make a report.

We congratulate the following people, whose achievements have been acknowledged: Chris Preston and Philip Oswald were awarded the 2012 Thackray Medal by the Society for the History of natural History (this medal is awarded for a significant achievement in the history of those areas of interest to the Society) and Rob Mungovan, whose work at Trumpington Meadows earned him a Green Apple Environment Award. It is also worth noting that Philip Oswald, my predecessor as Editor, and a stalwart of the Editorial Board, celebrated his eightieth birthday in April 2013!

Muntjac Deer in Cambridgeshire

Arnold Cooke

Reeves' Muntjac (*Muntiacus reevesi*) is a native of south-east China and Taiwan. It was first released into the wild in this country in 1901 near Woburn in Bedfordshire (Chapman, Harris & Stanford, 1994). Other releases, together with natural spread from the various foci, resulted in colonisation of much of southern, lowland Britain a century later (Chapman & Harris, 1996; Ward, 2005).

This review describes the Muntjac's colonisation of Cambridgeshire and how, when, why and with what success it has been managed. The main aim is to bring together a large amount of disparate and often unpublished information on Muntjac and their impact in woodland in Cambridgeshire.

Colonisation

Chapman, Harris & Stanford (1994) quoted A.J. de Nahlik as believing Muntjac occurred in 1952 at Great Raveley in what was formerly Huntingdonshire (V.C. 31). While this is possible, it was not until the 1990s that a significant population built up in Raveley Wood (Cooke, 2007). The first record of Muntjac in the Annual Reports of the Huntingdonshire Fauna & Flora Society dates from 1959: Muntjac were said to be resident throughout the year in Brampton Wood (Worden, 1960). The first record in old Cambridgeshire (V.C. 29) was in 1961 from Hayley Wood (Symonds, 1983). Symonds (1983) and Chapman, Harris & Stanford (1994) considered it likely that this was the result of natural dispersal from the Woburn area - and the deer in Brampton Wood may also have resulted from natural colonisation. Muntjac were seen on a number of occasions in south west Cambridgeshire in 1962, and their tracks were 'quite widely' distributed in the snow in early 1963 (Fordham, 1963).

In August 1970, I was with Bernard West when he found the skull of a buck in the nature reserve at Grafham Water. Small slots occurred in Monks Wood in 1970 - 1971 around pens containing captive deer (see Mellanby, 1973). At that time, there was considerable confusion locally between Muntjac and Chinese Water Deer (*Hydropotes inermis*), but the latter species was not positively identified in the Monks Wood area until Al Scorgie and I saw a buck on the verge of the B1090 in October 1977. Muntjac were positively identified in several areas of the wood prior to 1977 (Jefferies & Arnold, 1977), so the small slots seen in the early 1970s were almost certainly made by this species. By 1976, Muntjac were described by Jefferies & Arnold (1977) as being widespread and firmly established in Huntingdonshire. However, they were still relatively rare in the south of V.C. 31 and virtually unreported from the north. It was not until 1980 that they started being seen in Woodwalton Fen and Holme Fen, about five and ten km respectively to the north of Monks Wood (Cooke & Farrell, 1995; Cooke, 1998; Carne, 2000).

Despite being even further north than the Fens of Woodwalton and Holme, colonisation in the Soke of Peterborough began earlier with, for instance, Muntjac being seen in Bedford Purlieus in the early 1970s (Welch, 1975). Chapman, Harris & Stanford (1994) suspected that Muntjac were introduced to Northamptonshire in several places, as they occurred in Salcey Forest, Yardley Chase and Rockingham Forest in the 1930s; this, therefore, was the likely route for the relatively early colonisation of Bedford Purlieus.

In V.C. 29, during a general deer survey in 1980-2, Muntjac were found to be widely distributed throughout the southern half of the vice county (Symonds, 1983). They were recorded in two thirds of surveyed woods larger than 10 ha, being well established in some, such as Hayley, Ditton Park and Widgham Woods. There were also several reports of Muntjac within the City of Cambridge, as well as from gardens in Histon and Burwell. Muntjac were first noted in Wicken Fen in the mid 1980s (Carne, 2000).

By this time, Muntjac had become very abundant and conspicuous in Monks Wood, suggesting a very dense population. When Lynne Farrell and I started a dusk surveillance programme in spring 1986, we averaged 22.5 sightings per hour. The two largest ancient woods in Cambridgeshire, Monks Wood and Brampton Wood, then stood out as having particularly high densities of Muntjac. One of the main reasons that large woods have higher densities (Cooke, 1996; Rackham, 2003) may be that they have larger and quieter blocks of woodland in which the deer can shelter. Dung counting in Monks Wood showed that Muntjac activity increased away from the rides into the centres of the blocks (Cooke, 2006).

In 1994, I devised a scoring system, based on signs, both for the Muntjac themselves and for their damage in a wood (see Appendix 1 for a more detailed description of the method). Scores for Cambridgeshire woods (including woodland on several more open sites) are given in Appendix 2. Deer activity scores during the 1990s indicated that the largest woods (including Wennington Wood) already had dense populations whereas Muntjac were still colonising smaller woods (e.g. Aversley, Lady's, Raveley, Riddy and Wistow Woods).

During the 1990s, Muntjac were also being found more frequently in less optimal habitat, such as brick-pits, shelter belts, game cover crops, railway embankments, hedgerows and gardens. In my garden in Ramsey, where I lived between 1983 and 2007, a Muntjac first turned up in 1995, and occurrences became more common until, by the time I moved away, they had young in the garden. The first colonisers are often young bucks forced out of their natal areas and the first one in my garden was no exception. Muntjac in unusual places have frequently made news – in May 2003, one crashed into the glass doors of the old District Hospital in Peterborough, and died of its injuries (Arnold & Jefferies, 2004). In the same year, one was seen crossing the line near Peterborough Station; and John Parslow and I once watched a doe picking its way across the main line north of Huntingdon station.

The colonisation process at Monks Wood took about 15 years (1970 to 1985) for the population to reach a reasonably stable level (Cooke, 2006). At Holme Fen, it took about 18 years (1980-1998; Cooke, 1998, 2012). Around

Grafham Water, Keith Mason and I recorded every Muntjac we saw when undertaking the mid month wildfowl counts (seven counts per annum) from 1971 until 1998. Although the buck's skull had been found in 1970 (see above), we did not record our first live Muntjac until 1982, and numbers were still increasing in 1998 when we stopped counting wildfowl. At Woodwalton Fen, where Muntjac tended to colonise the drier, more-wooded south, average number counted per visit of 1 - 2 hours appeared to have stabilised by 2000 after about 20 years (Cooke & Farrell, 2002), but then increased again especially during the winter of 2009/10 (Figure 1). While it is possible that Muntjac numbers rose recently in response to management changes on the adjacent farmland, increased foraging during unusually cold winter weather may have contributed to the rise in sightings.

Bacon (2005) presented a tetrad distribution map for Muntjac in the whole of Cambridgeshire, describing the species as widespread and common in the south and west, with scattered records from other parts. In general, it was rarely recorded from the Fens, apart from sites such as the Ouse Washes and Wicken Fen. In 2010, I updated the map for Huntingdonshire and the Soke (Cooke, 2011); this map showed that Muntjac occurred over virtually all the area apart from the Fens in the north-east. Gaps within the main range in V.C. 31 to the west of the A1 could probably be explained by lack of recorders. In 2008, as an experiment, I looked for signs of Muntjac in six apparently-unrecorded tetrads to the west of the A1 and six on the Fens - I found them easily in all of the former group but in only one of the latter. There was also a gap in the distribution map on and around Wyton airfield, where Muntjac are probably less likely to be present.

Environmental damage caused by Muntjac

This section deals with problems caused by Muntjac grazing and browsing (any involvement in road traffic accidents or in transmitting diseases is not considered here). Even as late as the early 1980s, they were viewed as 'an almost innocuous asset to the countryside' giving 'pleasure to thousands and pain to few' (Dansie, 1983). They still give pleasure to many people, including to me, but their downside has become progressively more obvious.

Compared with Red (*Cervus elaphus*), Fallow (*Dama dama*) or Roe Deer (*Capreolus capreolus*), Muntjac are not considered a pest in agriculture (Putman & Moore, 1998; Putman, 2003). They are small deer, they are not a herding species, and they tend to avoid open fields more than other deer. If agricultural problems do occur, they are likely to be adjacent to woodlands with unusually dense populations. One such case occurred when a crop of field beans was grown next to Monks Wood in 1998, with significant damage being noted up to 70 m from the crop edge (Cooke & Farrell, 2001).

Many local gardeners are frustrated by the attention paid by Muntjac to their vegetables, shrubs, roses and other flowers, but generally Muntjac densities are relatively low in suburban areas and the deer can usually be deterred by netting (Chapman, Harris & Harris, 1994; Coles, 1997). However, Muntjac that set up

home in nurseries, small holdings, allotments or cemeteries can cause financial and emotional issues.

As with agriculture, Muntjac have comparatively little impact in commercial forestry and plantations, but conservation woodland with its much more varied features has been impacted (Putman & Moore, 1998, Putman, 2003). Muntjac and Fallow Deer are the deer species giving rise to most concern in English woodlands (Goldberg & Watson, 2011). Cambridgeshire differs from other eastern counties in that deer other than Muntjac are relatively rare over most of the county. Fallow Deer are largely restricted to the south of old Cambridgeshire and the west of the Soke, Roe Deer are still colonising and Red Deer have barely started (Bacon, 2005; Cooke, 2011). This means that Muntjac are the culprits at most of the sites where there are impacts from deer, and controlling this single species should lead to recoveries in conservation features. It should, however be remembered that other species have caused problems at some conservation sites – and sometimes for many years, for instance Fallow Deer at Hayley Wood (Rackham, 1975, 1976) and Castor Hanglands (Ward *et al.*, 1994). Roe Deer have been culled at Monks Wood since 2011 because of browsing damage to coppice regrowth.

Grazing and browsing by Muntjac in conservation woodlands can have the following impacts (Cooke, 2006).

1. Coppice regrowth is browsed to such an extent that stools fail to produce stems above 1 m and may die; so the coppice canopy fails to develop, having indirect effects on other features in the plot.
2. Regeneration of tree species such as Ash (*Fraxinus excelsior*) is affected because seedlings and saplings are browsed, broken and frayed.
3. Density of the shrub layer is reduced within the browse height of Muntjac (about 1 m) and species composition is modified.
4. The ground layer is altered with a general reduction in palatable flowering plants and ferns, and an increase in grasses and sedges.
5. Changes in species composition and structure of the vegetation indirectly results in effects on fauna, and most of these effects will be detrimental to conservation interests.

An effect on coppice regrowth is often the first problem to be noticed. This is because it can happen at a relatively low Muntjac density and a newly cut coppice plot is likely to be closely monitored. In contrast, gradual losses of common, unspectacular plant species might not be noticed for a number of years. For example, distribution of Dog's Mercury (*Mercurialis perennis*) in Monks Wood contracted from about one third of the wood in the 1970s to about 1% in 1993 before anyone noticed (Cooke, 2006).

Chronology of impact in conservation woodland

The first account of browsing by Muntjac on coppice in the county seems to be a study of food preferences shown by Muntjac and Fallow Deer in Hayley Wood (Symonds, 1985), although the level of damage inflicted by Muntjac was

described as tolerable (Symonds, 2003). Just because browsing or grazing is observed, it does not necessarily follow that an unacceptable impact will result.

A coppice plot first failed in Monks Wood because of browsing in 1985, coinciding with a major increase in Muntjac sightings (Cooke, 2006). Since 1990, attempts have been made to protect coppice in Brampton Wood (Cooke, 2005). In 1993, it became apparent that there were other conservation concerns in Monks Wood, including losses of Bluebells (*Hyacinthoides non-scripta*) and Dog's Mercury (Cooke, 2006). By 1995, these two species of ground flora were also affected in Brampton Wood, but to a lesser extent (Cooke, 1997, 2005). In 1994 in the nature reserve at Grafham Water, I first recorded coppice regrowth that had been badly browsed by Muntjac.

The Oxlip (*Primula elatior*) can be severely grazed by deer at densities that leave other flora largely untouched, with Fallow taking most of the plant, including leaves, while Muntjac focus on inflorescences (Tabor, 1999; Rackham, 2003). During the 1990s, Muntjac were a significant factor in the decline of Oxlips in Gamlingay, Bourn and Longstowe Woods, whereas they had little impact at Hayley Wood at that time compared with Fallow Deer (Rackham, 2003).

By the year 2000, the fabric of several other woods had been damaged by Muntjac. For instance, when scoring in 2000 (Appendix 2), I recorded a general browse line in parts of Archer's, Aversley and Lady's Woods. I had previously used Raveley Wood as an undamaged control for comparison with Monks Wood. However, in the spring of 2000, 12% of Raveley's Bluebell inflorescences were grazed by Muntjac, and Martin Baker (pers. comm.) recorded that 64% of Early Purple Orchid (*Orchis mascula*) inflorescences were lost to grazing.

Holme Fen is the largest wood in Cambridgeshire. By 2005, parts of the woodland floor that had previously been dominated by Bramble (*Rubus fruticosus* agg.) were opened up by Muntjac, and a browse line was evident in places. The mixed woodland in the south of Woodwalton Fen had shown evidence of browsing by Muntjac since the mid 1990s, but it was not until 2010 that this became very serious with a general browse line being discernible when the area was scored (Appendix 2).

Woods that I have visited less frequently, but which had signs of a general browse line and/or a damage score of 8 or more, were Buff Wood (2008), Gamsey Wood (2003, 2006, 2010), Hardwick Wood (2006/7), Holland Wood (2007), Jones Covert (1996), Little Paxton Wood (2005), Riddy Wood (1996/8), Upton Wood (2009) and Wennington Wood (2003 and 2007). Of these, Buff Wood has Fallow Deer and Gamsey, Holland, Riddy and Wennington Woods have Roe Deer, which may have contributed to the damage scores (although I try to score damage by other deer species separately). At Hardwick Wood, as at several other sites, some damage was due to Rabbits (*Oryctolagus cuniculus*) - there are many browsers in a wood in addition to deer. Studying the nature and amount of browsing on Ivy (*Hedera helix*) can indicate the relative severity of browsing by lagomorphs (Cooke, 2001).

Although most woods listed in Appendix 2 have had perceptible issues with feeding by Muntjac, some still have low scores. These are often small sites, such as Houghton Thicket, or sites with Fallow Deer, such as Castor Hanglands. Sites with significant densities of Fallow Deer have never, in my experience, been seriously impacted by Muntjac. This is hardly surprising as woods with a Fallow browse line are unlikely to provide much cover or food for Muntjac. In some areas away from the Fens, searching any copse or hedgerow may turn up the distinctive signs of Muntjac, specifically their small droppings, their tiny pointed slots, and the torn bases of bramble and ivy leaves, where Muntjac have grazed off the leaf ends. But in such situations, they never occur at densities found in larger, undisturbed woods.

Indirect impacts on other species of fauna were sometimes only appreciated years after they began. Thus the Nightingale (*Luscinia megarhynchos*) had declined for a decade in Monks Wood before deer browsing was considered as a contributory factor (Cooke & Farrell, 2001). However, people are now more aware of such possibilities with the subject of woodland bird declines, in particular, receiving much attention (e.g. Fuller *et al*., 2005).

Management options

Broadly, the two practical options for controlling vegetation damage by Muntjac at a site involve (1) putting a barrier between the deer and the vegetation or (2) reducing deer numbers. When trying to protect a small number of plants or groups of plants, it is simplest to construct small ‘exclosures’ of wire netting with 5 cm mesh and 1 m width, attached to posts. In Monks Wood, I have used such exclosures 4 x 4 m in area for 20 years, and have no evidence of Muntjac ever getting inside. The larger the area of the exclosure, the more likely Muntjac are to try to gain entry, especially if they have been displaced from their home range.

Coppice plots are discrete, well-defined areas that can be fenced with suitable material. For Muntjac, minimum recommended fence height is 1.5 m (i.e. higher than the small exclosures described above) and the lower part should have 75 mm hexagonal mesh or smaller (Putman, 2003; see this author for other practical details). It is unrealistic, however, to expect any fence to keep out Muntjac permanently. They are very adept at eventually getting under, through and even over fencing. Conservationists often use brash to protect coppice regrowth. This has advantages, including that it looks more natural, is easy to do, costs nothing and saves having a bonfire. It is, however, much less effective than wire fencing. Some species of tree are unpalatable to deer e.g. Aspen (*Populus tremula*) and Alder (*Alnus glutinosa*), and their regrowth does not require protection. Of the species that are commonly coppiced in Cambridgeshire woodlands, Ash and Hazel (*Corylus avellana*) are relished by Muntjac, but Field Maple (*Acer campestre*) seems less attractive and birch (*Betula spp*.) is even more rarely browsed. There are examples of coppice plots, for instance in Monks Wood, that were formerly dominated by Hazel and Ash, but are now dominated by Aspen and Birch.

This theme of some species being attractive to Muntjac and some not, also applies to shrubs and ground flora. Some plants seem never to be eaten; areas dominated by Ground Ivy (*Glechoma hederacea*) in Monks Wood appear to be partially avoided by Muntjac (Cooke & Farrell, 2001), such is their dislike of the plant. Bluebells are toxic to many animals but can be seriously impacted by high densities of Muntjac (Cooke, 1997, 2006). It follows that Bluebells, which may be widespread within a wood, can be protected if necessary by shooting to reduce Muntjac density to a level at which they are unaffected.

Critical deer densities at which impacts are reported have been reviewed by Putman *et al.* (2011). Based largely on observations made at Monks Wood (Cooke, 2006), they concluded that 25 Muntjac per square km impacted coppice and 50 per square km impacted ground flora. A problem applying these figures to practical management is that is notoriously difficult (and/or expensive) to estimate Muntjac densities. Putman *et al.* (2011) stressed the need for impacts to be studied prior to management action, while Waeber *et al.* (2013) urged for numbers and demography to be considered when planning a cull.

Oxlip, as has already been noted, is affected at very low deer densities, and, if it is widespread in a wood, is peculiarly difficult to protect. A large fence has been erected in Hayley Wood to exclude Fallow Deer, and the whole of Shadwell Wood in Essex has been fenced in an attempt to exclude both Fallow and Muntjac. Both of these fences have proved successful in separating (most of) the Oxlips from Fallow Deer. However, Muntjac are more difficult than Fallow Deer to fence out and keep out, and they have required culling within both of these fences. Muntjac have proved impossible to eliminate inside both large fences in Monks Wood (Cooke, 2006), and the wisdom of attempting to construct and maintain exclosures of more than a few hectares specifically for Muntjac must now be questioned. To protect a widespread, but sensitive, species in a wood with just Muntjac, moderate-sized fences may be the answer. In woods where the oxlip is relatively abundant, fencing coppice should help to protect this species as well.

Success of management

In this section, events at ten sites are reviewed. Not all of these have had significant management of their Muntjac population – but they do provide information of relevance to a discussion of what benefit any management might or might not have.

In addition to the simple scoring method, I have also devised a system of assigning impact stages to a site, which is better at detecting and describing change (Cooke, 2009). This method is also summarised in Appendix 1. It enables impact in a wood to be categorised by one of seven descriptions: no impact, slight, low, moderate, high, very high or severe. These descriptions are used in this account. Statements below on damage and impact are based on my unpublished observations, except where indicated otherwise.

Aversley Wood. Stalking began in 2000/1, by which time the wood had been colonised by Muntjac and impact was assessed as high. There was a general

browse line over parts of the wood, tree regeneration appeared affected, territorial fraying was widespread and abundant, and Dog's Mercury was seriously damaged in places. At that time, coppice was protected inside paling/wire fences. Stalking statistics showed that 182 Muntjac were shot in the first eight years, equivalent to 0.37 deer per ha per year in this 62 ha site. Both activity score and damage score decreased (Appendix 2), while impact was moderate during 2008-10 and low in 2011. Dog's Mercury had improved noticeably by 2006.

Brampton Wood. By the 1990s, Brampton Wood had been colonised by Muntjac for many years and impact was high. A browse line was noted in places, and Bluebells and Dog's Mercury were affected (Cooke, 1997, 2005). Coppice was inadequately protected, and it was not until 2004/5 that wire fencing was used (successfully). Stalking began in 2000, the initial intention being to shoot 40 deer per year (Peter Watson, pers. comm.), but with its large woodland blocks and many narrow paths, Brampton Wood proved to be difficult to stalk. About 250 Muntjac had been shot by the end of 2011, equivalent to about 22 per annum and to 0.16 per ha per year in its 132 ha. By 2004, there had been no perceptible improvement (Appendix 2), but impact declined to moderate during 2005-7 and to low during 2008-11, so shooting eventually got on top of the problem.

Gamlingay Wood. This wood was still 'almost free' of Muntjac in 1991, but, by 2002, they had become abundant and it was 'distinctly deer-bitten' being 'full of small, repeatedly browsed' Ash (Rackham, 2003, 2006). Scoring indicated increases in deer density and damage between 1994 and 2002 (Appendix 2). Oxlips have suffered a long term decline in Gamlingay Wood since the early 1900s, and Muntjac might have been an important factor in the decline recorded in the 1990s (Rackham, 2003, 2006). Stalking began in 1999, and I visited each year 2000-11, when impact was assessed as unchanging and moderate. Nevertheless, signs of a general browse line disappeared after 2004. Peter Walker (pers. comm.) has observed no marked change in Oxlip numbers in study plots during the period 1998-2012. Stalking information is fragmentary: 19 were shot in 2000 and 16 in 2002, but far fewer were shot later. So initially, roughly 0.3 deer per ha per year were shot in this 60 ha wood, but this decreased to considerably less than 0.1 in later years. Attempts have often been made to protect coppice with brash, paling or plastic fencing, but with variable results at best. Wire fencing has been used more successfully since 2004, apart from occasionally fencing in Rabbits.

Grafham Water Nature Reserve. Tracks of Muntjac were easy to find by the early 1990s in the reserve at the western end of the reservoir. Coppice damage and browsed ash seedlings were noted by 1994 to the west of Littless Creek, and attempts were made to protect coppice by the late 1990s. In 2001, two exclosures were erected in Savages Spinney, an area with consistently lower impact than Littless Wood, and one exclosure in Littless Wood itself. Deer

activity score doubled in the Littless area between 1995 and 2004 (Appendix 2). Littless Wood is part of a continuous block, also comprising Dudney Wood and Lady Grove – an area of about 50 ha that was sufficiently large for a high density of deer to build up. By 2004 and 2005, Bluebells and Dog's Mercury were badly grazed in Littless Wood, apart from inside the exclosure – immediately outside this fence, both species were virtually eradicated. A general browse line occurred on Blackthorn (*Prunus spinosa*) and Hawthorn (*Crataegus monogyna*) throughout the wood. Monitoring of Bluebells and Primroses (*Primula vulgaris*) by the Wildlife Trust demonstrated a reduction in grazing in the Littless area by 2010 (Matt Hamilton, pers. comm.). There has been no stalking within the Reserve, but an unknown number of Muntjac have been shot on farmland to the west and two more fences erected in the Wood. By 2011, however, problems persisted in Littless Wood, with Dog's Mercury more or less eradicated by grazing (apart from some surviving inside the fences), and virtually all palatable woody material removed up to the browse line. Impact was categorised as very high, and this is currently the most damaged wood managed by the Cambridgeshire Wildlife Trust.

Hayley Wood. The impact of Fallow Deer in Hayley Wood has been graphically described by Rackham (1975, 1999, 2003 and 2006). This brief summary tries to separate out any contribution from Muntjac. They were first reported in 1961 and, by the early 1980s, were well-established with breeding confirmed (Symonds, 1983). Counts during the deer drives, 1987-2000, ranged 1-12 Muntjac with an average of 5.4 (Symonds, 2003). Ray Symonds pointed out that these counts will have under-estimated the total population, but considered Muntjac density in the wood to be 'surprisingly low' because of competition with Fallow Deer. An activity score of only 1 in 1994 (Appendix 2) is consistent with this statement. So up to 2002, when the Fallow Deer were fenced out of about 80% of the wood, the contribution of Muntjac to overall deer impact was relatively insignificant.

Stalking of Muntjac inside the fence began in 2004/5, but few were shot until June 2006. Between 2006 and 2011, a total of 46 were culled, equivalent of 0.19 Muntjac per ha per year; the cull rate decreased from 0.43 per ha per year in 2006 to 0.1 in 2011 as the deer became scarcer and more difficult to shoot. Muntjac are less of a problem than Fallow to Oxlips, grazing the inflorescence rather than most of the plant (Tabor, 1999; Rackham, 2003). Within the fence, there was a marked increase in Oxlip numbers by 2008 (Oliver Rackham, pers. comm.), but a large proportion were still were still being grazed by 2010. Impact inside the fence was moderate or high in 2004-7 and low or moderate in 2008-10, suggesting an improvement as a result of the stalking. The stalker, Bob Smith, considered that 8-10 might remain inside the fence in 2008 (Mark Ricketts, pers. comm.), a density of 0.20-0.25 per ha. Impact was severe outside the fence in 2009 (the only year it was assessed), despite some Fallow being shot - showing the benefit of the fence in keeping out the larger species.

Holme Fen. Muntjac began to colonise the largest birch wood in southern Britain in 1980 and frequency of sightings during winter surveillance rose steadily until 1998. During the 1970s and early 1980s, the woodland floor was dominated by Bramble in some compartments, but Bramble had largely disappeared by the new Millennium. English Nature staff were concerned at the changes and their implications for wildlife in the woodland blocks - and sanctioned stalking during the summer of 2005. This had no effect on sightings the following winter, but from 2006/7 sightings were significantly reduced. Bramble height along transects recovered from 2006. The vigour of ferns, such as Narrow Buckler-fern (*Dryopteris carthusiana*), also recovered in places where the dark bases of dead and dying ferns were present when stalking started. By June 2012, 291 Muntjac were recorded as being shot, equivalent to an overall mean of 0.15 per ha per year. A study with small exclosures demonstrated that Muntjac browsing was still partially inhibiting Bramble growth between 2008 and 2011. In 2005, overall impact was assessed as high, with parts of West Block having severe impact. Overall impact has been moderate since 2009.

Lady's Wood and Raveley Wood. These two small woods are considered together. Lady's Wood is 7 ha in size and Raveley Wood is 6 ha – and they are only 600 m apart. Scores in both woods showed they were colonised by Muntjac during the 1990s (Appendix 2). By the start of the new Millennium, scores had reached peak levels in Lady's Wood and were approaching their peak in Raveley Wood. Activity scores tended to be higher in Raveley, and problems were becoming apparent for its ground flora by 2000-1. Impacts in both woods were, however, moderate. The Wildlife Trust arranged for stalking in Raveley Wood from 2000, but Lady's Wood remained without stalking. Stalking information is scarce: cull rate in Raveley was initially about 0.2 deer per ha per year, but no deer were shot 2005-8. Scores decreased at Raveley Wood (Appendix 2) and by 2011 impact was low. This suggested that stalking improved the situation, but scores also declined at Lady's Wood (Appendix 2), where impact was judged to be low by 2009. At Lady's Wood, Muntjac browsing may have reduced the site's carrying capacity by creating a browse line – in other words, they ate themselves out of house and home. It is also possible that the same process may have contributed to the recovery at Raveley Wood, as well at some other sites. It seems less likely that sufficient deer were shot at Raveley to have reduced deer populations in both woods. Lady's Wood maintained its status as the best local place for Bluebells despite its lack of stalking.

Monks Wood. Earlier events at Monks Wood are described in more detail by Cooke & Farrell (2001) and Cooke (2006). Muntjac numbers reached a peak in the mid 1980s and were then fairly stable for more than a decade apart from die-offs. The most severe incident occurred in 1994 when about half of the population died, mainly from pneumonia after the animals were weakened by starvation (Cooke *et al.*, 1996). On the afternoon of 7th February 1994, while on

a fixed route walk of 8 km around the wood, I counted 65 unusually conspicuous Muntjac foraging for something to eat. I repeated the walk next morning and counted 45 – has anyone else anywhere had more than 100 sightings in less than 24 hours? Not surprisingly, there was a long list of effects. Coppice was sufficiently affected throughout the late 1980s and early 1990s, despite attempts at protection that included electric fences (Cooke & Lakhani, 1996), for coppicing to be abandoned after 1994. By the mid 1990s, no Bramble thickets survived, Ash regeneration was virtually zero, ground flora was conspicuously impoverished and the ground layer was largely dominated by grasses and sedges. Rackham (2003) described Monks Wood, not unreasonably, as a 'Muntjac slum'.

Organised culling of deer just outside the wood began in the winter of 1995/6 with, for instance, 59 being shot when emerging from the wood in 1997/8. English Nature sanctioned stalking inside the wood in 1998/9, and from then until 2011/12, 925 were shot, equivalent to 0.42 per ha per winter. In recent winters, deer have become progressively harder to shoot with a decline in number shot per stalker-visit from 0.46 in 2007/8 to 0.23 in 2011/2. Two large exclosures (6.1 and 10.6 ha) were erected in the autumn of 1999, but these have proved far less effective than stalking in the wood in ameliorating impacts because it was impossible (1) to drive out all the Muntjac before the fences were completed, or (2) to eradicate them from inside because of their ability to gain access. Many conservation features began to recover within a few years. For instance, the number of Bluebell inflorescences in its main strongholds increased by a factor of three by 2000 and by a factor of 6 by 2002, but did not reach a peak until 2010. In contrast, unprotected young Ash in the height range 20-130 cm remained a considerable rarity until 2006. It remains to be seen what impact the *Chalara* disease will have on this species and on the general fabric of the wood. Deer impact, which was severe up until 1998, quickly decreased and has been moderate since 2006. In the spring of 2012, my surveillance sightings averaged less than two Muntjac per hour. While Monks Wood is no longer a Muntjac slum, some of the changes induced by Muntjac are likely to be irreversible, for instance the extent of cover of some species of ground flora. Other factors, such as aerial enrichment and succession leading to increasing shade, affect woodland processes, but these were outweighed by the high density of Muntjac in the wood during the 1980s and 1990s.

Wistow Wood. Wistow Wood is only 9 ha in size, but is only separated from Warboys Wood (40 ha) by a narrow lane. Scoring showed that Muntjac colonised through the 1990s and up until about 2005 (Appendix 2). Since then, damage scores have been stable and impact has been rated as moderate. While there have been no significant impacts, Ash seedlings and saplings are rare and often show signs of browsing. This is a particularly good site for Wood Anemone (*Anemone nemorosa*) and small patches of this species are occasionally heavily grazed. Deer paths crossing the lane show that exchange occurs between the two woods. This exchange may have increased in recent years as number of paths has been higher since 2010, but there is no indication

of a greater presence of Muntjac in Wistow Wood. Deer are not shot in Wistow Wood but they are in Warboys Wood, which apparently helps to keep the overall population in check.

Control of Muntjac: an overview

During the 1980s and most of the 1990s, attempts at protection in local conservation woodlands involved the use of fencing. Several woods had fencing for coppice or other features for a number of years before stalking was sanctioned. Now, however, culling has become more acceptable to both conservation managers and the general public – and at some sites (e.g. Woodwalton Fen) stalking has started without any fencing having been used.

Wire fencing worked well to protect features such as coppice providing it was of the correct specification and did not cover too large an area. There were satisfactory examples at Aversley Wood, Brampton Wood, Gamlingay Wood and Grafham Water Nature Reserve. However, a problem with fencing is that it displaces deer and can sometimes worsen the situation outside the fence.

Stalking can reduce deer numbers and lead to general improvements in a site's condition – providing enough deer are shot. If insufficient numbers are shot, then this will not affect the population level in the wood and/or will fail to prevent emigration into the wider countryside (see Waeber *et al*, 2013). These authors drew attention to the situation in Breckland forests where they estimated that 53% of Muntjac needed to be culled each year to offset productivity – this is an area with exceptional numbers of Muntjac. More than 50% were shot in Monks Wood each winter from 1998/9 to 2009/10. Between 1998 and 1999, the Monks Wood population seemed to change from being a 'source' to a 'sink' (Cooke, 2006) – in other words, there was likely to be net emigration in 1998, but net immigration from the surrounding countryside from 1999. The most effective culling involves management on a landscape scale (Goldberg & Watson, 2011).

At conservation sites where there are problems with Muntjac, I have advocated a cull rate of at least 0.3 per ha per year to achieve a reasonably rapid improvement. This will equate to shooting more than 30% of the population in virtually all woods, and more than 50% in many. At Monks Wood, the cull rate was substantially greater than this threshold – and impact fell quickly from severe in 1998, when stalking began, to very high in 1999 and to high in 2001. At Brampton Wood, on the other hand, where overall cull rate averaged 0.16 per ha per year, it was five years before impact dropped from high to moderate. Even at Monks Wood, recoveries are still continuing 15 years after stalking began. Features that are only affected at high deer densities, and only for a short time, tend to be those that recover first. But recovery times are usually much longer than conservationists expect and some things never recover (Tanentzap *et al.,* 2012).

There are, however, intrinsic problems with culling as a solution. First, it can be a perpetual treadmill (Putman, 1988). If it succeeds in reducing deer density, the population's productivity will increase. If stalking stops, the population is likely to recover. After roughly half of Monks Wood's Muntjac died in 1994, it

took only three years for frequency of sightings to return to its former level (Cooke, 2006). Secondly, Muntjac are individuals and stalking selects the most conspicuous deer and makes survivors more wary (Cooke, 2013). Shooting deer becomes progressively more difficult with time – and some stalkers give up and move elsewhere. So deciding to embark on a shooting programme is not a decision that should be taken by a woodland manager without considering the long term implications.

An additional consideration for a manager is what is an acceptable end point in terms of recovery from Muntjac impact? What I class as low impact may be acceptable to most people, especially as visitors enjoy seeing deer and low densities are good for biodiversity by, for instance, partially controlling Bramble (Kirby, 2001). However, low impact is probably impossible to achieve at some woods with current resources – and moderate impact might be tolerated in those situations.

Events in Lady's Wood, where the Muntjac population and its impact appeared to decrease in the absence of culling, might indicate that small woods do not require shooting to maintain the conservation interest. While this might apply to more resistant features, such as Bluebells, Muntjac densities are likely to reach levels at which, for instance, unprotected coppice regrowth is damaged by browsing. Monks Wood is another site where browsing by Muntjac clearly impacted their own population – general impoverishment of the wood's resources resulted in lower body mass and periodic die-offs (Cooke, 2006).

Despite the issues it raises, stalking has benefited Cambridgeshire woodlands in recent years. Figure 2 shows annual average values for deer activity and damage scores for 1994-2012 using the data in Appendix 2. The period 1994-9 was a time of colonisation. Only Monks Wood was scored in 1999, so data for that year should be treated with caution. By 2000, stalking had started or was about to start in a number of woods. During 2000-12, sample size varied between 6 and 16 sites per annum, and both activity score and damage score declined significantly (linear regression: activity score $P = 0.01$, damage score $P < 0.05$). Of the 17 sites scored 2010-12, impact stages were: slight at two, low at eight, moderate at four, high at two and very high at a single site (Littless Wood). Early in 2013, four further sites were scored (see footnote in Appendix 2) and impact stages assessed (slight at one site and low at three).

I have attempted to estimate the density of Muntjac living in woodland in an area of 130 square km in the south-west corner of the Fens extending into adjacent clay-lands. The area is a polygon demarcated by points at TL160908, TL213910, TL317812, TL234765 and TL188772; and it contains 10 villages and about 9.5 square km (7.3%) of woodland and wooded fen. The big National Nature Reserves at Monks Wood, Woodwalton Fen and Holme Fen are all inside this polygon. In the recent past, this area probably held the highest 'landscape' density of Muntjac in the county because it is one of most wooded localities and lacks populations of competing Fallow Deer. Muntjac densities in Monks Wood have been positively related to activity scores (Cooke, 2006), and densities in other sites have been inferred from their scores using the relationship at Monks Wood. The available data indicate mean density estimates

of 70 Muntjac per square km of woodland in 2001-5 and 45 per square km in 2006-10. Density in the wider countryside remained relatively stable during this ten year period and, if this is taken to be 2 per square km, then overall density within the polygon was 7.0 per square km in 2001-5 and 5.2 in 2006-10, with total numbers of about 900 and 670 respectively.

The future

Most people living in Cambridgeshire must now be familiar with Muntjac. But neither that, nor the fact that stalking has recently exerted some control over deer numbers in woodland, should be taken as implying that their colonisation process is complete. Muntjac may continue to colonise more marginal land in some areas or move into newly created habitats, such as biofuel crops. A factor that may affect their numbers is the increase in hard winter weather that has been seen since 2009/10. Hard winters in the past have increased mortality in Muntjac and slowed colonisation (Chapman, Harris & Stanford, 1994). So far, however, the current run of hard winters has led to increased foraging, especially by juveniles, without obviously increasing mortality.

Attempts will presumably continue to control Muntjac in woodlands with a combination of fencing and stalking. But with deer in general spreading their ranges nationally, regionally and locally (see Hailstone, 2013), the management burden is ever increasing. It is, though, an issue that is receiving much attention (e.g. Deer Initiative, 2011; Goldberg & Watson, 2011; Putman *et al.*, 2011; Waeber *et al*., 2013).

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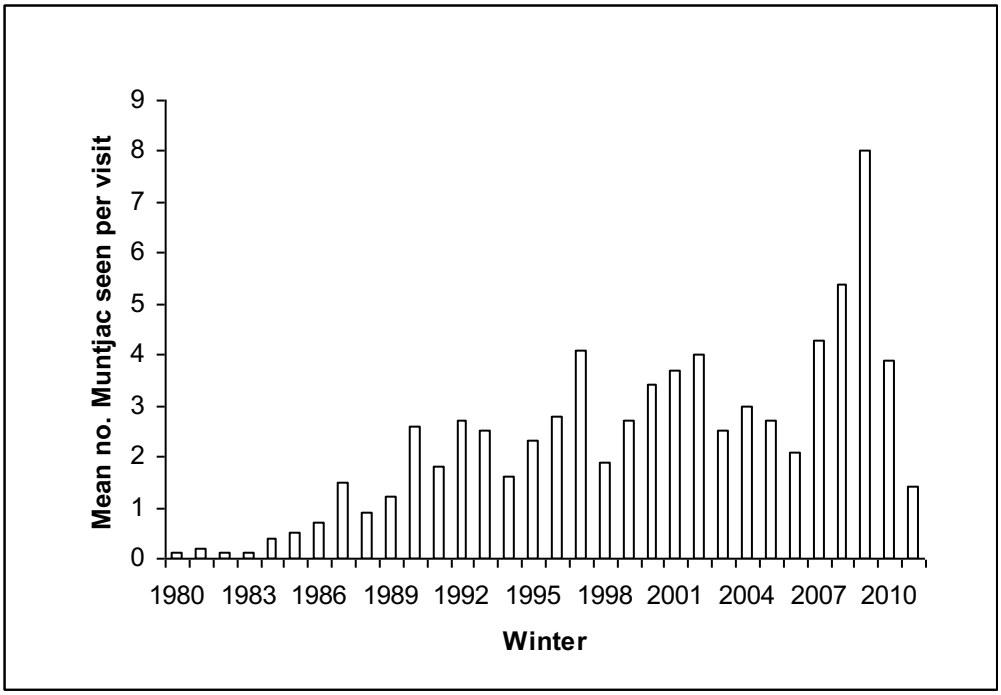


Figure 1. Mean number of Muntjac seen per dusk visit at Woodwalton Fen NNR, 1980/1-2011/12 (Lynne Farrell and I made approximately 30 visits each winter). Stalking began in April 2011.

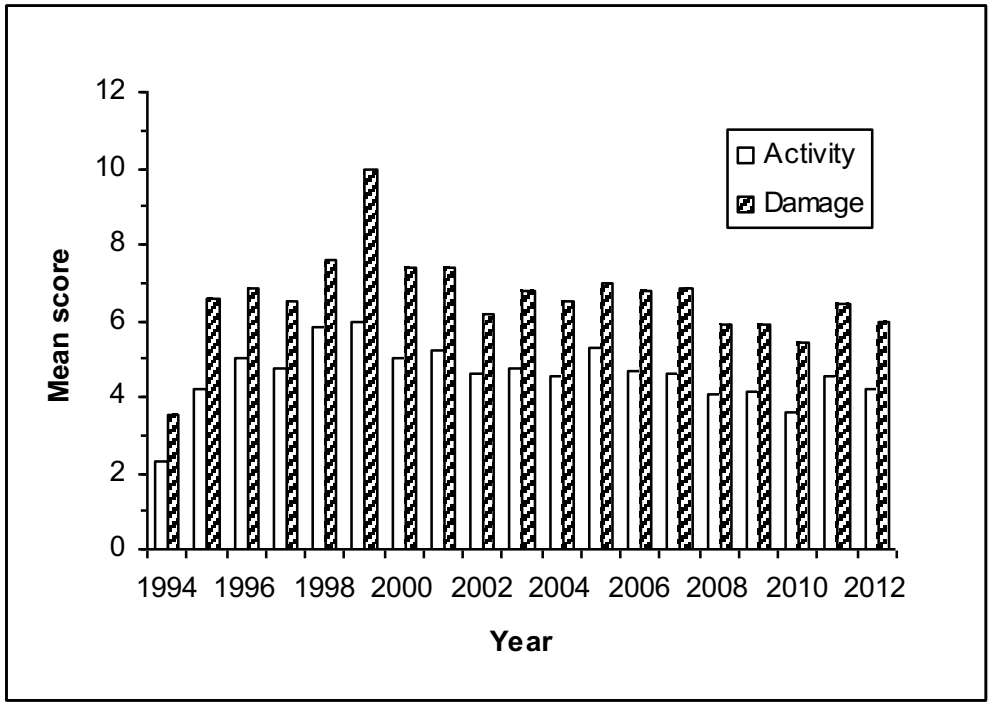


Figure 2. Mean Muntjac activity and damage scores for Cambridgeshire woodlands, 1994-2012, derived from data in Appendix 2.

Muntjac Deer in Cambridgeshire: Appendix 1

Scoring and assigning impact stages were developed for my own use, but they have subsequently been adopted by other individuals and organisations, sometimes in a modified form. Jamie Cordery of the Deer Initiative has amalgamated and refined the techniques to produce a final version that is suitable and sensitive for all species of deer (www.thedeerinitiative.co.uk/uploads/guides/183). Experience and/or training are required to use any of these methods effectively. I have undertaken all assessment of scores and impact stages reported in this article.

Muntjac activity and damage scores.

Scoring was initially developed for Muntjac but is applicable to other deer species with minor modification. In a situation where more than one species of deer is present, it is usually straightforward, if desirable, to separate activity signs, but less easy to do for damage signs. Typically a wood is visited for 1–2 hours, although woods larger than about 50 ha may need to be split up and each part scored separately. The method is used to compare between woods and, particularly, to monitor the same wood over a period of time – the wood being scored once per annum, preferably at the same time of year. Fuller descriptions, together with examples of how the method is used are given in Cooke (2006, 2007).

For the activity score, the relative abundance of each of four variables (deer, slots, droppings and paths) is scored 0 (if absent), 1, 2 or 3 (if at maximum abundance as was found in Monks Wood in the mid 1990s). The activity score can therefore vary from 0 to 12. Muntjac damage scores are based on recording five variables (browsing on woody vegetation, breakage of woody stems, browse lines, fraying and grazing on ground flora), each again being scored 0, 1, 2 or 3. Damage score can vary between 0 and 15.

Numerical scores should be accompanied by written descriptions of observations. If used annually in a wood, the method ensures that features are observed and recorded on a regular basis.

In the mid and late 1990s, I focused on scoring a range of woods. Then from around the year 2000, I also recorded a number of woods each year in order to monitor change.

Impact stages.

This method focuses on deer impact in woodland and has the following advantages over scoring for damage:

- all available information on impact can be incorporated into the assessment;
- it deals in greater detail with impact on woody vegetation in particular;
- it provides both detailed and succinct descriptions of overall impact.

A flexible list of 'indicators' is drawn up for a site. Basic indicators that will typically be included are impacts on unprotected coppice regrowth, tree regeneration, shrub layer and ground flora, together with extent of browse line, stem breakage and fraying. Observations on all of these indicators will probably be made during a scoring visit so fieldwork for the two methods can be undertaken simultaneously. However, additional observations can also be incorporated into assessment of impact, e.g. grazing levels on individual species. Each indicator is assigned to an impact stage depending on severity, and an overall impact stage is deduced, which is usually the median of the individual indicator stages. This will describe the impact from all deer species at the site (no impact, slight, low, moderate, high, very high or severe). The method, plus examples and photographs, is described in more detail in Cooke (2009).

Appendix 2. Muntjac scores (deer activity/damage) in conservation woodland in Cambridgeshire, 1994-2012

Site	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1		4/6					5/7					5/8	5/6						
2		2/7					7/10	7/10	7/9	6/8	5/8	4/6	4/7	6/7	5/7	5/7	4/6	4/5	
3		7/10			6/10		4/9	6/8	5/8	6/8	7/9	5/7	5/6	4/7	4/5	4/6	3/5	4/5	
4										5/5					5/8				
5															2/3				
6					4/2						5/4								
7																	1/2		
8							4/4												
9	4/3						4/6	5/7	5/8	5/7	3/6	5/6	5/6	5/6	3/6	3/6	4/7	3/7	
10										2/7			2/7				3/7		
11											1/3								
12		4/9									8/10							7/8	
13								4/6			5/6								
14													4/8	3/7					
15	1/3															2/3			
16									4/5		5/7	5/8	5/7	4/6	4/5	4/6	5/5		
17								2/6											
18														5/7					
19									3/5			9/6	9/6	6/7	6/6				
20									4/3										
21									2/3								3/4		
22			6/8																
23																	1/2		
24	2/3		3/4	5/6	5/7		5/7	4/7	5/6	3/6	3/7	2/7	3/7	3/6	3/5	4/5	3/4	3/5	3/4
25														5/7					
26											4/7								
27												9/8							
28										1/3									

29													5/7						
30		9/14	10/14		10/13		5/8	7/7	6/7	4/7	7/7	6/7	6/7	5/8	5/5	3/6	4/6	4/6	4/6
31					8/11	6/10	6/7	6/7	5/8	4/6	6/8	6/8	6/7	6/6	6/6	6/6	4/6	4/7	5/7
32							3/3		3/3		4/3	3/3	1/2	2/2	2/4	3/5	4/4	3/5	3/4
33																3/5			
34											2/3								
35	3/5		5/4	5/7	6/7		6/8	7/8	5/8	6/8	5/7	5/7	4/7	5/6	4/7	3/7	4/6	4/5	4/5
36		0/2																	
37	3/5		4/8	5/8	5/8								4/7						
38		4/7														6/7			
39															3/4				
40																5/6			
41		3/2														7/7			
42											4/7								
43													5/7						
44										6/7	4/7	3/7	4/6	5/6	3/6	3/5	3/5		
45	1/2									8/8				5/9					
46		6/7													5/6				
47			4/6							5/7			5/8	4/7	5/7	6/7	4/7	4/7	4/7
48		2/4	3/4	4/5	5/6										4/8		8/10	8/10	6/8
49		5/4																	

Sites: 1 Archer's Wood; 2 Aversley Wood; 3 Brampton Wood; 4 Buff Wood; 5 Castor Hanglands; 6 Chippenham Fen; 7 Fendrayton Lakes; 8 Five Arches Pit; 9 Gamlingay Wood; 10 Gamsey Wood; 11 Grafham Water Lagoons; 12 Grafham Water Littless Wood; 13 Grafham Water Savages Wood; 14 Hardwick Wood; 15 Hayley Wood before/outside the current fence; 16 Hayley Wood inside the current fence; 17 Hinchingbrooke Park; 18 Holland Wood; 19 Holme Fen Centre Block; 20 Holme Fen West Block; 21 Houghton Thicket; 22 Jones Covert; 23 King's Dyke Reserve; 24 Lady's Wood; 25 Little Less Wood; 26 Little Paxton Pits; 27 Little Paxton Wood; 28 Hemingford Grey, Marsh Lane Pits; 29 Midloe Wood; 30 Monks Wood; 31 Monks Wood, south west fence; 32 Monks Wood, centre fence; 33 Overhall Grove; 34 Pingle Wood; 35 Raveley Wood; 36 Redshank Spinney; 37 Riddy Wood; 38 Rolts Wood; 39 Salome Wood; 40 Shepherd's Close; 41 Southey Wood; 42 Upton Wood; 43 Wandlebury Country Park; 44 Warboys Wood; 45 Waresley & Gransden Woods; 46 Wennington Wood; 47 Wicken Fen; 48 Wistow Wood; 49 Woodwalton Fen, mixed woodland.

Four further sites were recorded in January and February 2013: Dogsthorpe Star Pit combined with Little Wood 2/5; Fulbourn Fen (southern woodland) 2/4; Fordham Wood 3/6; Lower Wood, Weston Colville 3/6.

Crested Cow-wheat (*Melampyrum cristatum*): a Cambridgeshire speciality in trouble

C. James Cadbury

Abstract

Crested Cow-wheat (*Melampyrum cristatum*) is a Nationally Rare and Vulnerable species on account of a major distributional decline. It is now largely restricted to North Essex (v.c. 19), West Suffolk (v.c. 26) and Cambridgeshire (v.c. 29), where it grows on Boulder Clay. Historically it has been recorded from 35 sites in Cambridgeshire vice-county. A survey in 2011 and 2012 of 14 sites from which the species had been recorded since 1970 revealed that it was still present at only seven. However, at three of these the population was large (1797 to 3480 inflorescences). Three of the extant sites were road verges and the other four were beside a bridleway or footpath. Only one was at the margin of an existing wood. Crested Cow-wheat was seen in 2009 at another site that was not visited in 2011 or 2012.

The seeds are large and probably drop in the immediate proximity of the parent plant. Germination takes place in the early spring but the seedlings are unlikely to survive unless there is bare or disturbed ground where competition from tall herbs is reduced by shade from hedgerow trees or by mowing. Rank vegetation, such as swards dominated by False Oat-grass (*Arrhenatherum elatius*) and Wood False-brome (*Brachypodium sylvaticum*), appears to have suppressed the cow-wheat in at least four of the seven former sites that were visited.

As an annual, populations of Crested Cow-wheat are subject to considerable fluctuations according to prevailing conditions. Since seed dormancy is probably limited, once the habitat for germination remains unsuitable for more than a short period a population may die out. Nevertheless, of the 35 historically recorded sites in Cambridgeshire, 12 maintained populations for at least 50 years. Yet only 12 of the 35 seem to have survived after 1986. A high proportion of the lost sites were woodlands. Careful surveillance and management of the surviving populations are of critical importance.

Information from a survey by Ken J. Adams in North Essex is included as an appendix.

Introduction

Crested Cow-wheat, like Sulphur Clover (*Trifolium ochroleucon*), is essentially a plant of chalky Boulder Clay in Britain. Since 1990 it has been largely restricted to three vice-counties – North Essex (v.c. 19), West Suffolk (v.c. 26) and Cambridgeshire (v.c. 29) – with colonies hanging on in Northamptonshire (v.c. 32), Huntingdonshire (v.c. 31), each with two post-1990 sites, and West Norfolk (v.c. 28), the eastern borders of Bedfordshire (v.c. 30) and Hertfordshire (v.c. 20), each with one site. There may be only 31 sites remaining in Britain (Adams, 2008). Many sites have been lost. It is Nationally

Rare, having been recorded in only 15 10-km squares between 1987 and 1999 (Preston *et al.*, 2002) and classified as Vulnerable (Cheffings & Farrell, 2005).

Crested Cow-wheat, with its toothed bright purple bracts and yellow and purple corolla, is a strikingly beautiful plant when flowering. It is a hemiparasitic summer annual forming haustorial connections with the roots of various herbaceous and woody plants (Adams, 2008). It was particularly associated with the margins of ancient oak woodland and its clearings and rides (Rumsey in Stewart *et al.*, 1994). It may, however, persist after a wood has been felled. Now it mainly occurs in linear habitats such as ditches and the verges of roads and tracks.

The purpose of this paper is to assess the status of Crested Cow-wheat in Cambridgeshire (v.c. 29). Papers on the species in neighbouring North Essex (v.c. 19) (Adams, 2008, 2009) were an incentive to carry out this survey.

Methods

An invaluable source for Cambridgeshire records up to 2000 is Gigi Crompton's website (Crompton, 2001). Six known sites for Crested Cow-wheat were visited in July and August 2011. These were revisited in July 2012, when another eight post-1970 sites were surveyed. Though the species was present at all six of the original sites it was only present at one of the eight additional sites (Figure 1).

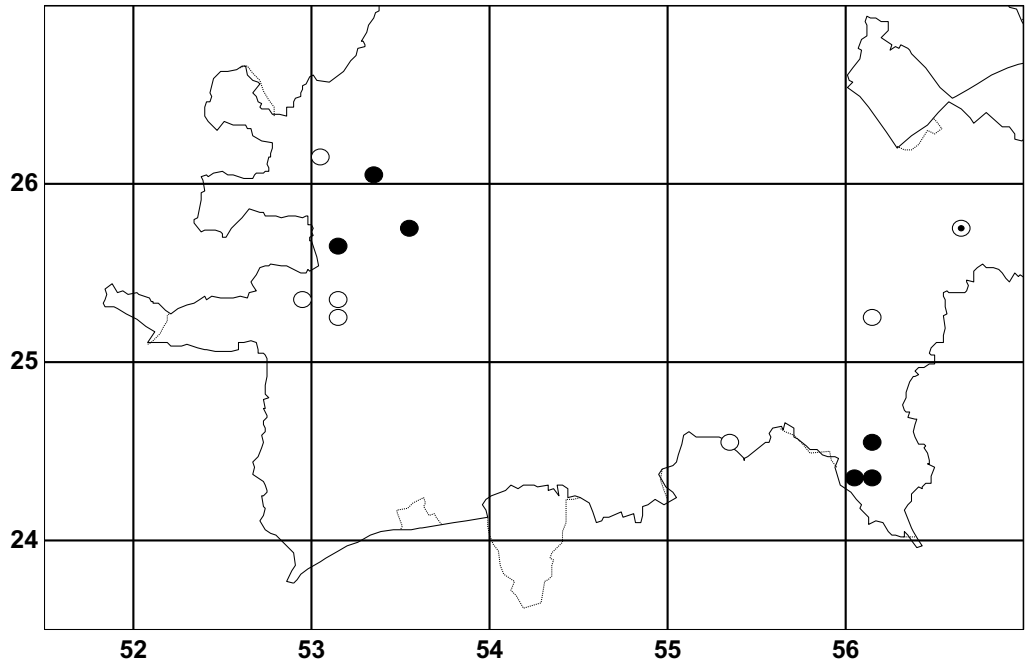


Figure 1. Map of the southern part of Cambridgeshire (v.c. 29) showing the 1-km squares containing sites where *Melampyrum cristatum* was looked for in 2009, 2011 and 2012.
[black dot] Squares containing sites where *M. cristatum* was found in 2009–2012.
[open circle] Squares containing sites where *M. cristatum* was not found in 2012.

Since it was difficult to assess the number of plants, which were usually intertwined, the number of flowering inflorescences and the extent of each population or sub-population were recorded, the location of the site was given as

an eight-figure grid reference and the habitat was recorded together with the associated plants. If Crested Cow-wheat was apparently absent, a possible explanation was noted.

In this paper a site is defined as the location of a population separated from another by at least 500 m. The separate patches at Whitensmere Hill, Castle Camps and Cardinal's Green are treated as sub-populations. At one site, Riddy Lane, Bourn, seedlings were counted in mid April and the site was revisited in September to investigate the fruit and seeds of Crested Cow-wheat.

Results

From Gigi Crompton's compendium of Crested Cow-wheat records (Crompton, 2001) it would appear that in all 35 sites have been recorded historically in v.c. 29, though for some of the older records the locations are rather vague. The earliest record is in a list compiled by Samuel Corbyn dated 20 May 1657 (Druce, 1912: also the first British record) and John Ray reported the plant "*In Madingley and Kingston woods, and almost in all woods in this County plentifully, likewise it overspreads all the pasture or common grounds you ride through going out of Madingley to dry Draiton*" (Ray, 1660; Oswald & Preston, 2011). Since 1987 it has been seen at 12 sites, 34% of the 35 (Table 1). In 2011 and 2012 the author visited 14 sites at which Crested Cow-wheat had been recorded since 1970. If a further site, near Cardinal's Green, where it was seen in 2009 by David Barden is included, there are only eight where the plant remains (23% of the 35) in seven 1-km squares and four 10-km squares – TL35 (3 sites), TL36 (1), TL64 (3) and TL65 (1). Four sites were in the south-west of the vice-county and the remaining four were in the south-east (Figure 1 and Table 2). Historically Crested Cow-wheat has been known from seven 10-km squares, all in the southern half of the county (Table 1). A record in Babington's (1860) Flora from near Royston has been excluded because it may well have been from outside v.c. 29.

At 12 sites in v.c. 29 Crested Cow-wheat has persisted for at least 50 years (Table 3). The longest known duration was at least 282 years at Kingston Wood, but there are eight other sites with over 100 years. Of the 12, only the Hardwick Wood site is still extant (now treated as two sites). Nine of these lost sites were woodland margins or rides and the Mines Farm site near Weston Green once bordered ancient woodland (Rackham, 1980, p. 85). Perhaps this is a reflection of the demise of coppicing.

From the eight 2009–2012 sites for Crested Cow-wheat there were three with large populations – Whitensmere Hill (Steventon End) with 3480 inflorescences, Riddy Lane (Bourn) with 2010, and Knapwell with 1797. The northern of the two Hardwick Wood sites had 389 inflorescences and the Castle Camps site 271, while the southern Hardwick Wood, Cardinal's Green and Wood Ditton sites each had less than 150 (Table 2). The population at Whitensmere Hill extended over 46 and 93 m along the verge of a minor road, that at Knapwell over 104 m along a road verge and that at Riddy Lane over 88 m on both sides of a ditch beside a bridleway.

Table 1: Chronological recording of *Melampyrum cristatum* in Cambridgeshire (v.c. 29): last recorded date for sites (Crompton, 2001, and this survey)

10-km square	Pre-1900	1900–59	1960–86	1987–99	2000–08	2009–12	Total
TL 25	1		1				2
35	2	3	1	1		3	10
36		1	1	1		1	4
54		2	2				4
64			1	1		3	5
65	1	3	2	1		1	8
66	1	1					2
Total	**5**	**10**	**8**	**4**	**0**	**8**	**35**

1987–99 were the years of recording for the New Atlas (Preston et al., 2002).
Crested Cow-wheat has been recorded also from five pre-1987 sites in square TL 43 in the administrative county of Cambridgeshire but in v.c. 19, North Essex.

Of the eight extant sites three were roadsides (Knapwell, Whitensmere Hill and Wood Ditton), four were beside a bridleway or footpath (Riddy Lane, the two Hardwick Wood sites and Castle Camps) and one was beside a disused railway (Cardinal's Green) (Table 2). Of the seven sites from which Crested Cow-wheat was absent when visited in 2012, four were road verges, two were beside footpaths and one (Hayley Wood) was along a disused railway (Table 4).

Trees shaded the Knapwell, Whitensmere Hill, Cardinal's Green and Wood Ditton sites, at Hardwick Wood a low hedge gives some shade and at Castle Camps the cow-wheat was growing more or less within a tall hedge at the edge of a field (grazed in 2011, arable in 2012). At the Hardwick Wood and Riddy Lane sites it was growing on the banks of deep ditches.

A total of 57 plant species were associated with Crested Cow-wheat at the eight sites. Only Common Knapweed (*Centaurea nigra*) and Hogweed (*Heracleum sphondylium*) occurred in all eight, and Wild Basil (*Clinopodium vulgare*), False Oat-grass, Wood False-brome, Cock's-foot (*Dactylis glomerata*), Bramble (*Rubus*

Table 2: Extant sites for *M. cristatum* in Cambridgeshire (v.c. 29) in 2009–2012

1-km square	Site	Grid reference, extent of population and first record	Population size
TL 3156	Bridleway, Riddy Lane,	TL 31345617 – 31395612 Extending over 88 × 6 m on both sides	2011: several thousand plants.

	Bourn	of ditch. First recorded 1992.	2012: 2010 inflorescences.
TL 3557	Bridleway, Mere Way, Hardwick Wood (south site)	TL 35165717 Extending over 8 × 2 m between deep ditch and bridleway, 34 m from S.W. corner of wood. First recorded 1949, but unspecified Hardwick Wood sites from 1860.	11.7.2011: 80 infl. 9.8.2011: 35 infl.* 24.7.2012: 33 infl. 9.8.2012: 147 infl.*
TL3557	Bridleway, Mere Way, Hardwick Wood (north site)	TL 35375778 Extending over 16 × 2 m between ditch and bridleway half way along west side of wood. First recorded 1957.	2.7.2011: 140 infl. 28.7.2011: 440 infl.* 24.7.2012: 94 infl. 9.8.2012: 389 infl.*
TL3360	Roadside, Knapwell	TL 33466005 – 33456012 Extending over 104 × 5 m on east verge of minor road from A428. First recorded 1971.	2011: abundant. 2012: 1797 inflorescences.
TL6043	Roadside, Whitensmere Hill, Steventon End	TL60484328 – 60674323 Two sub-populations: a) extending over 46 × 2 m (west); b) extending over 93 × 2 m (east). South verge of minor road. First recorded (on both sides of road) 1979.	2011: abundant (a & b). 2012: 2760 inflorescences (a) and 720 inflorescences (b).
TL6143	Hedgerow beside footpath, Castle Camps	TL61734328 – 61764332 Three discontinuous sub-populations extending over 15 × 1 m. First recorded 1999.	2011: *c.* 300 plants. 2012: 271 inflorescences.
TL6145	Adjacent to disused railway, Cardinal's Green	TL616455 Two sub-populations *c.* 5 m apart: a) 2 × 1 m, rough grass, arable edge; b) 6 × 2 m, scrubby woodland. First recorded 1975.	2009: 36 plants (a) and 17 plants (b) recorded by David Barden.
TL6657	Roadside, Wood Ditton	TL66625767 Extending over 5 m on S.W. verge at entrance to Wood Ditton stud. First recorded 1991.	2012: 20 inflorescences on *c.* 40 plants.

* Louise Bacon and Vince Lea have been monitoring the two sites by Hardwick Wood, making frequent visits each year from 2004 to 2012. Since annual mowing and raking began in 2010 the maximum count of inflorescences has increased significantly each year. The counts made at these two sites at the earlier dates given above are my own and those made at the later dates are theirs and represent their highest for each year.

Table 3: *M. cristatum* sites in Cambridgeshire (v.c. 29) with a long history (50+ years)

10-km square	Site	First record	Last record	Years
TL 25	Gamlingay Wood	1824	1969	145
	Hayley Wood	Before 1860	1977	117+
TL 35	Madingley Wood	Before 1660	1833	173+
	Kingston Wood	Before 1660	1942	282+
	Hardwick Wood	Before 1860	2012	152+
	Knapwell (Glebe Farm)	Before 1860	1990	130+
TL 54	Hildersham Wood	Before 1860	1981	121+
	Balsham Wood	1856	1953	97
	Borley Wood	1854	Late 1960s	110+
TL 65	Ditton Park Wood	1820	1991	171
	Mines Farm, Weston Green	1911	Late 1970s	65+
	Yenhall Wood, West Wratting	Before 1860	1908	48+

Data from Crompton (2001).

Table 4: Sites in Cambridgeshire (v.c. 29) visited in 2012 where *M. cristatum* was not found

1-km square	Site	Grid ref.	First and last records	Probable reason for loss
TL2953	Disused railway, Hayley Wood	TL291533 – 294534	Before 1860 to 1977	Rank vegetation.
TL3061	Roadside, Common Farm, south of Elsworth	305610	1971–1981	Rank vegetation.
TL3152	Path with ditch, Coombe Grove Farm, Longstowe	317529	1996 (1 plant)	Habitat still suitable.
TL3153	Roadside (A14), Longstowe	319532	1971 (abundant)	Rank vegetation.
TL5345	Path with ditch, Hildersham Wood	532459	Before 1860 to 1981	Habitat still suitable.
TL6152	Roadside, Mines Farm (abandoned), Weston Green	618521	1911 to late 1970s	Verge mown by 21.7.2012.
6657	Roadside near entrance to Ditton Park Wood	668573	1991	Rank vegetation.

fruticosus agg.) and Hedge Bedstraw (*Galium mollugo*) at five. Several species such as Cowslip (*Primula veris*), Hairy Violet (*Viola hirta*) and Sulphur Clover indicate base-rich soils, which were heavy Boulder Clay at all the sites.

At both the Whitensmere Hill and Riddy Lane sites the flowers were visited in July by two species of bumble-bee, *Bombus pascuorum* and in smaller numbers *B. lucorum*.

Investigations at the Riddy Lane site provided two explanations for the localised distribution of Crested Cow-wheat.

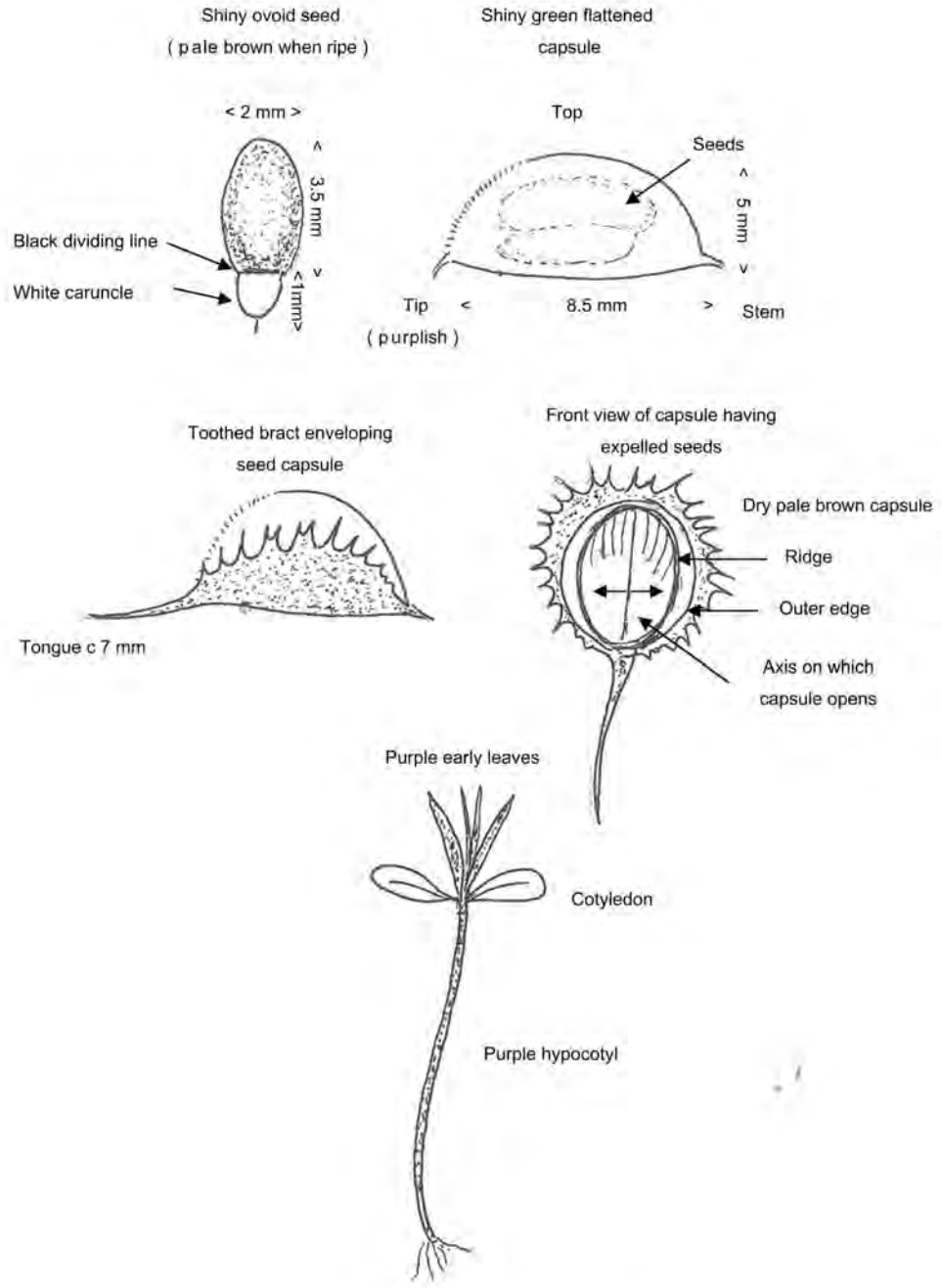
a. The seeds are surprisingly large – 3.5 mm in length, excluding a base (caruncle) of 1 mm, and 2 mm wide. The caruncle is an oil body (elaiosome), which apparently attracts ants (Adams, 2008). Four seeds are normally formed in each capsule, which is enveloped in a toothed bract (Horrill, 1972; Adams, 2008). However, sometimes only two seeds develop. At ripening the capsule opens from the dorsal margin to expel the seeds (Figure 2). The seeds, because of their size, are likely to drop in the close proximity of the parent plant, though ants (species unknown) may act as a dispersal agent (Horrill, 1972; Adams, 2008). More than 95% of the seeds had been expelled by 20 September in 2012.

b. The seedlings were showing well on 13 April 2012, when 1687 were counted. They were more developed on the north-east side (south-west-facing) of the ditch than on the opposite bank. It was apparent that they had a clumped distribution and were most abundant on bare ground disturbed by a flail used to cut the ditch bank vegetation, around the base of Dogwood (*Cornus sanguinea*) stumps and in damp hollows in the bank. This indicates that Crested Cow-wheat achieves limited dispersal of the seeds away from the parent plants. For the seedlings to survive, open or disturbed ground free of rank vegetation is necessary.

The seedlings had a slender purple stem (hypocotyl) with two spathulate cotyledons – not elliptic as figured in Horrill (1972). By mid-April the more advanced seedlings had one or two pairs of lanceolate leaves that were purple in colour (Figure 2).

Clearly Crested Cow-wheat has suffered a major distributional decline in v.c. 29. Three of the former sites visited in 2012 were road verges with rank vegetation dominated by False Oat-grass and Wood False-brome. The road verge at another former site had been mown but did not seem suitable since the vegetation appeared to have been rank. Moreover, summer mowing prevents the cow-wheat from seeding. The disused railway that borders the north margin of Hayley Wood had much tall vegetation including Greater Burnet-saxifrage (*Pimpinella major*) in abundance in two fenced exclosures and Common Valerian (*Valeriana officinalis*). A second site near Cardinal's Green (TL619458), where Crested Cow-wheat had been recorded in 1992, was overgrown by brambles when visited by David Barden in 2009. The pathside leading to Hildersham Wood, where the cow-wheat was last recorded in 1981, still appeared suitable (Table 4).

Figure 2. *Melampyrum cristatum* Seed, fruit and seedling



It would seem that the main causes of the decline in more recent times are summer mowing and the development of rank vegetation on the verges of roads and bridleways and the margins of woods. Crested Cow-wheat is not a good competitor, needing light and bare ground for seedling survival. Shade from hedgerow trees can suppress the taller vegetation, enabling the cow-wheat to thrive. Being an annual, the species usually requires suitable conditions in consecutive years. This explains some considerable population fluctuation at certain sites. At the Riddy Lane site only 17 flowering plants were recorded in

1992, 70–80 inflorescences in 1996, about ten plants in 1997 and about 450 inflorescences in 1998 (Crompton, 2001) compared with several thousand in 2011 and 2012. At the Whitensmere site it was recorded as being abundant on both sides of the road in 1979, with over 60 plants (?) in 1981, "still present in quantity" in 1991, with about 180 plants – and about 250 further east – in 1992 and with 300 plants in 1996 (Crompton, 2001); by 2011 it was again abundant and 3480 inflorescences were counted in 2012. This site is designated as a Protected Road Verge (PRV) by the Cambridgeshire County Council, which receives conservation management advice from the Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire. The roadside near the Knapwell site is also a PRV.

The seeds of Crested Cow-wheat may lie dormant for at least two winters, and possibly 10–15 years, before germination is triggered by coppicing or soil disturbance (Horrill, 1972; Adams, 2008). If such conditions do not prevail and the seed-bank is not replenished a population will eventually become extinct. This is a prognosis that threatens the species in Cambridgeshire unless the remaining populations and their habitat are carefully managed. The Hardwick Wood populations on Mere Way may owe their survival in recent years to vegetation clearance by the late Jean Benfield and latterly by Louise Bacon and Vince Lea. Since 2010 the two patches of Crested Cow-wheat on Mere Way have been mown annually close to the ground in autumn after seed-set (after about 21 September and before the end of November) and the litter raked off and removed. This management, based on a prescription from Natural England founded on research in Huntingdonshire (Hughes, 2005), has resulted in an encouraging increase in flowering but no increase in the extent of the colonies (L. Bacon, pers. comm.). A similar treatment was applied by the author at the Riddy Lane site on 21 September 2012.

Appendix: Crested Cow-wheat (*M. cristatum*) in North Essex (v.c. 19)

Two papers on the species in v.c. 19 provide much useful information for comparison with neighbouring Cambridgeshire (Adams, 2008, 2009). In Essex Crested Cow-wheat is largely confined to two areas in the north-west. One is between Langley and Great Chishill, where there were six extant sites in 2008 and 2009 and nine from which the species had become extinct. The other is east of Saffron Walden, with six sites in 2008 and 2009 and one where the plant was extinct. It has been lost from the only two sites elsewhere.

Crested Cow-wheat was recorded from 11 roadside verge sites, but in 2008/09 it was seen in only six of these, five of which were 'special verges' (the equivalent of PRVs in Cambridgeshire). Other habitats were tracks or bridleways (four, one extant), woodland margins and rides (five, three extant), arable field margins (three, two extant) and one deep ditch (lost). One of the lost verge sites was on Deben airfield and the Shadwell Wood site included a disused railway.

Frequent flailing before the plant has seeded was given as the reason for the loss of the species at four sites, scrub encroachment at two, trampling by horses and churning up by motor cycles and mountain bikes, arable cultivation, ditch

excavation and road surfacing at one each. Where verges were cut the litter tended not to be removed but was left to mulch, to the detriment of the annual Crested Cow-wheat. On drier frequently cut verges competition from Tall Fescue (*Schedonorus arundinaceus*) was also a problem. These causes for extinction are broadly similar to those that have occurred in Cambridgeshire. 'Special' and 'protected' verges, where subject to appropriate management prescriptions, have enabled the cow-wheat to survive.

The losses of 12 of the 24 recorded sites for Crested Cow-wheat in North Essex seem to have all occurred since 1968. In Cambridgeshire there are eight 2009–2012 sites and five sites have apparently been lost since 1970.

Of the 12 extant sites, two – a road verge near Langley and a steep roadside bank near Saffron Walden – had large populations of over one thousand plants in 2008/2009. Four sites had 50–100 plus plants while another five had less than 50.

Acknowledgments

Gigi Crompton's website on the Cambridgeshire flora was a key source for the historical distribution of Crested Cow-wheat. I gratefully acknowledge Louise Bacon and Vince Lea for allowing me to cite their management prescription and inflorescence counts for the two Hardwick Wood sites. Nick Millar and Kevin Walker provided information from the BSBI Threatened Plant Project about David Barden's detailed records made in 2009 near Cardinal's Green. Ken J. Adams kindly allowed me to quote from his detailed papers on the distribution and ecology of the plant, particularly his experiences of it in Essex. Nathalie Pillow typed the manuscript and labelled my drawings in Figure 2. Chris Preston created the map (Figure 1) and he and Louise Bacon made helpful comments on an earlier draft. I am most grateful to Philip Oswald for his meticulous editing.

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The Hemiptera of Coe Fen, Cambridge: The diversity of Auchenorrhyncha and the status and distribution of the tall fescue planthopper *Ribautodelphax imitans* (Ribaut.)

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Introduction

Coe Fen covers approximately 6.6 hectares of cattle grazed flood meadow on the banks of River Cam, close to the historic city centre of Cambridge. As common land, the site is designated as a County Wildlife Site and managed by Cambridge City Council as a Local Nature Reserve (LNR). The site appears close to its current form on maps dated 1574 and is understood to have been cattle grazed grassland throughout its subsequent history. Given this long history the range of flora is somewhat disappointing but does comprise damp neutral grassland indicator species including *Caltha palustris*, *Senecio aquaticus*, *Carex hirta*, and *Cardamine pratensis*, whilst *Salvia verbenaca* is frequent in the drier areas. The rare aquatic Whorl-grass (*Catabrosa aquatica*), has also been recorded on the site. The main habitats on Coe Fen include the central and perimeter drainage ditches, damp grassland, and willow woodland.

In recognition of the sites ecological and recreational value the City Council designated Sheep's Green & Coe Fen as a single LNR in July 2012. A Management Plan covering 2012 – 2021 has subsequently been prepared in partnership with the Bedfordshire, Cambridgeshire & Northamptonshire Wildlife Trust (BCNWT). The fen forms part of a complex of natural habitats including the adjoining Sheep's Green County Wildlife Site (also included within the LNR designation), the River Cam County Wildlife Site, the riverside wet woodland known as Paradise LNR, and the Cambridge Botanic Gardens County Wildlife Site, as well as the international renowned College Backs (predominantly formal riverside grounds).

Charles Darwin is reported to have surveyed Coe Fen for beetles and the current study of the sites Auchenorrhyncha provides a good example of how this endeavour continues, informing future sensitive management of this much loved urban greenspace.

Auchenorrhyncha – what are they and why are they interesting?

Hemiptera, or true bugs are one of the most diverse orders of insects; there are estimated between 50,000 and 80,000 species worldwide (McGavin 1999), with 2000 or so of these in the UK (Bantock and Botting 2010). Within this order resides the Auchenorrhyncha; an obligate herbivorous group containing the leafhoppers and plant hoppers. Small insects that are often overlooked, the Auchenorrhyncha are no less beautiful or ecologically important than other insects, providing food for numerous other arthropods and small animals. Not only that, they are useful indicator species; a high diversity of Auchenorrhyncha usually equates to a healthy habitat, with high structural and plant diversity (Hollier et al. 2005, Moir & Brennan 2007).

The discovery of a rare and interesting species on a Cambridge Meadow

In the summer of 2010 Alvin Helden, local entomologist and lecturer at Anglia Ruskin University, discovered a rare species of planthopper (Delphacidae) on Coe Fen. The insect in question, *Ribautodelphax imitans,* (see Plate 1, front cover) is rare in that it is only known on four other sites in the UK and has its own Biodiversity Action Plan (BAP). This discovery paved the way for further study into *R. imitans* and its auchenorrhynchan kin. A survey was carried out in 2011 from April to October in which all Auchenorrhyncha were identified. This article reports the principal findings of the survey.

Methods

Coe Fen was divided into ten sections to enable random sampling of the site (Figure 2). Samples of Hemiptera were collected on fifteen occasions between April and October 2011, at approximately two-week intervals (7 & 21 April; 5 & 20 May; 2, 14 & 30 June; 14 & 27 July; 15 & 24 August; 9 & 23 September; 3 & 18 October). On each date four samples were taken from each section, giving a total of 40 samples. Each sample was collected with a Vortis suction sampler (Arnold 1994) and consisted of ten sixteen-second sucks (Brook et al. 2008), covering a total area of $0.2m^2$ ($10 \times 0.02m^2$). Each sample was emptied into a sweep net and then a pooter used to collect all adult Hemiptera for preservation in AGA (alcohol-glycerin-acetic acid) solution (Gibb & Oseto 2006) and later identified to species using (Le Quesne 1960, 1965, 1969, Le Quesne & Payne 1981, Biedermann & Niedringhaus 2009, Kunz et al. 2011).

Results

A total of 7178 Auchenorrhyncha was collected from Coe Fen in 2011 made up of representatives from 43 species. Although many species were found on the site, a large proportion of these were represented in quite sparse numbers alongside the stalwart species such as *Javesella pellucida*, the commonest

delphacid on the site (probably the commonest delphacid nationally) and *Arthaldeus pascuellus*, a cicadellid species so common on Coe Fen that over 1000 more individuals were recorded of this species when compared to the next most abundant – the diminutive *Zyginidia scutellaris*. Other interesting finds included the nationally scarce species *Cosmottetix caudatus*, a species only previously recorded six times and *Athysanus argentarius* – although the latter is currently spreading very rapidly through the UK. Out of these *Ribautodelphax imitans* was the eighth most abundant out of all the Auchenhorryncha (third most abundant delphacid) (Fig. 1).

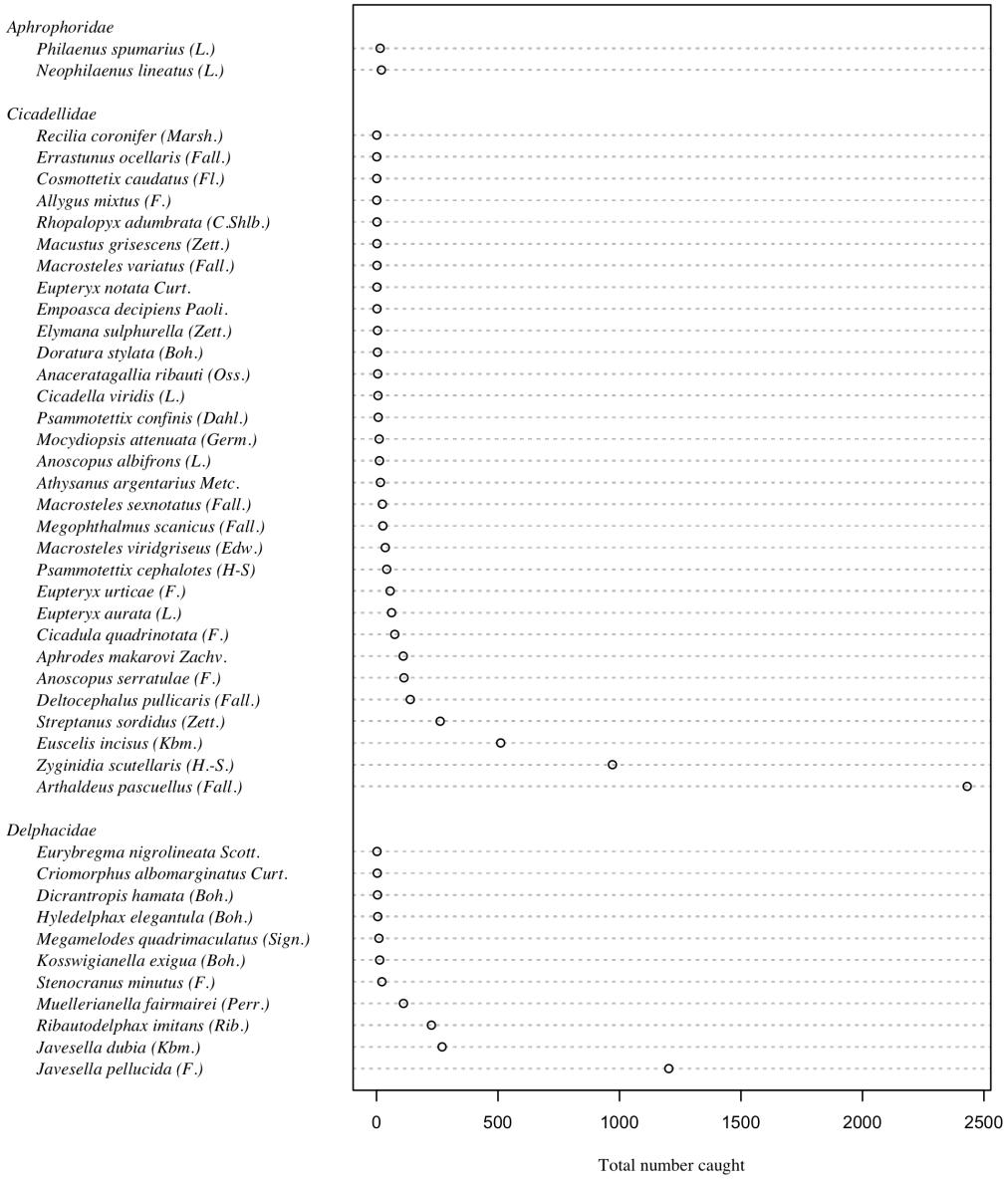

Figure 1 The total catches for each family group of Auchenorrhyncha; Aphrophoridae, Cicadellidae & Delphacidae on Coe Fen, Cambridge from April to October 2011

The population of *R. imitans* on Coe Fen as of 2011 was very healthy, a total of 226 individuals was recorded - 3.1% of the total Auchenorrhyncha population. The total numbers of *R. simians* found in each section are shown in Figure 2; the distribution was significantly different from an even distribution ($\chi 2 = 128.1$, d.f. = 9, $p < 0.001$).

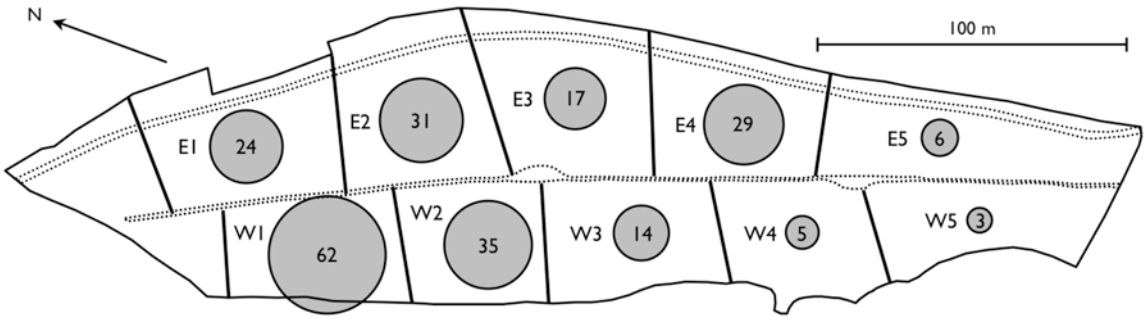

Figure 2 Map of Coe Fen, showing each of the 10 sections. Circles represent the relative sizes of R*ibautodelphax imitans* populations in each section - numbers show actual numbers caught from April-October.

Discussion

The survey work of 2011 helped illustrate the health of Coe Fen as a prime site for insect biodiversity. When compared to other work the number of Auchenorrhyncha species on Coe Fen was above the maximum recorded (39 species) over 100 surveys of chalk grasslands in Southern England (Maczey 2005). Even though the work at Coe Fen was more intensive than most other surveys (which often focus on fewer sampling dates) the 43 recorded species is a positive outcome for the site, helping position it as a top UK meadow for insects. In addition, the discovery of *Ribautodelphex imitans* has influenced the management prescription in the northern end of the site to ensure retention of the mature Tall Fescue (*Schedonorus arundinaceus*) tussocks, thought to be important in the planthopper's lifecycle (Nickel & Remane 2002). Along with other positive management decisions including the continuation of conservation grazing and the control of invasive weed species such as Nettle (*Urtica dioica*). Extensively managed grassland areas are so important for wildlife, especially within our cities which often lack green spaces. The recent changes in management practice and designation awarded to Coe Fen and others is certainly a step in the right direction, which will hopefully continue on the same path.

When we think of biodiversity we must not forget those smaller species. Although insects can often provide more of a challenge for the naturalist when it comes to identification, many species can be identified using a hand lens. Any records are invaluable to national recording schemes. Unfortunately however, in the UK those smaller less descript species are often subject to "Taxonomic Chauvinism" with many individuals and groups more interested in minority taxa (Leather 2009). The authors here stress that one should take a step back and think about those often forgotten-about diminutive insects – in this case the

pretty little Auchenorrhyncha of Coe Fen, just a stones throw from the city centre.

Footnote

The identification keys published by the Royal Entomological Society and written by Walter Le Quesne are now freely available for download from their website at http://www.royensoc.co.uk/content/out-print-handbooks

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A study of Marsh Carpet moth larvae at Wicken Fen in 2012

Norman Sills

Summary

The study aimed to confirm the presence of Marsh Carpet (*Perizoma sagittata*) larvae and to establish whether management had any effect on their numbers.

Sample plots (3m x 3m) were established in Sedge Fen (mown), Verrall's Fen (grazed) and by Wicken Lode (rarely managed) and positioned so that they contained the moth's sole food-plant, Common Meadow-rue (*Thalictrum flavum*), at a range of densities.

All 26 plots were examined on up to six dates in July/August. Features recorded in each plot included the mean height of Common Meadow-rue, the general height of other vegetation and the number of Marsh Carpet larvae.

A total of 21 larvae was found: four in two of the nine plots in Sedge Fen, 17 in six of the 15 plots in Verrall's Fen but none in the two plots next to Wicken Lode. Thus there were nearly three times more per unit area in the grazed fen compared to the mown fen.

Two comparable counts at Wicken Fen suggest that the Marsh Carpet larval population in 2012 was little different to that of 1959.

All plots contained up to 35 stems of Common Meadow-rue, but all *occupied* plots contained no more than 14 stems.

Larvae in Sedge Fen were on Common Meadow-rue stems that were slightly taller than the surrounding, tall, evenly-structured vegetation. Those in Verrall's Fen were on shorter, larger-headed stems in or next to vegetation that had been cropped or grazed down almost to ground level.

The larval period was the last week of July and the first three weeks of August so, ideally, mowing should not commence until at least late August.

The Common Meadow-rue flowers were not grazed by horses or cattle but horses bit off a small number of seed-heads.

In Verrall's Fen, the greater structural diversity of the vegetation was partly due to the uneven ground surface and the residue of scrub removal, as well as low-intensity grazing. In Sedge Fen, the need for an even surface for mowing and the absence of large mammals (wild or domestic) produced a simpler vegetation structure. The former area was of greater benefit to Marsh Carpet moths.

Beneficial aspects of the grazing regime were: the low intensity (0.5 animals per hectare); the inability of animals to trample or graze every part of the land due to the presence of natural obstacles; and the likelihood that the presence of livestock deterred Roe Deer (*Capreolus capreolus*) from eating the Common Meadow-rue flower-heads. A radical change in grazing pressure (lower or higher) could adversely affect the Common Meadow-rue and therefore the Marsh Carpet population.

Introduction

The Marsh Carpet moth is a species classified as Nationally Scarce A in the UK (a species found in only 16 to 30 10km squares) because it currently occurs in only about 20 10km squares and within only seven counties: Yorkshire, Nottinghamshire, Lincolnshire, Norfolk, Suffolk, Cambridgeshire and Huntingdonshire (Waring *et al* 2003). In earlier times it was also recorded in Worcestershire, Warwickshire and Kent (South 1961) as well as Northamptonshire.

The moth is dependent on a single plant species, Common Meadow-rue because it is the only species upon which its larvae will feed; the plant is widely distributed throughout most of England. Common Meadow-rue is a rhizomatous perennial of fens, wet meadows, river-sides and ditches but its range has declined since the 1930s due to drainage and agricultural intensification of grazing marshes (Preston *et al* 2002). However, it is fairly frequent in some parts of Norfolk and Suffolk and the 'Cambridgeshire' Fens and can be common where a conservation organisation manages a wetland for a wide range of wild organisms.

Several wetlands occur in the Fens and conflicts of interest occur at most, if not all, sites. An example is at Chippenham Fen NNR where "The Marsh Carpet was exterminated by… inappropriate cutting and grazing regimes…" since the late 1980s (Waring 2012). This example was partly responsible for prompting a study at Wicken Fen in 2012, in an attempt to understand whether cutting and grazing regimes there could also be regarded as "inappropriate". The same reference includes a suggestion that the species "needs especially close monitoring at Wicken Fen", where there is reported to be a "strong" population (www.wicken.org.uk)

At Wicken Fen, among previous records are those by Ford (1961). He quoted the Entomologists' Gazette of 1951 which reported that Marsh Carpet moths were "common" 30 years earlier but "very scarce" since 1925. Ford found 13 larvae in a continuous search lasting eight hours on 10 August 1959 and 11 more two days later (search-time not given). These were taken away to pupate and presumably the adult insects became pinned into collection boxes. He returned in 1960 and found eight and 19 larvae on 8 and 13 August respectively.

Aims

The principal aim was to determine whether the species was still present at Wicken Fen and, if so, whether it occurred in mown areas, grazed areas, or both. A secondary aim was to determine whether either of these two management practices caused better circumstances for the moth and then to account for that difference.

Methods

It was decided that the survey should be carried out within a fairly large, representative section of the old part of the reserve. This effectively became a 1.5km transect through Sedge Fen (SF) (along Gardiner's Drove, compartments

16-19) and into compartments 5 and 2 of Verrall's Fen (VF). Sedge Fen is managed by 3-year rotational mowing when practicable and Verrall's Fen is now grazed following scrub control. Two patches of Common Meadow-rue on the south bank of Wicken Lode (WL) were added as they were neither regularly mown nor grazed.

On 17 July, patches of flowering Common Meadow-rue were sketch-mapped. A week later, nine sample plots were marked on the ground (cane & flag) in SF but the plots' locations had to be confined to those mowing-strips that were not due to be mown in late summer 2012. Plots were positioned randomly as much as possible; all had to contain Common Meadow Rue but some were placed where Common Meadow-rue was sparse and others where it was more frequent. Each plot was a 3 m x 3 m square and placed within tall fen vegetation several metres from the drove-side. The grid reference of each plot was later determined by GPS. Within the first week of August, 15 plots were established in VF and two on the bankside of WL, all using the same basis as for SF, but 'marked' using GPS only.

Plot-examination began by counting the flowering stems on the day each plot was established. Then, during August, each stem was examined carefully, from several angles, to detect Marsh Carpet larvae; it took 15 - 30 minutes per plot depending on the number of stems. On 2 August, all SF plots, both WL plots and one plot on VF were examined. On 8 August all 26 plots were searched. On 15 and 22 August all but the two WL plots, and one mown plot, were examined and on 27 August the only plots searched (five) were those where larvae had been found in the previous week, plus the two WL plots and one other, hitherto vacant, plot.

During the process, it became apparent that the stature of the Common Meadow-rue stems varied, so, on 22 August, the vertical height of all intact stems (a few had been nipped off by livestock) within each plot was measured and sketches were made of three widely differing seed-heads. At the same time, the approximate height of the other vegetation in each plot was measured.

Results

Plot occupancy

Common Meadow-rue occurred in all 26 sample plots, of which eight (31%) also contained Marsh Carpet larvae. Plot occupancy within the three management types were: two of nine plots (22%) in the mown area (SF), six of 15 plots (40%) in the grazed area (VF) and neither of two plots which rarely received any management (WL). A total of 21 larvae was found within the eight occupied plots: four (19%) in SF and 17 (81%) in VF. There were 0.44 larvae per plot in SF and 1.13 larvae per plot in VF.

Plot occupancy and Common Meadow-rue density & height

The 26 plots each contained between three and 35 flowering stems in late July but the eight *occupied* plots each contained between three and 14 flower-stems (mean of 7.6). The 18 unoccupied plots also contained up to 35 flower stems but with a mean of 13.6 stems per plot.

Based on 24 plots with intact seed-stems (one plot had been mown and the other had had all seed-heads nipped off by horses), the mean stem height in SF and VF was 104.7 and 85.5 cm respectively and significantly different ($p = < 0.001$). The mean stem height of the two plots by WL was 134.1 cm. The mean stem heights of the two *occupied* plots in SF were 98 and 113cm whereas the mean stem heights of the five, intact, *occupied* plots in VF varied from 67 to 109 cm, mean 84.2 cm.

Thus larvae occurred more frequently in plots with fewer than 14 flower-stems and with a shorter mean stem height than the average of 99 cm based on all intact stems in all plots. However, of the 18 remaining plots, at least ten appeared to be suitable (<14 stems and mean stem height 67 – 113cm) but were unoccupied.

Plot occupancy and other vegetation

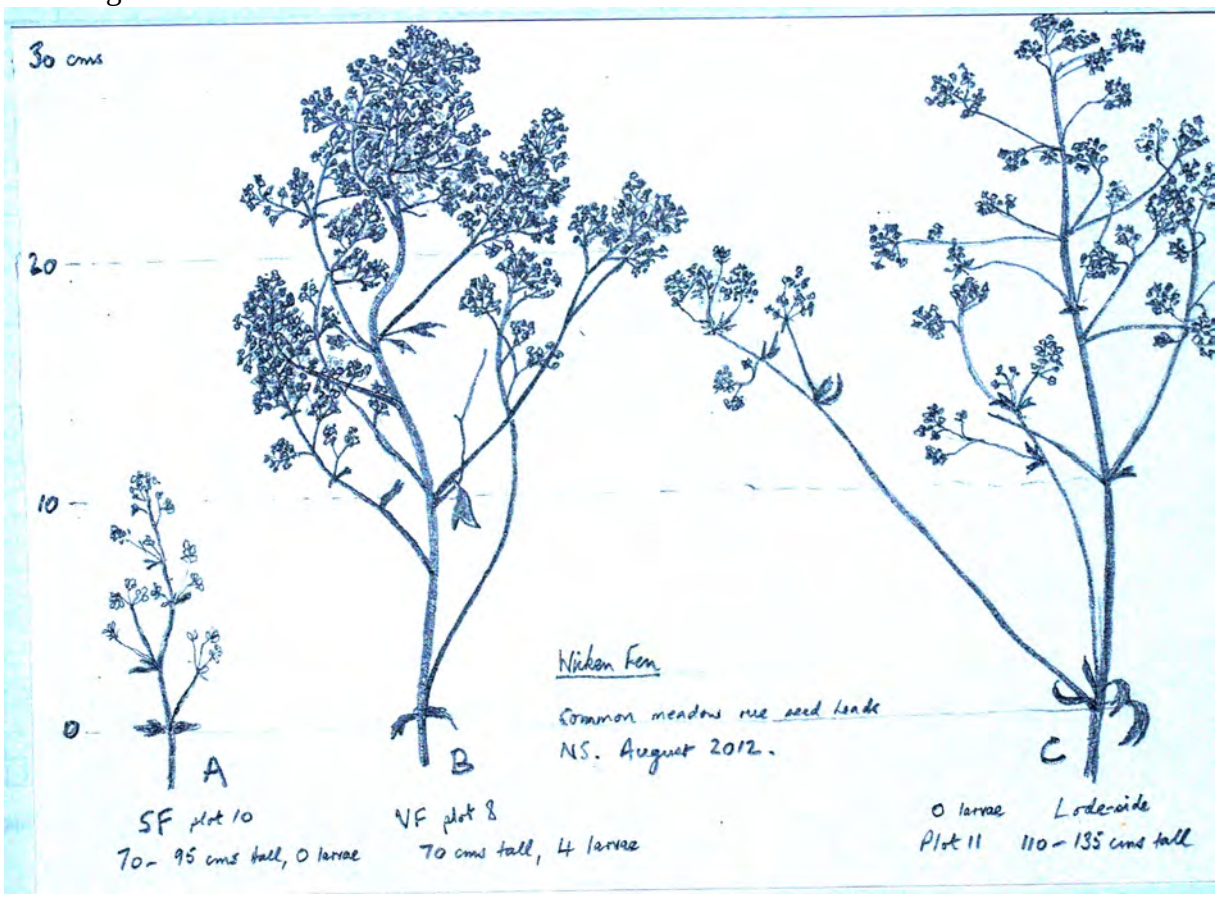
Measurements of other fen vegetation (*Juncus*, sedge, *Phragmites* etc) revealed a marked difference in vegetation structure between the three areas.

In SF (3 year rotation mowing) the fen vegetation grew unhindered through the sparse residue of leaf-litter. It grew to 80-130cm and as no animal tracks (eg Roe Deer) were evident, the vegetation structure was generally simple: fairly tall and dense. In August many of the Common Meadow-rue plants were the same height, or a little shorter, so may have been just above the adjacent vegetation in June/July when the female moths were laying eggs. The flower and seed-heads of the Common Meadow-rue were generally small – up to 12 cm – and fairly open as shown in figure 1A.

In the VF plots, most of the fen vegetation was shorter: 60 – 90 cm tall in August and every plot contained tracks of livestock. Although other fen species had been grazed, there was no evidence that any Common Meadow-rue *flower* heads had been eaten. The result was a diverse structure of fen vegetation – either shortened by grazing or reduced almost to ground level by grazing and trampling – with unaffected, flowering Common Meadow-rue growing very close to livestock-affected areas. The Common Meadow-rue was generally 70 – 110 cm tall, i.e. shorter than in SF, but relatively more exposed. Also, its flower and seed-heads were generally larger (up to 30cm) and denser: figure 1B is an extreme example. Fifty nine percent of the 17 larvae found in VF were on <4% of the stems examined there: just three, 70 – 90 cm tall, densely-headed stems on dry land at the edge of closely-grazed patches of vegetation.

The two plots by the bank of WL were dominated (in August) by rank *Phragmites* and bindweed 130 – 150 cm tall. The Common Meadow-rue was correspondingly tall (110 – 160 cm) with large but very open seed-heads as shown in figure 1C. Many of the flowers didn't develop into seed and many of those that did appeared to mature very quickly into dry, black, seed-heads.

Figure 1 Seed-heads of common meadow rue from (A) mown, (B) grazed and (C) unmanaged sites.



Larval period

The larval period was the last week of July to the third week of August with the peak about the first week of August. Sixteen larvae on 8 August were found during a six hour search. Interestingly, Ford (1961) found 13 larvae during an eight hour search almost exactly 53 years before.

Discussion

Female Marsh Carpet moths are presumably attracted to the "largest and most visible" (Waring et al 2003) flower-heads of Common Meadow-rue because this is where most larvae are found. This study agrees: all larvae were found in either large seed-heads on shorter-stemmed plants in exposed sites, or in smaller seed-heads on the tallest plant(s) of a less-exposed plot. This discussion examines some of the factors producing such conditions.

1. Management of Sedge Fen, south of Gardiner's Drove

   The 20 ha (approx.) area was cleared of scrub prior to 2006 with an aim to instigate mowing. A mowing regime demanded that all stumps, boughs, branches, hummocks and pits should be removed to give a level ground surface upon which to work; this is in contrast to Verrall's Fen. In 2006 a mowing rotation began on more than 20 strips of land, each 40 - 50 m wide and 100 - 200m long. The rotation was set at three years but, in practice, wet ground conditions have occasionally caused some disruption

to that plan. The strips are mown and the material removed using wheeled tractors. Measurements show that Common Meadow-rue, *Peucedanum palustre*, *Lysimachia vulgaris*, *Lythrum salicaria* and *Eupatorium cannabinum* were all shorter when in flower than at other sites. Whether compaction by machinery or summer flooding, or a combination of both, has led to shorter growth of these species is open to conjecture; perhaps drier conditions would benefit Common Meadow-rue more so than other fenland species.

2. Management of Verrall's Fen, compartments 2 and 5, about 25 ha.

   This area had the scrub-cover reduced prior to 2006 and a grazing regime implemented. In 2012, 18 Konik horses were in compartments 2, 3, 4 and 5 during the year. Also, eight Highland cattle had access to compartments 3 and 4 from mid-June and all four compartments from early July. Because no large-scale mowing was intended, the residue of scrub control (brash piles, stumps, logs etc) remained in place and these, as well as regenerating *Rubus* and *Frangula* etc, clearly acted as impediments to the movement of livestock; most Common Meadow-rue in the plots had not been trampled simply because of a single briar, a few logs lying side-by-side, or a regenerating bush.

   The plants were within reach of livestock but none in the plots, and seemingly none elsewhere, had had their flowers removed; a question remains about which large mammals (domestic or otherwise) eat or avoid the flowers of Common Meadow-rue. It is known that Roe Deer will bite off Common Meadow-rue flowers but they are rarely – if ever – seen in Verrall's Fen. David Hooton (*pers comm*) of The Deer Initiative considers it very likely that Roe Deer are deterred by the presence of cattle and horses. He suggests that if the livestock were removed, the deer would eat the Common Meadow-rue flower-heads. At other sites, perhaps cattle are being blamed for the depredations of deer.

   The eight cattle and 18 horses grazing all four compartments (50 ha) of Verrall's Fen give a theoretical density of 0.5 animals per hectare and it is thought that all four compartments were grazed more or less equally. This contrasts with Holme Fen NNR in Cambridgeshire where Common Meadow-rue has succumbed to over-grazing. Two hectares of fen had been mown in the past so was devoid of impediments to livestock movement; all parts stood an equal chance of being trampled and grazed. Also, the subsequent grazing regime (variously cattle, sheep and ponies) usually involved five to seven animals, or 2.5 to 3.5 animals per hectare, (Alan Bowley *pers comm*). So this was a grazing pressure five to seven times greater than in Verrall's Fen.

3. Management of Wicken Lode-side

   The land between the visitors' path and the lode is subject to *ad hoc* mowing and slubbing activities, by excavator, on an eight year rotation. In most years the vegetation is an unimpeded mixture of *Phragmites*, *Eupatorium cannabinum*, bindweed and *Urtica*, amongst which the Common Meadow-rue appears to compete for light.

Common Meadow-rue's response to adjacent vegetation

It appears that the height of Common Meadow-rue tracks that of the adjacent vegetation. In SF the fen vegetation varied from 80 – 130 cm in height and the mean height of Common Meadow-rue seed-stems in the nine plots varied from 79 – 130 cm (mean 105 cm). Based on the crude measurements of vegetation height and the precise height measurements of Common Meadow-rue, there were only three plots where the height of the tallest Common Meadow-rue stem exceeded the height of the other vegetation by 20 – 30 cm and two of these accommodated larvae.

By contrast, the standing vegetation in VF was generally shorter (60 – 90 cm) and with flattened or closely-cropped areas nearby. Although the Common Meadow-rue's mean height of seed-stems per plot was also shorter (67 – 109 cm, mean 85cm), they were taller than the adjacent standing vegetation, compared to SF, and obviously much taller than the close-cropped areas nearby.

The two Wicken Lode plots contained the tallest Common Meadow-rue seed-stems with means of 129 cm and 148 cm. All stems, except one, were equal to or shorter than the adjacent 130 – 150 cm tall vegetation and no larvae were found there.

It appears, therefore, that the height of Common Meadow-rue stems matches that of the vegetation in which they are growing. Where that vegetation is short or almost absent, the Common Meadow-rue will respond by growing almost as short and, probably as a consequence, will produce large flower-heads to which the female moths will be attracted.

Acknowledgments

Stuart Warrington, Owen Mountford and Peter Stroh encouraged the study whilst Chris Soans and other National Trust staff kindly permitted access. James Selby and Carol Laidlaw provided data on the mowing and grazing management, whilst Alan Bowley did the same for other sites.

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This article is an abridged version of a report which includes a comparison with a Marsh Carpet larvae survey at RSPB Lakenheath Fen reserve, Suffolk. An electronic version of the full report is available from: mail@normansills.plus.com

Cambridgeshire and Peterborough Otter Survey – 2012

Peter Pilbeam

Summary

A survey of all Cambridgeshire waterways, looking for signs indicating the presence of Otters, was conducted between the beginning of December 2011 and the end of February 2012. This was a repeat of surveys undertaken in 1992, 1997, 2002 and 2007. A total of 285 sites was visited and surveyed using the same methodology as in previous years, using bridge checks and walking adjacent riverbanks.

The survey showed an increase in positive sites from 26% of those surveyed in 2007 to 49% of sites surveyed in 2012. The major increase was in the Middle Level area of the fens, but all catchments showed at least the same number of Otter signs as in 2007 with increases in the majority.

Background

The first county-wide survey of Otters took place in Cambridgeshire in 1992. This confirmed that the known local decline of Otters had not reversed. The only evidence of Otter activity was along a short stretch of the River Cam near Cambridge, and an old spraint at Brandon Creek on the Norfolk border. Introductions of small numbers of captive-bred Otters took place in 1995 in the county and in 1994 and 1995 in the neighbouring counties within the same river catchments.

The county-wide survey was repeated in 1997, 2002 and 2007 – on each occasion an increase in Otter signs was observed. It is not currently possible to relate the survey data directly to the Otter population, but it is assumed that an increase in the number and range of signs (spraints) found corresponds to an increase in the number and range of Otters present.

Methodology

The survey method of the previous four surveys was repeated. At each of the 285 sites the bridge was checked as thoroughly as possible. Where possible, up to 600m of bank were also walked, usually 300m on either side of the bridge, concentrating on likely sprainting sites or wet mud where prints might be found. Any other bridges or possible spraint sites within 300m were checked. When spraint was found the survey stopped – signs of Mink, Water Vole and Brown Rat were also recorded up to that point. The data for those other species cannot therefore be considered as complete.

Survey conditions

The winter was unusually dry, following an unusually dry year, so river flows were very low for the whole of the survey period (classified by the Environment Agency as “exceptionally low” or “notably low”). This meant there was little danger of signs being washed away, but the possibility of low

flows discouraging Otters from using some areas. Snow at the beginning of February may have covered some signs, but also made it easier to find good prints. More surveys were carried out in December and January than in 2006/7, as the weather conditions made surveys possible throughout the winter.

Results

A total of 285 sites was visited and survey forms filled in. This was all but four of the 2007 sites - no new sites were added to the list. Site 40 was not visited and sites 1, 139 and 252 were not surveyed due to lack of access (in the case of Site 1 this was due to Environment Agency works). A summary of results is shown in the table below.

	2012	%	2007	%	2002	%	1997	%	1992	%
Otter	140	49	76	26	47	16	35	12	3	1
Mink	29	10	18	6	47	16	37	13	57	20
Water Vole	8	3	13	4	14	4	0	0	9	3
Brown Rat	28	10	72	24	-	-	-	-	-	-
Total sites	285		289		285		281		279	

Other species coinciding with Otter

Mink - 29 positive sites of which 22 (i.e. 76%) were also positive for Otter.
Water Vole - 8 positive sites of which 3 (i.e. 38%) were also positive for Otter.
Brown Rat - 28 positive sites of which 15 (i.e. 54%) were also positive for Otter.
Mink and Otter signs seem to be more closely associated than in previous surveys, perhaps because both species now occupy the most suitable habitats. Only very few Water Vole signs were found (comparable to previous years), and Brown Rat signs seem not to be associated with Otter presence or lack of it.

Discussion

Otter signs

The proportion of sites with positive signs for Otter in 2012 was 49%, considerably higher than the 26% in 2007, which in turn was higher than the 16% in 2002, 12% in 1997 and only 1.4% in 1992. The increase was particularly noticeable in the Middle Level and seems to indicate a significantly increased Otter population in the county, or at least Otter territories covering a larger area.

Mink signs

The number of Mink signs increased slightly from 6% in 2007 to 10% in 2012. This is a small enough difference to be attributed to the difference in surveyors, bearing in mind that this was not a dedicated Mink survey and sites where spraint was found may have been searched less carefully for signs of Mink.

If a clearer picture of how Mink populations are changing is desired, a specific survey should be carried out for Mink signs and repeated after a number of years.

Overall conclusions

Otter activity in Cambridgeshire has continued to increase between every survey since 1992, with the latest increase greater than that seen between 2002 and 2007. The success of Otters in the county does not relate to any further releases and instead seems to be due to natural colonisation. While lack of habitat is still an issue in some places, there are very few, if any, parts of the county with a watercourse but no Otter presence. Otters are moving into smaller watercourses and fenland areas, which indicates that Otter numbers are probably increasing.

Recommendations

Among several others the main recommendations are:

1 - Surveys and enhancements of riparian habitat should continue, and all habitat enhancement projects should take the likely presence of Otters into account.

2 - Opportunities should be sought for collaboration with a university to develop a research project addressing Otter numbers and territory sizes, preferably specific to this area.

3 - Areas where no Otter signs were found, despite good signs in previous years, should be a priority for re-survey to try to establish when Otters return and whether there is a reason for the absence of signs.

4 - The county-wide Otter survey should be repeated in 2017.

Full survey report - Cambridgeshire Otter Survey 2012; R Hawksley, unpublished.

The survey was co-ordinated by the Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire using surveyors from the Wildlife Trust and the Cambridgeshire Mammal Group with other volunteers.

A Land Flatworm new to Britain from Cambridgeshire

Brian Eversham

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Introduction

The dozen or so freshwater flatworms or planarians (Platyhelminthes: Turbellaria) found in Britain are familiar to anyone who has wielded a pond-net. By contrast, the terrestrial species are seldom recognised or recorded. The most recent synopsis of British flatworms (Ball & Reynoldson, 1981) included eight terrestrial species, of which three were considered probably native. By the time

of the latest review of the terrestrial species (Jones, 2005), this had risen to fourteen species, of which three or possibly four were considered native. The definitely native species, *Microplana scharffi, M. terrestris,* and *Rhynchodemus sylvaticus,* all occur in Cambridgeshire. In this paper, I note the arrival of a further non-native species.

Finding the flatworm

On 13 May 2012, I visited Shepreth L-Moor, a Wildlife Trust nature reserve comprising 7.3 ha of unimproved calcareous and neutral grasslands, wet grassland, and seasonally flooded areas. Turning over a rotting willow log in search of invertebrates, I found a small flatworm which I did not recognise. It was 12 mm long when extended, 4.5 mm long when contracted, broader in the rear half, shortly pointed at the tail, and tapering to a narrow 'head' at the front. It was translucent orange-brown marked with more opaque paler creamy-brown spots and blotches, which tended to be longitudinally elongate. There was an ill-defined darker brown stripe along each side, which was also marked and interrupted by paler spots and blotches. (See Figure XX). On closer examination, it had a row of tiny black eyes low down on the side of the body at the 'head' end. These extended along the anterior third of the animal, but were close together around the narrow head portion. There were about sixty in total. I photographed the animal several times *in situ*, then collected it in a small specimen tube along with a piece of the rotting log.

Habitat and associated species

The log lay in damp grassland composed mainly of Creeping Bent (*Agrostis stolonifera*) with some Yorkshire-fog (*Holcus lanatus*) and tussocks of Cock's-foot (*Dactylis glomerata*) and Tufted Hair-grass (*Deschampsia caespitosa*). The most abundant forbs were Bulbous Buttercup (*Ranunculus bulbosus*) and Wood Dock (*Rumex sanguineus*), with a clump of Stinging Nettle (*Urtica dioica*) and Bramble (*Rubus fruticosus* agg.) at one end of the log. It was partially shaded by a large, pollarded hybrid Crack x White Willow (*Salix x rubens*), a fallen bough of which touched the ground next to the log. It lay about a metre from a shallow ditch which forms the western boundary of the nature reserve, next to Meldreth Road, at O.S. map reference TL386475.

Under the log with the flatworm was a range of frequent or common invertebrate species typical of the habitat.

Woodlice: *Armadillidium vulgare, Haplophthalmus danicus, Porcellio scaber, Trachelipus rathkei, Trichoniscus pusillus.*

Millipedes: *Polydesmus gallicus, Tachypodoiulus niger.*

Molluscs: *Aegopinella pura, Arianta arbustorum, Cepaea hortensis, Deroceras reticulatum, Trochulus striolatus.*

Slime moulds: two species were producing sporangia on the log, probably *Arcyria denudata* and *Arcyria cinerea.*

On subsequent visits, I found two further mollusc species, *Arion intermedius* and *Pupilla muscorum* the springtail *Tomocerus (=Pogonognathellus)*

longicornis , the small ground-beetle *Oxypsephalus obscurus*, and a hibernating leaf-beetle, *Chrysolina polita*, under the same log.

None of the other invertebrates recorded are recent colonists or species particularly associated with gardens or disturbed habitats.

Despite two hours' further searching on 13 May, when I turned over every moveable log I could find on site, I found no further specimens of the flatworm. I have not found the species again on three subsequent visits.

Identification and probable origins

Consulting Jones (2005) when I got home, the multiple eyes placed the animal in family Geoplanidae, and therefore not native. The three or four native species all belong to the Rhynchodemidae, with just two eyes. Most of the Geoplanidae are native to Australia, New Zealand and south-east Asia. Of the known British species, the flatworm most resembled *Kontikia andersoni* in size, shape and overall colour. However, that species is pale fawn coloured with three rows of darker spots. The Shepreth flatworm was clearly different. I therefore emailed a photograph to Dr Hugh Jones, of Manchester University, who replied: "This is a new one on me! It is not *Kontikia andersoni*, which has brown spots in three rows dorsally. As you say, it is a geoplanid since it has a row of eyes round the anterior and laterally. By amazing coincidence, in April I was sent pictures of a similar looking specimen, but from the Netherlands! Another alien in the British Isles!!"

At Dr Jones's request, I preserved the specimen in 100% alcohol and it is now with him in Manchester. It has still not been identified, and may well represent a species new to science.

The global centre of diversity of land flatworms is in Australia and New Zealand, from where most of our non-native species have been imported. Several of the species of Geoplanidae found in Britain have been described here, and have not yet been found in their native range. An indication of the scale of the fauna yet to be discovered may be gained from Winsor (1997): a survey of land flatworms in Queensland increased the species list from nine to sixty-two, eight genera and 80% of the species being new to science.

It is likely that land flatworms travel via horticultural trade, and it has been suggested that export of tree-ferns (with soil and with moist spaces between the old fronds) provides an easy means of safe transport. Although adult flatworms are extremely fragile, and often disintegrate if touched, or if roughly transported, their egg cocoons are more robust and more resistant to desiccation.

It is a puzzle how an antipodean flatworm makes its way from potted plants to semi-natural habitats on a nature reserve, without being seen anywhere else. It may be no coincidence that there are five garden centres or nurseries within three miles of Shepreth L-moor, though I saw no garden refuse on the reserve or on the adjacent road verge.

Potential ecological impact

Another introduced flatworm from New Zealand, *Arthurdendyus* (formerly *Artioposthia*) *triangulates*, first found in Britain in the 1960s, has gained

notoriety and is regarded as a pest because it preys voraciously on earthworms. It is an offence under the Wildlife & Countryside Act knowingly to distribute the species. Another introduced species, *Australoplana sanguinea,* is also a predator on earthworms. It grows to 8 cm long, and *A. triangulatus* is even larger (up to 20 cm long). The Shepreth flatworm may well be much smaller when full grown (the somewhat similar *Kontikia andersoni* reaches only 2 cm). Nothing is known of the feeding of *Kontikia,* but the similarly-sized native species are all believed to be scavengers on dead invertebrates.

I would be very pleased to hear from anyone who comes across this new species of land flatworm, or indeed, any other species, in Cambridgeshire.

Acknowledgments

I thank Dr Hugh D Jones for confirming that the Shepreth flatworm is new to Britain. Thanks also to John Holden for naming the slime moulds (from photographs).

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River Cam Habitat and Access Enhancement Project

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Trumpington Meadows is located on the southern outskirts of Cambridge, where 1200 new homes are to be built. To serve the new community, a 60 ha riverside community park is to be established adjacent to the River Cam. Enhancements have been delivered to the river prior to the set-up of the park.

Whilst increased access to the countryside is generally welcomed, concern was expressed at the risk of increased disturbance to a presently remote reach of the river. This issue was debated at the planning application stage. It became clear that the environmental capacity of the river needed increasing to counteract the potential disturbance posed by increased access. However, Planning Officers did not consider the issue one that should oblige the developer to deliver specific river enhancements (given that many resources were already being put into establishing the riverside community park). A point of agreement was achieved on the case for enhancement and South Cambridgeshire District Council took the lead to deliver enhancements with funding secured primarily from the Department of Communities and Local Government / Cambridgeshire Horizons *Housing Growth Fund* (plus others including the developer).

A main objective of the project was to deliver safe access to the river which has been achieved along 225 m of bank by using 1240 tonnes of gravel to raise the riverbed and form shoals whilst regrading the adjacent banks.

The gravel should also provide new fish spawning areas and help increase invertebrate biomass. Large woody debris has been incorporated into revetments and two flow deflectors further diversify in-channel habitats. Five large rootballs have been secured to the bed to provide shelter “reefs”. Backwater habitats have also been created to add further visual interest to the site and to provide refuge for fish in flood periods.

The bank re-grading has also removed levees in places to allow water to spill out onto a wet meadow at lower flood levels thus delivering some local flood storage benefits and biodiversity gain for wetland birds. Hydraulic modelling has been used to demonstrate that maximum flood levels and flooded areas will not increase.

1. The River Cam

The reach of the River Cam subject to enhancement is in an area to be renamed as Trumpington Meadows. This is located south west of Trumpington on the outskirts of Cambridge, and will stretch from Byron’s Pool Local nature Reserve (on the Trumpington-Grantchester road) south beyond the M11 to near Hauxton Mill. It is part of a larger site that has been allocated for a mixed-use urban extension, resulting in 1200 new homes, a new school and employment centres. To serve the new community, Trumpington Meadows Land Company (a joint venture between Grosvenor Estates and the Universities Superannuation Scheme) and the Wildlife Trust will establish a 60 ha riverside community park adjacent to the River Cam. Most of the enhancements described below occur upstream (south) of the M11.

Throughout the forward planning stage it was considered important that the new inhabitants, and those from the wider area, should be able to enjoy the countryside setting of the River Cam just as Grantchester Meadows, a short distance downstream, is also enjoyed by local residents. At Trumpington Meadows, this opportunity is to be provided through the riverside community park, which will incorporate a series of cycleways and footpaths linking local villages with commuting cycle routes and pleasant informal walks. The River Cam Habitat and Access Enhancement Project is the first stage in the creation of the park and was taken forward by South Cambridgeshire District Council (SCDC), with funding of approximately £78,000 from the Department of Communities and Local Government / Cambridgeshire Horizons’ *Housing Growth Fund*.

In addition to providing new recreational opportunities, a main objective of the project was to increase the environmental capacity of the River Cam so that it would be resilient to the pressures placed upon it by increased human use and disturbance. The River Cam is designated as a County Wildlife Site as it provides an important biodiversity resource as a largely unmodified major river with good water quality and plant diversity.

The river is abutted by re-created wildflower meadows seeded approximately ten years ago following arable reversion. The logical next stage was to restore them as flood meadows - features that were once quite extensive along the Cam upstream of Cambridge. This phase of restoration focused on the drainage system in the meadows. A drainage ditch totalling 730 m runs parallel to the river. It was very silted up in places and was discontinuous due to dilapidated sluices and high bed levels at various points along its course. The restoration of the ditch system together with the re-wetting of the meadows gave an excellent opportunity to expand the original plan for enhancements to the river alone and develop a more holistic landscape-based project that would maximise biodiversity gain to the river and its floodplain.

2. The case for enhancement

The River Cam has been modified throughout much of its length. In the Trumpington Meadows area, dredging first took place in 1968 and again in the 1970s (Henry Lowe, *pers.com.*). This appears to have removed much of the coarse sediment from the river. In many places, the scrape marks left by the dragline could still be seen on the riverbed in 2009. This is typical of many chalk rivers where a limited occurrence of eroding features (such as a gravel seam on the outside of a meander) results in a limited supply of coarse sediment. Such a sediment supply is crucial if the river is to form natural features such as riffles or shoals. The dredging had also resulted in levees along the banks and the lowering of the river within its channel. The left hand (west) bank of the Cam appeared to have been the main recipient of the dredged material, with the formation of a noticeable levee, presumably designed to offer flood protection to the low lying farmland behind. Subsequent dredged material had clearly been placed on the right hand bank (the Trumpington Meadows side) as nutrients in the spoil have led to the dominance of weeds such as nettles. As with many slow flowing parts of the Cam, the riverbed had become a settling point for fine sediment, which in turn encourages a vigorous growth of Yellow Water-lilies and Unbranched Bur-reed. These plants have traditionally been removed by the Environment Agency with an aquatic weed cutting boat.

Trumpington Meadows falls within the East Anglian Chalk landscape. Chalk rivers are important habitats and consequently the restoration of such rivers is a target in the Cambridgeshire Biodiversity Action Plan (BAP). At one particularly interesting reach, natural regeneration has taken place as a consequence of the gradual erosion of a high cliff on the outside of a meander, and a gravel and chalk bed can be observed (Plate 1, inside front cover). The water clarity is good and the chalk river indicator plant species Water Crowfoot is abundant, with occasional Starwort. The water over the naturally formed riffle is approximately 0.2 m deep in many places, which contrasts with average depths of 1.44 m further downstream.

Whilst increased access to the countryside is generally welcomed, concern had been expressed at the risk of increased disturbance to this reach of the river as it is currently quite remote and has no public access. Furthermore, the site is known to contain an occasionally used artificial Otter holt, a Kingfisher bank

and Chub and Minnow spawning areas. Fish surveys also confirmed a good population of wild Brown Trout and Brook Lamprey. These habitats and species could be disturbed and damaged by people, especially if paddling in the single existing riffle became popular. Thus it became clear that the environmental capacity of the river needed to be increased.

3. Enhancement techniques

The design of the enhancements evolved through a process of site investigation and discussion with restoration specialists, together with hydraulic modelling and detailed consideration of topographical surveys. It was originally envisaged that two riffles would be created together with local bank re-grading and vegetation management. However, as the entire reach was investigated, a more holistic scheme was designed which made best use of the data gathered and knowledge gained. The designs of the new features were based on the reach's naturally occurring features – a relatively short riffle together with glides and shoals. Longitudinal profiles of the river bed, with measurements at intervals of ten metres, were especially useful for appropriately locating proposed new features.

3.1 Gravel shoals

Eight gravel shoals, totalling 195 m in length, were placed to diversify water velocities without significantly raising water levels upstream. This was achieved by careful placement and creating the shoals in an asymmetrical form so that flow in the main channel was largely unimpeded. The localised bed raising compensated for the historic dredging which had over-deepened the river.

The original design had been to create gravel riffles by raising the bed across the entire river width. However, hydraulic modelling of normal flow conditions indicated that this approach would have raised river levels upstream, with a risk of drowning-out the existing riffle. In addition, the owner of the land on the opposite bank had expressed concern over the possibility of the riffles being used as fording points by the public. Taking these points into consideration, the final design of the shoals retained a water depth of at least 0.5 m at some point across the river to deter people from crossing. (Plate 2, inside front cover)

The shoals were formed from clay-bound gravel rejects from a local quarry. The quality of the gravel varied and it was important to emphasise to the supplier the need to maintain a low number of fine particles. However, it was always considered desirable to have an irregular and more natural product as it contained a proportion of fine particulates that one would always observe in naturally deposited river sediments. Furthermore, the stability of the shoals was increased by using material that would bed together well, thus reducing the amount of interstitial flow. The shoals were topped-off with a dressing of a 50:50 mix of clean graded 40 mm and 20 mm gravel.

As the shoals were placed to allow public access to the river and could potentially become a well used recreation resource (such as for paddling by young children), the avoidance of a high flint content was very important. The

quarry was visited to ensure that the general content of the material was safe for use in a future public area (i.e. had a very low number of sharp stones).

The shoals are expected to increase fish spawning areas, particularly for Chub, Dace, Bullhead and Stone Loach. The increased substrate diversity will increase the range of invertebrate habitats and provide substrate suitable for the growth of Water Crowfoot. The potential for public access to the river has been significantly increased as the shoals form safe paddling points and areas where dogs can be taken to the water without eroding the banks.

3.2 Bank re-grading

For much of the river's length within the proposed park, the banks were steep and densely vegetated. This posed a potential hazard for people close to the edge, as hanging vegetation masked holes and overhangs, and in places the bank top could have given way. The bank re-grading over 225 m has created gently sloping banks adjacent to all of the shoals to provide safe water-side access with a gradient of the order of 1:4. The positioning of the shoals and the re-graded lengths of bank have been undertaken at locations considered to be less ecologically sensitive and located close to the new homes, thus providing an alternative range of shallows for the public to explore.

In some reaches, the levees were acting as flood barriers for low-level flood events. Bank re-grading at nine locations has deliberately removed the levees to allow water to spill out onto the floodplain at lower flood levels, thus delivering a flood storage benefit for small flood events and biodiversity gain for fisheries and wetland birds. Hydraulic modelling was used to demonstrate that the maximum flood levels and flooded areas for extreme floods remained unaffected.

March 2010 saw the river in flood, and interesting observations were made. The new breaches in the levees on the right hand bank allowed the water to move onto the flood meadow at a relatively high point within the reach. This appeared to relieve local flood heights at a number of critical meanders where over-topping of the banks had been observed in the past. Flooding of the opposite arable land appeared to be reduced as a result of locally increased flood storage created by the project. However, comments such as these from a single flood event should be extrapolated with caution. The site was visited 24 hours later and much of the floodwater had subsided – in previous observations of similar sized floods, the water ponded behind the levees and the embanked ditch.

3.3 Bank revetments

Whilst some trees did have hanging branches down to water level, there was little large woody debris below water. Increased winter flows flattened the marginal vegetation and the smooth channel was considered to offer little cover for adult fish. It was concluded that the channel required woody debris (both large and small) to increase its local channel roughness. Sensitive bank revetments in the form of Hazel faggots set on top of locally sourced brushwood from tree works were fixed behind chestnut posts over a distance of 358 m along

the bank. This was undertaken to significantly increase the marginal habitat for juvenile fish, Minnows and invertebrates. A recent fisheries survey showed a close association of Minnows, Bullhead and Spined Loach with the Hazel faggots (Environment Agency, March 2010).

Larger pieces of woody debris in the form of tree stems, branches and limbs were tethered to the outside of a wide meander to create the type of log-jam that collects debris after a flood. It is expected that in summer this feature should provide cover for fish species such as Chub and adult Trout as water velocities drop and marginal vegetation becomes established. It was originally intended to create this feature using a live Ash and a willow tree, however the unpredictability of the behaviour of such large stems (due to buoyancy and twist) meant that a different approach was required. Instead, the stems were cut and securely tethered with galvanised wire and metal reinforcing bars. This allowed the feature to be created in a manner that was lower in profile and less obstructive to the main flows. A number of large tree limbs extend down into the water and should offer a degree of protection to fish from predators such as Otters and Cormorants. After the first flood event, the feature has collected debris in the expected manner (Plate 3, inside front cover).

3.4 Flow deflectors

The river is one of relatively low energy, being of shallow gradient. The original concept was to use six flow deflectors formed from fallen tree stems, as they would have provided a feature natural to the river's form. Furthermore, they would have significantly diversified the local flow patterns within the immediate area of the features. However, unease at the risk of tethered trees within the main flow of the river was expressed by the Environment Agency and a suitable compromise was reached which saw the construction of two tapering brushwood, faggot and stone deflectors extending to half of the channel width. Whilst these features may initially appear slightly unnatural, the concentration of flow that they have created appears to have cleansed the bed of silt (a main objective) for a distance downstream of approximately 15 m. Fine sediment and sand collects in slack water, where a backwater habitat is provided. Flow deflectors of this construction may perform better than the original designs during times of low flow as they maximise the river's flow in a relatively confined area rather than relying on collected debris to channel flow (which was the expectation with tree deflectors).

The deflectors do not appear to have increased scour on the opposite bank owing to the correct positioning of the upstream-pointing face and the location of two willow trees, giving strength to the opposing bank. In time, this should allow for a very interesting feature to develop. However, the deflectors have to be inspected after flood events to ensure that they have not collected any large tree stems that could lead to excessive restriction of the flow or erosion in an unexpected manner.

3.5 Tree management

Riverside trees are being managed to reduce shading on the water and to encourage marginal plant growth. To date, the scheme has seen the re-pollarding of five veteran willows. As the site is prepared for the opening of the riverside community park, another phase of willow pollarding will take place. Less desirable riverside species such as lime and maple have been reduced or felled to provide wood for the bank revetments. The use of this material alongside the faggots helped to limit costs by reducing the requirement for purchased faggots (which can be an expensive item, especially in August, which is outside their main production season).

3.6 Ditch and sluice restoration

Prior to the main enhancements, a dilapidated ditch system of 730 m ran parallel to the river. The restoration and enhancement of this system was undertaken to deepen the ditches and create a two-stage channel. Whist undertaking the ditch works it was expected that a buried culvert would be found at a field entrance part way along the ditch, however, this was not the case. Therefore, to create a continuous length of ditch and to maximise the habitat connectivity between the river and ditch system, a new 800 mm plastic culvert was installed. This was a very significant measure, as once combined with the operation of two new sluices (one of which was relocated by 60 m to protect an artificial Otter holt) the ditch could act as a “wet fence” to control the movement of people within the park. Because of the restoration of the sluices, water levels are held slightly higher than before and the ditch now takes on a larger appearance. It is hoped that the gravel layer within the local strata will not cause leakage from the ditch system in dry periods. Bare earth areas of the ditch were planted with vegetation extracted during the original ditch maintenance. The main species planted were Reed Canary Grass, Meadowsweet, Marsh Woundwort, and Lesser Pond Sedge. These species all flourished, even in parts of the ditch surface that remained dry in summer. Wild grass seed and selected herb seeds were also sown by hand.

Another significant gain resulting from the placement of the new culvert was shown when the river was in flood. Where the ditch normally discharged into the river mid-way along the enhanced reach, the river level was such that it was actually flowing back over the mid-point sluice and causing water to run along the course of the newly widened ditch. This ditch diverted the water around the flood meadow and then allowed inundation of a lower part of the meadow. This effectively gave the Cam additional conveyance for the floodwater and appeared to relieve flooding on the arable land to the west. This is considered to be a significant local floodplain gain and will be interesting to observe in future flood events.

The ditch was also over-deepened in three places to act as a refuge during drought. This has advantages for the local Common Toads, which were observed spawning in the ditch in 2009. The correct cutting of the step in the two-stage channel relative to the height of the lowest sluice has also created a

wet ledge that should provide for the development of lush marginal vegetation (Plate 4. inside front cover).

3.7 Backwater habitat creation

Observations of the river in flood periods suggested that, prior to the enhancements, there were few places for river-life to shelter from high flows in the main river channel. To address this, work was undertaken to integrate the ditch system with two newly created backwaters just off of the main river. One backwater was linear in form and was located on the old course of a ditch that had historically entered the river (and had been observed as a low spot that allowed water to flood on to the meadow).

By lowering an area of land by 0.8 m, a second backwater habitat of approximately 2700 m^2 was created. This was at a location where floodwater had been seen draining off the meadow and back into the Cam. Interestingly, it is also at a point in the site where the land rises and forces the Cam to turn westwards. Archaeological trenches (which were a condition of the project's planning permission) revealed this area to have significant peat deposits. This suggests that many thousands of years ago, a slow backwater had been located in this low-lying land. The backwater would have become filled with sediment (now observed as the peat deposits) as the river meandered across the landscape. Perhaps in several thousand years the process will be completed again.

The large backwater had soil and peat removed to a point 0.1 m above the summer level of the river. It is expected that this area will be planted with Common Reed to provide a locally significant reedbed, which are not found immediately adjacent to the Cam locally. However, if the water level dropped (perhaps as a result of drought), the reedbed could be at risk of drying – this can be problematic for newly established reedbeds. To prevent drying, a series of eleven 0.15 m deep trenches was dug to ensure that the base of the proposed reedbed would always be just below water level. The backwater and trenches have provided areas of shallow open water considered to be ideal for reed planting within the peat, and as a nursery area for coarse fish. The area was planted with Common Reed in May 2010 and has become well established. (**Plate 5**, inside front cover).

4. Project delivery

The project has been managed by the author. Expert advice was initially provided by Dr Karen Fisher on behalf of the River Restoration Centre. Thr hydraulic modelling and flood risk assessment was undertaken by Dr Frances Elwell at Mott MacDonald. The various visions and designs of the project were collated within the engineering drawings of Andrew Pepper of ATPEC, who also managed the contract on behalf of SCDC. The Environment Agency has undertaken a range of ecological monitoring and has acted as a point of contact for general guidance and project development. The Cambridgeshire Wildlife Trust has provided support with small teams of volunteers and acted to further the project when the potentially tricky issue of future management was

discussed. The main contractor for the engineering work was the Fen Ditching Company.

The project was funded by the Department of Communities and Local Government / Cambridgeshire Horizons *Housing Growth Fund* (~£78K), with additional funding provided by Grosvenor/USS (£12.6K), the Environment Agency (£12.5K), the Wild Trout Trust (£10K) the Cambridgeshire and Peterborough Biodiversity Partnership (£3K) and the Cam Valley Forum (£1.5K).

5. Conclusions

- The River Cam Habitat and Access Enhancement Project will deliver significant environmental and social benefits.
- The proposed works are based on a sound understanding of the river's form and flow types.
- The proposed measures are appropriate to the landscape type and setting.
- The works will enhance the experience of visitors to the riverside community park.
- The works are expected to act as a showcase for river restoration techniques for the local area and it is anticipated that they will act as a catalyst for similar projects.

Acknowledgments

The author's sincere thanks go to all those involved in the project as its speed of delivery was achieved by having the appropriate skills within the team. However, without the support of Kirsty Human (SCDC Corporate Projects), Sean Missin (SCDC Procurement Officer) and Michelle Crees (SCDC Principal Planning Officer) the project may not have been delivered once the full scale of the vision's undertaking was realised. Dr Frances Elwell kindly proof read this paper.

A puzzling hybrid comfrey in Cambridge new to science: Symphytum × perringianum

Philip H. Oswald

About 13 years ago I noticed among patches of flowering White Comfrey (*Symphytum orientale*) growing in front of the hedge on the north side of Barton Road, Cambridge, just to the west of the turning into Clare Road, at TL44165749, a plant with pale mauve-tipped flowers which I at first took to be just a colour variant (Plate 6, inside back cover). On a subsequent visit I examined the plant more thoroughly and noticed that, though the paler underside of the leaves contrasted with the darker green upper surface just as in White Comfrey (Plate 7, inside back cover), the leaves felt slightly rougher to the touch, and that the calyces were more deeply divided with narrower lobes. Later I realised that the principal raised veins on the underside of the leaves carry the

same colourless bristly hairs as White Comfrey but that species' shorter, softer ones on the extensive network of finer veins are almost absent. Both White Comfrey and the mauve-flowered plant are evergreen, unlike, for example, Common Comfrey (*S. officinale*) and Russian Comfrey (*S.* × *uplandicum*).

I searched other road verges nearby and found two further similar plants, one on the east side of Clare Road very close to the turning, at TL44205750, and the other across Barton Road on the verge of 1 Millington Road, at TL44155744. Over the next few years these two plants were eliminated by tidy-minded local householders.

In 2001 I decided that I should be taking these finds more seriously, so on 14 June I collected for **CGE** flowering specimens of normal White Comfrey and the mauve-flowered plant from TL44165749. Next year, on 16 April, I took Dr Alan Leslie and the late Dr Franklyn Perring, the national expert on *Symphytum*, to Barton Road and the latter collected rooted material from the mauve-flowered plant in Clare Road for the collection of comfreys that he maintained in his garden at Oundle. He agreed with my tentative suggestion that this was a hybrid of White Comfrey, probably with Russian Comfrey – which is a fertile hybrid between Common Comfrey and Rough Comfrey (*S. asper*) – and thus itself a triple hybrid; we presumed that White Comfrey, among which it was growing, must be the female parent pollinated by a flying insect carrying pollen from the male parent growing somewhere not very far away. White Comfrey regularly flowers earlier than most other *Symphytum* species, but I was astonished to see the plant of its putative hybrid already in flower in Franklyn Perring's garden on 5 January the following year; however none of the comfrey plants on and near Barton Road were showing anything other than basal leaves on 23 January, and in a later year, 2009, the hybrid at TL44165749 was still not in flower on 15 April (Plate 7).

On 11 July 2003, because Franklyn Perring's house was to be sold before his death later that year, Pete Michna of Cambridge University Botanic Garden and I transported living material of all the *Symphytum* plants in his garden for planting in a special bed in the Botanic Garden. Here the Clare Road material became much more robust than any of the plants that I had originally found in the wild and clearly demonstrated its hybrid origin by flowering in almost every month of the year but never producing any fruit ((Plate 8, inside back cover). I noticed also that the colour of the corollas and particularly of the flower buds varied considerably, possibly in response to different light levels (see below); generally the base of the corolla is whitish grading into pale mauve at the apex but the buds can be a deep pink and sometimes the open flowers are more strongly coloured too (see photo 4). When Peter Sell was preparing Volume 3 of his and Gina Murrell's *Flora of Great Britain and Ireland* he wrote a detailed description based on this clump and he accepted Franklyn Perring's identification of it as a new hybrid between *S. orientale* and *S.* × *uplandicum*. As in the case of all the new taxa described in the *Flora*, I translated the description into Latin for its formal publication as *Symphytum* × *perringianum* P. H. Oswald & P. D. Sell nothospecies nova, with a specimen in **CGE** collected in the Botanic Garden on 19 May 2006 as the holotype (Sell & Murrell, 2009, p. 520).

Alan Leslie published the details of my finds on and near Barton Road and of subsequent events (including his observation that there were two plants of the hybrid at TL44165749 in 2007) in *Nature in Cambridgeshire* No. 52 in 2010 and Michael Porter (2011) repeated the main facts among 'Neophytes and casuals' in *New Journal of Botany* **1 (1)**.

At the request of Professor Clive Stace in November 2008 I sent living material from the clump in the Botanic Garden to Dr John Bailey at the University of Leicester, who made several counts of its chromosome number, all of them giving the unexpected result of 2n=26. All published results for *S. orientale* – and also John Bailey's count in 2008 of material from Norfolk – give 2n=32. The other parent ought therefore to have a count of 2n=20, but the only species that Clive Stace could find with this chromosome number is *S. ottomanum* Friv., a plant with pale yellow corollas endemic to south-east Europe and Turkey (Pawlowski, 1972) which is most unlikely to have grown anywhere in Cambridge and is in any case an improbable second parent species, since one would expect this to have purple flowers as *S.* × *uplandicum* does. *S. ottomanum* does have deeply divided calyces but it also has scales exserted for 2–5.5 mm from the corolla tube (Pawlowski, 1972), while in this hybrid, *S. orientale* and *S.* × *uplandicum* the scales are included. However it seems impossible to derive the hybrid from *S. orientale* (2n=32) and *S.* × *uplandicum* (2n=36 or 40) chromosomally, so its origin is now a mystery. Graham Easy has reported that he found a plant similar to the blue-flowered Caucasian Comfrey (*S. caucasicum*) on Barton Road in about 1981, and, although he is now uncertain about its identity, he has suggested that this may have been the second parent of the hybrid.

Stace (2010) mentions the hybrid in the third edition of his *New Flora* thus: "A sterile plant found among *S. orientale* in Cambs in 2001 has the habit of *S. orientale*, off-white flowers with corolla-tips pale pink turning to pale violet, a deeply divided calyx, and 2n=26. It is clearly a hybrid between *S. orientale* and a sp. with a coloured corolla and more deeply divided calyx, and presumably with 2n=20; it has been named *S.* × *perringianum* P.H. Oswald & P.D. Sell. It no longer occurs in the wild but is in cultivation." This is the first time that its chromosome number has been published. The final statement is, I hope, untrue, but, in view of the loss of two out of the three plants in the wild, it would be wise now to safeguard the remaining stock by a further transplant to the Botanic Garden. Although south-facing, the site on Barton Road is under overhanging ivy and lilac and growing conditions cannot be ideal; this may account for the paler flowers here than in the Botanic Garden (Plate 6 and 9, inside back cover).

The previous existence of plants with mauve-tipped flowers in three locations, albeit not far from one another, poses something of a problem: since the hybrid is infertile they cannot be accounted for as its progeny, so either they were the products of separate pollination events, which seems unlikely because the hybrid has never been recorded before, or else either seeds from a single pollination of a plant of White Comfrey or rooted material of the hybrid must have been transported from one location to two others, which at the sites

concerned seems just as improbable. A count of the chromosome number of the stock remaining in the wild might show that it is genetically different from that now growing in the Botanic Garden; if so, this could be an alternative explanation for the difference in flower colour.

I am grateful to Clive Stace, Alan Leslie and Chris Preston for their helpful advice.

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Towards a recovery programme for wetland plants at the Kingfishers Bridge Reserve

Roger C. Beecroft, C. James Cadbury, & Stephen P. Tomkins

Fenland plant communities are now in isolated areas in the vastness of their original East Anglian home. As a consequence, the least common plants of these communities are inevitably threatened. The Kingfishers Bridge Wetland Creation Project near Wicken Fen has, amongst its aims, sought to redress these local losses and so better understand the management of such species for conservation objectives. This project has been well documented in this journal (Tomkins, 1998 & 1999; Cadbury, 2005; Brown and Doberski, 2005; Beecroft, Cadbury & Mountford, 2007a). This is the first of two further *Nature in Cambridgeshire* papers specifically addressing fenland plant community restoration at this site. Since its inception, in 1996, this project has been deliberately experimental and has had both dramatic successes and dramatic failures. Species monitoring has been undertaken regularly. Full documentation has been made in annually produced reports obtainable from the authors (principally Beecroft *et al.*, 1996–2002 and Cadbury, 1998, 2002, 2004–2013). Whilst many birds and insects are able to colonise their habitats more quickly, this may be much harder for certain plants. In this paper the focus is on the recovery attempts for the three plant species that are the most rare nationally. In a subsequent paper the focus will be on several additional fenland plant species characteristic of this community and will evaluate fully the methods that this project has employed to re-establish a fenland community artificially on post-agricultural farmland and, given the natural succession and normal spread of plants, to assess the extent to which such assisted introductions need be managed at all.

Part 1: Three threatened species: Water Germander, Cambridge Milk-parsley and Fen Ragwort

Among Cambridgeshire's special plants, three, Water Germander (*Teucrium scordium*, Rare, Endangered), Cambridge Milk-parsley (*Selinum carvifolia*, Rare, Vulnerable, but probably now Endangered) and Fen Ragwort (*Senecio paludosus*, Rare, Critically Endangered), have each been the subject of efforts at Kingfishers Bridge to enhance their national status (Preston *et al.*, 2002; Cheffings & Farrell, 2005). Apart from trying to rescue these plants from extinction the programme at Kingfishers Bridge has aimed to undertake experimental management and to monitor the results.

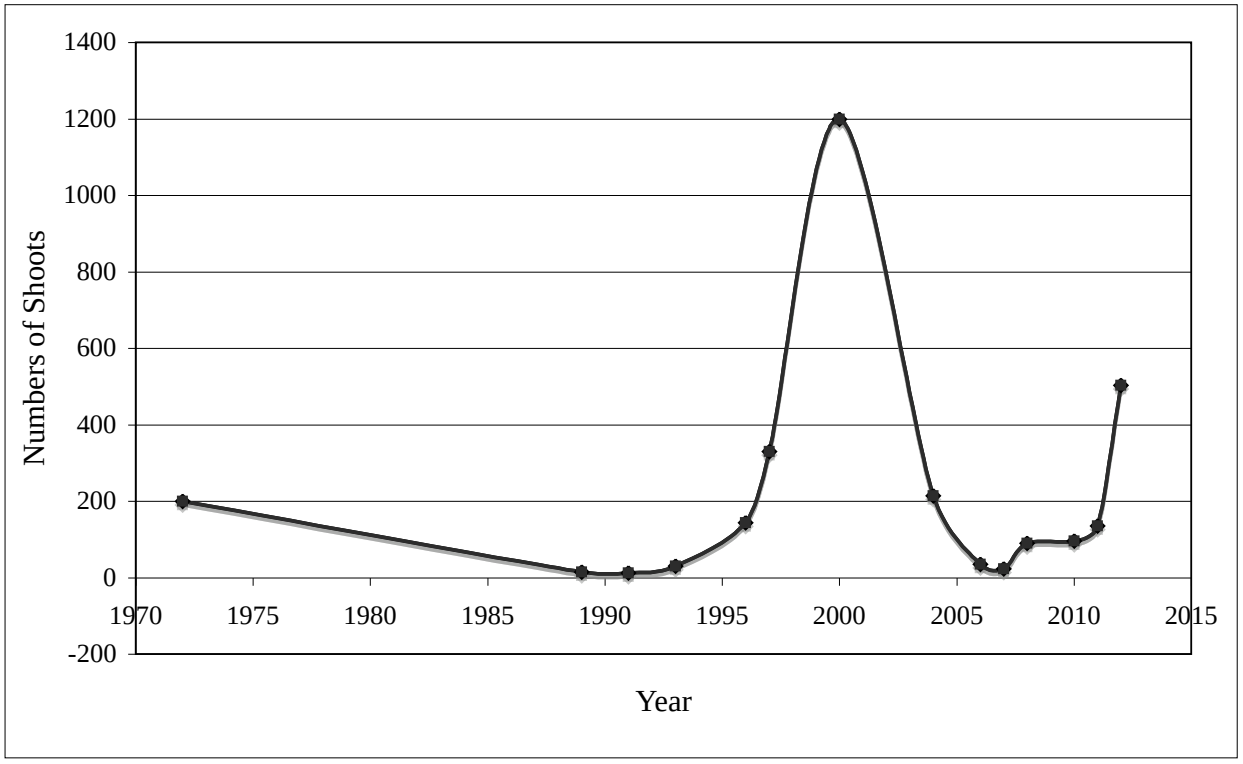
Water Germander (*Teucrium scordium*)

We have previously reported on this species recovery at Kingfishers Bridge (Beecroft *et al.*, 2007a). Only three indigenous sites remain in Britain – two in dune slacks in North Devon and one at Kingfishers Bridge (TL54487285), now the only one in East Anglia where it was formerly more widespread. Indigenous populations of Water Germander were last recorded at Stallode Wash, Lakenheath (v.c. 26) in 1980 and at Bassenhally Pit, Whittlesey (v.c. 29) in 1975 (Beecroft *et al.*, 2007a, 2007b). At Kingfishers Bridge Water Germander had survived somewhat precariously in a flooded limestone quarry pit and it was primarily for this reason that the site was notified as an S.S.S.I. in 1955. This 'Upware North Pit' was connected, probably from the late 18th century, by a navigable cut through to the River Cam. This would have served to transport the quarried limestone away. Before the present maintenance of a high river level (at Denver sluice) this wet pit would have had a natural draw-down in the height of water during the growth season.

Water Germander has been recorded on this site for over a century (C.E. Moss, North Pit, 20.9.1911, in Crompton, 2001). In 1972 there were more than 200 plants in three locations but by 1989 only 15 in one patch. By the early 1990s there were few plants and certainly very few flowering in the overgrown conditions of the pit. Andrew Green, the pit owner, was encouraged to safeguard its environment. In 1995 he instigated an experimental clearance of competing vegetation with positive results on Water Germander (Owen Mountford, pers. comm.). For practical monitoring reasons, since this plant is stoloniferous, counts are most easily made of shoots rather than individual plants. From 1996 the number of Water Germander shoots in the pit was counted more regularly. With the sanction of English Nature, the surrounding vegetation was cut back periodically in the autumns of 1996 to 2000 and then again since 2006 every other year until the present. The shading plants were mostly Common Reed (*Phragmites australis*), Lesser Water-parsnip (*Berula erecta*), Greater Pond-sedge (*Carex riparia*) and Water Dock (*Rumex hydrolapathum*) along with young willows. The population in the pit responded positively to a reduction in shading, but the apparent correlation is not the only factor at this site. Even when unshaded, without a summer draw-down in the level of the water, the increasingly swampy site is not ideal for Water Germander (Figure 1).

In view of the precarious nature of the population in the North Pit, soon after the inception of the Kingfishers Bridge Project Roger Beecroft took cuttings of Water Germander in 1997. The propagated plants were potted for one year and first planted out in August 1998. Initially 280 plants were introduced to a total of ten sites on the new wetland. The most successful sites comprised the then less vegetated wetland bordering the shallow lake, in what was still a developing reedbed, the 'Fen' area, the 'Winter Flood' grassland and two of the water-filled ditches (see Beecroft *et al.*, 2007a). Further cuttings from the initial cuttings were planted out in three subsequent years (Table 1). The long winter stolons have natural constrictions in them and are fragile, as if adapted to fragment easily. This spread of vegetative fragments was also increased with grazing by Greylag Geese (*Anser anser*), Canada Geese (*Branta canadensis*) and Eurasian

Figure 1. Water Germander at Upware North Pit, Cambridgeshire, in 1972–2012, the only extant population in East Anglia, showing some positive response of plants to the removal of shading competition in both 1995–2000 and 2006–2010



Wigeon (*Anas penelope*). The plants responded with an explosive increase in this new environment (Beecroft *et al.*, 2007; Cadbury, 2004–2012; Table 1).

A survey at the end of July 2011 revealed nearly 1.8 million shoots of this rare plant at Kingfishers Bridge. Such an increase is extraordinary and only comparable, perhaps, to the explosion of an alien exotic species in a new environment. Figure 2, essentially a log plot of the data in Table 1, serves to show the multiplicative rate of increase to have been about threefold *per annum* for the first five years (1998–2004) before the rate of increase slowed down.

One key habitat feature of this colonised environment is the summer draw-down of water from the winter and spring inundation. This water regime was planned to optimise wildfowl feeding and wader breeding and, on this site, may be controlled to some extent. As a natural wetland characteristic this would have been a feature of Water Germander's original native site in the limestone pit.

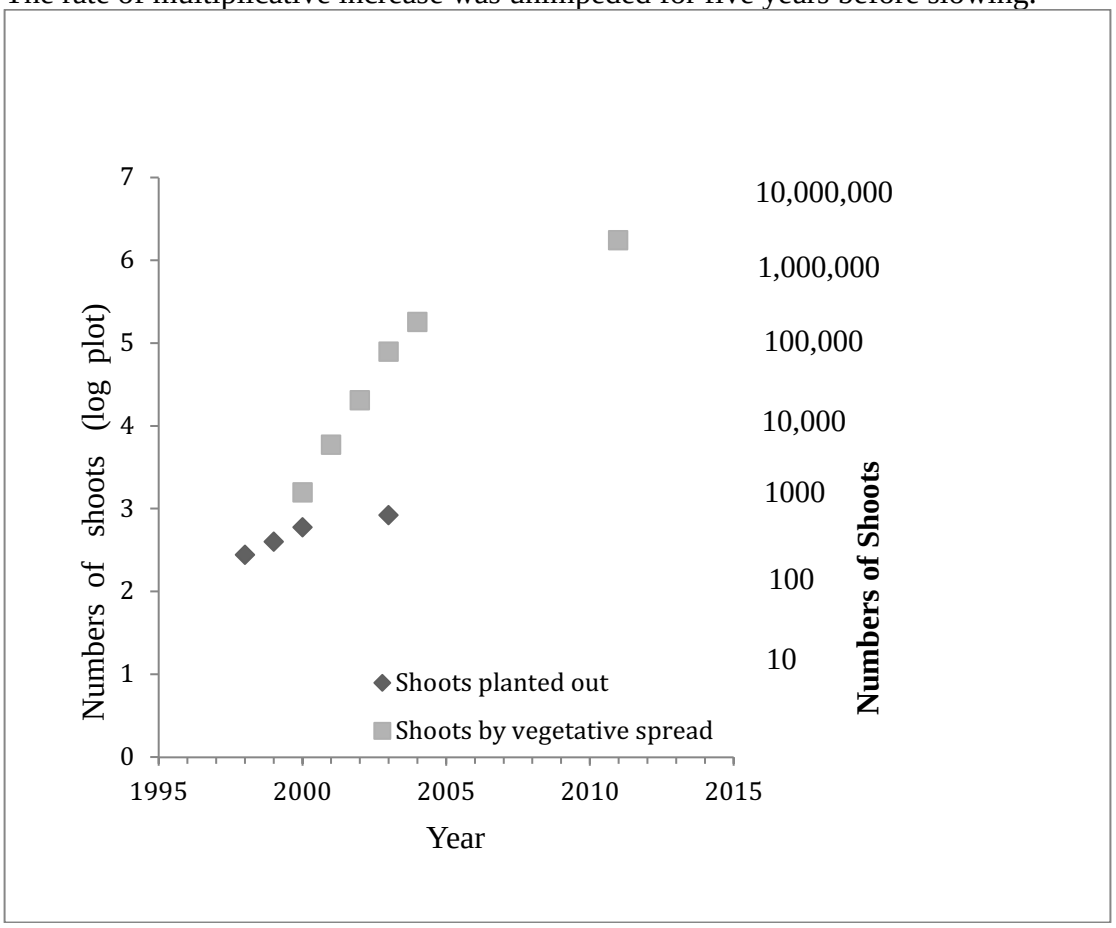
A concern for this plant's future at Kingfishers Bridge is the dense and deep mat (up to 20 cm) of New Zealand Pigmyweed (*Crassula helmsii*), an invasive alien that has spread over the draw-down zone and the shores of the lake and its islands since 2006, if not earlier. While mature Water Germander plants compete successfully with New Zealand Pigmyweed it might be more difficult for young plants to thrive. The lake edge bordering the 'Winter Flood' at Kingfishers Bridge now manifests a rough zonation with, successively, Water Mint (*Mentha aquatica*), Water Germander and then New Zealand Pigmyweed along the draw-down zone to the lake edge.

Table 1 Shoot counts of Water Germander from propagated stock at Kingfishers Bridge Wetland Creation Project

Year	Shoots planted	Shoots counted	Comment
1998	280		Initial introduction, 'Fen'.
1999	400		Further planting.
2000	600	1,845	Further planting & 1st field count.
2001		5,950	2nd field count.
2002		20,578	3rd field count.
2003	845		Last planting.
2004		181,000	4th field count: most on 'Winter Flood' and the lakeside draw-down.
2006			An increase was noted on the 'Winter Flood'.
2007			Spread to five islands on the 'Wader Meadow'.
2008			Now the dominant community over 2083 m^2 of 'Winter Flood'.
2011		1,766,700	5th field count: 1,505,600 on 'Winter Flood' alone, 110,500 on 'Wader Meadow', 64,700 on lake shore, 63,800 in 'Reedbed', 16,160 on the lake islands, 5480 in ditches, 170 on 'Confused Flood' and 290 on S.W. 'Sand Martin Pit' (Figure 3).

It should be noted that, apart from the new wetland at Kingfishers Bridge, the only other deliberate introduction of Kingfishers Bridge material into 'wild' situations has been at Bassenhally Pit, near Whittlesey (v.c. 29; TL297986), in 1999, when 41 shoots were planted in the nearby fen. This was only done because this site had lost its original native population by 1970. There were 1683 shoots there in 2004 resulting from this introduction (Mountford & Cadbury in Beecroft *et al.*, 2007b).

Figure 2. Colonisation by Water Germander at Kingfishers Bridge (log plot)
The rate of multiplicative increase was unimpeded for five years before slowing.

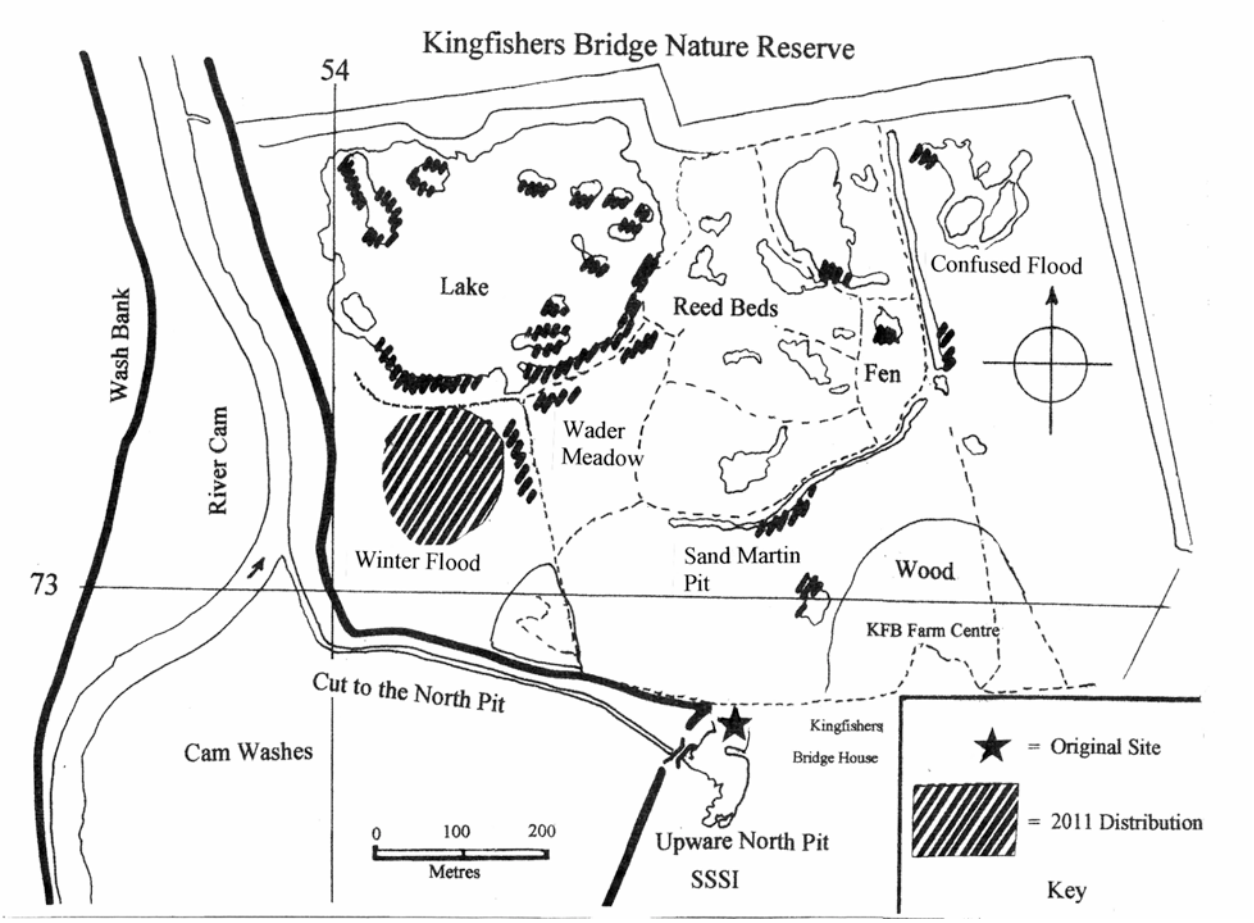


What has been learnt

In support of and in addition to the observations already made by Beecroft, Cadbury & Mountford (2007) it is clear that:

- Water Germander stolons are very important in its over-wintering strategy, continuing to grow slowly and being stout and stocked with food reserves.
- Stolons are fragile and wildfowl (geese and grazing ducks) seem to play a role in breaking up these stolons, so promoting their relocation by water dispersal.
- Sheep will eat but do not appear to target the shoots in their grazing, probably owing to the plant's chemical defences with its strong garlic-like smell.
- In dense shade Water Germander flowers very poorly, but it flowers vigorously in the open, where there is less competing vegetation. The importance of pollinators and of any natural seeding in its dispersal is still unassessed but likely to be less important than vegetative spread.
- In its relict Cambridgeshire S.S.S.I., where presently the habitat is too wet in summer and easily overgrown, Water Germander is less likely to survive. Where it is open to the light all year, where there are wildfowl grazing and where there are some physical trampling and a summer draw-down of water following winter inundation, it will do better.

Figure 3. A map of the Kingfishers Bridge Nature Reserve to show the location of the Upware North Pit SSSI, where Water Germander still persists, and those areas (cross-hatched) where this species has been introduced and is now spreading naturally. The thick dark line is the raised Cam Wash bank.



- Where these habitat conditions are met, together with a base-rich water supply or base-rich substrate, if Water Germander is present or introduced, it may be expected to colonise.

Cambridge Milk-parsley (*Selinum carvifolia*)

Since 1952 Cambridge Milk-parsley has been restricted in Britain to Cambridgeshire (v.c. 29), where it has been recorded at four sites. At Fordham Abbey it was known from 1882 until about 1949. Sawston Hall Fen (TL491400) supported a large population from 1969 until at least 1988. By 1997 a decline had set in; only 44 plants were counted in 2006 and there were none between 2007 and 2010. Fifteen seedlings were seen in 2011 but they did not survive into the summer and no plants could be found in 2012. From 1976 until 2007 there was very little or no grazing by cattle on the fen and as a result coarse and tussocky vegetation such as Purple Moor-grass (*Molinia caerulea*) and Tor-grass (*Brachypodium pinnatum*) developed. Grazing by cattle was reinstated, perhaps too late, in 2007. The fen also suffered from a lowered water-table (Cadbury & Mountford 2007, Cadbury 2009).

It would appear that Cambridge Milk-parsley is now limited to two indigenous sites. Chippenham Fen (TL648691) has by far the largest population and there are many young plants (O'Leary, 1995; Cadbury, 2009). At Snailwell meadows (TL640681), only 1.5 km away from Chippenham, there is only a small number of plants in two areas. Here the lack of grazing seems to have been detrimental to Cambridge Milk-parsley.

In August 1996, at the establishment of the Kingfishers Bridge project, compartment 5 was designated by Roger Beecroft and Andrew Green for the creation of a 'Fen' community (Tomkins, 1998, 1999). This 'Fen' slopes down to the north. Though the water-table is near to the surface over the one hectare it is not much flooded in winter, but it dries out progressively in summer. Bales of fresh hay were cut from compartments 10, 11 and 1 at Chippenham Fen in August and September of 1996. These were spread on the site to release seed. A more horticultural method was also employed: Cambridge Milk-parsley seed was collected, which germinated readily, and the resulting 300 seedlings were grown in trays in a poly-tunnel. More than 100 of these were then planted out in 1997 in quadrats along north-south lines on the 'Fen'. This would have maximised the soil water variation on this then sparsely vegetated site. Cambridge Milk-parsley was certifiably present in 1998 but it went unrecorded in the next eight years. It was presumed to have died out, but in 2006 nine plants, undoubtedly from the Chippenham source, were found together in the 'Fen'. Seven of these were flowering, indicating that they had indeed been present for at least two years undetected. This introduced population has been monitored each year subsequently and now shows promising signs of increasing

Table 2. Cambridge Milk-parsley in the 'fen' area at Kingfishers Bridge (recorded early July to late August)

Year	No. of plants and seedlings	No. of flowering stems	No. of umbels	No. of water buffalo
1996	Fen litter (hay) dispersed on site			
1997	> 100 seedlings introduced			
1998	Not refound despite searching			
1999–2002	Unrecorded despite searching			
2003–2005	No systematic search			
2006	First re-recorded 14.07.06: 9 plants	> 7		
2007	10 plants	22		2
2008	6 plants (47 seedlings)	20		5
2009	32 plants	19		4
2010	31 plants (59 seedlings)		95	7
2011	54 plants	23	66	9
2012	107 plants	100	146	9 + 2 calves

Asian Water Buffalo (*Bubalus bubalis*) have been used in U.K. conservation projects for some years, including at Chippenham Fen N.N.R. Roger Beecroft introduced these animals to Kingfishers Bridge in 2006 to help manage rank wetland vegetation and to open reedbed channels and pools for Bitterns (*Botaurus stellaris*). Since 2007 the 'Fen' area has been subject to grazing and trampling by these large herbivores (between two and nine in number) for a short period of a few weeks only between the end of June and August each year. Some inflorescences are grazed and trampled, but sufficient remain to allow seeding onto more open
poached ground.

This management opens up the sward and enables shed Cambridge Milk-parsley seed to germinate easily. Seedlings are light-demanding and seem not to compete well with other vegetation, but we have also established that a lot of trampling of young plants by buffalo is detrimental! We plan to continue experimentation and monitoring.

Fen Ragwort (*Senecio paludosus*)

The last confirmed 19th-century record of Fen Ragwort in Britain was in the neighbourhood of Chatteris in Cambridgeshire in 1883. It was present at Wicken Fen until 1857 and last recorded at Lakenheath Fen in 1817 (Michna, 2006). Considered extinct in Britain for nearly one hundred years, a very small population was discovered in a roadside ditch near Stuntney in 1972 (Walters, 1974). The ditch had been dug only in 1968 when a bypass was constructed on the A142. The Stuntney population has been monitored annually since 1972 and rather amazingly has survived at least until the present (2012). There have never been more than about five plants there, but they have produced up to 82 stems (Michna, 2006; Palmer, 2006). In 2011 there was a single plant with eight stems. The site is only five kilometres from Kingfishers Bridge.

Fen Ragwort was propagated from the Stuntney population, first at the University of Cambridge Botanic Garden, then later at Monks Wood from 1991, and more recently elsewhere. Fen Ragwort was one of the species covered by English Nature's Species Recovery Programme between 1999 and 2005. Terry Wells, of the Institute of Terrestrial Ecology at Monks Wood, took the lead on Fen Ragwort from 1991 until 2000; Tim Pankhurst and Richard Lansdown continued the project. Stock, propagated mainly from seed from Stuntney, was introduced to the wild at nine sites, one in West Suffolk (v.c. 23), one near Peterborough and the rest in Cambridgeshire (v.c. 29) (Wells *et al.*, 1994; Palmer & Lansdown, 2005; Table 3).

Table 3. The translocations of Fen Ragwort from the initial Stuntney stock (with overall survival of translocations < 4.5%)

Site	Plants introduced	Years of introduction	Plants surviving in 2012
Wicken Fen (N.T.)	50 + seed + 10	1992, 1993, 1997	None (lost by 2005)
Cam Washes	12	1995	None (lost by 1997)
Bradford's Farm, Stuntney	12	1995	None (lost by 1996)
Welches Dam, Ouse Washes (2 localities)	6 + 12	1996	None (lost by 2000 and 2009)
Flag Fen, Peterborough	12 + 6	1996, 2000	None (lost by 2002)
Barway, Soham	5 + 9 + 31	1999, 2003, 2007	None (lost by 2010)
Total attempted on all failed sites	**165+** plants and 270 seeds		**0**
Lakenheath Fen (14 localities)	12 + 12 + 13 + 90	1998, 2001, 2005	5 (flowering)
Woodwalton Fen (2 localities)	50, 40 + 12	1992, 1993, 1995	16 (flowering)
Kingfishers Bridge, Wicken	14 + 12 + 4 + 6 + 1	1997, 1998, 2005, 2007, 2008	1 (flowering)
Total attempted on all successful sites	**266** plants		**22**

In 2012 translocated Fen Ragwort was present at three sites. At Jackson's Bridge, in Woodwalton Fen, it has persisted for over 20 years at one of the two sites where it was introduced; at Lakenheath Fen it has lasted for seven years and in the 'Fen' area at Kingfishers Bridge for five years so far (Table 3). There are a further six sites where the introductions seem to have failed. At Welches Dam, in the Ouse Washes, it survived for 12 years and at Wicken Fen for seven years. Three of the Kingfisher Bridge translocations only persisted for one or two years. On Shropshire's Farm at Barway it probably survived only about seven years; here in August 2007 there were two plants, each with a single tall flowering basal shoot (1.8 m and 1.6 m), at one site where five two-year plants had been planted out in 1999, and at the other site eight of the original nine plants planted out in 2003 had survived, producing a total of 70 basal shoots, 48 of which were flowering. The average height of these shoots (n = 23) was 1.33 m (range 1.10–1.72 m). Lindsay Rolph, who was the Shropshire's Farm Conservation Officer at the time, grew a further 40 plants in pots from seed planted in the autumn of 2006. Nine of the plants were kindly donated to Kingfishers Bridge for introduction. Three plants were planted at each of three sites in 2007 and the other three on the bank of the River Cam in 2008. Of these only one small plant was surviving in 2012 and this was in the 'Fen' area. The other 31 pot-grown plants were planted out in the autumn of 2007 at the same

site as the 2003 Barway translocation. By 2011 none of these 45 introduced plants had survived (Lindsay Rolph, pers. comm.).

Peter Michna, Experimental Supervisor at the University of Cambridge Botanic Garden, has responsibility for keeping Fen Ragwort in cultivaton. In 1992 he reported only 0.6% of Stuntney seed to be fertile (Michna, 2006), which is a much lower fertility than seed from plants in Germany and the Netherlands. Similarly, 270 Stuntney-sourced seeds planted on bare ground at Wicken Fen only produced two plants (Palmer, 2006). However, Michna (2006) reported 33.5% viability in swollen achenes from plants grown at Woodwalton Fen. He reported 80% germination from good seed, immediately after harvesting, without vernalisation. On the other hand Lindsay Rolph took seed from plants translocated at the Barway site, refrigerated them and then sowed them in damp cotton wool; those that germinated were set on damp peat for growing-on in pots (40 grown successfully). We have found Lakenheath seed unviable in 2011. This real difference between sites may be in pollination or some other seasonal or growth-limiting factor. There has been no evidence of successful seeding through natural floral reproduction at any of these translocated sites, though the number of flowering shoots produced from a rootstock has tended to increase with age. Importantly, under cultivation, clonal propagation may succeed from stem cuttings or divided rootstocks.

There are several possible reasons why translocations have had low success:

- The grazing of shoots was recorded at six sites – by slugs and snails (Wicken Fen and Ouse Washes), by the larvae of Cinnabar Moth (*Tyria jacobaea*) (Lakenheath Fen), by Rabbits (*Oryctolagus cuniculus*) (Bradford's Farm, Stuntney), by sheep (Kingfishers Bridge), by cattle (Cam washes and Kingfishers Bridge) and by geese (Kingfishers Bridge). Plastic guards were used to protect plants at Wicken Fen, Flag Fen and Kingfishers Bridge, whilst there were fenced exclosures at the Ouse Washes, Wicken Fen, Lakenheath and Barway. We consider that mature plants would tolerate some cattle-browsing.
- Mature plants of three or four years of age may be able to compete with tall vegetation, but younger plants are poor competitors with Common Reed, Reed Sweet-grass (*Glyceria maxima*) and other tall plants and these contributed to the demise of Fen Ragwort at Wicken Fen, the Ouse Washes and Kingfishers Bridge. It was noted that mature plants growing among tall vegetation may develop twisted and brittle stems.
- Water level factors: Fen Ragwort can readily tolerate winter inundation (which might protect them from grazing by slugs). However, prolonged flooding, especially in summer such as occurred at the Ouse Washes between November 1997 and July 1998, is definitely detrimental. Fen Ragwort growing in a river flood-plain is likely to be well adapted to a summer draw-down of water levels. On the other hand, some sites, such as the drain at Bradford's Farm, Stuntney, have been too dry for the plant.

If further translocations of Fen Ragwort are to be undertaken, considerable care must be taken to select favourable sites such as the draw-down margin of a lake or pool. These plants may be propagated vegetatively by dividing the

rootstock of previously grown ones. The site should be at least damp in summer and not subjected to prolonged flooding, especially in summer. The general need is to be free of tall vegetation; mowing in autumn may be necessary. Plants should be tested further to see the effects of grazing and trampling by livestock and deer. Trampling may open up the sward for seedlings. Plants should be grown from seeds with swollen achenes. Germination is unlikely to depend on initial refrigeration (but worth testing) and seedlings will require frequent watering. Pankhurst & Lansdown (2005) suggest, from continental evidence, that Fen Ragwort regenerates naturally by pieces of rootstock being torn up by floods and lodging on bare soil in the unstable lower flood-plains of large rivers.

Conclusion

For these three species at Kingfishers Bridge, the most important recovery achievement has been the spectacular increase in Water Germander. Monitoring of its status should continue. Other translocation of Water Germander should be possible but should not be undertaken without careful assessment of its historical status and discussion of the aims. The one indigenous site in Cambridgeshire, although demonstrating the species' tenacity, is now provenly vulnerable. It has been encouraging to see the gradual increase in the introduced population of Cambridge Milk-parsley now that it appears to be restricted to just two native sites in Britain. It seems to be benefiting from grazing and trampling by Water Buffalo. Further monitoring and experiment should continue. The attempts to establish the Critically Endangered Fen Ragwort at Kingfishers Bridge have virtually failed, but so have most other attempts at re-establishing it elsewhere. More attempts should be made. The efforts of Andrew Green and the Kingfishers Bridge Trust in furthering wetland restoration and endangered plant species recovery must not be wasted. These results, both positive and negative, should prove helpful in guiding the recovery of these species elsewhere.

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Contributions towards a new algal flora of Cambridgeshire (Vice-county 29). 7. Phylum Rhodophyta (Red algae).

Hilary Belcher, Erica Swale and Eric George

The phylum Rhodophyta comprises not only the familiar red seaweeds but also a small number of freshwater genera whose chloroplasts are mostly not coloured red but blue-green or olive green. Notes on some of these which occur in Cambridgeshire have already appeared in this journal (Belcher and Swale 1991, 2002), and are listed below in the order used by Sheath in the second edition of the new British algal flora of John et al (2012), together with a species recorded from the River Chelmer near Chelmsford and probably also occurs here.

Chroodactylon ornata (C. Agardh) Basson (*Asterocytis smaragdina* Reinsch). Found regularly growing on older *Cladophora* filaments on twigs in the concrete-lined ornamental pond at Cambridge Regional College, King's Hedges Road, Cambridge. It forms short

branched uniseriate filaments, and the cells have distinct bright blue-green stellate choroplasts. (Belcher and Swale 2002). The cells are about 10μm wide and 10 - 15μm long.

Porphyridium purpureum (Bory) Drew et Ross (*P. cruentum* (Ag.) Nägeli). This colonial alga consists of numerous spherical cells about 10μm across, embedded in mucilaginous colonies superficially resembling drops of blood ("gory dew" of Victorian microscopists) occurring in damp places rich in sodium. Not reported from Cambridgeshire since G.S. West in recorded it from the wall of the Senate House (presumably from Senate House Passage), from the Leys School and by Newnham Mill (West, 1899). The lack of sightings is probably due to the virtual disappearance of horse-drawn traffic. (Belcher and Swale 2002).

Bangia atropurpurea (Roth) C. Agardh. This species, with uniseriate or multiseriate dark red filaments is known to favour neutral or slightly alkaline running water. We found it at Bottisham lock near Waterbeach in August 2000, among *Cladophora glomerata* filaments in a downrush of water. *B. atropurpurea* also has a juvenile so-called *Chantransia*-stage of narrow branched red filaments which burrows in molluscan shells (Belcher 1960).

Audouinella pygmaea (Kützing) Weber-van Bosse. G.S. West (1899) recorded an alga from a mill-stream at Sheep's Green, Cambridge as *A. chalybea* (A. Roth) Bory, but there is no figure nor any measurements. B.G. Sheath in John et al (2002) is of the opinion that is should be regarded as *A. pygmaea*, which is now generally thought to be the juvenile stage of one of a number of adult freshwater red algae. In the above case it was probably the young stage of either *Thorea hispida* or *Batrachospermum* sp., both of which occur in the Cam and Great Ouse river system.

Dealt with here, though not strictly part of the vice-county flora, algal growths which appeared to belong to this genus were handed to us which grew plentifully on the gravel in the open-topped and interconnected fish tanks, kept at 23 °C, belonging to Pet-Paks Ltd, an aquarists' and pet stores at Hardwick, near Cambridge. Brian Cockley, who gave us the samples, cleans out the tanks periodically, and told us that the algae were a real nuisance, growing as abundant pink and green tufts about 8 mm high, almost forming a turf. They appeared to consist of two species only, in about equal quantities, one having bluish green chloroplasts and the other red ones.

The bluish green one, with cells 35-45 μm long and about 12 wide, was identified as *Audouinella pygmaea.* The branched filaments bore many sporangia at the tips (Figure 1E), and germinating monospores were seen. A sample of this alga has been sent for DNA analysis, to see to which adult genus, if any, this plant belongs as a young stage.

Audouinella hermannii (Roth) Duby in D.C. (*Rhodochorton violaceum* (Kützing) Drew). This species, commonly found in hill streams in the north of England, has not been recorded from Cambridgeshire in a wild state, but surprisingly the red coloured tufts from the Pet-Paks aquaria was of this species, and in fact micrographs of the two Hardwick algae together looked remarkably similar to those of the same species from a hill stream illustrated in Lund and Carter-Lund (1995). (as *Rhodochorton* spp). No sporangia or spores were seen in our samples of *A. hermannii,* and the cells, as well as having pinkish red chloroplasts, were smaller than those of the *A. pygmaea,* 15-18 μm long by about 7 μm wide (Figure 1F).

Batrachospermum Roth. Until recently *B. gelatinosum* was the only species of this genus to be recorded from this vice-county (West 1899, Belcher and Swale 1991), both as *B. moniliforme* Roth). However in 2011 Janina Kwandrans from Krakow and David John of The Natural History Museum visited the pool containing springs at Cherry Hinton, sometimes known as the Giant's Grave, where *B. gelatinosum* is known to grow, and in addition found the two other species listed below. We did not see any of their samples nor any drawings or photographs, so they are not illustrated here. However, Figure 1A and B are of *B. gelatinosum*

from Northamptonshire, while *B. atrum* and *B. anatinum* are represented by habit sketches (Fig. 1, C, D).

Batrachospermum gelatinosum (L.) (B. *moniliforme* (Roth). Cherry Hinton, in ditch; Seven Springs, Shelford: brook at Fulbourn; West 1899. Pool at Cherry Hinton; various dates since 1970: stream at Meldreth; Belcher and Swale. Pool at Cherry Hinton: Kwandrans 2011. We have found the unusual endophyte *Chaetonema irregulare* Nowakowski (Chaetophorales) among its branches here.

Batrachospermum anatinum Sirodot. Pool at Cherry Hinton (the Giant's Grave); Kwandrans 2011. The whorls of branches of limited growth are contiguous in this species, see Figure 1C.

Batrachospermum atrum (Hudson) F.L. Harvey. Brook at Cherry Hinton running from the Giant's Grave into Cherry Hinton Park; Kwandrans 2011. In this species the whorls of branches of limited growth are much less developed and smaller than in *B. gelatinosum*, see Figure 1D.

Thorea hispida (Thore) Desvaux 1818 (*T. ramosissima* Bory) nom. illeg. We have not seen the adult stage of this plant, which looks like a branched strand of black knitting wool, within the vice-county, but we have seen it in the Great Ouse at Houghton Mill, and Arthur Marker, of the late Monk's Wood Experimental Station has observed the adult stages in the same river at Huntingdon, on the submerged parts of reeds.

Plants of so called *Audouinella chalybea,* probably the *Chantransia*-stage of *Thorea*, were seen at Waterbeach Lock, looking exactly like similar stages from the River Lea which grew below where *Thorea* was abundant. Swale (1962, 1963) studied these stages and observed the transition to the adult plant in culture. In that river the adult *Thorea* plants were only developed in favourable years, while the *Chantransia*- stage was always present.

Hildenbrandia rivularis (Liebmann) J. Agardh. Not apparently recorded from this vice-county, but included here because a sample was passed to us which had been scraped from stones collected from Hoe Mill on the River Chelmer, Essex (G.R. 52/707087), and it may well occur here in similar places. By the time it was passed to us the cell contents had disintegrated into a pink liquid, but the cell structure clearly showed it to be *Hildenbrandia rivularis* (Figure 1, G-J). This species is common in the north and west of Britain, appearing as pink patches on rocks in hill streams, but the Chelmer record is the only one we know of in East Anglia (Belcher and Swale 2005).

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Figure 1. Freshwater red algae (Rhodophyta).
A: *Bactrachospermum gelatinosum* (*moniliferum*), part of thallus, x ca500. B: the same, natural size; C: *Bactrachospermum anatinum*, the same, habit sketch, x ca.50. The whorls of branches of limited growth run into one another in this species. D: *Batrachospermum atrum*, the same habit sketch, x. 50. Here the whorls are much reduced. N.B. the various species of *Batrachospermum* cannot be identified by external appearance alone, but the sexual apparatus must be examined (the "birds' nests" in figure 1A). E: *Audouinella pygmaea*, part of filament, x ca. 750. F: *Audouinella hermannii*, the same, x ca 750. G-J, *Hildenbrandia rivularis* from the River Chelmer, Essex. G: erect filaments near centre of colony, H: cross section of these, I: prostrate filaments near the margin, J: prostrate filaments further back, all x ca. 500.

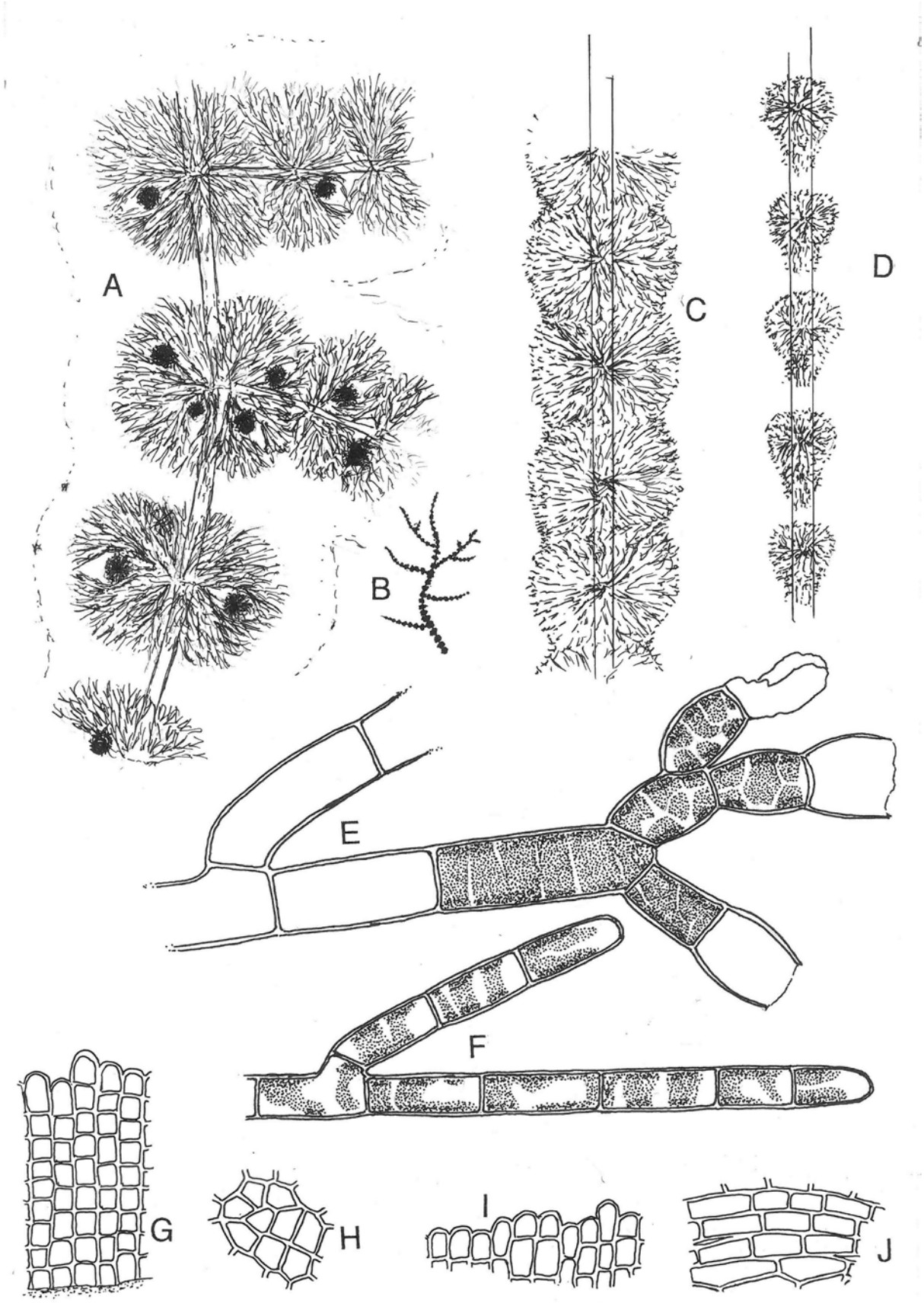

Figure 1. Rhodophyta

Diptera of the Devil's Ditch, Cambridgeshire

I Perry

Abstract

An annotated list of Diptera, associated with chalk grassland and scrub on the Devil's Ditch, Cambridgeshire is given, the result of a long term study by the author. Also included is all historical data of species of conservation importance, where known to the author. Brief notes on distribution and biology are provided and important groups of Diptera present on the Ditch are discussed.

Introduction

Since 1969 the author has made irregular visits to the Devil's Ditch investigating the Diptera fauna. This has revealed the presence of several species of national importance associated with herb rich calcareous grassland and scrub and many others likely to be restricted to this or just a few other sites in vice county 29. There has been a long history of recording Diptera on the Ditch, starting with Leonard Jenyns during the early 19th century and continued with James Edward Collin and some of his contemporaries during the first half of the 20th century. The present investigation has failed to reveal several species that were recorded in the past and it seems likely that many of these have now been lost, although a few may yet be refound.

The Ditch, like many other similar sites in Southern England, became largely covered in scrub during the latter part of the last century. This will have severely restricted the amount of suitable habitat available for many species and may have caused populations to become isolated from one another, a particular problem for a narrow, linear site. Added to this, many of the Diptera recorded on the Ditch exist as isolated populations on the northern edge of their range in this country, further adding to their vulnerability. In listing the flora of the Ditch, Leslie (2011) noted losses of some native plant species and with no resting seed or vegetative phase available, invertebrates may have been disproportionately affected when conditions became unfavourable. Since the early 1990s sheep grazing has been restored to some northern parts of the Ditch and large areas of scrub have been removed, as part of a Lottery Funded Restoration Project. It is hoped that these measures will help prevent any further losses, although restoring herb rich chalk grassland to areas previously under mature scrub is far from easy, as was noted by Stanier (1993). On the plus side in recent years several species of Diptera, particularly amongst the Tachinidae, have been recorded from the Ditch for the first time. These include species such as *Cistogaster globosa*, which was formerly restricted to just a few sites in southern England and has probably extended its range in response to global warming. Further colonisations are likely, although given the isolated position of the Ditch, this may only be possible for the most mobile of species and there is little indication that the majority of downland Diptera, many of which are very specific in their requirements, are increasing in numbers and spreading northwards.

Herb rich calcareous grassland can be very rich in certain families of Diptera, but as many species associated with this habitat are warmth loving, they are at their most diverse on the South Downs, with a decline in diversity as you move further north. Many Diptera develop in the soil, although being well drained chalk grassland precludes the presence of many species and only those adapted to such dry conditions, particularly noticeable on the steep slopes of the Ditch, can survive there. The soil of the golf course section is much sandier in parts and this explains why some species of Diptera associated with these conditions are present there, including some largely restricted to the Breckland in this region. With such a high floral diversity, it is not surprising that phytophagous Diptera are well represented on the Ditch. Many of the Chloropidae develop in grasses and are often numerous in sweep net samples on the Ditch. Several of the rarer species have been found, although in most of these cases the precise host plant associations are not known. Some of the Chloropidae such as *Oscinimorpha sordidissima* and the *Trachysiphonella* species appear to favour short turf and are more likely to be seen in the race course and golf course sections where such conditions are more prevalent. The northern sections of the Ditch are dominated by taller grasses such as *Bromopsis erecta (Bromus erectus)* with an abundance of tall herbs such as *Centaurea nigra* and *C. scabiosa*. Several species of Tephritidae associated with *Centaurea* are present on the Ditch here, including some of the rarer ones that develop in *C. scabiosa*.

Predatory species of Diptera of the family Asilidae are often conspicuous on the Ditch, such as the black winged *Dioctria atricapilla* which can be seen flying through long grass, with other species hunting from bare ground or bush foliage. Sweep netting bushes will often reveal large numbers of small predacious Diptera such as Empididae and the genus *Platypalpus* (Hybotidae). Another group of Diptera that is prevalent on the Ditch is of those that are parasitoids, developing in the bodies of other insects or in some cases other invertebrates. Amongst the Pipunculidae, which as larvae live inside froghoppers and planthoppers (Hemiptera: Auchenorrhyncha), the tribe Eudorylini which favours grassland habitats can be quite frequent on the Ditch, including some of the more local species. The Tachinidae, which are well represented on the Ditch, particularly in the northern sections where they may be found feeding at flowers of *Daucus carota* and *Pastinaca sativa*, are parasitoids of a variety of insects and in a few cases centipedes. Their main hosts are butterfly, moth and sawfly larvae, adult and larval beetles and plant bugs. They exhibit a full range of host specification, from species restricted to just a single host to *Compsilura concinnata* (present on the Ditch), which in the Palaearctic is known from over 200 host species from 3 different orders (Chandler 2010).

Sources of records

There have been no published lists of the Diptera occurring on the Devil's Ditch, although as a locality it is often cited in the literature. This list draws on a wide range of published records and museum specimens where they have been seen by the author. The main sources of records are:

(a) the manuscript list of Diptera in *Entomologia Cantabrigiensis* by Leonard Jenyns (1800-1893) donated along with his specimens to the Cambridge Philosophical Society and now incorporated into the collections of the Cambridge University Museum of Zoology. There are no dates given or data labels on the specimens, but records would have been made between 1818 when he arrived in Cambridge and 1849 when he left the county. A number written on the stage of the specimens (where they still exist), corresponds with numbering of the manuscript list, allowing the identifications to be checked.
(b) the records made by James Edward Collin (1876-1968) who lived for most of his life at first Kirtling and then Newmarket. He collected widely in the area, with many of his records from the Ditch coming from the 1930s. His collection, along with that of his uncle George Henry Verrall (1848-1911), who moved to Newmarket in 1879, is housed in the Hope Dept., University of Oxford (OUM). Unfortunately the data labels are face down in the cabinets and as many of the specimens overlap, extracting data is a very difficult and time consuming exercise and I have only attempted this for the Syrphidae several years ago. Some families have been curated since then, but most of the collection remains in its original state (Pont 1995). Fortunately Collin published widely on the Diptera and examination of his various papers has provided much useful information, although undoubtedly many more records from the Ditch remain undiscovered in his collection
(c) the Diptera collection in the Natural History Museum, London (NHM). This contains the collections of Colbran Joseph Wainwright (1867-1948) and Evelyn Cecil Muschamp D'Assis-Fonseca (1899-1993), both of whom were friends of James Collin and visited the Ditch with him. Unfortunately it has not been possible to check the whole of the extensive collection of Diptera held at the museum for records from the Ditch
(d) the Diptera in the Cambridge University Museum of Zoology (CUM). Unfortunately apart from what remains of the Leonard Jenyns collection, there is little material from the Ditch, although it did provide a few interesting records
(e) the records made by Ivan Perry during irregular visits to the Ditch from 1969-2012. Not all of the Ditch received equal coverage, with the area to the north of the Burwell Road and the golf course section having the majority of visits, with the sections in-between receiving less attention. The Ditch is wooded south of the Newmarket Railway and remains virtually unexplored for Diptera and is not included in this report

Much of the information on biology and distribution was obtained from Falk (1991) and the reviews of scarce and threatened flies of Great Britain, published or in preparation by the Joint Nature Conservation Committee, Peterborough. The conservation status of many Diptera is out of date or under review and is not included in this paper.

Interpretation of the List

The nomenclature and order largely follows Chandler (1998). Historical records cannot be assigned to a specific section of the Ditch, although they often

include Reach, Burwell or Newmarket in the data, giving some indication of where on the Ditch they were made. Unless otherwise stated, all records are those of the author and where possible have been assigned to a specific section of the Ditch. In dividing the Ditch into sections I have largely followed Leslie (2011), but have included some areas immediately adjacent to the Ditch and have not included any of the wooded area south of the Newmarket railway. Sections of the Ditch are indicated by numbers and letters in brackets as follows: (1) Reach to the old railway; also (1A) a narrow strip of grassland adjacent to the NE side of the Ditch running from the Reach car park southwards; (1B) a fallow field on the SW side of the Ditch bordered by the old railway and the Reach to Swaffham Prior road and (1C) the banks of the old railway.
(2) The old railway to the Burwell Road.
(3) The Burwell Road to the A14.
(4) The Running Gap to the Newmarket Road (A1304), often referred to as the race course section.
(5) The Newmarket Road (A1304) to the Newmarket Railway Line, often referred to as the golf course section. Some of my own records from here will have included the area immediately adjacent to the NE side of the Ditch, which forms part of the Steeple Chase Course and is maintained as short turf by the Jockey Club.

List of Species

Limoniidae

Dicranomyia sericata

A species of dry calcareous grassland, this small grey cranefly probably develops in the soil. (2) 24. iv. 1994.

Limonia maculipennis

Often associated with hedges in Eastern England, it probably develops in soil under scrub. (5) 9. v. 1999.

Asilidae

Asilus crabroniformis

This large and distinctive species was recorded by Jenyns from Newmarket Heath and there is a specimen in CUM labelled “Devils Dyke, Cambs 25. vii. 1924 A. W. Rymer Roberts.” It lays its eggs in dung, where the larvae appear to prey on the larvae of Dor Beetles *Geotrupes* sp. It has undergone a huge decline nationally since the early part of the last century and is certainly absent from the county now.

Dysmachus trigonus

Restricted to sandy ground it can be quite frequent on the coast in fixed dunes or inland on heaths. Biology largely unknown, but probably develops in the soil preying on beetle larvae. Said by Jenyns to be “not uncommon on Newmarket Heath and Devils Ditch in June.” Still present and known only from Furze Hills, Hildersham elsewhere in vc 29 (L. Bacon pers. comm.). (5) vii. 1995.

Eutolmus rufibarbis

This is a species of sandy ground in Southern England and is quite widespread in the Breckland. Larvae live in the soil where they prey on beetle larva. There appear to be no historical records for vc 29 and recent records may represent an expansion of the Breckland population due to hotter summers. It turned up at the edge of Chippenham Fen NNR in 2008 and was recorded on the Ditch the following year. (5) 24. vi. 2009.

Machimus cingulatus

This is another species of sandy ground and is quite widespread in Britain on heathland and in coastal areas. There is a recent (1995) record from Chippenham Fen (L. Bacon pers. comm.) but it is likely to remain restricted in vc 29 because of its habitat requirements. (5) 23. vii. 1995.

Leptarthrus brevirostris

In Southern Central and South East England this is a species of tall *Bromopsis erecta* chalk grassland and is considered a typical species of this habitat. However away from here it can be found in a variety of situations and appears to even inhabit acidic areas. Recorded from the Ditch by Jenyns and according to Verrall (1909), there is a specimen from there in OUM dated 2. vii. 1833. (2) 27. vii. 1976, 26. vii. 1977, (5) 20. vi. 1999.

Hybotidae

Platypalpus pictitarsis

The status of this species in Britain is not clear as it was formerly confused with *P. kirtlingensis*, which appears to be the more frequent of the two. (2) 22. vi. 1989, 12. vii. 2003.

Tachydromia halterata

There are only a few old records from south-east England and East Anglia, including some localities in Cambs. In June 1937 both sexes were found on the Ditch near Burwell by Collin (1961) and these were the last records from Britain. Very little is known about the biology of this species and it seems quite likely that it is now extinct in this country.

Empididae

Empis woodi

This species has been recorded from scattered localities across the south of the country and is probably under-recorded. Biology unknown, but appears to favour woodland and scrub on calcareous soils. (5) 2. v. 1995, 28. iv. 1998.

Dolichopodidae

Dolichopus agilis

Recorded from scattered localities as far north as Yorkshire, it is known from a variety of habitats, some being wetlands, whilst others are very dry such as the Breckland and the Ditch. Biology unknown but probably develops in the soil. (5) by large pines 2. vii. 1995, 5. vii. 1995.

Syrphidae

Cheilosia cynocephala

This hoverfly is a species of calcareous soils, where the larva tunnels into the stems of *Carduus nutans*. It appears to be sporadic in appearance with large numbers found by Collin on the Ditch at Burwell in 1937. There are no recent records from the Ditch, but it was found at the edge of Wicken Fen NNR in 2004.

Xanthogramma citrofasciatum

This is a characteristic species of dry calcareous grassland where there is an abundance of anthills. Larvae have been found in the nests of ants where they fed on ant-attended root aphids. Found on the Ditch at Burwell by Collin 2. v. 1939. (1C) 16. v. 2004, (5) 30. v. 1970.

Pipunculidae

Claraeola halterata

Pipunculidae are small, delicate flies with large compound eyes, which they use to good effect, hovering precisely through vegetation. The females have modified ovipositors which enable them to lay their eggs inside leaf hoppers (Cicadellidae), where the larvae develop as parasitoids. The precise host relationships of most of the rarer species is unknown. *C. halterata* is a species of calcareous grassland and seems to prefer quite short, herb rich turf and was seen on the Fleam Dyke in 2004. (3) 19. vi. 1988, (5) 5. vii. 1995.

Dasydorylas horridus

Recorded from a variety of habitats, with records from chalk grassland quite frequent. (2) 26. v. 1980, (5) 30. iv. 1997, 22. v. 1997.

Eudorylas arcanus
Habitat requirements of this rare species are not clear, it is recorded from various grasslands and woodland edge situations. The two records from the Ditch are based on female specimens and remain provisional. (2) 18. vi. 1988, (5) 5. vii. 1995.
Eudorylas zermattensis
This is a species of dry grasslands including coastal dunes and the Breckland. Known from scattered records across Southern England and South Wales. (3) 19. vi. 1988.
Conopidae
Zodion notatum
A species of dry grassland and heathland, recorded from just a few sites across Southern England and Wales. Biology unknown, but larvae of related species are parasitoids of adult solitary bees such as *Andrena* and *Halictus*. (1C) 31. v. 1981.
Ulidiidae
Ulidia erythrophthalma
This species used to be much more frequent and there are several records from Cambs during the first part of the 20 century. In recent years, apart from the Ditch, it has only been recorded from Salisbury Plain, Wilts (2003). Larvae are said to develop in dung, including human cesspits. (1C) 1. vii. 2004, 11. vii. 2004, (2) 4. vii. 1979.
Tephritidae
Urophora cuspidata
Restricted to calcareous grasslands in the south of England, it develops in the flowerheads of *Centaurea scabiosa* where it induces a gall. Found by Collin "sweeping *C. scabiosa* flowers in July on the Devils Ditch near Newmarket " (Collin 1937). (2) 4. vii. 1979, reared in 1981 from dead heads of *C. scabiosa* collected in December 1980.
Acanthiophilus helianthi
There appear to be no historic records from Cambs for a species which has become more widespread in recent years. Breeds in the flowerheads of *Centaurea* sp. and other Asteraceae. (2) 12. vii. 2003.
Merzomyia westermanni
This species is local across Southern England and is normally found on or near *Senecio erucifolius*, although it is still to be confirmed as the host plant. (1C) 29. viii. 1981, (2) 28. vii. 1976, 5. viii. 1981, 29. viii. 1981.
Oxyna flavipennis
A species which develops in a gall on the roots of *Achillea millefolium,* but is very local and seems to prefer sandy areas such as the Breckland, where it can be quite numerous. (1C) 11. vii. 2004, (5) 23. vii. 1995.
Orellia falcata
A rarely seen and local species, which develops in the roots of *Tragopogon pratensis.* It appears to be unknown from vc 29 before, although there is an unconfirmed record for 2008 from Angelsey Abbey (L. Bacon pers. comm.). (1A) 5. vii. 2007.
Terellia ceratocera
Restricted to calcareous soils where it develops in the flowerheads of *Centaurea scabiosa.* (2) 12. vii. 1978, 21. vii. 1980, 11. viii. 1984.
Terellia plagiata
This species develops in the stems of *Centaurea scabiosa* and as an adult is difficult to distinguish from *T. ceratocera.* The first British specimens were bred from the Ditch by C. G. Varley in 1934 and 1935, (specimens in CUM) and Collin collected it there in July 1935 (Collin 1937). (2) reared in 1981 from stems of *C. scabiosa* collected in December 1980.
Terellia colon
Another species that develops in the flowerheads of *Centaurea scabiosa,* but it is a bit more widespread, extending into northern England. (2) 1977, 1980, reared in 1981from dead heads of *C. scabiosa* collected in December 1980, 2003, (3) 1989, 2003.

Goniglossum wiedemanni
Develops in the berries of *Bryonia dioica* and normally found on or close to that plant, but appears to be sporadic in appearance. (3) 12. vii. 1978.

Lauxaniidae

Sapromyza obsoleta
Although it has been reared from a rabbit burrow, this is likely to be unusual as Lauxaniidae normally develop in decaying vegetable matter, such as fallen leaves. (5) 14. v. 1997, 22. v. 1997 swept from *Ligustrum vulgare.*

Sciomyzidae

Coremacera marginata
This distinctive species with darkened wings is a characteristic species of dry calcareous grassland, where its larvae are parasitoids of snails. (2) 18. vi. 1979, 18. vi. 1988, (3) 12. viii. 1989.

Opomyzidae

Geomyza venusta
A characteristic species of tall chalk grassland which has been reared from *Bromus* in France. (2) 28. viii. 1988, 23. vi. 1989, (5) 2. vii. 1995.

Chloropidae

Chlorops adjunctus
A species of dry grassland, mainly on chalk and widely distributed in England. Biology unknown, but most *Chlorops* species probably develop in grasses and sedges. (4) 6. vi. 2001, (5) 2. v. 1999, 1. vii. 1999, 22. viii. 1999.

Chlorops dasycerus
A local species of calcareous grassland in England and Scotland, with a late flight period. (2) 31. viii. 1991, (5) 20. viii. 1995, 1. viii. 1999, 22. viii. 1999.

Chlorops fasciata
A species of short chalk grassland, known from the Breckland and recorded from Fleam Dyke in 1937 (Falk et al in prep). (5) 9. v. 1999.

Chlorops interruptus
A local species of Southern England which has been associated with *Agropyron.* (4) 4. vi. 2001, (5) 9. v. 1999, 16. v. 1999, 27. viii. 2001.

Chlorops laetus
Known from a few sites in Southern England where it has been found in calcareous and neutral grassland. (2) 31. viii. 1991, (5) 20. viii. 1995, 1. viii. 1999, 22. viii. 1999.

Chlorops ringens
Known from Southern England and Wales, with a preference for dry grasslands. (5) 3. ix. 1995, 10. ix. 1995, 22. viii. 1999.

Neohaplegis glabra
Although normally associated with dry calcareous grassland, there are old records from Cambs for Chippenham Fen NNR and Woodditton Wood. (2) 18. vi. 1988.

Dicraeus styriacus
Records widely dispersed including Wales and Scotland. Biology unknown, but likely to develop in grass seeds like related species. Said by Collin to be “not uncommon on the Devils Ditch about the middle of June” (Collin 1946). (4) 4. vi. 2001, (5) 20. vi. 1999.

Dicraeus tibialis
Widely distributed in Britain in calcareous to neutral grasslands and is known to develop in the seeds of *Bromopsis erecta.* (5) 9. v. 1999.

Oscinimorpha arcuata
Recorded from a variety of grasslands in Southern England and Anglesey in Wales. (2) 12. vii. 2003, (3) 12. vii. 2003, (5) 2. vii. 1995, 20. vi. 1999.

Oscinimorpha sordidissima
Known from scattered localities throughout Britain, in my experience a species of short turf in a variety of grasslands. (3) 12. vii. 2003, (5) 9. v. 1999.

Trachysiphonella pygmaea
A species of short, calcareous grassland, known from a few sites in Southern England. Recorded from the Fleam Dyke in 1937 (Falk et al in prep). (4) 4. vi. 2001, (5) 20. vi. 1999.
Trachysiphonella ruficeps
Known from a few sites in Southern England and Wales, this is a species of short, dry grassland. (4) 4. vi. 2001, (5) 5. vii. 1995, 20. vi. 1999.

Anthomyiidae

Botanophila cuspidata
Recorded from just a few sites in Southern England, habitat requirements are uncertain, but some localities are chalk grassland. Biology unknown but it is likely to be phytophagus. Described as new to science in 1967 from material collected in part on the Ditch in April and May 1937 (Collin 1967). Appears to have declined in recent years and was not seen on the Ditch during the present survey.
Delia criniventris
Although widely distributed, in my experience rarely seen and normally associated with good quality chalk grassland. (2) 22. vi. 1993, (5) 1. viii. 1999.
Delia pruinosa
Known from just a few sites in Britain, mainly in Southern England where it breeds in the flowerheads of *Silene vugaris.* 31. v. 1955 Collin in OUM (Ackland & Pont 1996).
Leucophora sericea
A species of dry sandy areas and scrubby grassland, with larvae that live as cleptoparasites in the nests of solitary bees such as *Andena fulva* and *A. haemorrhoa.* Known from just a few localities in Southern England, it was found in the Suffolk Breckland in 2002. Recorded from the Ditch by Collin in 1905 & 1935.
Phorbia juncorum
Recorded from just a few localities in Southern England. Biology unknown, but probably develops in grass stems like related species. (1C) 26. iv. 1994, 10. v. 1994, 29. v. 1994, (5) 30. iv. 1997.
Pegomya steini
Widely distributed in England and Scotland, but probably under-recorded. Mines the leaves of various thistle species. (5) 27. v. 1995.

Fanniidae

Fannia atripes
Recorded from just a few sites across Southern England, with habitat requirements unclear and biology unknown. There is only one record for the Ditch, 16. v. 1964 Fonseca (Fonseca 1968). Recorded from the Suffolk Breckland in 2005 and may to still be present on the Ditch.

Calliphoridae

Eggisops pecchiolii
A species of calcareous grasslands mainly across southern England, where it seems to have become more frequent in recent years. Develops as a parasitoid of terrestrial snails. (1B) 12. vii. 2006, (3) 12. vii. 2006.

Rhinophoridae

Stevenia atramentaria
Recorded from scattered localities in the southern half of England and generally quite scarce. Has been reared from the woodlouse *Trachelipus rathkei.* (1A) 9. viii. 2006.

Sarcophagidae

Macronychia striginervis
Known mainly from southern counties of England, but extending north to Yorks and into Wales. Larva develop as cleptoparasites in the nests of solitary wasps such as *Ectemnius* sp. which breed in dead wood. Appears to have become more frequent in recent years and has now been recorded from several sites in Cambs. (5) 22. viii. 1999.
Blaesoxipha plumicornis

This species used to be restricted to a few southern counties, but in recent years it has expanded northwards and is now known from several sites in Cambs. Larvae are parasitoids of grasshoppers such as *Chorthippus* sp. (1C) 1. vii. 2004, 11. vii. 2004, (2) 8. viii. 2005.

Ravinia pernix

Widespread but local in southern Britain, where it appears to prefer hot, dry habitats. Breeds in dung where the larvae probably act as predators. (5) 30. iv. 1997.

Sarcophaga arcipes

Known from scattered localities across Southern England, where it seems to prefer dry grassland habitats. Several specimens from the Burwell part of the Ditch were collected in 1937 by Collin and Wainwright and by Fonseca on 11. vi. 1957. The number of historic records suggest that this species was quite frequent on the northern part of the Ditch in the past, but it is almost certainly absent there now.

Tachinidae

Belida angelicae

Recorded on the Ditch by Collin on 24. & 27. vi. 1936 (Wainwright 1940), which remained the only British record until it was found at Lode, Cambs in 1986. Larvae are parasitoids of sawfly larvae of the genus *Arge,* which feed on leaves of various shrubs such as *Rosa* sp. There seems to be no obvious reason why it shouldn't still be present on the Ditch, or why it is restricted to such a small part of the country.

Carcelia bombylans

Not recognised as British until recently (Collins et al 2002), it is proving to be quite widespread across southern counties of England. It is quite frequent in the Breckland, although the present record appears to be the first for vc 29. Larvae are parasitoids of hairy caterpillars, particularly of the family Arctiidae. (5) 1. vii. 2010.

Phryxe erythrostoma

This species may have been overlooked due to its resemblance to other *Phryxe* sp. and was only recently recognised as British (Chandler et al 2001). Its usual host is *Hyloicus pinastri* but it has also been recorded from other hawkmoth caterpillars. (1B) 12. vii. 2006.

Thecocarcelia acutangulata

This species was first recognised as British in 1986 and is proving to be quite widespread across southern England.. It is a parasitoid of the Hesperiidae and has been reared from the Essex Skipper *Thymelicus lineola.* (5) 10. viii. 2005.

Exorista mimula

Known from Southern England and Wales, it is a parasitoid of sawfly larvae that feed on shrubs, such as *Athalia rosae.* It can be quite numerous at times on the northern part of the Ditch, feeding at *Daucu carota* flowers. (1A) 28. vii. 2003, 5. viii. 2006, 7. viii. 2006, (2) 8. vii. 2006, (5) 10. viii. 2005.

Exorista grandis

Widespread but scarce throughout Britain, it is a parasitoid of the Emperor moth *Pavonia pavonia* and there is a specimen in CUM reared from that host at Burwell in 1914. (3) 12. vii. 2006.

Gonia ornata

Widespread but local throughout Britain, it prefers dry, sandy habitats and can be quite frequent on some coastal dune systems. It is a parasitoid of the Noctuidae such as *Agrotis* sp. Jenyns listed *G. auriceps* from the Ditch, which is a synonym of *G. divisa,* but the specimen in CUM is actually *G. ornata.*

Catharosia pygmaea

A recent addition to the British List (Falk 1998), it is now known from several sites in Southern England. It has been reared from the Groundbug *Beosus maritimus,* which is largely coastal in this country; so it must be able to utilise other species of Lygaeidae. (1A) 28. vii. 2003, 31. vii. 2003, 8. viii. 2003 all swept from *Daucus carota.*

Cistogaster globosa
Until recently this species was restricted to just a few sites in Southern England, but has since become much more numerous and expanded quickly northwards. It inhabits dry grassland and is a parasitoid of the shieldbug genus *Aelia* in particular *A. acuminata.* First noted in vc 29 in 2004, it is now quite frequent on the Ditch, where it can normally be found feeding on *Daucus carota.* (1B) 2006, 2009, (1C) 2006, 2008, (4) 2006, 2010, (5) 2007.
Opesia grandis
First record for Britain was from the Ditch in 2006 (Perry 2006) and although it has not been seen there since, in 2007 it turned up in a garden at Lode (Perry 2008) and has been seen there most years since. These are still the only places it is known from in this country and is very rare in Europe as a whole. Host unknown, but likely to be a species of plantbug Hemiptera, Pentatomidae. (1B) 11. vii. 2006 on *Pasinaca sativa,* (2) 8. vii. 2006 on *Daucus carota.*
Loewia foeda
Known mostly from Southern England it extends north to Yorkshire. Known from a variety of habitats it is a parasitoid of centipedes of the genus *Lithobius.* (1B) 11. vii. 2006, 15. vii. 2006, (2) 12. vii. 2003.
Bithia spreta
Recorded mainly from Southern England and Wales, with a preference for dry, calcareous grassland. Larvae are parasitoids of the micro-moth *Agapeta zoegana* whose larva feed in the roots of *Centaurea nigra* and *Scabiosa columbaria.* (1B) 16. vii. 2009, (1C) 11. vii. 2004, (2) 24. vi. 2003, (4) 5. vii. 2010.
Demoticus plebejus
A species of herb rich, calcareous grassland, mainly restricted to the South, with the Ditch being its most northerly locality. Host unknown, the population on the Ditch appears small and vulnerable. Found on the Ditch by Wainwright 27. vi. 1936. (2) 18. vi. 1988, 8. vii. 2006, 10. vii. 2006, 15. vii. 2006, (3) 12. vii. 2006.
Solieria inanis
Although widely distributed, *S. inanis* was always very rare and there appear to be no authenticated records from this country since 1957. Often confused with other species of *Solieria*, it seems to have been a species of grasslands, with several of the records coming from chalk downland. Collected on the Ditch by Wainwright on 24. vii. 1941.
Neaera laticornis
Known from Southern England, it used to be numerous on the Cambidgeshire chalk, including the Ditch which would have been its most northerly population in Britain. Said by Wainwright (1940) to be abundant at the Devils Ditch and at Fleam Dyke, there are specimens in the NHM collected by him on the Ditch in 1936 & 1941 and at Fleam Dyke in 1933 & 1934. Also in NHM there are specimens collected by G. M. Spooner at Fleam Dyke and Gogs Hills in 1953. The last record for Cambs appears to be for the Ditch by Fonseca on 10. vii. 1962. It is a parasitoid of the micro-moth *Eucosma hohenwartiana,* which develops in the seedheads of *Centaurea* and which remains widespread in the area, including a 2012 record from the old railway (L. Bacon pers. comm.).
Actia infantula
This species is probably overlooked and far more widespread than records suggest. It is a parasitoid of the mico-moth *Monopis laevigella,* whose saprophagous caterpillars are often found in bird's nests. (1B) 15. vii. 2006.
Actia lamia
Although widely distributed, *A. lamia* is rarely recorded and like the last species may be overlooked because of its small size. It is a parasitoid of *Epiblema scutulana* which develops in the stems of *Cirsium vulgare* and *Carduus nutans.*
Nowickia ferox
Although frequent in the Breckland and on heaths and dry grassland generally, *N. ferox* is rarely seen in v.c. 29. It has been reared from the Dark Arches *Apamea monoglypha* a

common and widely distributed moth. Recorded by Jenyns for the Ditch there is a specimen in CUM. (5) 9. ix. 2007 on *Succisa pratensis.*

Peleteria rubescens

Listed by Jenyns from the Ditch as *Nowickia ferox,* two of the specimens in CUM turned out to be *P. rubescens* (Wainwright 1928). It has only been seen once in this country since at Burnham Beeches NNR, Bucks 20. ix. 1931.On the Continent it is a species of warm, dry, open countryside and is a parasitoid of Noctuidae moths such as *Agrotis* and *Euxoa* and occasionally other families.

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A base-line survey of lichens in the West Cambridgeshire woodlands (and changes taking place in front of our eyes?)

Mark Powell, Louise Bacon and the Cambridge Lichen Group

Lying within an approximate triangle (bounded by St Neots, Potton and Cambridge) are a group of woodlands which the Cambridge Lichen Group chose to study in detail during the period 2010 to 2012. The woods included those famous, well-studied ones such as Hayley, Gamlingay, Hardwick and Waresley-Gransden, but also parkland and smaller or less well-studied woodlands too. Despite the proximity to Cambridge and its long history of naturalists, most of these woodlands lack any previous lichen records. While we may lament the dearth of historic information we console ourselves that lichenology in this region has finally begun just in time to document dramatic changes that are taking place now that the concentration of atmospheric sulphur dioxide is below the limiting factor for most lichen species. For a substantial period of time, and especially for about four decades following the Second World War, it is reasonable to assume that the West Cambridgeshire woodlands were subject to high levels of atmospheric sulphur dioxide arising from the background Midlands pollution boosted by the Marston Vale brickworks and the Little Barford power station. Mr J. R. Laundon (pers. comm.) tells us that "most trees and shrubs in the area were smothered with *Lecanora conizaeoides* from at least 1950 (probably from the late 19th century) until about 1980 or later, yet this

lichen is now completely absent from bark." In fact *L. conizaeoides* is still found, very occasionally, on acid-barked trees in the area but the point is well made; the decline of this species has been one of the most spectacular changes in our natural environment but it has gone almost unnoticed by non-lichenologists.

A casual walk around any of the West Cambridgeshire woodlands will give the impression that the lichen communities are sparse and contain few species. It is possible to walk for many metres within these woodlands and observe little more than *Lepraria incana* and *Lecanora expallens* on the lower trunks of trees. The lichenologist gains a much more complete picture of the lichens of a woodland site by exploring the following possibilities during the survey:

- Woodland edges provide access to well-lit twigs.
- Felled material and windblown branches provide proxy access to the canopy.
- The oldest trees should be searched for and examined thoroughly, especially ancient trees with exposed lignum.
- Niche habitats (such as exposed roots in the sides of large ditches, fallen trunks and tree stumps) often yield a few specialities.
- Particular species of trees and shrubs support their own suites of lichen species. Elder bushes often yield more than their fair share of records

Methodology

It took between three hours and a day, depending on the size and complexity, to record with reasonable thoroughness the lichens in each woodland site. Our surveys aimed primarily to generate a list of species for each site and to note any particularly interesting communities. No quantitative work was done. In retrospect, a subjective assessment of frequency using the DAFOR (or AFOR) scale would have allowed us to annotate the list below with an indication of how commonly we found each species. Instead annotations are restricted to the more unusual and least common species on the list; those species which are not annotated can be assumed to be relatively widespread and frequent.

The fieldwork was carried out using hand lenses and the common spot-test reagents (K, C and Pd). There was not a single survey during which every thallus could be named in the field and so small specimens were collected for subsequent microscopic examination. All specimens were retained and are housed in Herb. Powell.

The overall picture

If a transect is taken from Gloucestershire, north-eastwards through Oxfordshire, Northamptonshire, Bedfordshire and into Cambridgeshire, a gradual decrease in the richness of the corticolous lichen flora is seen. This is mainly due to the historical legacy of increasing sulphur dioxide levels as the predominantly south-westerly winds passed over an accumulating number of sources of pollution. There may be a smaller scale but reverse gradient across the study area with those woodlands closest to the west (and hence closest to the former Marston Vale brickworks and to the Little Barford power station)

showing the poorest lichen communities and generally lacking any relic communities. Gamlingay Wood, a large ancient woodland near the west side of the study area, lacks lichen species such as *Enterographa crassa* and *Schismatomma decolorans* which are present in the much smaller woodland area of Byron's Pool LNR which is situated at the east edge of the study area.

The West Cambridgeshire woodlands are experiencing a phase of active colonisation following the decline in atmospheric sulphur dioxide levels. The greatest biodiversity (though certainly not the top conservation priority) now occurs on the young bark of branches and twigs which are suitable substrata for many of the mobile species which are spreading into our area. Relic communities (by which we mean those containing lichens which we suspect have "hung on" in the region since pre-Industrial Revolution times) are rare (excepting a very few common, tolerant species such as *Lepraria incana* which we assume have been present on shaded, sheltered bark throughout). Our survey was too late to witness some of the earliest post-Industrial colonists (such as *Arthonia radiata*) but recent records of *Normandina pulchella* (at Fordham Wood, to the east of the study area) and *Rinodina sophodes* presumably represent an early phase of the spread of these species. It is highly unlikely that a final, steady state has been reached. Different lichen species differ enormously in the speed with which they can spread across the landscape. Some, such as *Arthonia radiata*, presumably produce emormous numbers of widely dispersed spores and this species was observed to "spread like a rash" in Bedfordshire in the period 2005 to 2010. Other species will make more sluggish progress, many of them returning from their refuge on the western seaboard of Britain where they survived in the relatively clean Atlantic breezes. Other lichen species appear to be almost incapable of spreading across the modern landscape and are restricted to unpolluted ancient woodland. Some lichen species which might have been present in our region before the Industrial Revolution are sensitive to compounds of nitrogen and so are unlikely to return while we are in our current period of mass artificial nitrogen-fixation. Lichenology is not the easiest branch of natural history and many of the "micro-species" require detailed microscopic examination. On the other hand, many of the species involved in the current changes are conspicuous "macro-lichens". With just a few months of dedication, any interested naturalist could be ready to help record the anticipated future changes. Members of the Cambridge Lichen Group are willing to help with the identification of specimens, for more information contact the principal author of this paper.

Relic communities

Lichen communities which survived the many decades of industrial pollution are rare in the West Cambridgeshire woodlands but there are some likely examples.

Enterographa crassa is one of thirty five lichen species listed in the Revised Index of Ecological Continuity which is used to grade the "ancient woodland" characteristics of deciduous woodlands (Coppins & Coppins 2002). The presence of a single species from the list is not generally considered significant

but *Enterographa crassa* seems to be more or less restricted to "old" sites and is thought to spread with difficulty. *E. crassa* has been found near the bases of old *Quercus* tree trunks, for example at Hayley Wood and Byron's Pool LNR. Most members of the genus *Pertusaria* are thought to spread with difficulty. Sites such as Sutton Park were severely affected by pollution due to the proximity to the Birmingham conurbation. Sutton Park has experienced a dramatic colonisation by many species in the last decade or so but not a single specimen of any species in the genus *Pertusaria* has been found (Powell & James 2010). In the West Cambridgeshire woodlands two species of *Pertusaria* (*amara* and *pertusa*) can be found on old tree trunks, often in association with *Lecanora argentata*, *Phlyctis argena* and *Pyrrhospora quernea*. Such communities probably represent relic ones.

Rain tracks and wound tracks both cause localised nutrient enrichment of tree trunks. Laundon (1973) reported that nitrophilous communities at Wicken Fen were mainly restricted to rain tracks and wound tracks: "In St Edmund's Fen by Monk's Lode there are a few mature trees (*Populus* spp., *Salix fragilis*) and a dead sallow shrub (*Salix cinerea*) bearing nitrophilous lichens (e.g. *Buellia punctata*, *Physcia* spp., *Xanthoria* spp.). The lichens grow chiefly in the rain tracks from the platforms at the top of the trunks of two pollarded crack willows, and from a bark wound on a poplar. Nitrogenous matter is washed down the rain tracks in sufficient quantity to enable the nitrophilous lichen community *Xanthorion* to become established." Nowadays the influence of nitrogen compounds on the landscape is such that the *Xanthorion* community is almost ubiquitous but Laundon's description of the situation at Wicken Fen suggests that the *Xanthorion* was somewhat resistant to sulphur dioxide pollution. In most cases rain tracks now, as then, comprise rather common species, especially from the genera *Amandinea*, *Phaeophyscia*, *Physcia* and *Xanthoria*. Occasionally more specialised and rare species are found such as the remarkable occurrence of a large colony of the BAP species *Bacidia incompta* in the wound track of a gnarled old *Populus tremula* tree at Eversden Wood. Such occurrences may represent an ecological continuity of habitat stretching back to pre-Industrial Revolution times.

Interesting habitats

The occurrence of rain and wound tracks has already been noted in the previous section. The *Xanthorion*, despite being dominated by vigorous nitrophytes such as *Phaeophyscia orbicularis*, *Physcia adscendens* and *Xanthoria parietina*, is often found to be rich in species. Careful scrutiny of a rain track in Hardwick Wood was rewarded by the discovery of the minute foliose species *Phaeophyscia nigricans*. A further feature of such nitrophilous communities is the presence of what would normally be considered as saxicolous species growing on enriched bark, examples being *Candelariella vitellina, Lecanora dispersa* and *Physcia caesia*.

Mention has already been made of *Sambucus nigra* bushes and the fact that they often support particularly interesting lichen communities. When growing at the edge of woodland the twigs and young branches are frequently dominated by

Xanthoria parietina but in the spaces between this vigorous foliose species, a suite of crustose lichens is often present, especially *Caloplaca cerinella*, *Lecania cyrtella*, *L. naegelii* and *Lecanora hagenii*. Of particular interest are elder bushes whose trunks are well-lit; this condition is more frequently found outside the main woodland blocks. For instance elder scrub beside the track to the sewage works on the west side of Gransden Wood is sufficiently exposed to support *Caloplaca phlogina* and *Rinodina pityrea* which have not been recorded within any of the woodlands. Nevertheless, well-lit elder scrub is found along the east edge of Overhall Grove, Knapwell and this supports extensive colonies of *Caloplaca ulcerosa* on its bark and the recently described *Opegrapha viridipruinosa* on exposed lignum. When more heavily shaded within the interior of woodlands, the lichen communities of elder bark are sparser; species include *Anisomeridium polypori*, *Lecania cyrtellina*, *Piccolia ochrophora* and *Strigula jamesii*.

The exposed lignum of ancient *Quercus* trees has been found occasionally to support *Chaenothecopsis nigra* in this region, for instance at Overhall Grove within the study area and at Brampton Wood about ten miles north-west of the study area. Members of the genera *Chaenothecopsis* and *Microcalicium* are likely to be under-recorded in this region, largely due to their minute size. In addition, being non-lichenized, they have tended to be neglected during general lichen recording. These small “pin-lichens” are of ecological interest because they appear to have the ability to survive long periods of industrial pollution in their sheltered, specialised habitat and may be relics of pre-Industrial Revolution communities.

The young bark of *Populus tremula* supports a very interesting community of lichens which we presume is a recent phenomenon. At Eversden Wood a fallen aspen branch yielded the first record of *Caloplaca pyracea* for the region in March 2012. The first English record of *C. pyracea* was made by Neil Sanderson in Hampshire, August 2011, before that the species was considered to be very rare and restricted to N.E. Scotland. *C. pyracea* has since been found at Lady Wood in Bedfordshire, Brampton Wood in Huntingdonshire and a further occurrence has been found within the study area on felled aspen trees in Gamlingay Wood. Along with typical lichen species of young bark such as *Lecanora chlarotera* and *Lecidella elaeochroma*, aspen seems to be unique in the number of normally saxicolous species present. These saxicolous species are not found in situations where the bark has been subject to enrichment by dust and often occur well within large woodland blocks. *Lecanora dispersa* is a particularly frequent member of this community and is accompanied by any of the following: *Caloplaca cerinella*, *Caloplaca holocarpa*, *Caloplaca saxicola*, *Candelariella aurella*, *Catillaria chalybeia*, *Lecanora albescens* and *Lecidella stigmatea*. If the apparently bare bark between the more obvious lichens is examined, tiny black perithecia of *Leptorhaphis atomaria* are sometimes found as at Gamlingay Wood (and Brampton Wood in Huntingdonshire); in England this species has only previously been recorded in Surrey. At Gamlingay Wood the felling of hybrid black poplars and aspen in the same coupe provided an interesting comparison; the “saxicolous” species were mostly absent from the

plantation poplars and on them *Leptorhaphis atomaria* was replaced by *Cyrtidula quercus*.

Species to watch out for

Around the turn of the Millennium there was a flurry of papers in The Lichenologist in which various species were described as new to science. These lichens are not found in records or herbaria before the 1980s but many have spread to become common across Western Europe. Examples that we have recorded in the West Cambridgeshire woodlands are *Bacidia neosquamulosa* and *Lecanora barkmaniana*. *Flavoparmelia soredians* was, until recently, largely restricted to areas close to the south coast of England but it has spread rapidly northwards and is now frequent in our region. The literature struggles to keep up to date with the changes. Gilbert *et al*. (2009) state of the distribution of *Fuscidea lightfootii*: "N. & W. British Isles, rare in the lowlands." In fact *F. lightfootii* is now rather frequent on twigs and branches, especially of *Salix* and *Fraxinus*. *Normandina pulchella* was found new to Bedfordshire in October 2012 and then new to Cambridgeshire (Fordham Wood) the following month. It seems likely that this species will repeat the behaviour it showed in Holland where it spread rapidly in the past decade and has even invaded cities such as Amsterdam. *Rinodina sophodes* is also appearing in the region and was found new to Huntingdonshire at Ramsey Heights in July 2012 and then new to Cambridgeshire on *Populus* twigs at Gamlingay Wood in October 2012. *Arthopyrenia analepta* is starting to turn up on twigs in the region and will probably become a member of the woodland community. Early in 2012 *Halecania viridescens* and *Psoroglaena stigonemoides* were found during a survey of Cliveden in Buckinghamshire and provide just two examples of the many taxa which we might encounter in the future.

Taxonomic challenges

Even in a well studied area like lowland England, the taxonomy of various lichens is still incompletely understood. In the species list below uncertainty of identification is indicated by the use of the abbreviation "cf.". In the case of *Porina byssophila* there has been much confusion with *P. aenea* and corticolous specimens of both have generally been recorded as the latter. *P. byssophila* however has a slightly different ecology (on older bark) and anatomical differences (larger spores, K+ blue-grey pigments in the perithecial wall). Although the identity of these specimens as *P. byssophila* is almost certainly reliable, such corticolous material needs to be carefully compared with saxicolous specimens. The literature (e.g. Orange *et al.* 2009) mention only rocks as a substrate and state that its distribution in England is restricted to the north-west. *Xanthoria ucrainica* was described by Kondratyuk (1997) and the name has been used by British lichenologists for pale coloured, fan-shaped specimens of the *X. candelaria* group. Many such specimens however grade into darker orange, subfruticose lobes, especially where better-developed, and all may be attributable to *X. candelaria* s.str..

What we missed

This is one of the most difficult problems to address. Each recorder has his or her suite of lichens which they are familiar with and each recorder has weaknesses and blind-spots. It is unlikely that we over-looked or misinterpreted many macrolichens so our species concepts for the "macros" will be comparable with those of other British lichenologists of this period. It should be noted however that even with the common and conspicuous lichens, species-concepts continue to evolve. Louwhoff (2009) hinted at a situation which became widely accepted by British lichenologists within the past two years: "Most specimens [of *Hypotrachyna revoluta*] may be attributable to *H. afrorevoluta* (Krog & Swinscow) Krog & Swinscow (1987), characterized by the relatively dark lower surface, small lobes and soredia initially formed in pustules." During the current survey we found both species but found that *H. afrorevoluta* is rather more frequent than *H. revoluta*.

The "micro-lichens" present a more difficult problem when trying to judge the thoroughness of the survey. The fact that we were picking up minute species such as *Arthonia muscigena* and recognised *Catillaria nigroclavata* as different from *Amandinea punctata* in the field suggest that the recording was reasonably thorough. Sterile, sorediate, corticolous crusts are a frequent feature of our modern landscape. Some, such as *Lecanora expallens*, are common and have distinguishing spot reactions. There are various sorediate crusts which were collected during the survey but which have not been positively identified and it is these which may represent the most significant oversights. *Bacidia viridifarinosa* was collected by Brian Coppins "on old *Ulmus*" in Madingley Wood in 1974 (Coppins *et al.* 1992). Although we did not visit Madingley Wood, this sterile lichen species may be frequent in the study area but is easily overlooked and we did not record it.

Amalgamated list of lichen taxa recorded in the west-Cambridgeshire woods

Records from the following sites were used in compiling the list: Byron's Pool LNR, Buff Wood, Cobb's Wood (Old Wimpole), Eversden Wood, Gamlingay Wood, Hardwick Wood, Hayley Wood, North Lodge Plantation (Croxton), Overhall Grove (Knapwell) and Waresley-Gransden Wood.

Nomenclature follows Smith *et al.* (2009)

Amandinea punctata

Anisomeridium polypori

Arthonia muscigena Found once during our survey on shaded bark at Eversden Wood.

Arthonia punctiformis

Arthonia radiata

Arthonia spadicea

Arthopyrenia punctiformis

Bacidia delicata Uncommon, mainly on shaded bark especially in the sides of ditches.

Bacidia incompta Found once during our survey, an extensive sterile colony on the wound track of a stunted *Populus tremula* in Eversden Wood.

Bacidia neosquamulosa May be relatively frequent in the sterile state when it is difficult to determine. Occasional fertile colonies are found e.g. on a *Fraxinus* trunk in Fordham Wood.

Bacidia phacodes Found during the British Lichen Society Autumn 2012 meeting, on large *Fraxinus* bole at north edge of Gamlingay Wood.

Bacidia sulphurella

Buellia griseovirens. Occasional, e.g. on *Populus tremula* in Gamlingay Wood.

Caloplaca cerinella

Cf. Caloplaca chrysodeta A candidate for this normally saxicolous lichen was found at the base of a large *Fraxinus* coppice stool in Eversden Wood.
Caloplaca holocarpa. On *Populus tremula* branches in Gamlingay Wood.
Caloplaca obscurella
Caloplaca pyracea On the young branches of felled *Populus tremula* trees, Gamlingay Wood.
Caloplaca ulcerosa. On *Sambucus* bark at Overhall Grove.
Candelaria concolor
Candelariella aurella. This normally saxicolous species is present in the community on *Populus tremula* branches at Gamlingay Wood.
Candelariella reflexa
Catillaria chalybeia. Large colony on upper trunk of *Populus tremula*, Gamlingay Wood.
Catillaria nigroclavata Occasional on twigs, e.g. on *Fraxinus* at east edge of Gransden Wood.
Chaenotheca brachypoda
Chaenotheca chrysocephala. Found once during the survey, on *Fraxinus* trunk in North Lodge Plantation, Croxton.
Chaenotheca ferruginea
Chaenotheca trichialis
Chaenothecopsis nigra Found once during our survey on the lignum of a veteran *Quercus*, Overhall Grove.
Chrysothrix candelaris
Cladonia coniocraea
Cladonia fimbriata
Cladonia macilenta
Cladonia parasitica Rare, on old tree stumps, e.g. at Gamlingay Wood.
Cladonia ramulosa
Cliostomum griffithii
Cyrtidula quercus
Dimerella pineti
Diploicia canescens
Enterographa crassa Rare, usually at base of old *Quercus* trunks, e.g. Hayley Wood and Byron's Pool LNR.
Evernia prunastri
Fellhaneropsis vezdae. Found once during the survey on small *Fraxinus* pole, The Glade, Hayley Wood.
Flavoparmelia caperata
Flavoparmelia soredians
Fuscidea lightfootii
Graphis scripta. Rather rare, mainly on old *Corylus* stems.
Hyperphyscia adglutinata
Hypocenomyce scalaris. Rare, e.g. on lignum of dead *Quercus* branch at Hayley Wood.
Hypogymnia physodes
Hypogymnia tubulosa. Infrequent, e.g. on fallen branch at North Lodge Plantation, Croxton.
Hypotrachyna afrorevoluta
Hypotrachyna revoluta
Jamesiella anastomosans
Lecania cyrtella
Lecania cyrtellina. Occasional, mainly on shaded *Sambucus* in old woodland, e.g. Gransden Wood.
Lecania naegelii
Lecanora albescens. On branches of *Populus tremula*, Gamlingay Wood.
Lecanora argentata. Infrequent and usually found on old bark in a community containing *Pertusaria pertusa* and *Phlyctis argena*, e.g. Gransden Wood.
Lecanora barkmaniana
Lecanora campestris. This normally saxicolous species occurs occasionally on well-lit, nutrient-rich bark, e.g. at the edge of Overhall Grove.
Lecanora carpinea
Lecanora chlarotera
Lecanora confusa
Lecanora conizaeoides. Very rare on bark, found on trunks of conifer trees in Gamlingay Wood.
Lecanora expallens
Lecanora hagenii
Lecanora cf. horiza. On young bark of *Populus tremula* at Gamlingay Wood. Specimens are to be sent to Czech Republic for sequencing.

Lecanora persimilis. Often difficult to separate from *L. hagenii*. *L. persimilis* is less common and more restricted in its ecology, preferring twigs with less spongy bark, especially *Fraxinus*.
Lecanora pulicaris. Infrequent, generally preferring acidic bark, but sometimes present with *L. chlarotera* on *Fraxinus* branches, e.g. The Glade, Hayley Wood.
Lecanora symmicta
Lecidella elaeochroma f. elaeochroma
Lepraria incana s. str.
Lepraria lobificans
Leptorhaphis atomaria. Found once on the twigs of felled *Populus tremula* at Gamlingay Wood.
Melanelixia glabratula
Melanelixia subaurifera
Melanohalea elegantula. Infrequent, on shaded *Fraxinus* trunks, e.g. Gransden Wood.
Micarea prasina s.lat. Occasional on the lignum of old tree stumps and long-fallen *Quercus* trunks.
Opegrapha atra
Opegrapha herbarum
Opegrapha niveoatra
Opegrapha ochrocheila
Opegrapha rufescens
Opegrapha varia
Opegrapha vermicellifera
Opegrapha viridipruinosa. A recently described species (2011), similar to *O. varia*, and is most often found on the lignum of *Sambucus*.
Opegrapha vulgata
Parmelia saxatilis
Parmelia sulcata
Parmotrema perlatum
***Pertusaria amara*.** Infrequent and usually on trunks of mature trees.
Pertusaria pertusa. Infrequent and usually on trunks of mature trees.
Phaeophyscia nigricans. Found once in nutrient-rich community on gently sloping *Fraxinus* trunk, Hardwick Wood.
Phaeophyscia orbicularis
Phlyctis argena
Physcia adscendens
Physcia aipolia
Physcia tenella subsp. tenella
Physconia grisea
Placynthiella icmalea. Infrequent on natural substrata in this region, e.g. on dead *Quercus* branches at Hayley Wood.
Platismatia glauca. Rare, e.g. on fallen branch at North Lodge Plantation, Croxton.
Porina aenea
Porina cf. byssophila. Not infrequent on the old bark of *Acer campestre* and *Fraxinus*, especially near the bases of old tree trunks.
Punctelia jeckeri
Punctelia subrudecta s.str.
Pyrrhospora quernea. Occasional, mainly on the bark of old trees.
Ramalina farinacea
Ramalina fastigiata
Schismatomma decolorans. Infrequently found during this survey, mainly on old *Quercus* trunks as at Byron's Pool LNR.
Scoliciosporum chlorococcum
Scoliciosporum pruinosum. Found once on *Carpinus* stem in Buff Wood.
Strigula jamesii
Trapeliopsis flexuosa. Rare on natural substrata in this region, e.g. on long-dead *Quercus* branch in Hayley Wood.
Usnea cornuta. Found once on the branch of a felled *Quercus*, Hardwick Wood.
Usnea subfloridana. The most common member of the genus in this region but infrequently recorded during the survey.
Xanthoria candelaria s.str.
Xanthoria parietina
Xanthoria polycarpa, Xanthoria cf. ucrainica

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Waterbeach Airfield and Barracks – a survey for the record.

Louise Bacon

Waterbeach Barracks and disused airfield is an active MOD training site, but which has a large area of open space, most of which is not used particularly heavily by the MOD. It is located to the north of Waterbeach village, bounded to the west by the A10 and to the east by agricultural land. The southern part of the site is the active barracks and associated MOD buildings; the disused airfield is contained within its own fence.

The Cambridgeshire & Peterborough Environmental Records Centre decided to hold a "recorders day" on site in the summer of 2011. The objective of this day was several-fold; to provide an opportunity to the Cambridgeshire recording community to record in their favoured species groups on a site to which they would rarely gain access; to spend a day with others of the recording community; and to provide the site owner with an insight into the species found on their site. Following the success of the first day, it was agreed that we would return earlier in the season in 2012 for a follow-up visit.

The Waterbeach site is (at the time of survey) an active MOD site, so we had pre-arranged our visits and security gate clearance was a smooth process, giving time for some of our recorders to find a few species around the lights of the Guardroom building. On the 2012 recording day, although for once it was not

raining, it was very windy, and about 5 hours was spent by most people on the airfield; the botanists then obtained permission to spend a further two hours amongst the active buildings and residential part of the site, which was not covered by others.

The site has a wide range of habitats. There is a golf course, a couple of playing fields and a pair of lakes, one of which is used by a local fishing club. In addition, the disused runways are still extant, part used by a model airplane group, and other habitats on site include several plantations, grassland, several disused buildings and other disused concrete and rubbly areas, etc., as well as grassland, both managed as part of the golf course, and unmanaged and slightly scrubby. A section of the very northern part of the site is arable, and there is an adjacent disused building and very large stack of straw bales. The unmanaged grasslands are rich in flowers, especially species like Ox-eye Daisy which provide good nectar sources for several insect groups. Scrub invasion from hawthorn is almost inevitable in an unmanaged area such as this. The golf course has several small pools, which in 2011 were almost dry. The large lakes, although used for amenity fishing, are well-fringed with vegetation and plenty of surrounding trees. The belts of plantation woodland were of a wide variety of species both broadleaved and coniferous, with little understorey, making them not as valuable as habitat as older woodlands would be.

Our 2011 visit was timed to coincide with the annual down-time of the military activities, making access to all areas of the site possible except for those areas associated with munitions storage and similarly hazardous activities, which are always fenced off due to the number of non-MOD users of parts of the site. This meant that we had in excess of 2 km^2 available to us for exploration – a daunting task for a six-hour recording day. The 2012 visit explored essentially the same area – all the recorders were on their second visit and tended to work patches which they had not tried the first time but which seemed of interest. A reasonably thorough survey of the plants of the site was carried out by the Cambridge Natural History Society in 2008, and botany will not be as thoroughly covered as other aspects of the site.

These visits were arranged prior to the announcement by the MOD that the site was to be closed in 2013, and the decision has been made with the site staff to publish and make publicly-available all the knowledge gained of the biodiversity of the site prior to its near-inevitable change of use in the coming year or two. A full set of species records form the two visits can be found on the NBN Gateway or from the local environmental records centre.

This paper summarises what can be found in two six-hour visits by a group of dedicated observers, and will presumably stand as a record of the wildlife on site until the point of its closure as a military site. In total, over the course of two days, 1007 species were recorded. In 2011 we recorded 804 and in 2012, 409 species. In addition, the fungus group made a separate visit on 5th November 2011 and recorded 20 additional species, making a total of 1027 species recorded. As far as we know, no aquatic sampling was done, so the lakes themselves will hold more species as yet unrecorded. Anecdotal evidence from MOD personnel also has a list of species recorded, including bats, Grass Snake

and several hawkmoths (usually found at the guardroom lights, photographs shown to us include Lime and Privet Hawkmoths). These are not included in the report. Of the species recorded, 40 are defined as Nationally rare or Nationally scarce (N or NS, and for insects Na or Nb, based on distribution) These subdivided as follows: Beetles 5 Na, 15 Nb, 1 Ns, Flies 3 N, True bugs (Hemiptera) 1 Nb, Bee/wasps 2 Nb, Lichens 2 Nationally Rare, 7 NS, vascular plants 4 NS.

The table below shows the species recorded in both seasons by taxonomic group.

Taxon group	number of species	2011	2012
acarine (Acari – gall forming mite)	3	2	1
bird	54	41	44
centipede	2	2	2
conifer	2	2	
crustacean	3	3	2
plant	228	168	128
fungus	39	35	5
harvestman (Opiliones)	2	2	2
horsetail	1	1	1
insect - beetle (Coleoptera)	127	109	28
insect - booklouse (Psocoptera)	3		3
insect - butterfly	9	14	4
insect - caddis fly (Trichoptera)	1	1	
insect - dragonfly (Odonata)	11	8	5
insect - earwig (Dermaptera)	1	1	
insect - hymenopteran	31	28	5
insect - lacewing (Neuroptera)	3	2	1
insect - moth	55	47	10
insect - orthopteran	7	8	1
insect - scorpion fly (Mecoptera)	1		1
insect - snakefly (Raphidioptera)	1		1
insect - thrips (Thysanoptera)	1	1	
insect - true bug (Hemiptera)	120	115	6
insect - true fly (Diptera)	131	120	18
lichen	100	60	89
millipede	1		1
mollusc	12	7	6
reptile	1	1	
slime mould	1		1
spider (Araneae)	73	47	43
terrestrial mammal	3	3	1

The rest of this article comprises comments and highlights from the recorders involved.

Lichens

The lichen surveys of Waterbeach Airfield and Barracks recorded 99 lichen taxa, most of which are common species. The lichen communities of disused airfields had been seriously neglected until the late 1990s when Oliver Gilbert surveyed 50 disused military airfields across lowland Britain (Gilbert, 2000) Gilbert concluded that disused airfields "offer an extensive, man-made, saxicolous/terricolous habitat extending across Britain" and that several of the lichen species were scarce and unexpected in a habitat only 50 years old. The lichen communities of the trees and shrubs on the airfield are rather poor with the only notable lichen found on Elder (*Sambucus nigra*) bushes. Elder bushes are widely recognised as being of particular importance for both lichens and mosses and they should be retained where possible. The various concrete structures and disused concrete pads support a rich assemblage of lichens and should not be demolished without good reason. Disused airfields often contain a glorious clutter of debris and disused structures providing a range of metal, concrete and wooden substrata. Such structures and rubble should be preserved in areas where it is practical to do so. Of particular interest is the bridge at the south end of the lake and especially the wooden boards which form boardwalks at the outer sides of the parapets.

Fungi

John Holden, South Cambridgeshire fungus group, 5th Nov visit: "It was particularly interesting to find *Arrhenia spathulata*, an uncommon small ear-like fungus growing in moss at the side of the track, which none of us had seen before."

Spiders

Ian Dawson, Spider expert: "A couple of the spiders were of interest: an adult male *Trachyzelotes pedestris* (we found an immature in 2011), otherwise known in Cambridgeshire from the old railway line at Hayley Wood, and Cherry Hinton East Pit, though I think Ray Symonds has also found it recently at Fleam Dyke; and the money spiders *Ceratinopsis romana* and *Meioneta beata*, both previously found only at Boxworth in vc29, though also at Castor Hanglands and Monks Wood."

Vascular plants

Botanists: "The highlight on the Airfield was finding that *Galium parisiense*, first seen last year, is actually present in great numbers over a vast area in the south-western part of the site. This species seems to be having a renaissance in the UK at the moment and we have recently had it in three other new areas.

Outside the airfield of course the Barracks turned out to provide the sensation of the day, the verges holding good populations of *Medicago minima*, *Vulpia ciliata* subsp. *ambigua*, *Trifolium arvense* and *T. scabrum*: the latter

representing perhaps our only extant population of any significance in the county!"

"Botanically it was a delight. To find *Galium parisi*ense was so widespread and abundant was a revelation and between us we chalked up a really good list of additions. A second site for *Oenanthe pimpinelloides*, finding good *Aphanes australis* and a big colony of *Polypogon monspeliensis* were also highlights. The time spent afterwards on the area around the buidlings was even more of a treat as the hint provided by *Medicago minima* at the start of the day suggested. The species was widespread on the verges and in places was accompanied by more *Trifolium scabrum* than anywhere else in the county, together with *Trifolium arvense* and a good colony of *Vulpia ciliata* subsp. *ambigua*. Shame about the future plans for the area. But it has been good to see it now!

On our trip around the barracks we even had a short tutorial from Mark Powell who showed us how much interest there could be in a big block of concrete, which included another rare lichen!"

This report stands as a testament to the wealth of biodiversity in scrubby disused grassy places with a few plantations and some scruffy old concrete, and we would like to acknowledge the helpfulness and enthusiasm of Major David Hornby who gladly arranged access to the site for naturalists on these and other occasions. No doubt much of this will be lost to the inexorable creep of suburbia within the next few years and it was a pleasure to be able to visit the site.

Trumpington Meadows

A report on the CNHS Field Studies area of 2012

Jonathan Shanklin

The Cambridge Natural History Society visited the area being developed as Trumpington Meadows for its field studies in 2012. In addition to the housing development, the area includes a country park and farmland. This report discusses features of the site, whilst a diary giving highlights of the monthly visits is available on the Society web pages. We logged over 1200 records of 438 plant species, and also recorded other phyla. Record sheets for the area are available on the Society web pages.

Each year since 2004 the Cambridge Natural History Society (CNHS) has selected a different area of the city for extensive study over the course of a year. Areas close to the city have been chosen to allow participation by students and others without easy access to transport. The long term intention is to have a rolling programme with return visits to sites after a decade. Primarily these studies have concentrated on the vascular plants, however other phyla have been recorded, usually on an *ad hoc* basis. Whilst many of the study areas may be considered as lacking in interest, the detailed studies have revealed axiophytes

(desirable, though not necessarily uncommon, plants) and red-listed species growing in them, some of them previously unknown in the area.

Although this year we had hoped to cover the Cambridge University North West Cambridge site prior to its development, permission was not forthcoming. Initial inquiries for an alternative venue were welcomed by the BCN Wildlife Trust and so a last minute switch was made. The 2012 study therefore covered Trumpington Meadows, which includes new housing, a new country park and farmland, together with relict features such as a short section of the old Oxford to Cambridge railway line and some coprolite pits. It is essentially bounded to the north by Grantchester Road, to the west by the River Cam, and to the east by the A10. For some of our visits we visited the existing Byron's Pool LNR, and also included the Trumpington Road P&R car park. The area includes parts of eight monads, often small, with the majority of the site in TL4354 and TL4353.

The year began with a continuation of the drought, but weather patterns changed in April and continued with generally cool and wet weather. After March, four of the next eight months had rainfall substantially above average. Records from the NIAB site near Cambridge show a total of over 700mm of precipitation for the year, twice that of 2011, and the highest for over half a century. Not surprisingly, we were not so lucky with the weather on our outings this year, though it only rained on three of them.

Geology of the area

The full geology of the Cambridge area is described in *The Geology of the country around Cambridge* (Geological Survey of Great Britain, 1969) and can also be seen interactively in the British Geological Survey "Geology viewer". The land generally slopes westwards from 17m OD near the A1309 down to the river Cam at 8m OD. The river runs through an alluvial plain several hundred metres wide, with terrace gravels on either side. The geological map shows the Gault at the surface near the M11, though the stickiness of the clay seemed to be ameliorated by surface gravels. A recently cleared area on the north side of the M11, shown as Gault on the map, appeared to be chalk marl. This formation, dating back to the Cretaceous nearly 100 million years ago, was only obvious where the coprolite pits had been excavated and at Byron's Pool pond.

The geology gives a subtly different flora across the area. Dwarf Spurge (*Euphorbia exigua*) was present across much of the chalk marl, but absent nearer the river. Bur Chervil (*Anthriscus caucalis*) was present in the field south of the M11 after agriculture ceased and before it was resown. Alder (*Alnus glutinosa*) and willow (*Salix* sp) thrive in the damp meadows by the river. A relict chalk flora remains on the east side of the coprolite pits, where it had been protected from agricultural sprays by the access road.

History of the area

Archaeological work, carried out by the Cambridge Archaeological Unit, formed part of the preliminaries to development and some spectacular finds were made. The highlight was an Anglo-Saxon Christian grave of a teenage girl who was buried on a bed with gold and garnet cross on her chest. The burial

includes grave goods, and so is thought to date from around AD 650, when Christianity was just beginning to be introduced into the area. Other finds included mid to late Neolithic (4000-5000 years ago) burial monuments and Iron Age (2100-2500 years ago) pits, as well as the Anglo-Saxon material.

The Oxford to Cambridge railway (the Cambridge & Bletchley Branch of the London & North Western Railway) ran north of the M11. It was built in 1862, opening on August 1, and trains ran until the withdrawal of passenger and freight services in 1968. The track was removed in 1969. East of the A1309 it now forms the Guided Busway. A short section of embankment in TL4354 is all that remains in our area, running up to the River Cam. A few typical plant species survived on the length, including Des Etangs' St John's Wort (*Hypericum* x *desetangsii*), Field Scabious (*Knautia arvensis*) and Common Toadflax (*Linaria vulgaris*).

A series of coprolite pits dug during the First World War lie south of the M11 in TL4353. These are now heavily shaded and we failed to find Cut-leaved Selfheal (*Prunella laciniata*) and Sharp-flowered Rush (*Juncus acutiflorus*) reported from here in the past. The remaining chalk flora on the east side does include species such as Dwarf Thistle (*Cirsium acaule*) and Hoary Plantain (*Plantago media*) and might have had Sickle Medick (*Medicago sativa* ssp *falcata*), though this was unfortunately cut by the farmer before it could be determined. An old ditch leading down to the pits has a good flora associated with it, including three species of orchids.

The Cambridge Plant Breeding Institute was created as part of the Cambridge University Department of Agriculture in 1912. It separated from the University in 1948 and acquired the Trumpington site in 1950, moving there in 1952 with offices near the site of the present Park & Ride car park. The PBI was privatised in 1987, passing through a series of hands until the land was sold to developers and the buildings demolished in 2009. Changing Forget-me-not (*Myosotis discolor*) had been reported from the PBI site, but we did not see it during our visits.

The western corridor along the river will become Trumpington Meadows country park. This will have a network of foot and cycle paths running through herb-rich grassland, which is being created by sowing seed of known provenance. Some landscaping to create drainage ditches and a balancing pond has been carried out, though these areas are still at a very early stage of succession. The park area will be managed by the BCN Wildlife Trust, who will have maintenance facilities on site.

The built environment

We didn't have access to the part of the site where building was in progress, nor did we attempt to investigate the verge of the M11. The Hauxton Road had most of the expected verge plants. One of the meeting points was by the pond in the Trumpington Park & Ride car park. This had an interesting, though mostly introduced flora, including plants such as Betony (*Betonica officinalis*) and Bogbean (*Menyanthes trifoliata*). The alien invader Floating Pennywort

(*Hydrocotyle ranunculoides*), which in places was seen in abundance in the river, had also found its way into the pond.

Notable plant species

Sowing of wildflower mix has obscured the origin of some of the notable species that might have been in the area naturally. In particular Corncockle (*Agrostemma githago*), Corn Buttercup (*Ranunculus arvensis*), Cornflower (*Centaurea cyanus*) and Corn Marigold (*Glebionis segetum*) were all introduced in Emorsgate EC1 and EC2 cornfield seed mix and Sainfoin (*Onobrychis viciifolia*) was also introduced. An area of predominantly Night-flowering Catchfly (*Silene noctiflora*) appeared near the introduced plants, although it was not supposed to be part of the mix, but seed is sold by Emorsgate Seeds. Several rare or "nice" arable weeds appeared on the lighter soils following landscaping work, notably Small Toadflax (*Chaenorhinum minus*), Dwarf Spurge, Common Cudweed (*Filago vulgaris*), Fine-leaved Fumitory (*Fumaria parviflora*), Venus's Looking-glass (*Legousia hybrida*), Prickly Poppy (*Papaver argemone*), Rough Poppy (*Papaver hybridum*) and Wild Pansy (*Viola tricolor*). Unfortunately much of the land on which these species were found is destined to become grassland, and it is a pity that thought is rarely given to conservation of arable weeds when new reserves are created. Early Meadow-grass (*Poa infirma*) was found on the old railway embankment. Adder's-tongue (*Ophioglossum vulgatum*) grows in damp grassland near the river, as does Grass Vetchling (*Lathyrus nissolia*) in another meadow. A few trees could be regarded as notable in the wild, but the ones we saw were all planted.

Bryophytes

Most records were made during a joint meeting with the Cambridgeshire Group of the British Bryological Society, which took place in November, though Jonathan Shanklin had noted liverworts throughout the year. By diligent searching, eight liverwort species were found in the area, with the least common being *Aneura pinguis* on the side of the P&R pond.

The November visit began with a quick look at Trumpington churchyard, a traditional site for budding Cambridge bryologists, though *Didymodon nicholsonii* and *Tortula protobryoides* on paths were new for the churchyard. The pond in the meadow at Byron's Pool LNR, which has a chalky bank, was disappointing, with *Barbula unguiculata* being dominant, but there were a few stems of *Aloina aloides*. Mark Hill found the introduced species *Hennediella macrophylla* on the clay bank of the river near the entrance gate. It was previously known from the Cam only by the Backs and at Little Abingdon, but is slowly spreading. The new ditches and an exposed bank of chalky marl supported a good range of pioneer and ruderal species, including plentiful *Tortula protobryoides*. The bridge over the M11 had acquired several species, including "Car-park moss" *Brachythecium mildeanum*. The old coprolite pits had rather too much scrub for much interest, but Richard Fisk found some delightfully small-sized *Fissidens viridulus* by a rabbit hole.

A curious feature of the flora was the low diversity of *Bryum* species. Tuberous *Bryum dichotomum* was abundant, but, apart from *Dicranella staphylina*, the common arable tuber-bearers were either absent or in quantity too small to be detected. This is no doubt partly the result of extensive and deep soil disturbance, but it is possible that very strict husbandry at the former Plant Breeding Institute had eliminated both the tuber-bearers and *Riccia*.

Fungi

A few fungi were recorded as casual records during the course of the year, but a fungal foray held in October provided the majority of records. The Byron's Pool woodland produced two notable finds: the uncommon Arched Earthstar (*Geastrum fornicatum*) and Striate Earthstar (*G. striatum*) in their preferred habitat of rich woodland soil by rotting stumps. We also found Yellow Stainer (*Agaricus xanthodermus*), which the new Collins Guide says is now occasional and apparently decreasing. The new grassland seemed too young to produce much of note, and the coprolite pits were also disappointing. A slightly older strip of grassland near the long demolished Shepherd's Cottage produced Garland Roundhead (*Stropharia coronilla*) and the uncommon Smokey Roundhead (*S. inuncta*).

Lichens

Mark Powell provided expert tuition on two of the autumn visits, the first in the worst weather of any of our visits. He has contributed the following text:

"It would be difficult to imagine a colder and wetter September afternoon. Not only does wet weather hinder the taking of notes but it also reduces the distinctiveness of lichen species. Subtle surface textures and characteristic colours are obscured when lichen thalli are wet. Nevertheless it was decided that an attempt at recording would be made and the chemically treated perimeter fence of the Park and Ride yielded some of the characteristic lichens of such toxic wood. *Lecanora stenotropa* is virtually indistinguishable from *L. polytropa* in the field and it is the latter which is commonly found on sandstone headstones in churchyards. If it were not for "tanalised" fences the former would have very few records but it seems to be the consistently occurring member of this pair on such woodwork. A specimen was collected and confirmed as *L. stenotropa* on the basis of its narrow spores. *L. stenotropa* not only tolerates the copper compounds used as wood preservative but actively accumulates it in its tissues and the fruits of this lichen had a visibly blue tint even in the abominable conditions. Jonathan pointed out a fascinating feature of these lignicolous thalli – their elongated oval shape. We are familiar with similar shaped thalli on young tree trunks where the regular radial growth of the lichen is distorted by the expanding girth of the trunk. In the case of elongated thalli on fence rails the mechanism is not so easily explained – obviously the fence rails are not expanding in any dimension. The long axis of the thalli was seen to be consistently parallel with the wood grain and so some feature of the lichen's development must make it grow more rapidly with the grain than across it. An even more consistent lichen of chemically treated wood throughout Britain

forms extensive granular crusts with minute pinkish pycnidia. This was well developed on the fence at Trumpington Park and Ride. Despite the fact that it is common and widespread its exact identity is not yet known. The filiform conidia make us confident that it belongs to the genus *Bacidia* but the lack of fruits has prevented a specific diagnosis. It will be interesting to see how this problem is resolved. Perhaps some apothecia will be discovered or else genetic sequencing might reveal its relationships. I tentatively suggested that it might be a well-known species such as *B. saxenii* whose fruiting is suppressed by the toxicity of its chosen environment. Jonathan made the interesting suggestion of transplanting some to a non-toxic substratum to see if this would stimulate fruiting. Although lichens can be remarkably hardy (*Xanthoria parietina* survived ten days in the hostile conditions of space hanging outside the International Space Station) they are notoriously fickle and temperamental if any attempt at transplantation is made. I doubt whether the sort of transplantation studies which have proved so useful in elucidating the taxonomy of vascular plants will work with lichens.

Although rather recent, the concrete curb stones of the car park have beautiful mosaics of species such as *Caloplaca oasis, C. saxicola, Candelariella aurella, Lecanora albescens, L. dispersa* and *Verrucaria nigrescens* with "macros" such as *Xanthoria elegans* and *X. parietina* forming more conspicuous and three dimensional ornamentations. It was on a similar curb with a very similar community of lichens at an industrial estate in Northampton that I found the first authentic British specimen of *Caloplaca soralifera* earlier this year. This illustrates the intrigue of concrete. Most times what is found is a familiar suite of ubiquitous lichens but once in a while something remarkable turns up. Today the conditions were not conducive to finding rarities and it was decided that a brisk walk to the motorway bridge might generate some internal warmth.

The aluminium railings of the bridge over the M11 have a dark scurfy crust which could easily be mistaken for an algal crust or for "grot". Careful examination with a lens reveals dark, convex fruits and my suspicion of *Scoliciosporum umbrinum* was confirmed when microscopic examination of these fruits showed that twisted S-shaped spores, spirally arranged in the ascus were present. This lichen is rather common on sandstone headstones but also has a more specialist ecology and has been found on "bare" aluminium of bridges at Waterbeach Airfield and at Great Staughton. The most abundant lichens on the tarmac and concrete of the bridge are *Aspicilia contorta* subsp. *contorta* and *Caloplaca crenulatella*. The only cyanolichen of the day was found on the northern footway of this bridge but, other than the presence of apothecia, little could be distinguished about its features in the field under a thick film of water. It was tempting to write it off as something like *Collema tenax* but a specimen was collected and subsequent microscopic examination showed that a cellular cortex is present. The tentative determination of this specimen is *Leptogium turgidum* but further work is required.

Examination of concrete retaining walls at Shepherd's Cottage yielded only a limited community of lichen species but it was interesting to observe the

“ghosts” of various phases of inundation of these concrete panels (by piles of spoil etc.) still delimited by abrupt variations in the lichen communities.

The October weather proved kinder to both bryologists and lichenologists. One of the mature oak trunks in the Byron’s Pool wood yielded a surprise in the form of *Enterographa crassa* which is a lichen species which is listed in the Revised Index of Ecological Continuity; it is considered to be a poor coloniser that is usually restricted to ancient sites. Together with *Opegrapha vermicellifera* and *Schismatomma decolorans* these species probably represent a relic community which survived on sheltered tree bases during the many decades of severe atmospheric sulphur dioxide pollution. *Porina byssophila* has, until recently, been considered to be a nationally scarce lichen of siliceous rocks but recently it has been realised that it is not uncommon on tree bases, at least in Eastern England. *Chaenotheca brachypoda* is an attractive “pin-head” lichen with bright yellow-green pruina covering the spore mass. An enormous colony was found on the underside of a gently sloping willow trunk. There are microscopic features which differ from the description of this lichen species in the literature and one must always keep an open mind for the not infrequent discovery of new taxa for the British Isles. *Lecanora barkmaniana* is one of the “new” lichen species of which no evidence can be found before the 1980s. *L. barkmaniana* was described as new to science in 1999 and seems to be spreading and thriving in the modern eutrophicated landscape.

The available substrates for lichens are rather sparse in Trumpington Meadows within TL4354 but records were made from concrete, an iron manhole grille as well as various trees. *Opegrapha viridipruinosa* was described as new to science in 2011 and good colonies were found on adjacent tree trunks beside the River Granta, one ash, the other willow. The ash trees on the embankment of a disused railway track supported only a modest lichen mycota but the presence of *Lecanora confusa* and *Fuscidea lightfootii* show how quickly the lichen communities are changing – both have only appeared in Eastern England in recent years. Short posts supporting rabbit netting beside the M11 barrier have extensive algal crusts but with colonies of fertile lichen thalli intermixed. In the field the possibility of a species of *Vezdaea* was mooted but microscopic examination show this to be a species of *Bacidia*, probably *B. chloroticula*.

Some bare clayey ground and a track in Trumpington Meadows within TL4353 yielded our only glimpses of cyano-lichens with two taxa of *Collema*. Vertical wooden boards of a revetment beside a punt-house support an extensive sorediate crust of a species of *Caloplaca* – the under-recorded and misunderstood *C. phlogina* is the most likely candidate. On wooden rails made of former telegraph poles support a spectacular lignicolous community whose composition is similar to that found on sandstone gravestones. A lecideine species was not recognised in the field but turned out to be exuberant *Catillaria chalybeia*. The specimens of various mysteries and uncertainties from today will be retained in my personal herbarium; eventually taxonomic problems are sorted out but there is a long way to go.”

Invertebrates

Bare ground near the site entrance proved to be a hot spot for ladybirds on the March visit, with Seven-spot (*Coccinella 7-punctata*), Adonis (*Hippodamia variegata*) and Eleven-spot (*Coccinella 11-punctata*) crawling over the bare earth. Following visits added Harlequin (*Harmonia axyridia*), Orange (*Halyzia 16-guttata*), Two-spot (*Adalia 2-punctata*) and Twenty-four-spot (*Subcoccinella 24-punctata*). Occasional damselflies (six species) and darter dragonflies (two species) were seen between May and October, but conditions were rarely good for sighting. This was true for butterflies too, with ten species seen between April and October. Galls were easier to find in the circumstances, and we recorded over a dozen. A few galls of the mite *Vasates quadripedes* were seen on leaves of a planted Sugar Maple (*Acer saccharinum*); this species was first reported in London as recently as 2002. The Cambridge Wednesday voluntary conservation group paid a visit during National Insect Week to record invertebrates. The county moth recorder had set traps overnight, giving an amazing haul of 82 moth species, which were inspected when the group arrived. The total included a few local or migrant species, and also the Nationally Scarce Cream-bordered Green Pea (*Earias clorana*).

Vertebrates

We rarely had birders with us, but did note 22 species. No sightings were particularly memorable, although it was nice to see Lapwing (*Vanellus vanellus*) in September.

The site is perhaps most notable for its population of Brown Hares (*Lepus europaeus*) and we occasionally saw as many as dozen on the meadows, with some indulging in boxing displays on our March visit. The next most commonly noted mammal was Muntjac (*Muntiacus reevesi*). Although we didn't see any, Otters (*Lutra lutra*) currently use the River Cam, whilst American Mink (*Neovison vison*), which had been present, are subject to a control program. Amphibians (Common Frog (*Rana temporaria*) and Common Toad (*Bufo bufo*)) and reptiles (Grass Snake (*Natrix natrix*)) are present.

Conclusion

Sowing of wild-flower mixes has obscured the original distribution pattern of many species. Despite intensive agriculture, arable weeds, including several which are red-listed, have survived in the seed bank. Hopefully this seed bank will remain, despite the planned conversion to grassland. Altogether we made over 1200 records of 438 vascular plant species or subspecies and records of over 400 other species. A diary style record of the visits and the full species lists are on the Society web page.

The 2013 survey is covering the area part of which is being developed to become Great Kneighton. Although the present CNHS group tends to concentrate on plants, we make records of other organisms too and would welcome beginners and experts with other interests. Do come and join in. Dates for the monthly surveys, and flora lists for many of the wildlife sites near Cambridge are on the Society web page.

Acknowledgments

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A New Era for Cambridge University Herbarium

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Abstract

The significance and scientific importance of the University Herbarium collections are outlined. The relocation to new premises is briefly described. The continued future use and development of the Herbarium is advocated.

Cambridge University Herbarium (CGE) has local, national and international significance deriving from its outstanding collections. With 1.1 million specimens of pressed, dried plants it ranks as only perhaps the fifth largest herbarium in Britain yet it is disproportionately type-rich, with type specimens from across the globe collected by many of the leading botanical explorers of

their day such as David Douglas, Joseph Hooker, Richard Spruce and Charles Darwin. The Herbarium's significance, therefore, encompasses the biodiversity-rich countries of the world. CGE has also one of the world's finest collections of British material in which all the critical genera and many infraspecific taxa are represented, all named by specialist taxonomists. New British material is still being added by local botanists.

Cambridgeshire has been described as 'possibly the best known region in the world' regarding its plant life (Walters, 1999) and was famously the subject of the first county Flora, John Ray's *A catalogue of plants growing around Cambridge* (Oswald & Preston, 2011). The county's flora has a long continuity of study, in part due to the teaching of botany at Cambridge University. Plant specimens at CGE date from the first Professor of Botany at Cambridge, John Martyn (1699–1768), to the present, compiling a 300 year biological timeline. Whilst care must be taken to recognise bias in temporal and spatial coverage in natural history collections (Ward, 2012) the British collection at CGE is ideal for long-term ecological research, providing coverage of the diversity of Britain's habitats and climatic environments. The large continental European collection provides material with which to compare plants found in Britain (Sell and Murrell, 1996).

Cambridgeshire is fortunate in retaining an interactive network of enthusiastic plant taxonomists, professionally trained and amateur, to study the county's changing flora. Since all knowledge of plants is predicated on the identity and relationship a plant has to other plants, their study depends upon taxonomy. Taxonomists use the Herbarium to identify variation within a species, to consult plant material and books for revisions and monographs of plant groups and to document biodiversity.

Ecologists, ethnobotanists, geneticists and biogeographers, for example, might also use the Herbarium as specimens provide alerts to the presence of new invasive weeds, document plant-use within indigenous cultures, provide material for DNA analysis and tissue for microscopic studies and chemical analysis, provide information on species distribution in changing landscapes and reveal the existence of new species to science.

A team of taxonomists showed recently that many species new to science can be found in herbaria after lying undiscovered for decades (Bebber *et al*., 2010). They explored how long it takes for new species collected in the field and placed in herbaria to be identified, and concluded that of the 70,000 flowering plants experts believe are yet to be found, up to half may already be in herbaria awaiting identification. Their study highlights the importance of collections such as those at CGE. Examining specimens in herbaria, Bebber's team revealed, may be as important as future (costly) field studies. At CGE work has begun to photograph specimens and create a database, enabling global digital sharing of images which will facilitate possible future discoveries of new species in its collections.

The historic specimens at CGE owe their existence to a time when scientific study fully emphasised natural history collections and, in Britain at least, taxonomy. More recently whole-plant study has been overshadowed by

molecular, laboratory-based techniques, often funded by global corporations with pressing interests in increasing crop yields and the development of bio-fuels, but herbaria are still vital and can inform molecular studies. A herbarium is more than just a physical collection of plants that have been pressed, dried, and stored in packets or mounted on paper. Specimens include labels with critical information about the plant's identity, geographic location, ecological habitat, flowering time, and collecting history. Each specimen embodies the species' morphology and its genome, and the entire collection can therefore be seen as a huge data and DNA repository. The use of herbarium specimens in molecular studies, by way of destructive sampling, has thus far been slowed by difficulties in obtaining amplifiable DNA but recent study has shown possible ways forward (Särkinen *et al*., 2012). In 2010 a team of plant scientists studying the evolution of Cucurbitaceae were successful in extracting DNA from CGE's specimen of *Sicyos villosa*, a plant now world-extinct and known only from this single Galapagos specimen collected by Charles Darwin in 1835 [1]. Their work provided insights not only into the nature of dispersal of plants to oceanic islands but also highlighted questions about the extinction of island plants, questions of increasing importance as our biodiversity diminishes (Sebastian *et al*., 2010).

In recognition of its enduring importance to the world, in November 2011 CGE was relocated to a purpose-built facility in the new Sainsbury Laboratory in Cambridge. The collections had outgrown their previous home. All the bryophytes, for example, had been stored away from the old Herbarium in less than ideal, damp conditions and vulnerable to attack from insect pests. Now all the collections are under one roof for the first time in decades. Metal storage compactors allow easy access to specimens and the new building provides separate areas for 'wet' and dried material. The specialist environment created for the new Herbarium is designed to meet the stringent criteria required to maintain the integrity of this priceless collection. A relative humidity of 40% +/-5% and a temperature of 18°C, +/-2°C are maintained as part of an integrated approach to pest management which minimises the elements essential for insect pest survival and limits damage to specimens from insect larvae which feed on dried plant material. A regular vacuuming regime reduces dust and debris in the Herbarium that could harbour insects and a sealed, solid floor ensures extra defence. All 1.1 million plant specimens were frozen for 5 days at –40C prior to relocation to kill any insect pests and any found in the future can be controlled by freezing in CGE's own freezers. Three major pests which attack herbarium specimens are Vodka Beetle (*Attagenus smirnovi*), *Attagenus pellio* and Warehouse Beetle (*Trogoderma variabile*). *T. variabile* is found throughout the Northern Hemisphere and unlike many *Trogoderma* species the adult can fly. Of all the *Trogoderma* species, it is the most commonly found in stored, dried foods but is also found in homes and museums. In herbaria *T. variabile* is a special threat, the larvae soon turning specimens to dust and frass. Poisons are no longer used to control insects at CGE and diligence in spotting potential outbreaks is a vital part of the day-to-day practice of staff and volunteers at the Herbarium.

Volunteers of all ages and backgrounds are most welcome to help in the Herbarium. Current volunteer projects include the incorporation of the *Rubus* collection of Gaston Genevier; the incorporation of the Monks Wood herbarium collection; unpacking and ordering the 19th century Bunbury collection; curating fungi; incorporating bryophytes; database work; mounting specimens on to paper; incorporating recently collected Cambridgeshire species; and mounting and incorporating the vast *Ficus* collection, possibly the best of its kind in the world. If you would like to volunteer for one of these projects, or have an idea for a volunteer project of your own, especially if you have a particular interest in the taxonomy of algae, or would like to visit for research purposes, please see the contact details below. Researchers, both amateur and professional, are also very welcome to visit the Herbarium, by arrangement.

For any herbarium to become actively and meaningfully involved in today's science it needs outstanding curatorial leadership to win the support of funders and administrators. CGE is currently without a curator and needs advocates in both the professional and public arena. A curator would promote research and the importance of its collections to administrators and colleagues but all botanists both amateur and professional, individually and collectively, can create public awareness of the importance of this internationally significant collection. The conservation of biodiversity is one of the world's most pressing and complex issues and information is needed about the identities, characteristics, and requirements of plants in order to manage our precious natural resources which are so very often taken for granted.

[1] To see the entire CGE collection of Darwin's plants collected on the Beagle Voyage visit www.darwinsbeagleplants.org

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Announcing a Fenland Flora: Plant Recording in the Cambridgeshire Fens

Owen Mountford and Jonathan Graham

The nature of Fenland

Fenland is amongst the most intensively farmed areas of Europe, stretching from Lincoln in the north to Cambridge in the south and occupying about 4000 km^2. Reclaimed over centuries from tidal marshes and floodplain fens with shallow freshwater lakes such as Soham Mere, the 21st century landscape is one of large arable fields separated by ditches that feed into a highly engineered network of main drains and rivers. Most of this former wetland is at or around sea-level and depends upon complex flood defences to protect it from marine and riverine flooding. Older human settlements in Fenland are often situated on slightly higher land (normally 2-10 m above sea level) that would have been islands within the ancient undrained wetland or on old causeways across the morass, and it is on these clay islands standing above the peat and alluvial soils that the great majority of pre-19th century development is situated.

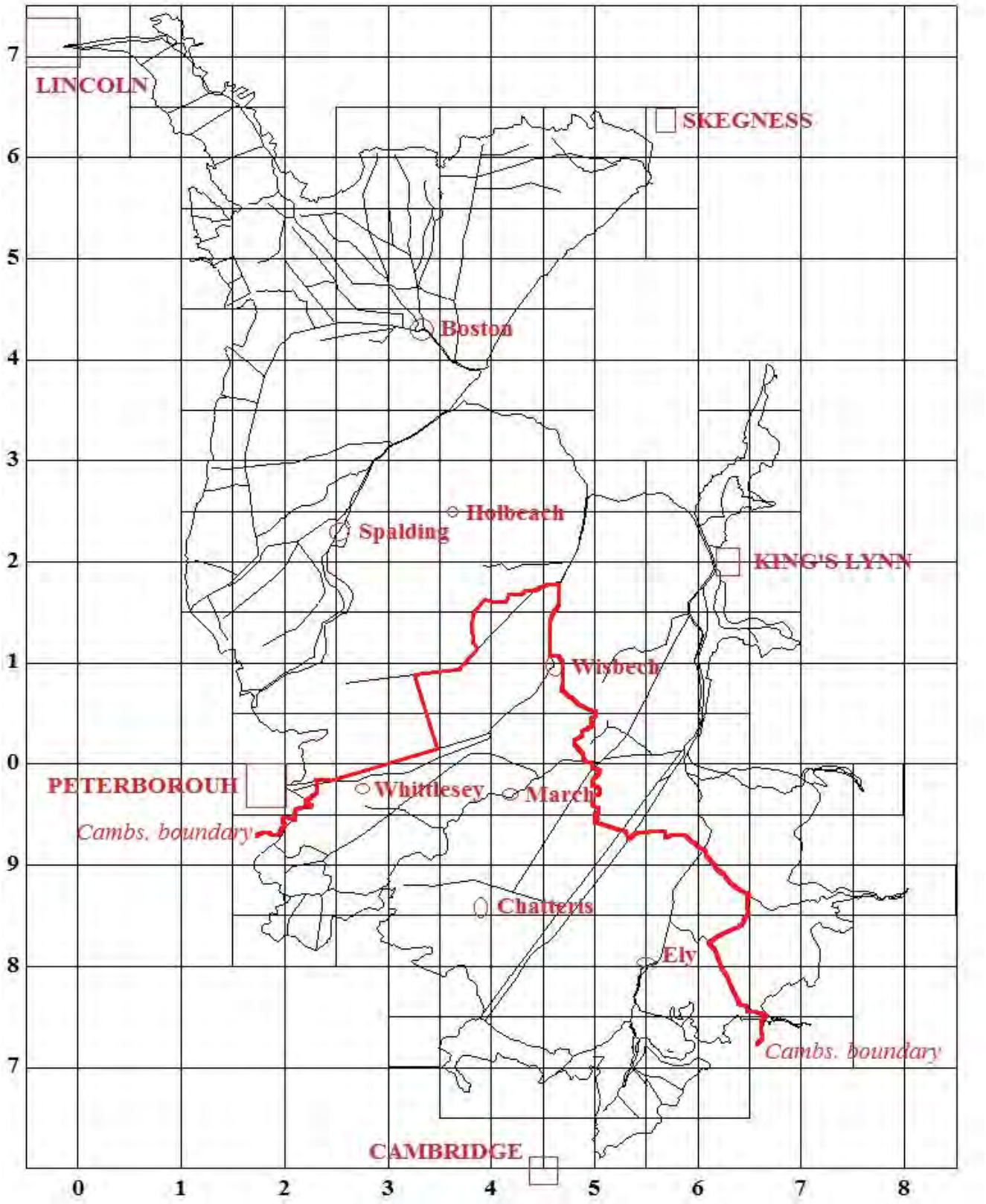
Within the modern Fens, the main refuges for native wetland plants and vegetation are drainage channels, older road verges and floodbanks, and locally flooded gravel and clay workings. On the "islands" were natural woodlands (the last felled in World War II) and grasslands created for livestock and the draught animals that worked surrounding arable land. Increased human population, mechanisation of agriculture and the demise of mixed farming greatly diminished the extent of these old grasslands during the 20th and 21st centuries. Between the *First Land Utilisation Survey of Britain* (Stamp 1937) and the *Land Cover Map* of 2007, the proportion of arable land rose from 68% of Fenland to 83.7%, whilst the grassland area fell from 22.4% to only 8.6%.

The counties that make up Fenland have been studied botanically for 350 years but, almost without exception, the Fenland parts of these counties have been relatively neglected. Cambridgeshire has the longest tradition of flora writing in the UK, beginning in 1660 and with a further important, innovative account imminent. However few botanists have been resident in the Cambridgeshire Fenland (Alfred Fryer of Chatteris was an important exception) and those coming from outside have often perceived the region as of little interest, focusing on the delights of the boulder clay woods, the Devil's Dyke and the Breckland fringe. How can botanists redress the balance and pay attention to the treasures the Fenland does hold?

The *Fenland Flora* project: Defining the Fens

The Fenland Basin is now the subject of a major long-term survey (*ca* 2006-2016) to map the distribution of the entire vascular flora and to characterise the plant assemblages that occur in this mainly artificial landscape. The project breaks with the UK tradition of floras for administrative counties in that the focus is a landscape defined by topography, hydrology and soils – see **Figure 1**. Of floras in lowland England, only John Trist's *Ecological Flora of Breckland*

Figure 1. Boundary of the Fens as used in the *Fenland Flora*
(Showing main settlements, watercourses and Cambridgeshire (vcs 29 & 31) border to aid location)



(1979) is really comparable to this innovative project. The guiding principles for defining Fenland are:

Altitude < 5m AOD, except on wholly included Fenland islands

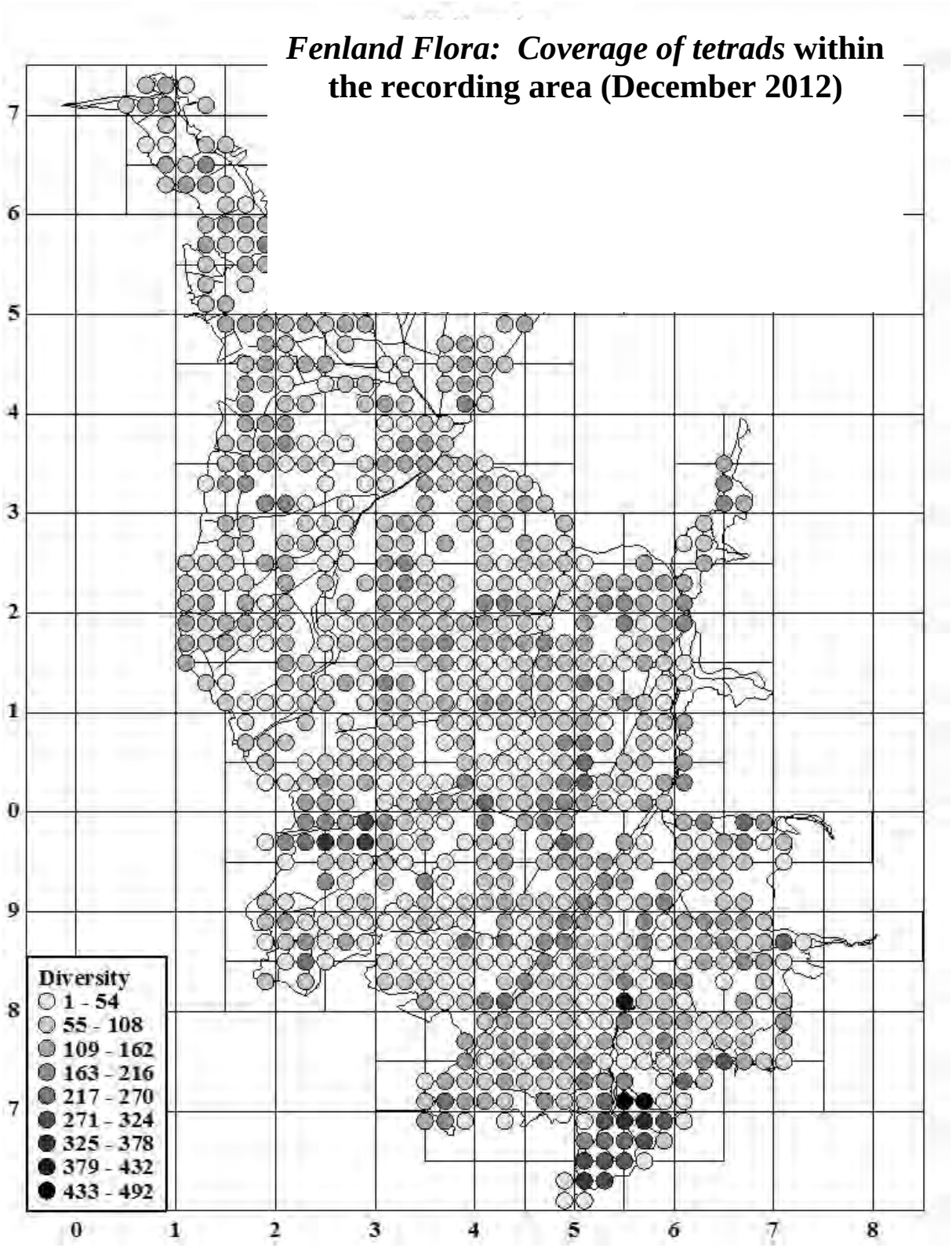
On loamy peats and groundwater gleys, but including brown soils and stagnogleys on islands

The recording unit for the survey is the 4km^2 tetrad of the UK national grid (see the Nature in Cambrisgeshire website for a list). The approach combines new field surveys of all important habitats present within each tetrad and a compilation of records from published and database sources for the period since 2000, as well as an account of floristic change over the centuries and up to the present day.

Progress to spring 2013 and next steps

The ***Fenland Flora*** project is assembling a database of species growing in this region. The focus for new surveys has been mainly on areas particularly under-recorded previously, but important datasets from sites of conservation importance (*e.g.* Wicken Fen and the Ouse Washes) have also been incorporated. Despite the incomplete coverage, clear patterns are already emerging, especially for aquatic macrophytes and the species of older grassland. These surveys confirm the importance of some well-known sites (*e.g*. those highlighted in the *Fens Biodiversity Audit*) as well as indicating new areas meriting attention and populations of regionally scarce plants. The project has worked closely with Alan Leslie and Nick Millar (Cambridgeshire Flora Group – CFG) and has contributed information directly to all other projects in vice-counties that overlap Fenland and which are coordinated by BSBI recorders. This partnership with CFG will continue, and some joint field excursions are planned in 2013.

In the first phase of the project we have made considerable progress in surveying the Fenland, but we now want to redouble our efforts and involve more people with an interest in this unique area. The ***Fenland Flora*** will continue to target tetrads without any modern data or with very sparse information, attempting to complete coverage of the region in the next 4-5 years. Attention will also be paid to the river valleys entering Fenland where they meet the definition of the flora area, as well as any potential hotspots for botanical diversity.



Anyone interested in contributing to the Fenland Flora should contact:

Owen Mountford at om@ceh.ac.uk (NERC Centre for Ecology & Hydrology, Maclean Building, Benson Lane, Crowmarsh Gifford, Wallingford, Oxfordshire, OX10 8BB *or*

Jonathan Graham at jonathan.graham@ntlworld.com

Green-flowered Helleborine (*Epipactis phyllanthes*) on Robinson Crusoe Island, Cambridge

Monica Frisch

The Green-flowered Helleborine (*Epipactis phyllanthes*) is a not very showy lowland orchid, found in shady places. A.J. Richards (1994), quoted in The Online Atlas of the British and Irish Flora, says "This plant is found in a variety of rather bare, dry, shaded sites under trees on well-drained, usually somewhat acidic, soils with a relatively low humus content. It is frequently associated with *Pyrola minor* [which is not found in Cambridgeshire]. Typical sites include beechwoods on flint capping, or on sandstone, Scots Pine/birch scrub on Bagshot Sands, Hazel coppice on sandy alluvium, pine plantations on sand-dunes and on sand-dunes themselves. It can also be found in riverside *Salix* scrub, where it tolerates occasional flooding."

It is not a common plant – the BSBI maps scheme shows it in 167 hectads (10 km squares) out of over 2,800, or less than 5%, mostly in south-east England, but with a scattering elsewhere in England, Wales and Northern Ireland (where it is on the Priority List of threatened species requiring conservation action), but not Scotland. But a few of those locations are in Cambridgeshire.

It has been recorded intermittently at sites in Thriplow, near Newmarket, and in central Cambridge, where it has been known for over a century. It was first recorded by A.S. Shrubbs in 1896 on Robinson Crusoe Island in the River Cam just north of Fen Causeway, and the species is still there. Gigi Crompton's invaluable online catalogue details records for it there up to 1987, with her final entry reading 'none found, PD Sell, G Crompton & U3A, 10.8.1992'.

Cambridge Natural History Society looked for it during their survey of Coe Fen in 2005, but with no success. Then in April 2010 I heard that it had been seen the previous year. I followed this up and received some details of the plants that had been found in July 2009.

So in 2010 I looked for Green-flowered Helleborine but, despite the Google map which had been sent to me, marking the different locations, I did not find any.

In 2011, on 22nd July, I tried again and, imagine my surprise, found two plants which were certainly helleborines. They were very small, probably less than 15 cm high, but Alan Leslie (the BSBI County Recorder) confirmed they were indeed Green-flowered Helleborine. They were to the west of the path that leads towards Fen Causeway. One was on fairly bare ground in the middle of a small track that leads at right angles towards the ditch; the other was amongst ivy at the base of a shrub in a little clearing slightly further north.

In 2012 the species did better. I found about a dozen spikes on 17th July, scattered over an area of a few metres, about half with flower buds (TL44845761). I also spotted another plant slightly further north (nearer the footbridge). Though one or two spikes got broken or grazed off, by August

several had produced seed capsules. There were still a few withered stalks visible in November. Richards (1994) says that "Well-developed individuals are rarely encountered, apparently because of drought stress" so it will be interesting to see how it does in 2013, given that for most of 2012 there was no shortage of rain.

In 2012 I also searched, unsuccessfully, for the species south of Fen Causeway where G. M. S. Easy had recorded "2 large flowering plants on island south of Fen Causeway, 448.575", in 1987. I felt the area was possibly a bit open and not sufficiently shady and cattle grazing may be a contributory factor.

The plant has also been recorded from Thriplow and, while the last entry in Gigi Crompton's catalogue says 'no *Epipactis* found in a quick search, G. Crompton & K. Tucker, 17.8.1992', it was refound in the ash belt at the north end of Thriplow Meadows in 2011 by Guy Belcher. The Catalogue also lists intermittent records between 1950 and 1985 for the Newmarket area but Alan Leslie has no post 1985 records from the beechwoods along the roads south of Newmarket. He notes that the storms did change this area considerably.

The Coe Fen and Sheep's Green commons, including Robinson Crusoe Island, were formally designated as a Local Nature Reserve in July 2012 so these historic riverside meadows, close to the heart of the City, will be managed for people and wildlife. The proposed management plan seeks to reduce the extent of invasive perennial weeds, enhance the old river channels and manage the veteran willows to maximise their habitat potential. With reference to Robinson Crusoe Island the management plan says:

"Woodland: On Robinson Crusoe Island and the small island formed to the west of Coe Fen by the drainage ditch: some Willow *Salix* sp., Sycamore *Acer pseudoplatanus* and Poplar sp. *Populus* sp. are present. The scarce Green-flowered Helleborine *Epipactis phyllanthes* has also been recorded on Robinson Crusoe island (last record 2010) along with Common Butterbur *Petasites hybridus* and the introduced Purple Toothwort *Lathraea clandestina*, a parasite on willow and poplar trees.

Woodland: Small areas of woodland on the islands on site contribute to the biodiversity of the site. There is potential for their improvement if non-native woody species are removed. The resulting increase in light through the canopy to the woodland floor will allow the native under-storey to develop."

Although the BSBI Atlas says "populations tend to be sporadic, often not persisting for longer than about 30 years" (Carey & Dines 2002), Green-flowered Helleborine has persisted on Robinson Crusoe Island for 116 years, and the species has been known at Thriplow for over 50 years. While Richards (1994) says "the apparent irrationality in its choice of site, and its absence from most apparently suitable areas in districts where it does occur, makes it difficult to prepare a coherent conservation strategy for this species" Green-flowered Helleborine clearly finds the conditions on Robinson Crusoe Island suitable. Care must be taken that management, such as removal of non-native woody species and letting in more light, does not have the effect of enabling more vigorous plants to thrive to the cost of Green-flowered Helleborine. I intend to continue monitoring how it does at Robinson Crusoe Island.

Acknowledgments
Thanks are due to Alan Leslie for his thoughtful comments on the first draft.

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Bourn Free: Rescuing Water Voles and other Wildlife

Jess Hatchett, Ruth Hawksley & Vince Lea

The plight of the Water Vole has been discussed previously in Nature in Cambridgeshire. Jefferies *et al* (2004), showed that it is the most rapidly declining mammal in Britain, and that the important population in the county has been severely depleted. The main reasons for the decline are a combination of habitat loss and predation by the introduced American Mink (Green & Baker 2004). Various lines of evidence show that Mink predation is the main driving force behind the decline. It was hoped that the return of the Otter to our waterways (Hawksley 2008) would help reduce the Mink population. Several years have elapsed since the two mustelid species have shared our waterways, however, and there has been no response from the Water Voles, suggesting that Mink remain a problem. Studies in the Thames valley show that with the combined presence of native Otters and Polecats, American Mink are ecologically squeezed but not eliminated from the habitat (Harrington *et al.* 2009). Water Voles evolved in the absence of American Mink, and although they are food for a wide range of predators – Stoats, Foxes, Buzzards, various owls, Herons and Pike to name a few of the main ones – they have always had one place of safety, their bank side burrows with underwater entrances. By diving underwater and swimming into these lairs, they could avoid predators. American Mink have changed this situation, as female Mink are small enough to enter the burrows, and can follow them underwater. On arriving in a new area, Mink usually eradicate Water Voles within a short period, but persist in the area by switching to a varied diet including fish, aquatic invertebrates, other mammals up to the size of Rabbits, waterbirds, particularly Moorhens, and amphibians. This means that Water Voles are unable to recolonise once Mink have appeared, and there is no balanced predator-prey relationship as would occur with species which co-evolved. Water Voles only persist in complex, large habitats where it is possible for them to evade total predation – examples

being extensive reedbeds & upland bogs (MacPherson & Bright 2009) and extensive networks of ditches and dykes in fenland (Chen 2010).

While efforts have been underway in fenland to improve the fortunes for Water Voles for some time, very little has been done in South Cambridgeshire. The Bourn Brook has been chosen for such a campaign by the Countryside Restoration Trust, in collaboration with the Wildlife Trust BCN, mainly on the basis that this watercourse flows through the farmland owned by the CRT in Barton and Comberton, and the upper reaches are close to the WT headquarters at Cambourne, where a remnant population of Water Voles was known to exist. This campaign centres on the need to remove Mink and was launched in September 2010 with the very witty and catchy title of Bourn Free. This project has expanded to consider all non-native species in the brook, to include habitat improvements along the watercourse, and to extend to other parts of the upper Cam catchment area. As part of the programme, the Bourn Brook was surveyed by the Wildlife Trust (Hawksley *et al* 2011) for invasive plants, habitat conditions and the presence of Water Voles. Small isolated colonies of Water Voles were found, but their population was highly fragmented and vulnerable to extinction. After two Mink-free breeding seasons, signs of Water Vole recovery are beginning to appear.

Introduction to the Bourn Brook

The Bourn Brook rises in Eltisley, and flows east to the Cam at Byron's Pool. The catchment is in the boulder clay district of south-west Cambridgeshire. Numerous small side-streams and ditches feed into the brook, coming off the impervious clay catchment, with a relatively steep slope, making the Bourn responsive to heavy rainfall. As well as flooding, low flows are also a regular problem as there is relatively little base flow. This gives the Bourn a quite different character to the chalk-fed streams further south, such as the Mel and Shep. In response to the spate characteristics, several attempts have been made in the past to 'improve' the flow, with the aim of moving water through the channel more rapidly. Examples include straightening, dredging and deepening of the channel, cutting off meanders and clearing blockages and weed. While these efforts may help remove water from the immediate vicinity of the works (thus protecting farmland), they have the effect of moving flood waters more rapidly downstream where they have the potential to cause flooding in the urban areas of Cambridge, as a component of the Cam. At low flows, these engineering efforts reduce the water quantity in the brook, not helped by increased water abstraction. Well-drained arable land, compared to more natural grassland or tree cover, gives a greater response to rainfall events, so all these factors combined mean that the brook has a more extreme flow regime than it would have had in the past.

The landscape around the Bourn is generally agricultural, although there are some settlements close to the brook, including Bourn village, through which the brook flows. In recent years, two golf courses have been created around sections of the brook. While most of the farmland in the Bourn catchment is intensive arable production, there are stretches of farmed grassland on the flanks of the

brook in many areas, with sheep- and cattle-grazing in different parts and hay meadows in the lower reaches. Most of the arable land nowadays has 6m wide grass margins along the brook, and there are some larger areas of non-cropped grassland which have been introduced with the aid of agricultural subsidies encouraged by the EU Water Framework Directive regulations, aimed at water protection. Nonetheless, evidence suggests that the brook has high levels of agricultural runoff, bringing silt, nutrients, organic material and pesticide residues to the watercourse. Google Earth aerial photography shows that the extent of riparian grassland has declined since WW II. On the other hand, the extent of tree cover has increased over the same time period, due to reduced willow pollarding, scrub invasion and some tree planting, for example of hybrid poplars.

As well as the physical changes to the Bourn Brook and the land management around it, numerous biotic changes have occurred, mostly detrimental in terms of biodiversity interest. One such is the spread of Invasive Non-Native Species (INNS). The most obvious one in late summer is Himalayan Balsam (HB), Britain's tallest annual plant at some 2-3m height, with distinctive white to purple flowers and heavy sweet scent, followed by the explosive seed capsules which can scatter hundreds of seeds around the river bank. Less numerous but more problematic is Giant Hogweed. This perennial plant is even taller than the HB, and it is hazardous to humans, causing skin rashes on contact, especially if the affected area is exposed to sunshine. The enormous hollow stems are tempting for children to play with, and if used as blow-pipes can causes serious problems. In the water itself, another INNS is the Signal Crayfish, originally from North America. This species out-competes our native White-clawed Crayfish and is resistant to, but a carrier of, crayfish plague, fatal to the native species. Following the spread of the Signals, White-clawed are no longer found in the Bourn. In addition there are American Mink, as described above.

Conservation efforts on the Bourn Brook

In 1994, the Countryside Restoration Trust (CRT) acquired its first piece of farmland, a small field in Barton parish, next to the Bourn Brook. At the time, the land was in arable production, but historically there had been grassland adjacent to the brook. This part of the field has been restored as a hay meadow, as have many more riparian fields acquired by the CRT in subsequent years; with ten such fields, about a quarter of the length of the brook is now in CRT ownership. In addition to restoring grassland to the brook, willows and osier beds have been planted in certain areas, pollarding of veteran willows has been reinstated, and new willows are now being pollarded, as they reach maturity. A few ponds have been added or restored close to the brook. The watercourse has been allowed to return to some of its natural character, with fallen trees left in the channel and some efforts at improving the variation in flow and structure, for example with a riffle added to an area previously canalised to cut off a former meander.

During the years since this start on conserving the Bourn Brook habitat, wildlife monitoring has been conducted using a variety of surveys – breeding bird censuses, butterfly transects, bat surveys, and compiling lists of casual sightings, among others. Throughout this period, Water Voles have failed to make a comeback – very occasional sightings are all that can be claimed. On a couple of occasions, after sightings of Mink, the CRT farmer set traps and caught a few Mink, but this method is not very satisfactory as it is hard to know when Mink return after a trapping campaign ends. The method of catchment control of Mink, aided by the use of specially designed rafts, was developed by the Game Conservancy (now the Game & Wildlife Conservation Trust, GWCT) (Reynolds *et al.* 2004). This allows a thorough removal of Mink from a catchment, and rapid detection of the return of the Mink, to alert to the need to set traps again. The beauty of the method is that the Mink raft, which floats in the river, is highly attractive to Mink; they explore it and especially the tunnel sited on top, but it rarely gets visited by non-aquatic species. The tunnel can hold a clay base which collects footprints, and tells the Mink controller that there are Mink around. The tunnel can also be used to house a live-capture cage trap, which Mink readily enter. When traps are set, the raft has to be visited daily to check for any capture, but with the clay, the raft can be left to collect evidence over a period of a week to a month, which is much less effort. Trapped Mink are dispatched humanely, following guidelines developed by GWCT and which was recognised by receiving the first Universities Animal Welfare Award.

After a slow start, with limited equipment and on CRT land only, we gradually accumulated more Mink rafts, some donated, some built by volunteers. More and more landowners were contacted and all were willing to have Mink rafts on their stretch of the brook. In the first winter, we deployed 15 Mink rafts and caught 41 Mink (this includes 16 caught by a local gamekeeper who was already regularly trapping Mink anyway). No Mink signs were seen during the summer of 2011, but in the autumn there was an influx of mainly young Mink, presumably from other watercourses. In a study from the north of Scotland, Mink were found to travel an average of 15.7 km and over a quarter moved between catchments (Bryce *et al* 2011). We reduced the number of Mink rafts on the Bourn to the optimal spacing of one per km and used the surplus rafts, along with a number of new rafts, to set up a network of Mink rafts on the adjacent river Rhee, plus part of the Cam near the confluence with the Rhee, with the aim of reducing the likelihood of future Mink invasions to the Bourn. This operation on the Rhee in the winter of 2011-12 resulted in a further 16 Mink being trapped; the autumn 2011 catch on the Bourn was 14 Mink, but in winter 2012-13 only four Mink were trapped on the Bourn, showing that re-invasion rates were greatly reduced, as well as the fact that we now had achieved Mink-free status on most of the River Rhee as well. The Mink control scheme was extended onto the Cam between Hauxton and Hinxton during the winter of 2012-13, resulting in capture of a further 22 Mink. Together with other trapping activity elsewhere in this catchment area, and by gamekeepers, poultry farmers and fishing clubs, a total of 160 Mink have been trapped during the

three winters of operation of the Bourn Free project, and signs of Mink (based on footprint evidence from over 60 Mink rafts distributed throughout the area) are greatly reduced from 'nearly everywhere' to 'hardly anywhere'. The majority of time spent doing this work has been provided by volunteers, co-ordinated and assisted by the author.

In 2012, the WT surveyed the Rhee (Hatchett *et al.* 2012) and found further small Water Vole populations. The hope is that in a Mink-free environment these populations may eventually join up with those of the Bourn, creating greater population stability and a secure future for the Water Vole. The only worry is that the 2012 breeding season was marred by frequent catastrophic floods, which may limit the number of young produced by the various small colonies. Future surveys are planned to evaluate the response by the Water Voles. Until recently, the main Water Vole colonies have been confined to less favourable habitat, as the richer riparian stretches of the lower reaches of the Bourn & Rhee are also favoured by Mink, which have excluded the voles, forcing them to retreat to the smaller water courses where there is less food and greater risk from terrestrial predators such as Stoats.

Plants

The 2011 WT survey revealed that HB had colonised most of the Bourn. Although considered by some as a benign addition to the flora, occupying a niche that does not compete with native plants, HB causes a number of problems; it can shade out native riparian plants, which are the main food for Water Voles; its dense stands which die down in the winter do not hold soil together, so can lead to erosion; dense stands in streams can reduce water flow; bare mud which the plants colonise is an important habitat for invertebrates and wading birds; the flowers are such an attractant to bees, that native plants lose out when it comes to pollination services. The most upstream plants were around the village of Bourn, with no sign in the upper reaches around Caxton, but with extensive populations through Bourn, Caldecote, Toft, Comberton and Barton. Approximately 11 km of the watercourse had Himalayan Balsam. The only areas within this stretch where HB was not abundant were either very shady wooded parts, where HB grows weakly, or areas where grazing animals had access to the banks, and could graze the plants down. In some favourable silty sections, HB was the dominant plant, but generally it occurred as a component of mixed vegetation stands. The other INNS surveyed was Giant Hogweed (GH), which had been recorded in small numbers around Bourn Golf Course in 2002 but was now found to be far more abundant and widespread, from Bourn to Toft.

In 2012, the project partners began to tackle the Himalayan Balsam problem by hand-pulling of the plants with volunteer groups. Efforts started in late April 2012, when the brook was facing a severe drought situation, and vast areas of muddy riverbank were exposed, resulting in a dense growth of HB seedlings, with the appearance of gargantuan mustard and cress. Within a week, however, drought turned to flood, and the brook burst its banks – a rise of well over a metre, which persisted with regular rainfall top-ups over the following three

weeks or so. By the time the floodwaters subsided, a return visit to the site where the first clearance had ended showed that the next section of seedlings (which were looked at when work finished on the first session) had all perished. This major flood at HB germination time had profound effects on the attempts at clearance during the rest of the 2012 season. Comparatively little HB occurred at the expected interface between the stream and the banks, but plants instead appeared at all heights along the bank, and in numerous other situations, such as side ditches, wet hollows above bank tops and even in the crevices of veteran willow pollards. The persistently wet summer meant that these plants, which require damp conditions, thrived. Although the overall HB population was greatly reduced by drowning of the majority of seedlings, the search for plants was made more difficult due to their varied locations. Many were deep within bramble patches or half way up steep inaccessible banks; for most of the brook, wading in stream to search for HB means that the average person's head is well below the top of the bank, and any growing above the bank would be missed. In a normal year there would be very few in such situations, but in 2012 they were equally distributed from low water to high water marks. The repeated flood events during the summer also brought seed up from the seedbank, resulting in staggered germination throughout the year; it was common to find 2 m plants flowering in July alongside 20 cm seedlings growing in the dense bank side herbage, which made the search more difficult than with uniform germination of plants.

Despite several volunteer events having to be cancelled due to dangerous water conditions, over 400 person-hours of Himalayan Balsam pulling were conducted along the Bourn. Typical search patterns involved a pair of operatives wading – one checking each bank of the brook, and a third person walking along the bank top to spot higher plants. This arrangement also fulfils Health and Safety requirements for working in water. Volunteers included teenagers from Comberton Village College, working for their Duke of Edinburgh (DoE) Bronze Awards, mid-week WT volunteer regulars, CRT 'Rustics' (the regular volunteer group there), and the Cambridge Conservation Volunteers. Based on repeat searches along worked sections, volunteers were at least 80% efficient at finding HB. Nineteen volunteer sessions were held, with at least one staff member from WT or CRT supervising each event, and volunteer numbers ranged from one to 15 per session. DoE sessions lasted a maximum of two hours, while other events were up to six hours in length. By marking off completed sections on a map, we were able to co-ordinate efforts and attempt to cover the whole brook in the course of the summer, but cancellations due to weather and other circumstances meant that approximately 80% of the length was in fact tackled. The subsequent winter 2012-13 has seen several more severe floods, including one 2 m above base flow at the Comberton gauging station so we anticipate major dispersal of any seed produced during 2012. The summer 2013 will doubtless require a similar effort to control the spread of this plant, but we wait with interest to find out exactly where and how abundantly it occurs.

During the HB pulling sessions, volunteers were asked to note the location of any Giant Hogweed plants they observed. This species requires specialist

treatment; it cannot be handled without gloves, and the persistent tap root cannot be pulled out. Locations of observed plants were given to the Environment Agency, whose staff cut the plants down and treated the cut stems with herbicide in a carefully controlled way. The number of visits by EA staff to conduct this work was also reduced by flood events, and further control is planned for 2013. It was noted that this species had increased in number and range in just the 12 months between the Hawksley *et al.* (2011) survey and the control year 2012.

Other INNS such as Floating Pennywort and Water Fern (*Azolla*) were not seen on the Bourn, although volunteers were given identification sheets and asked to search for them. Both of these species were found on the Rhee, however (Hatchett *et al.* 2012).

Crayfish

As Mink include crayfish in their diet, and the Bourn Brook was known to hold a population of the American Signal Crayfish, a notorious INNS, we were interested to observe the effect of removing Mink from the watercourse. In summer 2011, crayfish trapping was undertaken at several locations along the Bourn from May to August – peak activity for crayfish is during warm water periods. Only two Signal Crayfish were caught, after 56 'trap nights' i.e. one crayfish trap operated overnight = one trap night. On some occasions up to 20 traps were operated at a time, at other times smaller numbers were operated for longer periods (with regular checks), according to time and human resources available. In 2012, 54 trap nights resulted in a capture of 27 Signal Crayfish – a dramatic capture rate increase of over 10 times more crayfish per trap night. The indications are that removal of Mink has aided the Signal Crayfish. Remains of crayfish are frequently found in Otter spraint and at Otter feeding stations, however, so it may be that the native predator will increase consumption of this species in the absence of Mink. In the Cam, fisherman report that Perch in particular prey on Crayfish, which may be another potential biological control agent of the future, but Perch are seldom seen in the Bourn. Seven species of fish were caught as by-catch in the crayfish traps, particularly Bullheads, Stone Loach, Minnows and Sticklebacks. All of these except the mid-water Minnow species declined in capture rate from 2011 to 2012, which may be a reflection of competition or predation by the crayfish on these species.

The possibility of scaling up Bourn Free crayfish trapping activities are not, currently, realistic as a means of controlling this highly prolific species, and many authorities discourage trapping as a control method because it can encourage further increase in survival of juvenile crayfish – they are highly cannibalistic. Trapping will continue as a monitoring tool only, until any suitable management techniques are developed. Discussion with a researcher at Anglia Ruskin University suggests that if intensive trapping can be conducted, it is possible to control Signal Crayfish to a level where they cause less harm to the ecosystem (Vaughan-Stancliffe *pers comm).*

Native wildlife

While the description of aliens taking over this little watercourse may leave us with a sense of despair, it is worth recording that several important native species do occur and will, we hope, benefit from the removal of Mink. One complete surprise during the first trapping period was the capture of a female Polecat. Photographs were taken (Mark Hows, Cambridgeshire Mammal Group) and the animal was released from the trap unharmed; it was sighted hunting in the same area several weeks later. The photographs were verified as a true Polecat by a national expert (Johnny Birks). This species has been recolonising England and has the potential to restrict the return of Mink to the watercourse, but is less aquatic in behaviour so poses relatively little threat to Water Voles – the main diet consists of Rabbits and Brown Rats.

The Mink rafts are also a useful monitoring tool for the now ubiquitous Otter, which regularly use the tunnel rooves as a spraint site. They seldom enter the tunnel to leave footprints – the aperture is rather tight for this much larger animal – and our traps are designed to be far too small for Otters to enter. Occasionally, camera traps have been set up to monitor raft activity, and Otters appear on these, including one occasion when a female was followed by a male six hours later, suggesting a possible breeding pair. Removal of Mink should increase the food resource available to Otters, as was shown by the GWCT on the Monnow catchment (Reynolds, *pers comm*).

The Bourn also holds a few pairs of Kingfishers, with numbers fluctuating according to winter freezing levels and summer flood events (so currently at rather a low ebb). Their breeding holes are just as tempting to a hunting Mink as Water Vole burrows – as shown on footage broadcast by Springwatch in June 2012 http://www.bbc.co.uk/blogs/natureuk/2012/06/kingfisher-Mink-predation-last.shtml. Given a run of suitable weather years, we would expect an increase in this species in the absence of Mink, as long as the increase in crayfish does not lead to a decline in the small fish preferred by Kingfishers. It is not known to what extent Kingfishers include crayfish in their diet, although it has been recorded as a component.

Moorhens have been recorded on the Bourn Brook during CRT bird surveys since 1999, but numbers have not increased despite extensive habitat improvements. Throughout this period, juvenile Moorhens have been rarely seen, and it is a well-known fact that eggs and chicks of this species are quickly found and eaten by Mink, so again, we hope to see an increase in this species. Waterways Breeding Bird Surveys have suggested that Moorhens are becoming scarcer on small waterways, but the population is maintained by successful breeding on larger waterbodies and small, isolated ponds, habitats less frequented by Mink (http://blx1.bto.org/birdtrends/species.jsp?s=moorh).

Water Voles were recorded at four locations on the Bourn Brook in 2011, but casual observation during 2012 showed them at several new locations, including feeding signs on CRT property in Barton for the first time in years, and between Toft and Caldecote, an area mid-way between two of the 2011 colonies. This site was the subject of habitat management (bank side scrub coppicing) by the

Cambridge Conservation Volunteers, to increase the herbage content of the river banks, a critical food supply for Water Voles.

Conclusions

Mink and Water Voles cannot co-exist on lowland watercourses, so a co-ordinated, catchment wide Mink control scheme is the only potential conservation answer to the problem of the dramatic decline in Water Voles. This programme is now underway and initial responses from the Water Voles are beginning to show a turn around in their fortunes. Control measures are also underway against the two principal non-native plants, Himalayan Balsam and Giant Hogweed, but it is too soon to know how effective this work has been so far. Signal Crayfish seem to be benefiting from the removal of Mink, a potentially unfortunate side effect which will be kept under surveillance. All of this work is funded on a shoestring by grants from the Environment Agency and DEFRA, co-ordinated by two charitable organisations working closely on the ground and supported by advice, landowner contact details and volunteer hours from FWAG, the Cam Valley Forum, Cambridgeshire Mammal Group and the Cambridge Conservation Volunteers and many others. Landowners along the Bourn Brook have been remarkably co-operative regarding all aspects of this project, and without their support the joined-up approach that is so crucial to tackling non-natives in a watercourse would not be possible. Given the tiny size of the Bourn Brook relative to the watercourses of the UK as a whole, most of which have similar problems, it is clear that there is a very long way to go before thriving populations of native wildlife can once again be enjoyed as a matter of course during a walk along the river bank. We hope that the Bourn Free project can be used as an example to others to improve their waterways; any readers who would like to volunteer with us to help work on the Bourn during 2013 – 14 and gain experience of this type of work would be welcomed.

Volunteers wishing to help with Mink rafts, crayfish trapping and habitat restoration such as willow pollards and ponds on the CRT property should contact the author, Vince Lea vincelea@btinternet.com 01223 262999. For WT Water Vole surveys along the brook contact Ruth Hawksley ruth.hawksley@wildlifebcn.org (01954 713500). Volunteers wishing to help with Himalayan Balsam control and recording Giant Hogweed may contact either of the above project officers. We provide waders and it is a great experience to wander along the stream bed!

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Geodiversity

Ken Rolfe

When travelling around the County of Cambridgeshire I tend to think of Greater Cambridgeshire, including Peterborough, and this article covers the geodiversity of this greater region. I would like to try and address in this article the subject of geodiversity, the geology and landscape, and the connection with the biodiversity, the flora and fauna, of the county.

Geologists express time in millions of years whereas archaeologists use thousands of years and this really underlines the fact that the Earth has been around much longer than man, who is a relatively recent species inhabiting the planet. There is a term being used, which I rather embrace and that is one of 'geoarchaeology' and there is no better example to study than at Must Farm, Whittlesey and the recent discovery of a number of Bronze Age boats and other man made artefacts.

Greater Cambridgeshire is part of the geology of Britain, which in turn forms part of the Eurasian Plate, one piece of a giant jigsaw of plates that make up the story of plate tectonics. These plates have probably been moving around the surface of the Earth throughout geological time, and are still moving today.

So how did Greater Cambridgeshire arrive in the Northern Hemisphere when it is proven that the Eurasian Plate has travelled over time from the Southern Hemisphere through the Equator to where we are situated today?

This story was the subject of the first in a series of one-day seminars being produced by the Cambs Geosites Team and took place during September 2011 at the Department of Zoology, University of Cambridge. The next seminar is scheduled for September 2014 and will cover the rocks and minerals of the

county.

As the county travelled north, with the plate, we begin the journey with the Jurassic Period from around 208 to 146 million years ago, the time when dinosaurs inhabited the land and the seas and the Oolitic Limestone north of Peterborough and the Oxford Clay were deposited beneath the oceans. Today, we can see the evidence of this in the Peterborough Museum, where the story is told of how the Oxford Clay was deposited and the evidence of the various fossils of creatures that lived in the ocean at that time displayed.

Sea urchins, ammonites, belemnites, ichthyosaurs and plesiosaurs, along with the oyster *Gryphea*, known as the Devil's Toenail, are but a few of the creatures that inhabited our county long before man was to make an appearance. Fossils of many of these ancient creatures have been discovered in the limestones and the Oxford Clay of the Jurassic Period. The Hanson Quarry at King's Dyke, Whittlesey has produced, and is still producing excellent fossils from the Oxford Clay, representative of the earlier life of the county and some of these can be seen at the Peterborough Museum and at other museums across the county.

The Cretaceous Period from around 146 to 65 million years ago covers the continuing journey northwards of the county and the laying down of the Chalk Seas. The Wildlife Trust reserve at Cherry Hinton, Cambridge has excellent outcrops of the chalk, with clear interpretation boards, telling the story of the chalk and explaining that particular part of the journey. It is very interesting to see the different biodiversity found at Cherry Hinton compared with that of the Oxford Clay region and the connection between the geodiversity and the biodiversity.

During the Early Cretaceous Period the Lower Greensand, Gault Clay and the Upper Greensand formations were laid down. One of the best locations to see these formations is in the Upware/Wicken region of the county. Here, there is an ancient coral reef as well as phosphatic nodules that are known locally as coprolites. This is one of the principle locations for future work by the Cambs Geosites Team during 2013 and beyond forming part of the 'Fen Edge Geological and Landscape Trail' project.

The next significant geological event for the county is the Quaternary Period from around 2.6 million to 10,000 years before present, consisting of the Ice Ages and the interglacial periods. This is when the county was covered by a great thickness of ice and during the interglacial periods great quantities of outwash deposits, mainly sands and gravels, and the boulder clay were laid down on top of the earlier deposits.

The last 10,000 years form the Holocene Age and is considered to be an interglacial period. This is very much the story of the Fenland deposits and the formation of the peat. Prior to the draining of the Fens by man this Fenland Basin area consisted of marshes and a number of 'islands'. This area is unique in Britain and along with the Fen Edge forms an enormous part of our natural heritage.

Ancient rivers were buried by the Holocene deposits, and have started to reappear as 'roddons' since the draining of the Fenland Basin, and the shrinkage and wastage of the peat that followed (Smith *et al* 2012).

It is the Fen Edge and the Fenland Basin that will form the main interest and development of the 'Fen Edge Geological and Landscape Trail' using existing footpaths and rights of ways from Peterborough through to Isleham. The Fen Edge for this purpose is based on the 5 metre contour of the Ordnance Survey 1: 25,000 series of maps.

Producing this trail forms the main project work for the Cambs Geosites Team over the next few years. The trail will take in the minerals and the building stones and will add the geodiversity to that of the biodiversity of the region.

The Cambs Geosites Team is a sub-group of the Cambridgeshire Geology Club and is dedicated to identifying and conserving the Regionally Important Geological Sites (RIGS) throughout Cambridgeshire and is joined by its sister organisation GeoPeterborough in completing this task.

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Additional Sulphur Clover (*Trifolium ochroleucon*) populations at Knapwell, Cambridgeshire

Philippa M. Harding and Paul T. Harding

In 2011 two populations of Sulphur Clover were recorded in two areas on Protected Road Verge (PRV) S23 at Knapwell (Cadbury, 2012). Cadbury recorded 37 plants along 23 metres on the western side, north of the entrance to Glebe Farm and, on the eastern side, 15 plants along 14 metres, north of the track to Whale Barn (called New Farm on earlier maps). Cadbury also noted that PMH had observed Sulphur Clover on the western side, south of the track to Whale Barn.

On 12 July 2012 we surveyed the western side of PRV S23, from opposite the Whale Barn track south to the end of the PRV near Wood Farm Bungalows, and the opposite length of unprotected verge on the eastern side of the road. We found a total of seven separate populations of Sulphur Clover, five on the PRV (western side) and two on the unprotected verge (eastern side) - see Table 1. Each of these populations consisted of single or small numbers of plants, with no population apparently more than 1 square metre in area. The position of each population was located by measurement from the nearest numbered telegraph pole and from the edge of the road.

Table 1
Location of additional Sulphur Clover populations recorded in 2012 at Knapwell

West side (PRV S23)		
Telegraph pole No	Distance from pole	Distance from road
29	7.5 m north	3.5 m
29	24 m south	4 m
29	27 m south	2.8 m
30	22 m south	4 m
31	5.5 m south	4 m
East side (unprotected)		Distance from road
Opposite pole No 30	6 m south	3 m
Whale Barn track	0.5 m south	3 m

Management

As was noted by Cadbury (2012), lack of management (especially periodic cutting) must, in the long term, threaten populations of Sulphur Clover on roadside verges in the county. Since 2012, responsibility for the management of PRVs appears to have been devolved from Cambridgeshire County Council (CCC) to parishes (parish councils and parish meetings). This was poorly defined by CCC and, not unexpectedly, poorly understood in parishes without a voluntary PRV Warden or some other local expertise.

All the Knapwell populations can be considered to be threatened unless measures are taken to introduce and maintain periodic cutting of the verges with Sulphur Clover. The populations counted by Cadbury (2012) at Knapwell have been maintained unintentionally, mainly by the cutting of limited sightlines by private individuals and CCC Highways. The long western part of PRV S23 discussed above was cut in the winter of 2011/2012, as part of the routine hedge management of a local farm. In consultation with the Knapwell Parish Clerk, we arranged for this western verge to be cut again in February 2013. The effects of cutting in successive winters, on these recently discovered Sulphur Clover populations, will be examined in 2013.

Conclusions

By comparison with other recorded locations for Sulphur Clover in old Cambridgeshire (v.c.29), as listed by Cadbury (2012), the roadside verges south of Knapwell village are probably the most important single area in the old county for this species. Measures to provide suitable management for these verges have been introduced, but are entirely dependent on voluntary action.

Reference

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Sulphur Clover: a correction

Louise Bacon

In his paper last year 'Sulphur Clover *Trifolium ochroleucon*: its decline in Cambridgeshire (v.c. 29)' (cited above), James Cadbury included Hatley Park grassland among the sites listed in Table 3 where this species had apparently been lost, with the grid reference TL274518, a last record of 2007 and ploughing as the reason for the loss. Reference to data held by the Cambridgeshire & Peterborough Environmental Records Centre showed that the grid reference cited is 1 km north of the still extant and thriving population of Sulphur Clover in the private grassland of Hatley Park and thus in the middle of an arable field.

Vascular Plant Records

Alan Leslie

In recent years it has been striking that some plants generally regarded as native in the British Isles (if not always in Cambridgeshire) have been increasing their range across our county. Those such as Sea Couch (*Elytrigia atherica*) are part of a national trend for maritime plants to spread along major roads and beyond, but this species is now turning up here in some much more unlikely places, where it seems to have been overlooked for some time. Other species whose records are steadily increasing here, especially over the south of the county, include *Galium parisiense*, *Poa bulbosa* and *Sagina apetala* (the last being the taxon we used to know as *S. ciliata*). Nor have we been left out of the national trend for new records for the nationally rare *Fumaria reuteri*, which turned up last year in one spot along the new guided busway. Trying to assess how these plants reach us and are then locally dispersed can fill many an idle hour of speculation, although solid evidence can be much harder to find!

No less remarkable in the records listed below are the reappearance of Trailing St John's-wort (*Hypericum humifusum*) at Gamlingay, the result of clearance work in Gamlingay Cinques and the discovery of a colony of *Rosa sherardii* on a road verge by the Four Went Ways roundabout at Little Abington. The former is surely the result of buried seed being brought to the surface, but the latter is harder to explain, for this is predominantly a northern rose and not one which has as yet has been noted as part of recently planted hedges. Perhaps it is a genuine bird-dispersed record: we have just a few accepted, older records of this species, which has also occurred very locally elsewhere in southern England.

Botanists often ignore mown turf as a potential recording area and plants like *Torilis nodosa* have quietly infiltrated large parts of the county in mown verges: indeed this species is probably spread by the mowers. Sometimes even better things come to light and a group of us fortunate enough to be allowed to wander

through the army barracks at Waterbeach, shortly before they closed, found that the mown turf there was full of interesting annuals which 'should not have been there', such as *Medicago minima*, *Trifolium scabrum*, *T. arvense* and *Vulpia ciliata* subsp. *ambigua*, most of them in some quantity. Perhaps they were introduced with sand and gravel some time ago or arrived on military boots or vehicles. The community they formed was reminiscent of some areas of mown turf on the Cambridge Science Park at Milton, where a wider range of 'Breckland' plants is known to occur: that site too had a previous military history.

Some plants are overlooked simply because access to the particular site is difficult (e.g. the *Carex paniculata* reported below from Chippenham Fen) or they are missed because they are inconspicuous and flower early, such as the *Carex caryophyllea* reported by Jonathan Shanklin from a new site near a public footpath at Pampisford. However, other plants gain a reputation for being 'difficult', or are so similar to others, that recorders either forget or choose not to check them out. This seems to have happened to our thymes, for although *Thymus polytrichus* subsp. *britannicus* is undoubtedly our commonest thyme, records for the Large Wild Thyme, *T. pulegioides*, had become few and far between until recently. Now a few recorders have developed an 'eye' for this plant it has been recorded in several new locations and refound in some old ones. Steve Hartley, for instance, has refound it in several places on the Fleam Dyke, from where it seems to have been last reported in 1885, and he has also found it in a new location on the Devil's Ditch and in the East Pit at Cherry Hinton: all well-known and well-botanised areas. Several of these new records have been confirmed by the BSBI referee, Prof. Donald Pigott.

Over this last year the records given below have come from 14 ten kilometre squares, but with quite a bias to the south of the county this time, although the one new bramble to the county, *Rubus rudis*, was a Fenland triumph for a Cambridgeshire Flora Group excursion at Parson Drove. These meetings offer good botanising in a range of areas throughout the county and have continued to produce some remarkable results, besides getting a lot of general recording done. My thanks go to all those who take part and to all other recorders who let us know of their new records. Many of you will know that my BSBI Co-Recorder, Nick Millar, has decided to step down from this role, so for the time-being all new records will need to be sent to me. On behalf of all local botanists, I should like to take this opportunity to thank Nick for all the time and effort he has given to this work over the last eleven years, not least in databasing records and dealing with the many diverse queries that come to county recorders, for his effective liaison with recorders in connection with various BSBI projects, for his assistance to me in preparing accounts for the new Floras (this I am assured will continue!), as well as for running the Cambridge Flora Group, a task which will also now devolve to me.

The new Flora continues to take shape, with another year of solid progress: indeed for the first time I am thinking about getting to the end and there will probably be more to say about this next time.

Allium oleraceum A good population, with at least 40-50 flowering stems, scattered along the uncut part of a broad grassy verge, north side of Potton Road, Guilden Morden, TL27784485 - TL27784487, A.C. Leslie (CFG excursion), 22 September 2012. An entirely new locality for Field Garlic, which has always been a rarity in the county and has otherwise only been seen recently on a trackside above Little Abington.

Asplenium ceterach (*Ceterach officinarum*) Fifteen small plants on north-east face of brick wall, south-west margin of churchyard, Abbey Church, Newmarket Road, Cambridge, TL463589, A.C. Leslie, 8 September 2012. A new site for a very rare Cambridgeshire fern; the churchyard gate is normally kept locked, which may account for how it has eluded discovery before now. One of our few other sites, at Outwell, was recently destroyed when the building on which it grew was taken down, and our best population, at Hinxton, has recently been severely depleted after the recapping and repointing of the wall on which it grows.

Carex caryophyllea A few flowering spikes, near public footpath through unimproved meadow, Pampisford, TL50284850, J.D. Shanklin, 17 May 2012, growing with *Cirsium acaule*, *Luzula campestris* and *Galium verum* etc. A new locality for a very local Cambridgeshire sedge, easily missed by virtue of its diminutive stature and early flowering.

Carex nigra x *C. elata* (*C.* x *turfosa*) Several clumps, showing considerable variation, along ditch running through the centre of the western part of Shepreth L-Moor, Shepreth, TL3847, A.C. Leslie & P.A. Harmes (**CGE**, conf. M.S. Porter), 3 June 2012. Dick David noted this hybrid as abundant here in 1977 but it has not been noted on the Moor since 1978. Our only other recent record is on Chippenham Fen, in 1992.

Carex paniculata At least 50 plants of varying sizes in wet alder carr, south side of Poor's Fen, Chippenham Fen, TL64386907, A.C. Leslie, 11 October 2012. Now a rare plant in the county, lost from many sites only recently; this may be the largest population in the county and it has not been recorded from the Fen before.

Clematis armandii One self-sown plant in crack between pavement and front wall of 8 Pound Hill, Cambridge, TL44435914, A.C. Leslie & P.D. Stanley, 28 October 2012 (**CGE**). First v.c. record for an evergreen climber, a late winter or early spring-flowering, Chinese species, grown in quite a number of Cambridge gardens.

Dracocephalum parviflorum One plant on disturbed waste ground alongside platform 3, at the railway station, Cambridge, TL461571, A.C. Leslie, 14 June 2012 (**CGE**, det. E.J. Clement). Second v.c. record for American Dragon-head, a North American, annual to biennial labiate, which in this instance had small very pale pink flowers (they are more usually blue).

Elytrigia atherica (a) a large patch on the north side of Long Road, just west of the bridge over the guided busway, Cambridge, TL45475566, A.C. Leslie (CNHS excursion), 1 January 2013, (b) a large colony on an area of rough ground planted with shrubs, by track between houses, Commercial End, Swaffham Bulbeck, TL55766323, A.C. Leslie, 7 November 2012. Sea Couch has been featuring in these records for some years, but these two new records show how its spread has been overlooked in areas away from the most obvious 'maritime' verge communities.

Epilobium lanceolatum Garden weed, 93 Barton Road, Cambridge, TL435576, C.J. Cadbury, 28 July 2012. This is the fourth time in the last 30 years that Spear-leaved

Willowherb has appeared in the city of Cambridge, usually as a garden weed. Not seen elsewhere in the county since the early 1950s.

Fumaria reuteri Several plants at base of wire fence, beside foot/cycle path alongside the new guided busway, just north-west of Milton Road, Cambridge, TL46706128, A.C. Leslie, 20 May 2012 (**CGE**, conf. R. Murphy). First v.c. record; this species has been occurring at new localities scattered over the British Isles in recent years, so this fits with a national trend. However, its mode of origin here is unclear.

Fumaria vaillantii At least nine patches on recently cleared ground, Mutlow Hill, Fleam Dyke, TL546543, D.J. Barden & M. Frisch, 4 June 2012. Subsequent investigation showed that it was growing here with *F. officinalis* subsp. *wirtgenii*, *F. parviflora* and *F. densiflora*, together with one probable plant of *F. caroliana*; it was also frequent in the adjacent field to the north-east, very close to the site of a record made by Philip Oswald in 1952.

Galium parisiense (a) two large patches around Four Went Ways roundabout, Little Abington, TL52305021 and TL52235024, A.C. Leslie, 21 June 2012, (b) one patch on sandy ground in rough field, by Hauxton gravel pits, TL43275215, A.C. Leslie, 13 July 2012. Two more sites for Wall Bedstraw, which has been accepted as a rare native in East Anglia and now seems to be spreading here as elsewhere in the country. A return visit by a Local Records Centre recording team to the old Waterbeach airfield in June 2012 revealed that this species is now abundant in many areas of the site, having first been noted there the previous year (see *Nature in Cambridgeshire* **54**:74 (2012)).

Geranium nodosum One flowering plant on top of tall brick wall, on the Tennis Court Road boundary of Downing College, Cambridge, TL45105792, A.C. Leslie, 19 June 2012. First v.c. record for this shade-tolerant perennial species from southern Europe, widely grown in gardens and used as a ground cover plant in the College grounds.

Gnaphalium luteo-album (a) One on unkempt, gravelly drive, by house on south side of Main Road, Parson Drove, TF37500857, S. Hartley (CFG excursion), 11 August 2012, (b) many plants on block paving drive, Histon, TL44246404, J.D. Shanklin, 16 August 2012. Two more sites for Jersey Cudweed, demonstrating that this formerly very rare British native is now spreading beyond its headquarters on the streets and on railway property in Cambridge city.

Gypsophila muralis One flowering plant in road gutter in front of 31 Riverside, Cambridge, TL46265913, A.C. Leslie, 8 September 2012 (**CGE**). A garden annual, with masses of small pink flowers, only recorded previously from Histon in 1926 and as a pavement weed in Ely in 2001.

Hypericum humifusum Several plants on an area stripped of surface soil, in lower part of the pit, Gamlingay Cinques, TL 226529, C. Turner, 13 July 2012. Subsequently flooded for more than three months so its survival may be in doubt; this was the first record in the county for Trailing St John's-wort since 1990 and it is not known to be extant anywhere else in the county. It was last seen at Gamlingay in the Trust meadow in 1977.

Impatiens balfourii Numerous plants, some of which subsequently flowered and fruited, self-sown in road gutter outside 52 Sturton Street, Cambridge, TL46395818, A.C. Leslie, 10 June 2012. First v.c. record for an ornamental Asian annual, with pink and white flowers; it has been cultivated for some years in the garden nearby.

Lythrum hyssopifolium Three patches in a bare, sparsely vegetated scrape flooded in winter and spring, Ferry Lagoon, Fen Drayton, TL34417023, J. Miller, 2 August 2010. An estimated 240 plants in what is a second site for Grass Poly in this complex of old gravel workings (cf. *Nature in Cambridgeshire* **48**: 94(2006)).

Medicago minima Frequent and locally abundant in dry, open, mown verges around army barracks, Waterbeach e.g. TL49486626, TL49556673, TL49606687, TL49366681, A.C. Leslie, N.P. Millar, J.D. Shanklin & C. Turner, 9 June 2012. Probably an accidental introduction here, perhaps with sand and gravel; a rather similar situation to populations previously discovered on Cambridge Science Park, which also has past military history.

Melica altissima One flowering plant on top of tall brick wall, bordering the garden of 6 Wordsworth Grove, Cambridge, TL44295771, A.C. Leslie, 12 August 2012. Our second record for this cultivated, ornamental perennial grass; this was the variant with purplish spikelets, known in gardens under the cultivar epithet 'Atropurpurea'.

Myosurus minimus Three populations (in field gateways and a field corner), Cow Fen, Swavesey, TL37936818, TL37756822 and TL37976778, J.D. Shanklin, 10 May 2012. Entirely new populations of Mousetail, which had been recorded just to the south on Hill Farm, south of Swavesey in 1956.

Phalaris minor One large plant on disturbed north-west bank of former railway cutting (now part of the guided busway), Trumpington, TL450546, A.C. Leslie, 1 July 2012 (**CGE**). A rare alien in the county and our only recent record: perhaps sometimes overlooked as *P. canariensis.*

Poa bulbosa (a) Abundant along c.80 yards of ring road, from opposite spur road to buildings 1-10 along to the entrance to the Trinity Centre, Cambridge Science Park, Milton, TL46776141-TL46816146, A.C. Leslie, 25 February 2012 (**CGE**), (b) About 100 clumps under large London Plane, Cherry Hinton Hall grounds, Cherry Hinton, TL48225630, A.C. Leslie, 18 March 2012, flowering well 20 May 2012 (**CGE**), (c) scattered clumps around base of three old beech trees, beside the games field, Wandlebury, Gogmagogs, TL49535331-TL49595326, A.C. Leslie, 3 November 2012. A remarkable three new sites for this summer-dormant, wintergreen grass, native on the coast but assumed to be an alien inland in Cambridgeshire. It has been recorded here now from many road and tracksides, but has also been found in three places under trees on old estates.

Polycarpon tetraphyllum (a) scattered in cracks in between brick paving of gated parking area, behind 109 York Street, Cambridge, TL463585, A.C. Leslie, 29 May 2012, (b) several in pavement cracks outside 34 City Road, Cambridge, TL457585, A.C. Leslie, 28 September 2012, (c) scattered on pavements, in front gardens and in road gutters along Water Street and Fen Road, Chesterton, Cambridge, e.g. TL46926002, S. Hartley, October 2012. After the first recent record, made in the city in 2011, these three new sites also reflect a national trend for more records. By a remarkable coincidence all are close to where local botanists live.

Rorippa sylvestris x *R. amphibia* (*R.* x *anceps*) Ditch at south-east end of Silage Wash, south-west of Sutton Gault, Ouse Washes, TL425791, A.C. Leslie & C.J. Cadbury, 19 September 2012 (**CGE**), also in several other places in other washes to the south-west. Recent records begin to suggest that this hybrid is common along the length of the Ouse Washes and has been overlooked; it probably spreads independent of its parents. Otherwise seen recently along the Ouse near Over and on Whittlesey Washes.

Rosa micrantha (a) one bush in south-western hedge bordering the Roman Road, above Hildersham, TL55824998, S. Hartley, 26 July 2012, not far from a W.H. Mills record: 'Roman Road by Borley Wood'' (Evans, 1939) which has not been reported since, (b) At least three bird-sown bushes in a dense patch of young *R. canina* on north-west facing verge of slip road down to the south-bound carriageway of the A11, Four Went Ways, Little Abington, TL52275016, P.D. Stanley, 29 October 2012 (two more possibly planted in hedge line behind, November, 2012, ACL), (c) one on south edge of churchyard, by Wimpole Hall, TL337509, P.D. Stanley, 29 October 2012, the recorder considered it not planted. W.H. Mills recorded the Small-flowered Sweetbriar in many of our boulder clay woods, but subsequent recorders have had trouble repeating these observations and it remains a rare rose in the county. It may be increasing, but is occasionally planted. It is worth searching for in any area with many new birdsown roses.

Rosa sherardii Four plants on north-west facing verge of slip road down to south-bound carriageway of A11, Four Went ways, Little Abington, TL523501, P.D. Stanley, 29 October 2012, conf. R. Maskew. On further investigation at least 16 bushes were found in this area extending along the road (from TL52275016 to TL52185006), as well as in grassland around a large, fenced-off, concrete drain nearby. The plants appear to be of varying ages and none show any evidence of being planted, nor could the species be found in any neighbouring planted hedges or shrub belts. It occurs here with *R. canina* and a few *R. micrantha*. We have only three previous acceptable records for this rose, which is predominantly found in northern and western Britain, and none of these is known to be extant. This is assumed to be the site for an unconfirmed record of *R. mollis* made by J.D. Shanklin the previous year.

Rubus echinatus Climbing over low brick wall separating village store car park from the south side of B1046, Comberton, TL38205625, P.J. Reynolds, August 2012, det. ACL. A rare bramble in the county, otherwise only reported from Morden Grange Plantation, a track in Royston and on Chesterton Sidings.

Rubus rudis A large patch on roadside bank of village pond, Parson Drove, TF37610864, A.C. Leslie (CFG excursion), 11 August 2012 (**CGE**, conf. A.L. Bull). First v.c. record for a bramble which is rare in East Anglia, but more common in the counties just to the west of our northern borders.

Sagina apetala (*S. ciliata*) Scattered along the base of low brick wall bordering a garage forecourt and the pavement, Newnham Road, Cambridge, TL44485769, A.C. Leslie, 30 June 2012 (**CGE**, conf. N. Jardine), growing with the much more common *S. filicaulis* (*S. apetala* subsp. *erecta*). Included here to draw attention to the fact that this formerly rare plant of a few sandy areas in the south of the county has been spreading along road verges and pavements in the south of the county in recent years. Both species are variable and in the early part of the year in particular plants in pavement cracks can be prostrate, with an apparent leafy central rosette, and are readily recorded as *S. procumbens* unless one looks closely to find that they usually have longer leaf points and at least some, often gland-tipped hairs.

Sedum dasyphyllum Scattered on and at the base of walls, in several places along the High Street, Bassingbourn, e.g. TL332439, J.D. Shanklin, May 2012. P.D. Sell has subsequently indicated that he has known this in the village for many years. A rare alien in the county, although known to have been naturalised on walls at Fulbourn since the mid nineteenth century.

Trifolium angustifolium About 6 plants in a tight cluster on the slope of the western approach to the guided busway bridge over the railway, west of Addenbrooke's Hospital, Cambridge, TL45625507, A.C. Leslie, 29 July 2012 (**CGE**). First v.c. record for a southern

European clover, with linear-oblong leaves and long heads of white to pink flowers. Perhaps a contaminant here of grass sown on the slopes.

Trifolium scabrum Locally abundant and quite widespread, in dry, open, mown verges around army barracks, Waterbeach, e.g. TL49556673, TL49366681, A.C. Leslie, N.P. Millar, J.D. Shanklin & C. Turner, 9 June 2012. Undoubtedly the largest population of Rough Clover in the county, but probably an introduction here some time ago, perhaps with sand and gravel.

Veronica gentianoides Three plants on waste ground, Thrifty car rental site, Newmarket Road, Cambridge, TL47325941, A.C. Leslie, 12 May 2012. First v.c. record for an attractive garden perennial, from the Caucasus and south-west Asia, with loose spikes of pale blue flowers.

Veronica peregrina Two plants in gravel under display benches, plant centre at Anglesey Abbey, Lode, TL53356212, P.D. Stanley, 29 October 2012, growing with another nursery weed *Cardamine corymbosa* . This is our fourth record for this alien annual speedwell, but so far it does not seem to have become naturalised in the county.

Viola odorata var. *sulfurea* A large patch in mown turf, on bank beside footpath from Kiln Lane to the river, Ely, TL55638050, A. Balmford, reported in 2012, but known here for a few years; another patch discovered nearby the same year. A rare variant of Sweet Violet with creamy white flowers, flushed orange in the centre and with a violet spur. Previously recorded only at Wilburton and Great Shelford.

Vulpia ciliata subsp. *ambigua* (a) Frequent along dry, rather bare verge, beside the Barrington road, just north-west of level crossing, Foxton, TL40804886, A.C. Leslie, 28 July 2012, (b) numerous clumps along cycle/foot path beside guided busway, just south of Long Road, Cambridge, TL45645558, A.C. Leslie, 23 June 2012, growing with *Bromus tectorum* and *Apera interrupta* , (c) frequent along a stretch of dry, open, mown verge, Waterbeach army barracks, TL49606687, A.C. Leslie, N.P. Millar, J.D. Shanklin & C. Turner, 9 June 2012, (d) scattered over a large area of dry, sandy field between the A11 and the old main road, south of Four Went Ways, Abington, TL52174992, A.C. Leslie, 21 June 2012. These four further records demonstrate that this annual grass has now become quite widespread across the south of the county, away from the traditional sites on the sands in the east of the county. There is some evidence to suggest that, at least in part, this spread may be associated with imported sand and gravel.

Reference

Evans, A.H. (1939). *A Flora of Cambridgeshire.* Gurney and Jackson, London

Bryophyte records

M. Burton and C.D. Preston

2012 was the last year of recording for the new national bryophyte atlas. The attention of the British Bryological Society Cambridgeshire Group was again concentrated on Huntingdonshire (v.c. 31), in order to improve coverage of the county for this project, and this is reflected in the records below.

Mosses

Bryum pallescens **31:** large colony extending for hundreds of metres along the base of the metal perimeter fence of Molesworth airbase, TL086770, C.D.P., 24.3.2012, and many plants found fruiting by M.B., 8.6.2012, **BBSUK**, conf. T.L. Blockeel. Fruiting on old thatch, Hemingford Grey, TL290707, L. Farrell, 16.1.2013. First v.c. records of a species which is characteristically found in sites polluted by heavy metals.

Didymodon acutus **29:** numerous patches on bare chalk soil on roadside verge, with *Aloina ambigua*, *Barbula unguiculata*, *Bryum argenteum*, *B. ruderale*, *Pseudocrossidium hornschuchianum*, *Microbryum rectum* and *Tortula lanceola*, road along N. side A11(T), S.W. of Beech Tree Cottages, Great Wilbraham, TL54845416, and small patch in S-facing grassland, Fleam Dyke N. of A11(T), TL54465455, M.O. Hill, 3.2.2013. The rediscovery of this species at Cherry Hinton chalk pits was reported last year; this is the first time that *D. acutus* has been seen at a Cambridgeshire site other than Cherry Hinton since 1960.

Eurhynchium crassinervium **31:** on bark of trees by ditch on edge of Raveley Wood, TL252784, C.D.P., 3.3.2013, **BBSUK**, conf. T.L. Blockeel. First record from v.c 31 since it was recorded at Kimbolton in 1928.

Fissidens dubius **29:** 12 x 7 cm patch on bark of very mature elder trunk at foot of S. side of railway cutting, immediately W. of Fleam Dyke, TL543545, M.O. Hill, 3.2.2013. **31:** on ant hill in calcareous grassland, Great Stukeley Lodge Railway Cutting, TL234758, M.B., 10.11.2012, **BBSUK**, conf. T.L. Blockeel. This calcicole has long been known from Fleam Dyke and other chalky habitats in v.c. 29, but it has never previously been found as an epiphyte. It has not previously been recorded from v.c. 31, but chalky habitats are much rarer in Huntingdonshire.

Physcomitrium pyriforme **31:** with old capsules on poached area at stream edge in Boughton mediaeval village, TL199648, M.B., 12.8.2012. Second record from v.c. 31; the previous one was made in 1967 from grass leys on the south side of Monks Wood.

Pohlia wahlenbergii **31:** ditch bank in Waresley Wood, TL2654, M.O. Hill, 30.9.2012. Second record for v.c 31; it was previously recorded in Little Paxton Wood in 2011 and it appears to have declined in v.c. 29.

Rhynchostegium megapolitanum **31:** short mown grass verge in Hemingford Grey, TL307707, M.O. Hill, 23.12.2012. The third recent record from v.c. 31; all three have been made by M.O.H. and the species has clearly been overlooked by other bryologists.

Liverworts

Marchantia polymorpha subsp. *polymorpha* **31:** edge of a shaded pool in clay pit, Orton Pits, TL1694, M.O. Hill, 10.11.2012. The nominate variety of this common species is only rarely recorded in East Anglia; the only previous records from v.c. 31 are from Holme Fen, where it was last seen in 1964.

Metzgeria consanguinea **31:** on *Salix* in a swampy area of St Ives Thicket, TL301717, M.O. Hill, 23.12.2012. This epiphytic liverwort is expanding its range; it was first found in v.c. 31 in 2011.

Riccia sorocarpa **31:** in a ditch, Brownes' Piece, TL2554, J.D. Shanklin, 30.9.2012, conf. M.O. Hill. This is only the second record for the vice-county; the earlier record was also from this area, a field near Gamlingay Wood, in 1958.

OBITUARY

Ken Joysey

Ken Joysey, who died on 25th November 2012, spent most of his scientific career in the Museum of Zoology. Ken came to Cambridge from research training at University College London, initially to the Department of Earth Sciences. Subsequently he crossed Downing Street to the Museum, which he entered as Assistant Curator in 1955. In 1970, the distinguished vertebrate palaeontologist Rex Parrington retired and Ken took over as Director.

Ken was Director of the Museum for 25 years (he retired in 1995) but even before he took up this role he had been part of a small group of members of the Department who collaborated with Arup Associates in the design of the Arup Building. This was a very time-consuming occupation, especially because Ken was responsible for masterminding the move of the Museum contents out of the old building and back into the new.

At UCL, Ken had worked on rates of evolution in fossil echinoderms, and an interest in quantifying evolutionary change underpinned all his subsequent work. At Cambridge he took a special interest in Ice Age mammals, and did extensive field work and collecting in the surrounding areas. Many of his colleagues knew him mostly in connection with this work. From 1970, however, Ken became actively involved in the study of molecular evolution. He had the advantage that his wife, Valerie, was working as an immunologist in the area of transplant immunology, and so conversations about proteins were a normal part of domestic life. Ken was already exploring this new area when a collaboration developed with Hermann Lehmann and Alex Romero-Herrera in Biochemistry. This collaboration ran very productively for 6 years, and Ken maintained involvement in the area for many years after. In 1974/75 Ken was a member of the Zaire River Expedition, led by John Blashford-Snell. Ken had done National Service (and had subsequently been seconded to the Ministry of Defence) so he was eminently suited to this military and scientific expedition which provided valuable material for research and for the Museum.

Ken had equal facility in zoology and geology, and he was an inspiring teacher of undergraduates, having taught for all the time of his presence in the Department. Many people currently working in the fields in which he lectured were inspired by his genuine and conspicuous enthusiasm, and remember him with affection and gratitude.

Ray Symonds, the Senior Assistant in the Museum under Ken, writes

"Ken played a massively important part in the design and development of the present Museum building. The previous building had been a typical Victorian Museum and I'm sure that it was largely Ken's vision, museum expertise,

technical know how and attention to detail that ensured we got a Museum whose design and facilities were quite remarkable for their day and are still worthy even by modern standards.

Of enormous importance to me when I first started in the Museum was Ken's encyclopaedic knowledge of the collections, the collectors, the archives, the Museum's curatorial procedures and technical details of collections management. This was ALL the collections, not just those for which he had curatorial responsibility or had a research or teaching interest - there cannot be many people in the history of the Museum who have acquired such an in depth, detailed knowledge. His willingness to share this was vital to my career development. Whenever I asked Ken a question about the collections or the Museum's procedures I would invariably receive a comprehensive tutorial that not only answered my immediate question but provided me with all the background and related information. These sessions would frequently go on into the early evening but were invaluable and extremely enjoyable!

His passion for the collections and the animal kingdom, coupled with a passion for passing on knowledge and teaching was not just reserved for members of staff or students. I frequently witnessed him doing the same for members of the public, of all ages, visiting the galleries. I am not sure if that is how Museum Directors should spend their time but it is a measure of the generous nature of the man that all you had to do to be a recipient of his wisdom and enthusiasm was to show an interest!"

Adrian Friday and Ray Symonds

BOOK REVIEWS

Fauna Cantabrigiensis. The vertebrate and molluscan fauna of Cambridgeshire by the Rev. Leonard Jenyns (1800–1893): transcript and commentaries. Richard C. Preece & Tim H. Sparks (editors). The Ray Society, London. Hardback. vii + 226 pp. ISBN 978-0-903874-44-1. £65 (£25 concessionary price to Ray Society members).

Leonard Jenyns was one of the early naturalists who left a great legacy of carefully documented work; studying at Cambridge at the time of Henslow and Darwin and then moving to Swaffham Bulbeck as Curate and later Vicar, Jenyns clearly also had a wide range of natural history knowledge and interests. This work principally covers the years 1820–1849 when Jenyns was based in the county, but his account, and the modern commentary, add further Victorian records which are relevant. Initially written as a commentary on collections for the museum of the Cambridge Philosophical Society (later to form the basis of the University Museum of Zoology), Fauna Cantabrigiensis is a rarely seen document, and this book publishes it, alongside modern perspectives on the species listed, for the first time. Whilst this in itself would make the book well worth a delve (possibly a library copy), the thing which actually makes it into a

book that you need to own and dip into again and again is the final chapter entitled ‘Discussion and conclusions’ (pp. 163–201). This is a review of the landscape changes since 1820 when the account starts to the present, with other land-use statistics and weather comments, and makes a fascinating if somewhat depressing read: just how much our landscape has changed is not easy to imagine. The section on the faunal changes between Jenyns’ time and now also makes the book a must; the authors have clearly undertaken a huge amount of research on faunal distribution changes, introductions and extinctions not just locally but in a national context, which should help us all get a feel for just how different our vertebrate fauna is now from that of 150 years ago.

The draining of the fens is a recurring theme in the final chapter: our waterways were clearly very different in Jenyns’ time, especially when the number of marine mammals and fish is considered. It is clear that access to the sea was relatively easy, not obstructed by the sluices and pumping stations we have now – those vital pieces of engineering which keep the modern fens as an agricultural heartland and habitable. Frequent references to Whittlesea Mere, the draining of which was beginning as Jenyns left the county, and the other meres that had already gone by that time, highlight the real element of fens that we have lost, and the one I personally find most difficult to envisage – large, presumably fairly shallow, expanses of open water and marsh. One fact which I will in future use to help me when trying to imagine the expanses of wetland lost is that the modern Grafham Water reservoir in Huntingdonshire, the largest body of water in the modern county, is only around half the area of Whittlesea Mere.

The main species accounts are surprisingly easy to follow: a distinctive font is used for Jenyns’ handwritten text, reproduced as written, with a taxonomic update where needed for either scientific or common names and then, if appropriate, a comment updating status or other details. Although it is somewhat slow to wade through it species by species, this is undoubtedly a valuable resource. Among the things that really stand out are some of the unusual species splits which Jenyns (and presumably at least some of his contemporaries) used. For instance, he appears utterly convinced of the existence of two species of Eel, the narrow-nosed and the broad-nosed, something which to us seems utterly strange. Mammals seem to be particularly prone to this splitting, with several colour variants being promoted to full species, although Jenyns himself does start to question one or two of these, for instance the Chestnut Shrew of Bottisham. The fish section makes interesting reading, as not much more seems to have been discovered about our piscifauna and our current knowledge can probably be described as poor. The stand-out feature to me is the number of sea fish recorded; even today our main rivers are tidal through much of the fens, but we rarely hear of sea fish being found. Wisbech was a busy port and not far from the sea, so I find it hardly surprising that sea fish were regularly recorded there: it is possible that they still occur but no one notices!

The birds section really serves to highlight the changes in the county landscape: the loss of grasslands, changes in our wetlands and the intensification of agriculture are starkly highlighted by the bird species accounts. For instance, the Stone-curlew is described by Jenyns as being present in most summers in

more or less plenty, but by the time Marr & Shipley's *Handbook to the Natural History of Cambridgeshire* was published in 1904 it was already deemed to be uncommon. A century further on we seldom see this bird in the county and nationally it is regarded as a rare breeding species. It also shows the changed attitudes to wildlife: shooting specimens for the collection was normal for many and persecution of predators, both mammalian and avian, was widespread and is made mention of several times as a reason for species declines – in the case of the Red Kite, for example, even noticed by Jenyns himself as well as in the modern commentary.

Jenyns had a strong interest in molluscs: the other sections rely as much on information from his contemporaries as from himself, but the molluscs were very evidently one of his collecting specialities. This means that the identity of specimens can be checked against the shells still in existence, which has helped greatly to clarify some of the very significant changes in taxonomy that have taken place in molluscs, more so than in any of the vertebrate groups. I do not think I have ever read as comprehensive a review of Cambridgeshire's snails and slugs as here.

For those who are not keen on museum specimens, the illustrations are not likely to enthuse; however, many of the colour plates of key species from the zoology collections do add a valuable reference, in part serving to document important species possibly lost. There are other plates, such as an excellent one illustrating species differences in a genus of small freshwater snails which are considered very difficult to identify specifically in modern times: armed with those, I'd be more confident at giving *Pisidium* shells a second look.

The discussion chapter adds so much context that it could be a publication in its own right, and much of it has already been mentioned. One extra feature of this chapter is the inclusion of species which have colonies or have become established in the area since Jenyns' time; some of these are potentially problematic non-natives such as deer, squirrels and mink and others probably less problematic such as aquatic molluscs.

One of the other nice touches is in the index, where the entries are in the fonts relevant to either Jenyns' records or the modern text, including local common names. A niggle here is that sometimes the entries just refer one to another part of the index! This is just a minor gripe of mine in what has to be one of the best narratives on 200 years of changing distributions of a county's fauna.

Jenyns also left us with three volumes of notes on invertebrates. We will have to wait for the publication of that work, which will no doubt be an even greater tour de force, but the present volume, over 200 pages of superbly researched facts and commentary with prolific references to follow up on just about any fact that sticks in the mind for further investigation, is definitely worth acquiring by anyone with a curiosity over what has changed in 200 years, surely as appealing to historians as to naturalists.

Louise Bacon

John Ray's Cambridge Catalogue (1660) translated and edited by P.H. Oswald and C.D. Preston. The Ray Society, London. Hardback. ix + 612 pp. ISBN 978-0-903874-43-4. £75 (£35 concessionary price to Ray Society members).

The genre most associated with the empirical revolution of the sixteenth and seventeenth centuries is the encyclopaedia. Thomas Elyot, using the word "encyclopaedia" for the first time in English in 1531, defined it as "a heap of all manner of learning", a phrase that suggests its copious and unrestricted form. From about 1530 all kinds of encyclopaedic works were produced, although many were not presented in encyclopaedic form or intended as works of reference so much as works of "doctrine". (The word "encyclopaedia" is from the Greek for the circle of liberal arts and sciences essential to good education.) The great encyclopaedic age may well be the seventeenth century, when various species of learning, from natural history to antiquarianism, were coming into being or undergoing a root and branch clear-out of old and exploded ideas and being re-established on more reliable, empirical bases.

John Ray's *Catalogus plantarum circa Cantabrigiam nascentium* (1660) [Catalogue of plants growing around Cambridge] is exemplary of this encyclopaedic-empirical trend. As its editors observe, the work appeared within (and reflects) the "transition between the mediaeval and the modern world views": based on Caspar Bauhin's celebrated 1622 catalogue of wild plants growing around Basel and heavily reliant on a large group of contemporary English and continental phytologies and herbals, Ray's *Catalogus* also shares some of its features with quite different works, Thomas Browne's *The Garden of Cyrus* (which Ray calls a "golden little book"), chorographies such as those by Camden and Drayton, John Aubrey's *Miscellanies* and *Adversaria Physica*, and even Abraham Cowley's versified *Plantarum libri sex*. The generic range and purpose of these books indicates the interesting breadth of Ray's ultimate (but unachieved) ambition to create a *Phytologia Britannica*.

The *Catalogus* (of over 600 entries, plus appendices and subsequent updates) has been meticulously edited by a pair of scholars who combine classical learning (Philip Oswald) with botanical expertise (Christopher Preston), and this makes for a wonderfully compendious and supremely useful volume. Ray's discursive Latin has been translated, but in aiming to elucidate the enterprise of the catalogue the editors have happily resisted any impulse to smooth away its bristlingly learned entries. They retain their flavour and thus the flavour of early-modern scholarship; for example, for *Parietaria judaica* L.:

> Parietaria *Ger. J.B.* vulgaris *Park.* I, sive officinarum & Dioscoridis *C.B.* Helxine
> *Brunf. Matth. Dod. gal. Fuch. Gesn. hort. Lugd. Cam.*, for whom it is also Urceolaris Scribonii. Vitriola sive Perdicum *Lob. Cæs. Tur.* Muralium *Jun. nomenc. Pellitory of the wall.* On rubble & old walls.

This forbidding list of abbreviated names in two fonts, like a disturbing bouquet of nightshade, is explicated by the *apparatus criticus* of the edition, which is in part designed to demonstrate Ray's intention to synonymise an

English plant-name like “pellitory” with the *Muralium*, *Parietaria*, *Urceolaris*, *Helxine*, *Vitriola*, *Perdicum*, or even *Stellaria media* of Junius, Gerarde, Camden, Gesner, L’Obel *et alii*. The edition gives every other sort of paratextual aid (as does Ray himself), from footnotes to a gazetteer and biographical directory, to assist the reader in comprehending Ray’s vast undertaking.

The editorial effort and care so apparent in this edition is monumental; and Ray’s *Catalogus*, although not the only major work of this type and of this period to deserve such treatment, is one that fully repays it. The texture and depth of this kind of late-Renaissance learning is evident in other difficult works like Robert Burton’s *Anatomy of Melancholy* and Browne’s *Pseudodoxia epidemica*, and these have been similarly edited in recent years. What is especially interesting about the availability of Ray in this form is the way the catalogue exposes what may be the presiding empirical task of the seventeenth-century natural historians, who in order to describe the creation accurately had first to perform the Adamic task of *naming* everything in it. This was no easy job: not only was a rationalised, internationally recognised Linnaean taxonomy and nomenclatural system 60 years away, but different countries and languages, even different local dialects and usage within the same country, had a spectrum of names for things that may or may not have been identical. One has only to think of Thomas Browne and Christopher Merrett attempting, at about the same time as Ray, to establish by letter the identity of British flora – a tree-fungus unknown from any authority “vnto some … seemed to resemble some noble or princely ornament of the head & so might bee called fungus Regius vnto others a turret, top of a cupola, or Lanterne of a building & so might bee named fungus pterygoides, pinnacularis or Lanterniformis you may name it as you please” – or of British birds – “Haue you a Yarwhelp, Barker, or Latrator a marsh bird about the bignesse of a Godwitt … the bill 2 inches long the legges about that length the bird of a brown or russet colour … I am much unsatisfied on the names giuen to many by countrymen … Fulica and cotta Anglorum are different birds though good resemblance between them, so some doubt may bee made whether it bee to bee made a coote except you set it downe fulica nostras, & cotta Anglorum”. This somewhat desperate swapping of details to arrive at some kind of certainty is something Ray would have understood instinctively, and it informs his own practice.

The arts of naming and describing were among the most critical and yet the most difficult for the scientific project of the early-modern era, and listening to Browne shows us why Ray’s attempt to make synonyms is so important. Whether to establish the variety of the creation by naming it accurately (an act of worship as well as the development of a scientific tool) or to produce a taxonomy of useful products (as georgic and utilitarian writers like John Beale, John Evelyn and Samuel Hartlib do in their works on apples, timber, vegetables and bees), the work of synonymising and its attendant philological and etymological practices makes Ray’s catalogue as interesting to the literary scholar as to the historian of science. Ray punctuates his entries with a marvellous array of English plant-names, including Great golden Maiden-hair, or Goldi-locks (*Polytrichum commune*), Iack by the hedge or Sawce-alone

(*Alliaria petiolata*), Stinking water Horse-tail (*Chara*) and Brank (*Fagopyrum esculentum*), and with etymologies like the explanation of *Julus* to nominate the myriapod *Scolopendra* owing to its resemblance to a catkin. Unsurprisingly, Thomas Browne was an admirer of Ray.

But, within the fluid and capacious remit of an encyclopaedia, Ray offers much more than botanical and philological lore. He notes practical uses for plants (translucent vessels can be turned from maple, birdlime is made from holly root, alder, roasted and aged, is hard enough to be used as whetstone); he makes social observations about the herb-women; invokes proverbial wisdom (having "more virtues than Betony" is high praise), suggests identification by smell (*Cynoglossum officinale* "gives off the smell of a hot wet dog"), and superstition (a sprig of *Artemisia* will protect a traveller from fatigue). Perhaps most interesting of all is the pervasive sense of Ray as the individual investigator, a clear personality who gives intimations of his life, tasks, travels and perceptions. In this he reminds us of Burton, Aubrey, Boyle and a host of other naturalists whose investigative and personal lives had no obvious or distinct boundary. Ray's preface is cast in the standard Renaissance format of modest disclaimer, and yet he gives us a very particular account of himself: the catalogue developed out of a recuperative period following an illness, when serious studies gave way to riding and walks around Cambridgeshire, and his serious attention to botany emerged from an initial delight in the splendid show of flowering fields. He cannot resist, however, marking himself as virtuously superior in this. "Some," he says piously, "take delight in the tennis court, some in drinking, gaming, amassing money or procuring men's favour"; he, on the other hand, is producing work of moral heft that demonstrates God's glory.

That demonstration required perambulations around the county, and the *Catalogus* reads like a chorography or county history with its constant specification of place. *Allium vineale* is found "On Iesus Colledge wall, nigh the gate which opens out of the rode into Garlick fair; also about a gravell pit near the foot way leading from Christs Colledge to Cherry-Hinton"; *Asperugo procumbens* is seen "In the hedge of a lane leading out of the fields to Newmarket, near the church which stands by the Kings house, and in the close adjoyning to the Churchyard". Ray is inadvertently mapping not only the botanical creation but the county itself. Such chorographic interventions and details participate in the catalogue's delightful and characteristic combination of the grand and the marginal, of the magisterial creation and its unnoticed instantiations that previously, he confides, "we so often trod underfoot". This combination is found everywhere in early-modern encyclopaedias and not only adverts to the immense range of early-modern scholarship but also inscribes the relation of the micro- to the macrocosm in the very fabric and structure of these works.

This edition of Ray is, like Ray's own task in making the catalogue, an unusual and heroic project. Its remarkable concision and generous latitude of information and explanation casts a most welcome light on a kind of literature that might otherwise remain obscure.

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The wettest year on record: weather notes from Cambridge University Botanic Garden 2012

John Kapor

January 2012 saw a reasonable rainfall with the 18th being the wettest day (10.5 mm). There were six air frosts with the 14th being the coldest night (-3.9 °C). The temperature rose to 12.9 °C on the 3rd, and with several warm sectors passing over us during the month it reached double figures on twelve days. From the 29th a flow from the east became established and on the 30th the maximum was only 3.4 °C.

What a month **February** turned out to be! Until the 14th, winter was in control with 14 cm of snow falling on the evening of the 4th followed by another 3 cm on the 9th and all of this settling very readily with a maximum temperature of only 0.5 °C. There were two very sharp frosts on the 12th and 13th with the air temperature dropping to -13.6 °C overnight on the 12th. After the 15th, the thaw set in and a succession of weak fronts crossed us; there was a very mild day on the 23rd when 17.4 °C was reached. Precipitation was below average.

March was another dry month with most of the rain falling in the first week. After the 7th, only 2.3 mm of rain fell in the remaining 24 days. There were three slight air frosts with the lowest of these being -1.3 °C on the 19th. There were twenty ground frosts. As a result of high pressure, there were some very warm and sunny days and 21.3 °C was reached on the 28th.

The rain arrived in **April**, although only 21.6 mm fell in scattered showers up to the 20th. As farmers say, there were a lot of wet days with no rain, but then it changed. We started to catch some heavy rain – there were five days with hail and three with thunder. 23.8 mm fell on the 28th, contributing to a very wet month. The last April to have had over 100 mm was in 1998 with 108 mm. The temperatures in April were lower than in March in several respects.

In **May** the wettest day was the 3rd with 22.3 mm, but only 1.1 mm fell between the 16th and the 30th. There were a couple of days (25th, 26th) when there were cloudless skies. The maximum was 26.9 °C on both 27th and 28th, but there was a cool night on the 7th with -3.0 °C grass minimum.

June was a wet month, made up of showers and several areas of more general rain, with the 10th collecting 21.5 mm. The 28th reached 28.1 °C but in contrast we had a ground frost of -0.5 °C on the 13th.

July was another unsettled month with showers and prolonged spells of rain. On the 14th, one of these produced 28.0 mm. It was the wettest month of the year with 130 mm, making this the third month of the year with over 100 mm. In 1998 we also had 3 months with over 100 mm but they were distributed across the whole year. The maximum temperature was 28.8 °C on the 24th, during a settled week. There were a couple of cool nights.

Until the 25th, **August** had been a much drier month with only 17.2 mm and the warmest day of the summer was recorded on the 19th (31.3 °C). Then Cambridge caught some intense falls of rain during the afternoon of the 25th with hail and a considerable amount of thunder. During the three and a half hours of these storms 49.4 mm fell. This intensity of rain inevitably caused local flooding in Cambridge and the tide marks of debris that had been washed about could be seen all over the Botanic Garden during the following days. This brought the August total to 76 mm, and the annual total to more than that for the whole of 2011.

September was on the dry side with the greatest soak being 14.8 mm on the 23rd. 28.5 °C was reached on the 9th and the maxima remained in the 20s until the 11th. Thereafter we saw three touches of ground frost with the first of these on the 12th with -0.5 °C.

October was again wet with 14.7 mm on the 4th. There were some mild days at the beginning of the month with 18.3 °C reached on the 1st but by the end of the month a northerly flow gave some wintry showers with a covering of hail early on the 27th. There was one slight air frost of -0.4 °C and ten slight ground frosts.

November was another month with above average rainfall, including 12.7 mm on 4th. There were some mild days during the unsettled month with 15.9 °C on the 13th but the maximum on the 30th was only 4.4 °C. There were 14 ground frosts with the lowest -7.4 °C on the 30th.

December started on the colder side with the first light covering of snow for the winter on the 5th. Then on the 12th the sun came out after freezing fog had coated the trees in rime. It has been several years since we have had such a stunning wintry scene. These conditions did not last, as unsettled and milder weather soon returned with spells of rain making this another wet month.

The wet December took the annual rainfall total to 813 mm, more than double the 2011 figure of 380 mm. It was the wettest year since annual records were first collected at the Botanic Garden in 1900, exceeding 1903 (776 mm), 1958 (737 mm), 1924 (728 mm), 1960 (724 mm), 1950 (720 mm), 2001 (706 mm) and 2000 (704 mm), the other years with over 700 mm.

	Mean max temp		Mean min temp		Max temp	Min temp	Rainfall		Rain days >1mm	
	(°C)	*diff*	(°C)	*diff*	(°C)	(°C)	(mm)	*diff*	No.	*diff*
January	9.1	*2.0*	2.8	*1.5*	12.9	-3.9	42	*-2*	7	*-4*
February	7.6	*-0.2*	0.5	*-0.5*	17.4	-13.6	21	*-12*	4	*-4*
March	13.6	*3.0*	2.8	*0.1*	21.3	-1.3	22	*-18*	3	*-7*
April	12.8	*-0.2*	4.0	*0.0*	19.0	-3.5	102	*60*	17	*8*
May	17.5	*0.6*	8.2	*1.5*	26.9	0.9	51	*7*	11	*3*
June	18.9	*-0.9*	10.5	*0.8*	28.1	3.9	106	*52*	16	*7*
July	21.3	*-1.3*	11.9	*0.0*	28.8	6.9	130	*89*	17	*10*
August	23.3	*0.8*	12.8	*1.1*	31.3	7.8	76	*28*	8	*1*
September	19.5	*0.5*	8.8	*-0.9*	28.5	4.5	30	*-22*	5	*-4*
October	14.0	*-0.9*	6.8	*0.0*	18.3	-0.4	79	*24*	12	*3*
November	10.7	*0.3*	3.9	*0.4*	15.9	-2.8	64	*13*	13	*3*
December	8.2	*0.3*	2.1	*0.0*	13.6	-4.6	89	*38*	15	*5*
2012	14.7	*0.3*	6.3	*0.4*	31.3	-13.6	813	*256*	128	*20*

The ‘diff’ columns show the difference between the 2012 value and the 1971-2000 mean.

Plate 6 *Symphytum* x *perringianum* by Barton Road (27 April 2011).

Plate 7 *Symphytum* x *perringianum* by Barton Road (15 April 2009).

Plate 8 *Symphytum* x *perringianum* in Cambridge University Botanic Garden (18 July 2010).

Plate 9 *Symphytum* x *perringianum* in Cambridge University Botanic Garden (10 May 2005).

Plate 10 Crested Cow-wheat (*Melampyrum cristatum*). See article on page 22. Photograph by Louise Bacon.

Plate 11 Head of flatworm (un-named) showing the eyes. See article on page 46. Photograph by Brian Eversham.