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Spotted Flycatcher (*Muscicapa striata*) Geolocator light-sensor just visible. Photo Lee Barber

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EDITORIAL

Yet more changes.... we hope you like it... we have gone all modern, with lots more photos, throughout the text.

We see this as the start of widening our audience, and the range of articles we have this year will hopefully be continued in future years and encourage more quality submissions and new subscribers. It feels like a bumper issue; we have the regular contributions of bryophyte, vascular plant and weather report, and the report on the field season for the CNHS. We also have articles on the colonisation of adjacent grazed fields with flora from Devil's Dyke, bryophytes of Devil's Dyke, on the current status of Fen Ragwort, a plant continuing its tenuous foothold in the county in a roadside ditch, and on the vegetation status of Wicken Fen.

It's not all plants, as we also have an insight into Spotted Flycatchers, and a great study (part of a Masters degree) on the effects of ground-level lighting of cycle routes on bats using the open spaces of Cambridge. The Cambridgeshire & Peterborough Amphibian and Reptile Group provide contributions as they often do, this year an update on the Slow-worm translocation at Wandlebury and issues around identification and attitudes to snakes such as our native adder and escapee snakes, too.

Short notes on new things could easily become a regular feature, and we have a new gall,the 'Cornish pasty gall' and a new Bee which is possibly starting to colonise - the Violet Carpenter Bee. This insect is our cover star this year - I think it looks amazing and hope to connect with one sooner or later.

It was a bumper year for books by local authors on local topics - we have reviews on six different publications this time, the excellent and much-anticipated county floras for vascular plants and bryophytes, two books on fenland, one on the Great Fen project by Alan Bowley, retired NNR Warden, and Francis Pryor gives us an archaeological viewpoint. Arnie Cooke has produced a significant work on our two non-native deer, the Muntjac and Chinese Water Deer, and for those not at plant overload, we also review Plants of Lowland Grassland of Britain and Ireland.

We also have two obituaries; Gigi Crompton was a key part of the county botanical scene, and Robin Stevenson, although Norfolk-based, did a huge amount of bryological work in orchards, including those of northern Cambridgeshire such as around Wisbech.

The editors would like to congratulate two of our contributors on recent awards. Alan Leslie has been given the Presidents' Award, from the Wild Flower Society and the Botanical Society of Britain and Ireland, for his Flora of Cambridgeshire (reviewed in this issue), and Nathan Smith has received the 2019 W.T. Stearn Essay Prize for an essay on the history of mycology which will be published in a future issue of Archives of Natural History.

Front Cover Photo. Violet Carpenter Bee by Roger Few

Management at Wicken Fen – maintaining the variation

J.O. Mountford & T.H. Sparks

The history of ecological management

In many respects, the National Trust property of Wicken Fen is the archetypal British nature reserve (Friday 1997). Its history and evolving management reflect closely the changing philosophies of nature protection in Britain. Hence, Wicken went from a phase of preservation (non-intervention), through a growing emphasis on active management for conservation in the 20th century to the contemporary focus on ecological restoration (Sheail *et al*. 1997), rehabilitating degraded habitats and creating new wetlands on land that has been under arable cultivation for many decades (Colston 2003).

Both conservation and restoration are underpinned by research on the most effective management to achieve their aims. Amongst the first experiments in the ecological management of vegetation for conservation objectives were the "Godwin Plots" (Friday and Harvey 1997), and this relationship continued at Wicken Fen throughout the 20th century (Friday *et al*. 1997; Lock *et al*. 1997; Rowell 1983). Early approaches often comprised either minimal interference or regimes that were modelled on traditional practices of vegetation cutting and drainage channel maintenance. Detailed research on the requirements of plant communities and the precise nature of traditional management led to more refined methods (Rowell *et al*. 1985). The challenges of habitat restoration and understanding the impacts of water and nutrient regimes necessitated new research e.g. to integrate hydrology and plant ecology into the design of restoration trajectories (Hughes *et al*. 2005). It was clear that site management plans such as those at Wicken must be evidence-based (Sutherland 2000).

The Wicken Fen National Nature Reserve (NNR) is amongst the best known and most studied of all wetlands, both in the UK and in Europe as a whole (Friday 1997) and results from here have contributed to quantitative descriptions of the ecological and hydrological requirements of fen vegetation (Wheeler *et al*. 2004, 2009). However, despite this effort, there remain aspects of the Fen's management where the scientific background remains partial or where new problems have arisen e.g. either too little or too much water; increased nutrient inputs from the atmosphere or agriculture; the use of extensive horse and cattle grazing; and growing visitor numbers.

Fen management at Wicken in the early 21st century

The management of Wicken Fen NNR in the 20th century was summarised in Friday (1997), especially the chapter by Lock *et al*. (1997), both in terms of historical and the then current practices. Following a survey by Mountford *et al*. (2005), management was slightly simplified and accounts of the regimes applied from 2000-2019 are given in the management plans (National Trust 2011, 2016), and summarised by Martin Lester in the report by Mountford and Sparks (2019). The present account reviews the management practised during the vegetation surveys of 2004-5, 2010-2 and 2017-8 in terms of water management, cutting/mowing, carr clearance and grazing.

Water management: Apart from the management of watercourses, both for their intrinsic biodiversity value and as conduits, the management of water has focussed on arresting the fall in the water-table that resulted from the oxidation and wastage of peat in the surrounding farmland. This problem was partly dealt with by a waterproof membrane along the north edge of the Fen (installed in 1990) and in 2011-2 by pumping water from Monk's Lode into the Sedge Fen. However, during the mid-2010s, the Trust observed that ground conditions on the Sedge Fen were wetter than planned and the site managers did not need to use the wind-pump as often as expected. This greater wetness appeared to follow an unexplained and unregulated increase in water input from the adjacent farmland, markedly limiting the Trust's ability to apply the required cutting and mowing management.

Cutting and mowing: fen vegetation is essentially transitory in nature, giving way to mature forest in time. Herbaceous fen may survive for centuries, especially where perpetuated by management for fen crops (reed, sedge and marsh hay). As nature conservation replaced exploitation, the Trust used fundamentally the same cutting/mowing methods to maintain the valuable habitats of tall-herb fen, sedge and litter (Rowell 1983; Rowell

et al. 1985). The "traditional" 3-year rotational cutting of *Cladium* blocks in July and August was replaced from 2005 by cutting of 40m wide strips. Mowing of litter (*Molinia* etc.) followed a fairly typical hay-making method, and was once carried out in all seasons except winter, with varying frequency. Annual litter mowing is now largely confined to a late summer or early autumn cut, and is more limited in extent than it was in the period up to 2005. The other main targets of mowing are the droves, typically 10-15m wide, straight and passable by tractor when sufficiently dry. Drove mowing typically comprises cutting the central portion several times a year with a light tractor and rear-mounted mower, whilst the margins are cut annually in autumn (as litter).

Recent very wet ground conditions have meant that the "marsh-hay" cannot always be dried and used, and mowing of some droves has in some years been impractical. Additionally, although the planned management is to mow ca 40-50 hectares per year on a 1 year in 3 rotation (in order to allow the tall-herb fen communities to thrive), the unplanned summer and autumn wetness of the Sedge Fen in the mid-2010s severely hampered the ability of the National Trust to get conventional cutting equipment onto the fen, disrupting the normal cutting cycles. The Trust therefore looked into the feasibility of using cutting equipment more appropriate to wetland conditions. The Broads Authority provided the Trust with the use of their Fen Harvester - a custom-built forage harvester that is extremely lightweight and runs on rubber tracks. Following successful trials, the Trust purchased their own machine which was used during the late summer of 2018 to cut the droves, sedge fields and tall-herb fen. However, the entire resurvey phase of the present project took place before the Fen Harvester had been used and the data thus reflect the last year of a period of disrupted management on the Sedge Fen.

Carr clearance: Beginning in 2000, scrub became a management target on Sedge and Verrall's Fens and a large programme of clearance was undertaken, completed just after the management-related vegetation survey of 2004 (Mountford *et al*. 2005). In total ca 48.5ha of carr were cleared, especially in Compartments 2-5 in Verrall's Fen and 12-19 in the Sedge Fen. Parts of Compartments 2-4 by Howe's Ditch were not cleared due to the extremely wet conditions there. The scrub and woodland in St Edmund's Fen etc. remain unmanaged, except for localised remedial work for access. Bushes and trees were felled and the stumps treated with herbicide (glyphosate) to prevent re-growth. Much of the wood felled in Verrall's Fen was stacked in large piles, with the original intention of allowing the cut timber to dry for up to two years, and then burn the piles, though such disposal has not occurred. Some parts of Verrall's Fen have shown marked regeneration of scrub, especially of buckthorns, suggesting that further remedial action may be necessary unless browsing by horses is effective. Alternatively, young scrub in some places could be allowed to mature, and management in the form of cutting, followed by 'aftermath grazing' by livestock, could focus on smaller areas that support (or have the potential to support) a relatively rich assemblage of light-loving grassland/fen species, thus creating a dynamic vegetation mosaic to the benefit of flora and fauna.

Grazing: Until the 2000s, grazing in the NNR was largely confined to Adventurers' Fen. On Verrall's Fen, cutting regimes were abandoned after carr clearance and extensive grazing with Konik ponies was introduced. The original planned grazing intensity was 100 livestock units (lsu)/ha/yr, although early on the stocking rate was as low as 55 lsu/ha/yr. At first, only non-breeding animals were used (ca 20 geldings and unproductive mares), and allowed to roam freely and forage in Compartments 2-5. The Koniks were later complemented by Highland Cattle, a breed that can also tolerate the wet conditions and low forage value of fen vegetation. A similar regime is practised on parts of Adventurers' Fen (specifically Brett's and Trevelyan's Pieces), as an extension of the main area of grazing management on Baker's Fen.

Vegetation surveys at Wicken Fen – their objectives and methods

Survey rationale

The first comprehensive survey using the National Vegetation Classification (NVC: Rodwell 1991-2000) was completed in 1999 by Rosemary Parslow and Adrian Colston of the National Trust, combining field mapping of NVC types and aerial photographs to produce a working map for Verrall's Fen, the Sedge Fen, Wicken Poors' Fen and St Edmund's Fen. That map depicts the vegetation cover of the NNR at the "high water mark" of carr expansion, prior to the major clearance campaign of 2000-2004/5. At the end of the carr clearance, the NNR

management plan became due for revision. Thus, the Trust and English Nature decided to assess the range of management regimes applied to the old fen in order to test their efficacy in achieving the stated biodiversity aims. This assessment was achieved through a survey of NVC types in the herbaceous fen of Sedge and Verrall's Fens to see whether the variety of regimes was delivering comparable variety in vegetation. The results of this survey were reported in Nature in Cambridgeshire (Mountford *et al*. 2005) and provided evidence that allowed some simplification of the management regimes applied during the 2010s.

The hydrology and water-budget of the core NNR were assessed (McCartney *et al*. 2000; Harding *et al*. 2005) and the site management rigorously examined during the period 1990-2012, associated with the Wicken Vision and other new initiatives (Colston 2003; National Trust 1999, 2016). Despite the persuasive evidence for improving the water supply to the NNR, the Trust decided that such ambitious management should be carefully monitored. Consequently, a team of plant ecologists and soil scientists from the Trust and its Local Committee conducted an NVC survey of the NNR: In 2010: the "old fen" (Verrall's and Sedge Fens), Breed Fen and Little Breed Fen; in 2011: St Edmund's and Wicken Poors' Fens and compartments 43-49 of Adventurers' Fen; and in 2012, the reed-bed compartments (50-52). The surveyed compartments are depicted in Figure 1, covering the entire NNR except compartments 40-42 and 53. The overall objective for this vegetation study was to underpin the management plan for the whole NNR, testing not only the impact of particular management initiatives but also the general quality and condition of the habitats. The 2010-12 survey was envisaged as a baseline from which to assess change and inform future management, and an internal report to the Trust was submitted (Mountford *et al*. 2011). A resurvey in 2017-18 comprised the first assessment of such change, following precisely the same methods and recording as closely as practicable the same locations. The project asked a number of questions, key amongst which were:

- How had the vegetation changed between 2010-12 and 2017-18 and to what extent could this be related to any management regime (both pre-2005 and as applied since)? In particular, had the conservation value been maintained or enhanced and what evidence was there for recovery from scrub clearance and for the impact of grazing and rewetting?

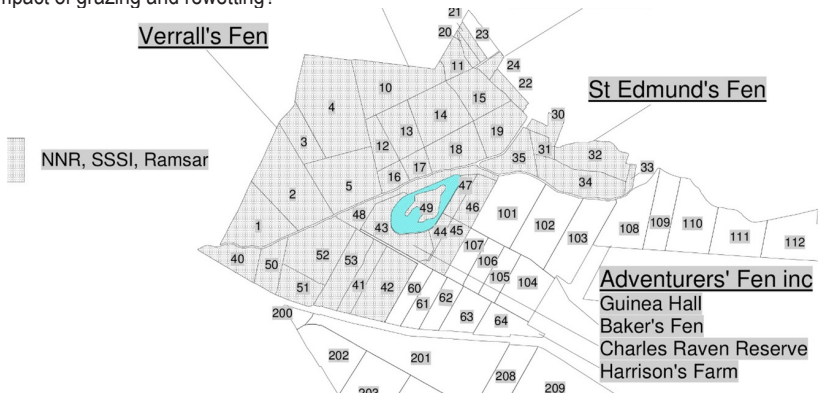

Figure 1:Wicken Fen National Nature Reserve – map of compartments (© National Trust). The vegetation survey of 2010-18 covered a) Verrall's Fen (compartments 1-5); b) Sedge Fen (compartments 10-19); c) Little Breed Fen (compartments 20-24); d) St Edmund's Fen (compartments 30-34); e) Wicken Poor's Fen (compartment 35); and f) Adventurers' Fen (compartments 43-52 – nos. 50-52 comprise the reed-bed).

Field Methods:

In preparation for the survey, a regular grid with a spacing of 100m was superimposed over the whole NNR, using the Ordnance Survey National Grid as the framework. The grid was divided into two portions, separated by Wicken Lode. All grid cells were assessed in both 2010-12 and 2017-18, except for five quadrats in the reed-bed which could not be reached at the later date. In total, 205 quadrats were recorded in both 2010-12 and 2017-

18. The survey points were precisely located at the centre of each grid cell using a hand-held GPS, except in a very few instances where site conditions made reaching the exact centre impractical and hence the vegetation was assessed as close as possible to the centre (with position of the revised location recorded). At each survey point, a quadrat was recorded: 16m^2 (4m x 4m) in tall herb vegetation; 100m^2 (10m x 10m) in carr; and 4m^2 (2m x 2m) in a few cases on mown droves. Within the quadrat, all vascular plants and bryophytes (other than epiphytes on the shrubs) were recorded, together with an estimate of the percentage cover for each species. The methods used in the 2004 survey (Mountford *et al*. 2005) had differed somewhat, focussing on uniform areas of herbaceous fen and in relation to management compartments. Hence, any allusion to this earlier survey is confined to qualitative appraisal of the herbaceous vegetation types present within the compartments of Verrall's, Sedge and Little Breed Fens.

Vegetation classification and analysis:
Each vegetation sample was classified within the National Vegetation Classification using the TABLEFIT procedure (Hill 2015) which produces an output that lists the top five NVC types in terms of goodness-of-fit ratings (GoF) to the constancy tables of the NVC. This output should be treated with some caution: a) not putting much faith in GoF ratings <50%, though acknowledging that they provide some information; b) output often indicates very similar GoF ratings for several NVC types; and c) NVC types are not really distinct and predictable entities but rather they are approximations to recognisable assemblages of species. Maps were produced showing the distribution of samples allocated with high GoF to different NVC types – a full set was included within the final report to the National Trust (Mountford and Sparks 2019). In the main, these maps were only interpreted at the compartment scale, though some of the spatial patterns shown within compartments are clearly a useful reflection of the situation on the ground.

As well as focussing on vegetation composition, analysis used Ellenberg Indicator Values that provide an insight into how the overall flora at a point reflects environmental conditions. The Ellenberg system has been modified for the UK (Hill *et al*. 2004) and the values for light (L), fertility (N), wetness (F) and soil reaction (R) were employed for the present work. These Ellenberg indicator scores were used with cover-weighted mean values calculated in Excel. Mountford and Sparks (2019) provided a summary of the mean Ellenberg Indicator Values for all sample points on both the baseline and resurvey dates.

The impact of management was assessed through an analysis in relation to four simple categories of management history i.e. a) those that had (n=95) or had not (n=110) experienced carr clearance in the 2000s; b) those that had (n=54) or had not (n=151) been arable prior to 2000 (Adventurers' Fen only); c) those that had (n=79) or had not (n=126) been grazed in the 2000s; and d) those that had (n=55) or had not (n=150) been partially mown in the 2000s. In addition, and in order to avoid overlapping management categories, four distinct types were also allocated to quadrats as follows: 1) zero management (n=94); 2) carr clearance and horse grazing (n=51); 3) carr clearance and mowing (n=46); and 4) cattle grazing (n=14).

Analysis of individual species to assess change between the baseline and resurvey was undertaken using the nonparametric Wilcoxon paired test, because of the large number of zeroes (i.e. absences) in the data. Testing of differences between the two surveys was restricted to those species present in ≥10 quadrats in at least one of the two surveys. Significance was adjusted for ties. A similar approach was adopted for analysis of certain summary variables (Simpson's Index, Species Richness, and the four weighted Ellenberg variables). However, for these it was considered that the more powerful paired t-test would be reliable. Differences in cover for each species and each quadrat between the baseline survey and resurvey were calculated. For each species, the influence of carr clearance versus no carr clearance on the difference in cover between the two surveys was assessed using the nonparametric Kruskal Wallis test, again because of the large number of zeroes, with significance adjusted for ties. The analysis was repeated for the remaining three management histories (ex-arable, grazing, mowing). Changes in mean values between the baseline and resurvey for the summary variables were assessed using two sample t-tests. Similarly, differences between management types practised in the 2010s and those from the resurvey were assessed for each species using the Kruskal Wallis tests, here effectively a nonparametric one-way ANOVA.

In addition to these analyses, the species percentage covers of all 195 recorded species in the 410 quadrats (205 baseline and 205 resurvey) were analysed by Detrended Correspondence Analysis (DCA) in the CANOCO 5 package. Values were log (x+1) transformed and the analysis down-weighted for rare species. Ten supplementary "environmental" variables (carr clearance, ex-arable, grazing, mowing, bare ground, standing water, litter, vegetation height in 2017-8, algae and quadrat size) were added to assess how they related to any plant community patterns that might be identified.

Changes in individual species between 2010-12 and 2017-18

Over the period of the vegetation monitoring studies since 2000, some 230 species of vascular plant and bryophytes were recorded in the quadrats. This total compares with ca 450 vascular plant and 125 bryophyte species on the overall list for the Trust's land. Focussing on the more frequent species, some general trends can be identified, though many of these are more pronounced in particular parts of the NNR with distinct management histories. There was a general reduction in species richness and diversity as measured by the number of species per quadrat and Simpson's Index (Table 1A overleaf).

The decline in species-richness was associated with the general spread of *Phragmites australis* (from 27% mean cover to 38%) especially on Sedge Fen and the ex-arable land of Adventurers' Fen, *Calystegia sepium* (6% to 8%) and *Urtica* species (5% to 8%). More localised increases were observed in carr areas and Adventurers' Fen (*Carex riparia*) and on Verrall's Fen, following carr clearance and grazing (*Carex disticha*, *C. panicea* and *Juncus subnodulosus*). Declines were observed in *Calamagrostis canescens* (9% to 3%), *Phalaris arundinacea* (7% to 2%), *Angelica sylvestris, Calliergonella cuspidata* and *Eupatorium cannabinum*, especially on the "old fen. *E. cannabinum* had previously undergone a large increase in the early 2000s following creation of bare ground through carr clearance.

Patterns in species abundance can be linked to management regime. It should be noted that the different elements of management can be confounded i.e. grazing is generally associated to past carr clearance, areas of past arable management are now largely unmanaged or subject to only light grazing. Cleared (and grazed) land on Verrall's Fen was characterised by sedges (*Carex flacca, C. otrubae, C. panicea*), *Juncus subnodulosus, Molinia caerulea, Cirsium palustre, Galium uliginosum, Lythrum salicaria, Scutellaria galericulata* and *Thalictrum flavum*. Ungrazed land (including the mown area of Sedge Fen) had markedly greater cover of *C. canescens, Carex riparia, Cladium mariscus, E. cannabinum, Lycopus europaeus, Lysimachia vulgaris, Mentha aquatica* with *Salix cinerea* and *Brachythecium rutabulum* in ungrazed carr stands.

Changes in summary variables between 2010-12 and 2017-18

Between the baseline survey (2010-12) and the resurvey (2017-18), there was a decline in the mean number of species per quadrat from 16 to 13 and in Simpson's Index of diversity (Table 1A). Diversity declined especially in compartments which had been arable in the mid-20th century (Table 1B). Although the species richness per quadrat had declined, this was significantly less pronounced in areas that had been cleared of carr and then horse grazed i.e. Verrall's Fen Compartments 2-5 (Table 1C).

From individual Ellenberg indicator values for species, one can derive a summary for a quadrat that is the cover-weighted mean value of all the species recorded. Table 1A presents the results of paired t-tests showing any significant changes in cover-weighted mean Ellenberg values for light (mL), wetness (mF), reaction (mR) and fertility (mN) for the whole survey between 2010-12 and 2017-18. Table 1B gives equivalent results for these mean changes in relation to the types of management practised during the 2000s (i.e. prior to the baseline survey) with significance based on 2-sample t-tests. Finally, Table 1C provides ANOVA results for changes between the four mutually exclusive management regimes followed in the 2010s: a) zero management; b) carr clearance coupled to horse grazing; c) carr clearance with mowing; and d) cattle grazing only.

When the vegetation of the NNR as a whole is considered, there was no clear change in Ellenberg light between baseline and resurvey, with a mean value of ca 7 indicating vegetation in generally well-lit places. However, there was significant divergence in the mL values over the 2010s between areas where carr had previously been

Table 1 A, B, C Wicken Fen NNR (Baseline 2010-12 vs Resurvey 2017-18) – for 205 quadrats, results for mean Simpson's Index of Diversity, mean number of species and mean cover-weighted Ellenberg indicator values (L: light; F: wetness; R: reaction; N: fertility)

Variables with a significant difference (P<0.05 – in bold) in mean values between baseline and resurvey, together with probability values for significant results (ns = result not significant)

A. Overall change - result of paired T-tests

Vegetation variable	2010-12	2017-18	P
Simpson's Index	0.74	0.68	<0.001
Number of species	16.26	12.89	<0.001
Weighted Ellenberg L	6.98	7.01	ns
Weighted Ellenberg F	8.19	8.36	0.002
Weighted Ellenberg R	6.68	6.68	ns
Weighted Ellenberg N	5.56	5.56	ns

B. Change in relation to management in 2000s – results of 2-sample t-tests

Vegetation variable	Carr cleared?			Arable in past?			Grazed in 2000s			Mown in 2000s		
	No	Yes	P	No	Yes	P	No	Yes	P	No	Yes	P
Simpson's Index	-0.06	-0.07	ns	-0.04	-0.14	0.003	-0.07	-0.06	ns	-0.06	-0.09	ns
Number of species	-3.56	-3.15	ns	-3.66	-2.57	ns	-3.83	-2.63	ns	-2.15	-6.69	<0.001
Weighted Ellenberg L	-0.02	0.09	<0.001	0.05	-0.02	ns	0.03	0.03	ns	0.01	0.09	0.016
Weighted Ellenberg F	0.13	0.22	ns	0.09	0.40	0.037	0.18	0.16	ns	0.05	0.50	<0.001
Weighted Ellenberg R	0.00	-0.02	ns	-0.03	0.06	ns	0.12	-0.20	<0.001	-0.11	0.28	<0.001
Weighted Ellenberg N	0.11	-0.14	ns	-0.02	0.04	ns	0.12	-0.21	<0.001	-0.08	0.20	0.002

C. Change in relation to management – results of ANOVA

Vegetation variable	Zero management	Carr clearance & horse grazing	Carr clearance & mowing	Light cattle grazing	P
	94 quadrats	51 quadrats	46 quadrats	14 quadrats	
Simpson's Index	-0.07	-0.03	-0.10	-0.13	ns
Number of species	-3.13	-1.84	-4.96	-5.36	0.01
Weighted Ellenberg L	-0.02	0.05	0.12	-0.04	0.01
Weighted Ellenberg F	0.08	-0.17	0.55	0.83	<0.001
Weighted Ellenberg R	0.01	-0.37	0.31	0.17	<0.001

cleared (where mL increased indicating better illumination) and sites where there had been no carr clearance. This indicator also increased where sites were mown in the 2000s. In contrast, Ellenberg wetness increased significantly (from 8.19 to 8.36), indicating that the whole Fen had become generally wetter i.e. species typical of constantly damp (but not wet) soils were giving way to a flora of altogether more typical of wet, badly-aerated soils. This trend toward wetter conditions appeared most pronounced in compartments on former arable land and also where mown in the 2000s i.e. the Sedge Fen. There was no evidence that there has been a general change in Ellenberg soil reaction over the monitoring period, with the flora remaining typical of fairly weakly acid to weakly basic conditions. However, the flora where the site had not been grazed in the 2000s but rather had been mown (i.e. the Sedge Fen) showed a rather higher mR value than in the grazed and unmown areas i.e. species of calcicolous conditions were associated with cutting and zero grazing. Examining the present

management, there also appeared to be some link between lower pH and horse-grazing. Finally, although there was no overall change in Ellenberg fertility of the Wicken flora, remaining at ca 5.5 i.e. comprising species indicative of average fertility, the vegetation in the different parts of the NNR showed somewhat different trends. The composition in areas that were ungrazed but mown during the 2000s appeared to have become increasingly typical of more fertile situations than where the fen was simply horse grazed. However, in contrast light cattle grazing (as in parts of Adventurers' Fen) showed a trend to more fertile conditions.

Changes in plant community between 2004 and 2017-18

Changes in the 2000s

Changes in herbaceous vegetation between the compartment-based survey of 2004 (Mountford *et al*. 2005) and the baseline survey of the present study were examined in Verrall's Fen (Compartments 2-5), Sedge Fen and Little Breed Fen (the 2004 work did not cover Compartment 1 of Verrall's Fen, Wicken Poors' Fen, St Edmund's Fen and Adventurers' Fen, nor carr in Verrall's and Sedge Fens). Differences in methodology meant that rigorous statistical analysis was impractical, though a qualitative assessment of vegetation type was possible. Overall, there was remarkably little evidence of change between 2004 and 2010, and the pattern of the five key vegetation types remained broadly the same i.e. M13 *Schoenus nigricans-Juncus subnodulosus* mire, M22 *Juncus subnodulosus-Cirsium palustre* fen-meadow, M24 *Molinia caerulea-Cirsium dissectum* fen-meadow, S24 *Phragmites australis-Peucedanum palustre* tall-herb rich fen and S25 *Phragmites australis-Eupatorium cannabinum* tall-herb fen (Rodwell 1991-2000).

M13 mire was only found where the fen was cut at least 1 year in 2 and represented by a variant (without *Schoenus nigricans*!) that is transitional to fen meadows. In 2004, M22 fen-meadow showed a strong preference for annual cutting in late summer with some evidence that its extent had increased in Verrall's Fen under Konik-grazing but that it might have declined along the drove edges in the Sedge Fen. M24 was mainly represented in 2004 by the M24a sub-community and appeared to be cut less frequently than M22, with the biggest stands being where the vegetation was cut once every 2 years in late summer, though also occurring where mown more frequently along Wicken drove margins. Cover of M24a seems to have increased slightly under Konik grazing applied after clearance of carr between 2004 and 2010 (i.e. in Verrall's Fen). Tall-herb rich fen (S24) is variable, with the classic Wicken variant (S24c *Symphytum* sub-community) most common, possibly indicating a more disturbed situation. The 2004 survey showed S24 to be commonest under a biennial summer cut but good stands were found under a wide range of mowing frequencies. The broad distribution of this community remained unchanged during the 2000s, except in Little Breed Fen where reed invasion of a wet mesotrophic grassland produced tall-herb fen and in parts of Verrall's Fen where carr clearance led to a better fit with S24 in 2010 than had been the case in 2004. Finally in 2004 S25 tall-herb fen was found under the full range of cutting frequencies (annual to 1 year in five), but was probably best represented under less intensive regimes. The overall extent of S25 was similar in 2004 and 2010, though again succession after carr clearance produced a closer fit to this tall-herb fen by the later date.

Changes in the 2010s

The results of the NVC community mapping were presented as a series of maps by Mountford and Sparks (2019) showing the distribution of quadrats allocated to particular vegetation types in 2010-12 and in 2017-18. The following account summarises these 20 maps. The situation on the old fen (Verrall's and Sedge Fens) between the baseline and the resurvey was far more dynamic than during the 2000s, at least in part reflecting the changes in management, both planned, such as increased grazing and the rewetting of the Sedge Fen, and enforced, such as more intermittent mowing. When one considers the NNR as a whole, there was a clear loss of species from many, indeed most, parts. The reasons for this generalised change vary in the different areas of Wicken Fen. The most marked reduction in species-richness was in the Sedge Fen, where the recent lack of regular cutting imposed by wet conditions led to loss of forbs from both the tall-herb fen and fen-meadow communities. The lower-growing forbs and mosses in particular are disadvantaged by competition for light with vigorously-growing reed, *Cladium mariscus* and *Juncus subnodulosus*. Lack of management in the Sedge Fen and parts of Adventurers' Fen, including the reed-bed (Compartments 50-52) has also led to accumulation

of thick litter, further limiting the growth of shorter plants. Declines in the grazed parts of Verrall's Fen and elsewhere were much less severe.

There was no perceptible general change within the carr and woodland communities, whether within the north part of Sedge and Verrall's Fens or in St Edmund's Fen. However, there was some local variation within the areas of carr, such as the increased cover of the moss *Brachythecium rutabulum*, possibly reflecting darker conditions. In addition, in the westernmost compartment of Verrall's Fen (Compartment 1), there was evidence of carr colonising the previously more open swamp.

Grasslands are important at Wicken, although most of the conservation effort has focussed on fen-meadows, notably those dominated by purple moor-grass and designated under EU habitats directive as 6410 *Molinia* meadows on calcareous, peaty or clayey-silt laden soils i.e. *Molinion caeruleae* (European Commission 2013). Other grasslands are confined to the marginal parts of the NNR, on the slope up to the Upware-Wicken-Soham ridge where the soil is mineral and on areas with a history of arable cultivation where the peat has wasted. In such places, mesotrophic grasslands were recorded in all years, though within the NNR, these communities showed invasion by reed or thorn scrub.

The combination of wetter conditions in the Sedge Fen and reduced or zero management there and elsewhere favours the spread of tall competitive graminoids such as *Phragmites australis* and *Cladium mariscus*. The resulting swamp vegetation has become more extensive not only on the Sedge Fen, but also in many parts of Adventurers' Fen. Some of the tall-herb fens (S24, S25, S26 and S28) have also become increasingly reed-dominated. Tall-herb fens include types which are poor in rich-fen specialist plants i.e. S26 *Phragmites australis-Urtica dioica* and S28 *Phalaris arundinacea* tall-herb fens. There is evidence that these communities, especially S26, are spreading on the NNR both as a result of reed invasion of grassland and as higher quality tall-herb fens deteriorate. These changes can be linked to reduction in the prescribed management frequency on the Sedge Fen, and may also be encouraged by atmospheric nitrogen deposition, which favours reed growth and that of forbs like *Urtica* spp.

In most British tall-herb fens, the principal vegetation is of the S25 type, which in terms of composition is intermediate between S24 and S4b (the *Galium palustre* sub-community of reed-swamp). It lacks the full range of rich-fen species or has them only at very low frequency and abundance. Indeed, S25 only has three constant species (reed itself, *E. cannabinum* and *Galium palustre*) whereas S24 has twelve constants (*Calamagrostis canescens, Cladium, Eupatorium, Filipendula ulmaria, Galium palustre, Juncus subnodulosus, Lysimachia vulgaris, Lythrum salicaria, Mentha aquatica, Phragmites australis, Thysselinum palustre* and *Calliergonella cuspidata*). The S25 community has spread in the Sedge Fen at the expense of S24, as the tall-herb fen has become more species-poor, losing some of the characteristic species of S24, at least at the quadrat scale even if still present in the compartment. This change reflects the increasing density of *P. australis* and also to some extent of *Calystegia sepium*. S25 is also spreading on Adventurers' Fen, as both existing reed-swamp acquires more tall herbs and as reed invades wet grassland. Where the management involves more intensive grazing by horses, however, S25 tall-herb fen retreats. Changes in the distribution of S24 tall-herb fen are linked to these trends in S25, being much reduced in the Sedge Fen and in Verrall's Fen where its cover has also contracted following the horse-grazing. Despite the impoverishment of S24, *Thysselinum palustre* (Milk Parsley) itself seems to have increased, especially where the Fen Harvester was tested and the display in August, 2018 of this key species in Compartments 15 and 19 was remarkable.

Whereas tall-herb fen depends on cutting every other year or less frequently, fen meadows (M22 and M24) need annual or biennial mowing. Hence, the problems with getting cutting equipment onto the Sedge Fen before the purchase of the Fen Harvester led to very reduced areas of these communities on Compartments 10-19. On Verrall's Fen, where the water-levels were not raised and horse-grazing was the method of vegetation control, such communities have spread: M24a *Molinia caerulea-Cirsium dissectum* fen-meadow (*Eupatorium cannabinum* sub-community) and especially the Iris pseudacorus sub-community (M22d) of the M22 *Juncus subnodulosus-Cirsium palustre* fen meadow. The dominants in these grazed areas of the old fen are *Juncus*

subnodulosus and low *Carex* species, replacing reed and reed-like grasses. The spread of these lower-growing communities is linked to an increase in the mean Ellenberg light indicator value (mL), reflecting the better-illuminated situation brought about by carr clearance and suppression of reed, leading locally to short grass and sedge swards. This part of the NNR is the only area where the overall mean wetness indicator value (mF) was lower in 2017-18 than in the baseline years.

Implications for the management of vegetation and water

Since the first land at Wicken was acquired by the National Trust in 1899, numerous management objectives and methods have been applied, resulting by 2000 in a complex management plan with layers based upon experimental approaches, interpretation of outcomes, and traditional practices (Lock *et al.* 1997). At the start of the 21st century, this spatial and temporal complexity proved unwieldy and expensive. Although research showed that factors other than management (especially hydrology) affected vegetation composition, the National Trust wanted to know what contribution this complexity of mowing regimes made to overall biodiversity. The 2004 survey (Mountford *et al.* 2005) supported some rationalisation of the regimes into two, flexibly-applied cutting regimes. The first of these would comprise annual late-summer mowing for fen-meadows and mires wherever such vegetation was still extensive, and also along drove margins. The second regime would be applied to sedge fields and compartments with tall-herb fen, where the vegetation would be cut 1 year in 3 during the summer. These recommendations were integrated with plans to safeguard the water-supply on Sedge Fen to produce a new management plan (National Trust 2011), which would require a programme of review and monitoring.

Firstly, the impact of carr clearance combined with grazing by Koniks (more recently augmented by Highland cattle) has been largely to maintain species-richness but has altered the vegetation significantly. The intention of the management plan was to create a diversity of vegetation types in Verrall's Fen that included close-grazed "lawns", fen-meadow (M22 and M24) and retain some tall-herb fen (S24 etc.), as well as the northern fringe of carr. To some extent, this has been successful and Verrall's Fen in 2017-18 was structurally diverse, with much increased fen-meadow. However, this part of the NNR has undergone drastic management changes over the past 20 years, and is still showing considerable local variation and dynamism in terms of vegetation type.

Any concerns over the direction of vegetation change in Verrall's Fen would be offset were the Sedge Fen a refuge with consistent management over the decades and conservation of key plant communities. This was certainly the intention in the management plan, with its attention to mowing regimes as well as to raised water-levels after the phase of carr-clearance (especially in Compartments 12-19). However, the Sedge Fen became much wetter than was intended due to unexplained and unregulated inputs from elsewhere than Monk's Lode. This factor prevented the timetabled mowing of compartments and droves, with mowing postponed until later in the season or sometimes missed altogether. The quality of the tall-herb fen markedly deteriorated during the 2010s where it was too wet to cut, resulting in a transition from the forb-rich S24 (which requires regular mowing for maintenance) to poorer S25, a community typical of unmanaged fens, and locally to Cladium mariscus swamp (S2). Similar impacts were discernible in the areas of litter vegetation in the Sedge Fen, with spread of dominants (especially Juncus subnodulosus) at the expense of forbs.

Although not explicitly part of the present project, there was concern about the droves on the Sedge Fen, whose varied flora includes uncommon species. Both Trust staff and expert visitors expressed their disquiet that prolonged waterlogging was delaying or preventing the mowing of droves. The situation was reviewed by Mountford (2015) from an ecological perspective and by the Trust's staff from both conservation and practical points of view. These discussions led to the testing of the Fen Harvester and, in turn, to its purchase as a management tool for tall-herb fen, the litter and the droves.

Within the NNR, light cattle grazing as a sole technique is practised in parts of Adventurers' Fen (Brett's and Trevelyan's Pieces) and in the field immediately north of the William Thorpe Building. Cattle grazing was formerly used in other parts of Little Breed Fen. In this handful of compartments, there has been a general coarsening of the vegetation with reed invasion leading to a decline or loss of lower-growing species. These parts of the NNR

Table 2: Verrall's & Sedge Fens – changes in frequency of major vegetation types linked to management between baseline and resurvey (as indicated by numbers of quadrats ascribed to NVC types by the TABLEFIT procedure)

Vegetation type	location	Baseline (2010-12)	Resurvey (2017-18)
S2, S4, S6	Verrall's Fen	0	0
S2, S4, S6	Sedge Fen	3	7
S25	Verrall's Fen	5	5
S25	Sedge Fen	4	17
S24	Verrall's Fen	27	10
S24	Sedge Fen	26	18
M24	Verrall's Fen	6	9
M24	Sedge Fen	8	5
M22 (and M13)	Verrall's Fen	9	19
M22 (and M13)	Sedge Fen	5	1

generally do not hold habitats of high conservation value, although Compartment 22 has supported a population of the uncommon *Taraxacum palustre* (Fen Dandelion) which has been the subject of study (Walker *et al*. 1999).

Extensive parts of the NNR receive no management at all. This regime was applied to carr where natural processes maintain the habitat value. Although the clearance programme of 1999-2005 was vital to increase the extent of tall-herb fen and fen-meadow, it was also desirable to retain some mature carr with its combination of fen and shade species in the ground layer, as well as distinctive assemblages of epiphytic bryophytes and lichens. Mature carr occurs on Sedge Fen (Compartments 10, 11 and 15) and St Edmund's Fen, as well Verrall's Fen (Compartment 1 and the north edge of Compartments 2-4). Other areas of the NNR receiving no intervention comprise much of Adventurers' Fen, including the reed-bed (Compartments 50-52). Throughout this area, unmanaged dense reed has expanded, leading in some areas to a poor reed-bed and in others to a transition to tall-herb fen.

Over the past 50 years, much of the most complex management on the NNR has been conducted on the "old fen" i.e. Sedge and Verrall's Fens. These fens have much of the high-value plant communities targeted by nature conservation designations, both national and international. Table 2 provides a summary of the vegetation change in these fens, focussing on the most important vegetation types from a biodiversity perspective (tall-herb fens, fen meadows and swamps). On Verrall's Fen, the impact of grazing is clear, with tall-herb fen (S24) being replaced by fen-meadows (M22 and M24). The changes on the Sedge Fen reflect two linked causes, the increased wetness and the consequent reduced mowing intensity. Thus, S24 fen has declined sharply and has been replaced by the species-poor S25 type whilst all types of fen-meadow have reduced in extent.

At present the confounding of rewetting and reduced mowing on Sedge Fen makes it difficult to assess how effective controlled rewetting will be once the effective mowing regime of the Fen Harvester has had an impact. However, although the clearest changes in the Sedge Fen result from lack of management and expansion of competitive fen dominants (*Phragmites, Juncus subnodulosus* and *Calystegia sepium*), there is also evidence of the expansion of plants typical of wet rather than merely damp soil conditions (e.g. *Cladium mariscus* and higher Ellenberg wetness value). Once the management of the Sedge Fen is fully compliant with that planned (National Trust 2011, 2016), it will be possible to distinguish the effectiveness of rewetting through further monitoring.

Conclusions – management recommendations for the different parts of Wicken Fen NNR

Since the launch of the Wicken Vision and the programme of carr clearance, the management of the NNR has changed noticeably compared to the previous half-century. This dynamism in management regime has led to changes in the vegetation. Some of these changes may be complete, others are still under way; some changes fit the aims of the National Trust, whilst others are due to circumstances outwith the Trust's control. With such

considerations in mind, it is possible to review the management of each part of the NNR and propose how the management regimes could be adapted in the future.

Verrall's Fen: The carr areas in Compartment 1 and north parts of Compartments 2-4 receive no management and, assuming that their habitat value must be retained, there is no pressing need to intervene. The vegetation in those parts of the fen with extensive Konik grazing has retained its range of plant species but the spectrum of plant communities was different in 2017-18 compare to the baseline, with more fen meadow and lawns. The decline in tall-herb fen on Verrall's Fen may be tolerable if that on the Sedge Fen retains its quality. There may be a benefit from reintroducing mowing in some areas (e.g. adjacent or near to the 'rides') for a few years to test whether livestock favoured these mown strips, and then maintained shorter swards without further mowing.

Sedge Fen: Once again, the northern carr zone should be retained for the foreseeable future. However, the herbaceous communities have undergone marked changes during the 2010s with a severe loss of quality in the tall-herb fen and a reduction in the extent of fen-meadow communities. Thus, the National Trust bought the Fen Harvester to implement the prescribed mowing regimes under the wetter conditions now present on the Sedge Fen. Since the present assessment was conducted before the Fen Harvester could have an impact, the recommendations here must be provisional. There is a pressing need to review the success of the new machinery in the next 2-3 years, and then possibly adjust the regimes both there and on Verrall's Fen should the loss of high quality tall-herb fen and fen meadow continue.

Little Breed Fen: Small compartments lying on the border between peat and clay, management is rather heterogenous, delivering different benefits, and merits a compartment-specific account. However, the Fen Harvester will be able to manage Compartments 20 and 22 initially on a 4-year cycle. Compartment 20 was grazed at one time but has had little management since 2005 and is developing a fen vegetation, which will be amenable to use of the Harvester. Compartment 21 had lines of thorn scrub separated by valuable mesotrophic grassland. There was no scrub control from 2000-18, other than that required for bird-ringing, resulting in loss of shorter grassland with *Ophioglossum vulgatum* and *Ophrys apifera*. In 2018, a scrub coppicing programme was re-introduced, allowing use of a new motor-scythe to restore sward quality. Compartment 22 has been cattle-grazed since 2000 with management focussing on Taraxacum palustre and the transition from fenny to coarse calcicolous grassland. The grazing regime may maintain the grassland transition but more attention to the dandelion area may be necessary, possibly necessitating higher stocking rates. Compartment 23 (plantation) had modest plant conservation value in 2004 but has gradually acquired elements of a shade flora. Creation of the butterfly walk etc. has been the main conservation action and vegetation changes have been neutral or positive. The Trust has recently introduced a 16-year coppice cycle to complement hedge-laying and access improvements. Compartment 24 is very small and has had limited management with periodic cattle-grazing and a little carr clearance near the brick-pits. Incorporation into the nature trail is planned and there is no clear need to change the management.

St Edmund's Fen: Compartments 30-34 have been essentially unmanaged for many years, other than some mowing of the pathways by the bird-ringing group or where the margins of the education area have been trimmed back. Even this management became less intensive in the 2010s. However, the carr and shade vegetation remained of unaltered quality or, indeed, improved slightly under this management as the woodland matured. The present study therefore provides no justification for a change in this regime of zero or minimal management.

Wicken Poors' Fen: Although this area falls outwith the Trust's direct management responsibility, the Poors' Fen has been kept under observation by scientists associated with the National Trust and very occasional interventions made in consultation with the Wicken Parish Council. Many rare or scarce species typical of wet open mossy mire once occurred here but were lost by the mid-twentieth century (Crompton 2006; Walters 1997). Recently, the Poors' Fen has become coarse, herb- and species-poor, with *Cladium* and carr expanding. Any attempt to restore the value of this area will require close collaboration with the Parish

Council and discussions are under way to use the Fen Harvester coupled to some scrub cutting. Central scrub would be cut back alongside introduction of an 8-10 year cycle of vegetation management.

Adventurers' Fen: This fen has had little intervention since 1999, when its management became more integrated with that of Baker's Fen and the Vision project. Some grazing by livestock from the Vision area has occurred, especially in Brett's and Trevelyan's Pieces, but this is managed extensively and the animals seem to avoid the area during summer due to the abundant Diptera. As a result, the mere shores and much of the former wet grassland have become reed-dominated, resulting in a loss of drawdown species and impoverished communities elsewhere. *Crassula helmsii* is established among reed by pools and any management attempting to rehabilitate the mere etc will have to take this into account. Some uncommon species appear to be able to coexist with *C. helmsii* (e.g. *Juncus compressus*) but management should be tailored to ensure that *Crassula* is not transported to other parts of the NNR, where less tolerant fen species occur. Other parts of this block (Compartments 43 and 48) have been, and will remain, largely unmanaged.

Adventurers' Fen Reed-bed: Partly due to practical difficulties in resurveying these compartments (50-52), giving management recommendations is not simple. However, the evidence indicated that the Trust should review its management, since the lack of cutting in the 21st century had led to an accumulation of thick reed-litter and a species-poor fen or reedbed. Here again the Fen Harvester has aided operations, with cutting operations recommencing in late 2018 on a prescribed 4-year cycle. There will also be selective scrub clearance, cutting back bushes in compartment centres and also some from the fringes, in order to prevent further spread.

Testing the effectiveness of site management in realising conservation goals was a major consideration in commissioning the present project, and indeed those that were conducted in 2004 and 2010-12 (Mountford *et al*. 2005, 2011). The management of the NNR is complex, with many complementary objectives (National Trust 1999, 2011, 2016), and meeting these objectives is affected by the Trust's overall priorities, finance and external factors such as weather. Though the results of this project gave some reasons for concern, it must be stressed that they precede the impact of the Fen Harvester and other initiatives. Thus the Trust has already taken remedial action and early observations indicate strongly that the deterioration traced in this paper has been arrested. The Trust is to be congratulated in setting up such a rigorous monitoring programme that allows them to adjust management to meet both foreseen and unforeseen challenges.

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Plate 1: Impact of horse grazing in Verrall's Fen – creation of a lawn and poaching under a tree

Plate 2: Aftermath of Fen Harvester in Sedge Fen

Plate 3: Unmanaged carr in St Edmund's Fen

Some Cambridgeshire microfungi from wetland sites

C.D. Preston

In this note I have summarised recent records of a few fungi and downy mildews from wetland sites in Cambridgeshire (v.c. 29). All the species are parasitic on living hosts. One or two are probably genuinely rare in Britain, but the others, although infrequently recorded, are probably widely overlooked. I have entered details of the records on the British Mycological Society (BMS) database and deposited the voucher specimens in the Cambridge University Herbarium (CGE).

***Cercospora moravica* (Petr.) U. Braun (Capnodiales: Mycosphaerellaceae)**

Cambs (v.c. 29): On leaves of *Caltha palustris* (Marsh Marigold), Lake Ewart, Cambourne, at S.E. edge of lake, TL314592, C.D.P., 2.6.2018 and at S. end, TL313592, C.D.P., 11.5.2019.

My attention was drawn to this fungus by very conspicuous brown leaf spots on some of the older leaves of the host, which may originally have been planted here where it grows as large clumps. Microscopic examination showed compact groups of straight or sinuous conidiophores 17–33 µm long emerging from stomata on both sides of the leaf and bearing filiform, septate conidia (asexual spores) measuring 45–125 x c. 2–2.5 µm. The only known host of *C. moravica* is *Caltha palustris*. The fungus was reported by Braun (1995) from France, Germany, Czech Republic and European Russia, but there are later British records from Dorset, West Sussex, Surrey and Warwickshire, and in 2019 Arthur Chater and I found it in Carmarthenshire and Montgomeryshire.

***Entyloma matricariae* Rostr. (Entylomatales: Entylomataceae)**

Cambs (v.c. 29): On leaves of *Tripleurospermum inodorum* (Scentless Mayweed) growing in a lightly disturbed area in an infrequently used gateway by footpath along S. side of Swavesey Lake, Fen Drayton Lakes RSPB reserve, TL353696, C.D.P., 29.6.2019, conf. U. Braun.

This record is of the asexual (anamorphic) stage of this smut fungus, which was at one time known by the separate name of *Entylomella trailii* (Massee) Ciferri. The upper leaves of the host at Fen Drayton had alternating bands of green and yellow tissue; the lower leaves were yellow and shrivelling. Dense more or less hemispherical white clusters of fungal conidiophores arose from the yellow parts of the upper leaves (Fig. 1), bearing conidia which measured c. 7.5–12.5 x 2.5 µm. The anamorph has been described by Braun (1999). In Britain *E. matricariae* was first reported on *T. inodorum* from Aberdeen and Finstown, Orkney by J.W.H. Trail (Plowright 1891) and Mordue & Ainsworth (1984) added a record from Argyllshire. There is one record on the BMS database, from Enfield, Middlesex (2004).

Fig. 1. *Entyloma matricariae* on leaves of T*ripleurospermum inodorum*, Fen Drayton, 29.6.2019.

***Peronospora violacea* Berk. (Peronosporales: Peronosporaceae)**

Cambs (v.c. 29): On corollas of *Succisa pratensis* (Devil's-bit Scabious), on both plants with the usual, blue-purple flowers and those with pale pink flowers, in a large stand of the host in cut fen vegetation by path parallel to Spinney Bank, Compartment 10, Wicken Fen, TL556707, C.D.P., 16.9.2019. Also seen in similar vegetation in Compartment 12 E. of Drainer's Dyke, TL552706, and on the N. side of Gardiner's Drove, TL552704.

This downy mildew is a specialist parasite of the flowers of plants in the Dipsacaceae. Colonies were very sparsely distributed on the corollas and styles of infected *Succisa* plants at Wicken, with sporangia which appeared deep violet in colour in the field (but not when viewed with transmitted light under the microscope). *P. violacea* is more frequently reported in Britain than the other species dealt with in this note, with scattered records from much of Britain but not hitherto from Cambridgeshire. It might also be expected to occur in the county on its other British hosts, *Knautia arvensis* (Field Scabious) and *Scabiosa columbaria* (Small Scabious).

***Plectosphaerella alismatis* (Oudem.) A.J.L. Phillips, Carlucci & M.L. Raimondo (Plectosphaerellaceae)**
Cambs (v.c. 29): On *Alisma plantago-aquatica* (Water-plantain) at the following sites: Ditch, Stanground Wash, Peterborough, TL206976, Marcus Yeo, 20.7.2014, herb. M. Yeo. Ditch to which cattle have access, extending from N. side of Ferry Mere to N.E. corner of Ferry Lagoon, Fen Drayton Lakes RSPB reserve, TL345704 to 352699, C.D.P., 29.6.2019. Dried-up pool in Bog Garden, Cambridge University Botanic Garden, TL453572, C.D.P., 26.7.2019. Shallow swamp by pond, Rough Cover, Cam Washes SSSI, Kingfishers Bridge reserve, TL542746, C.D.P., 11.8.2019.

This fungus was very conspicuous at the Fen Drayton reserve and the Botanic Garden, where infected leaves had numerous spots and contrasted markedly with the immaculate uninfected leaves alongside them (Fig. 2). The leaf spots were c. 1.5–2 mm wide, dark brown with a grey centre, and surrounded by a diffuse yellow zone; some spots had coalesced, especially at the leaf apex which was sometimes entirely darkened (Fig. 3). The Kingfishers Bridge population was much less conspicuous with only a few small infected leaves. The 0–1-septate conidia are small, measuring (10–)13–21 x 3–5 µm. Photographs of both the leaves and the conidia of this species are provided by Ozaslan *et al*. (2018). Although this species was listed by Grove (1935, 1937) – with separate entries for two of its numerous synonyms, *Ascochyta alismatis* and *Rhynchosporium alismatis* – and by Ellis & Ellis (1985), there appear to be few historic records from Britain. However, there are more recent reports on the BMS database from single sites in Herefordshire (2003), Shropshire (1989) and Surrey (1999). It appears to be widespread in Ireland, judging by records I made with friends from the Dublin Naturalists' Field Club in August 2019 in three counties (Dublin, Meath and N. Tipperary); by Lough Derg in Tipperary it grew on both *Alisma lanceolatum* (Narrow-leaved Water-plantain) and *A. plantago-aquatica* (details of these records are on the BMS database). Elsewhere it is known from other members of the Alismataceae and in Australia it has been studied as a possible agent for the control of rice-field weeds in this family (Pitt *et al*. 2004).

Fig. 2. Infected and uninfected leaves of *Alisma plantago-aquatica* at Fen Drayton, 29.6.2019.

Fig. 3. Leaf of *Alisma plantago-aquatica* infected with *Plectosphaerella alismatis*, Fen Drayton, 29.6.2019.

***Puccinia convolvuli* (Pers.) Castagne (Pucciniales: Pucciniaceae)**

Cambs (v.c. 29): On *Calystegia sepium* (Hedge Bindweed) at the following sites: Amongst *Phragmites, Lamium album, Urtica dioica* etc. in dry fenland area by path, Fowlmere Watercress Beds (RSPB Reserve), TL409454, C.D.P., 23.10.2018 (III). Trackside by small willow holt, E. side of Ouse Washes S.E. of Welches Dam, TL473848, C.D.P., 26.9.2018 (II, III). Amongst *Phragmites,* Manea Pit, TL481890, C.D.P., 26.9.2018 (II, III). Rank waterside vegetation, with *Galium aparine, Urtica dioica* and a few *Phalaris arundinacea* shoots, outer bank of Old Bedford River N. of Welches Dam, TL475866, C.D.P., 1.7.2019 (0, I). By path through fen vegetation near West Mere Hide, Wicken Fen, TL553698, C.D.P., 19.6.2018 (I). Amongst *Phragmites* Wicken Fen, by Spinney Bank, TL558710, and on N. side of Monks Lode, TL560701, C.D.P., 16.9.2019 (II, III). In damp scrub under light alder shade, Fordham Hall Yard Wood, TL632700, C.D.P., 10.9.2019 (II, III).

Wilson & Henderson (1966) described this as a very rare rust species in Britain, known to them only as an unlocalised record on *Calystegia sepium* attributed to Miss Jelly by Plowright (1889). Miss Jelly was presumably Eliza Catherine Jelly (1829–1914), who lived in Surrey from 1871 onwards and was a microscopist and an expert on bryozoa (Torrens & Winston 2002). Legon & Henrici (2005) quite reasonably rejected the species as British as they knew of no supporting voucher specimen, but it was found at a site in Dorset soon afterwards (2009). There are subsequent records on the BMS database for single sites in East Kent (2017) and West Norfolk (2017) and Arthur Chater collected it at Runnymede, Surrey in 2019. The only host recorded from Britain is *Calystegia sepium*, although it is reported from *Convolvulus arvensis* (Field Bindweed) in mainland Europe (Termorshuizen & Swertz 2011). All stages of the life-cycle are found on the one host, and those I have observed are indicated in the list above as 0 (spermagonia), I (aecia), II (uredinia) and III (telia). It is not clear whether in Cambridgeshire it is only recorded to date from wetland sites because it is restricted to *Calystegia sepium*, which is a native species and characteristically grows in such habitats, or whether its preference for wetlands leads to its occurrence on this species rather than on the frequent, closely related alien *C. silvatica* (Large Bindweed) or on *Convolvulus arvensis*. I have not come across any suggestion that it is a wetland species elsewhere.

Fig. 4. Stand of *Calystegia sepium* infected with *Puccinia convolvuli*, Wicken Fen, 16.9.2019.

In view of its history in Britain the number of recent sites in Cambridgeshire is surprising. Rust fungi have been relatively well recorded in Britain and this is a reasonably conspicuous species (Fig. 4). In summer its presence is betrayed by purplish or brownish leaf spots, often surrounded by an aureole of yellow leaf tissue. By late October at Fowlmere in 2018 the leaves of the host were yellowing and only the infected areas remained green; such 'green islands' are described for other biotrophic fungi by Ingram & Robertson (1999, p. 50). Wicken is just about the only site in Cambridgeshire which has been relatively well surveyed for microfungi, especially between 1995 and 2003 when Alan Silverside made almost annual visits and Brian Wurzell also recorded there, suggesting the possibility that the species might have spread recently. If it is increasing, this will no doubt become apparent from an increase in records elsewhere in Britain.

***Puccinia scirpi* DC. (Pucciniales: Pucciniaceae)**

Cambs (v.c. 29): On *Schoenoplectus lacustris* (Common Club-rush) on W. side of Old Bedford River immediately S. of Ship Inn, Purls Bridge, TL477868, C.D.P., 26.9.2018 (III). Frequent and locally abundant on N*ymphoides peltata* (Fringed Water-lily) along a 3.9 km length of Old Bedford River from Pumping Station, Welches Dam, TL 471860, to N. of Fortrey's Hall, TL448829, C.D.P., 1.7.2019 (I).

This rust fungus is the rarest species reported in this note. It was first recorded in Britain at Earith, Huntingdonshire, in the winter of 1894/5, and last collected there in 1915; the above records may represent the rediscovery of this population some 10 km downstream of the original site. It was subsequently seen at various sites in southern England, but the only record since 1980 on the BMS website is from a pond in Fermyn Woods, Northamptonshire, in 2010. Brian Wurzell recorded it on *S. lacustris* at Brett's Piece, Compartment 46, Adventurers' Fen, Wicken, in 1999, a puzzling record as it must presumably have been present there in the absence of *Nymphoides*. Evans *et al*. (2006) listed it as Critically Endangered in Britain, and it appears to be rare and declining in mainland Europe too. It is perhaps restricted by its requirements for two hosts to complete its life cycle, the early stages (0, 1) occurring on *Nymphoides* (Fig. 5) and the later ones (II, III) on Schoenoplectus. For a more detailed account, see Preston (2020).

Fig. 5. Leaf of Nymphoides peltata infected with aecia of Puccinia scirpi, Old Bedford River, 1.7.2019.

Acknowledgements

I am grateful to Uwe Braun for confirming the identity of *Entyloma matricariae*, and to Arthur Chater for details of his record of *Puccinia convolvuli* as well as constant encouragement. I also thank the National Trust, RSPB and the managers of Kingfishers Bridge for access to their reserves.

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New chalk grassland communities beside the Devil's Ditch

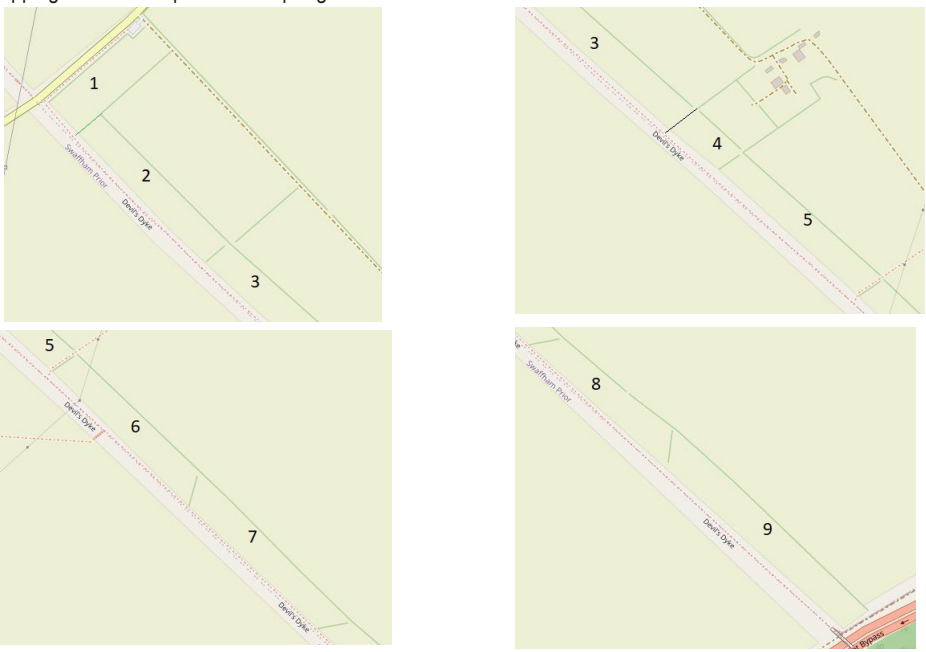
A.C. Leslie

Chalk grassland communities have long been diminishing in extent and quality in the county, and one only has to look at Babington's remarks in his Flora of Cambridgeshire (Babington, 1860) to see that this has been a cause of dismay since the first part of the nineteenth century. It is thus welcome, in this context, to have a good news story to report, for in several places there is now evidence that plants have been moving off the Devil's Ditch and forming new or significantly augmented chalk grassland communities on adjoining land. This has been observed in at least two areas: (a) along the north-eastern side of the Ditch between the A14 and the Burwell Road (i.e. on the Ditch Farm section), and (b) in a triangular field fenced off by the Jockey Club at the edge of Newmarket Heath, at the point where the Ditch meets the Newmarket railway.

The Ditch Farm section

This comprises nine fields of varying sizes (in total covering over 17 hectares) running as a continuous block from the Burwell Road to the A14 (and for descriptive purposes here numbered 1 to 9 from the Burwell end).

Burwell fields 1 through 9, starting from the Burwell to Swaffham Road and numbering south to the A14. Mapping base from Openstreetmap.org



In the 1980s most if not all these fields were cultivated land, from which occasionally arable weeds, such as *Geranium columbinum*, strayed on to the lower slopes of the Ditch. By the time the present Farm tenant, Martin Rix, arrived here in 2013, the fields had been sown with an agricultural mix suitable for chalk pasture, although its precise composition unfortunately is unknown. Except for the first three fields to the north-west of the permissive path that runs from the Ditch across to the north-east to Heath Road (field nos 3, 4 and 5) the fields are all part of a Higher Level Stewardship (HLS) scheme and receive no fertilisers or other chemical treatments. However, in order to try and improve the quality of grazing, the three non-HLS fields were ploughed and resown in 2015/2016 with a mixture containing Chicory, Sainfoin, Perennial Ryegrass and White Clover, although the amount of the first two still present in 2019 was very limited. In recent years at least, the sheep are introduced to these three fields in April/May each year and are gradually moved down towards the A14. Later in the year some are used to graze the Ditch and may have access to the fields at the same time.

It appears that it was not until 2011 that any formal note was made of plants having moved off the Ditch into these fields, when I recorded the considerable quantity of *Carlina vulgaris* flowering across the field (no.2) beside the top of Galley Hill; this population was by then very evident from the vallum footpath. *Campanula rotundifolia* was also clearly present there as well. In 2014 I looked more closely at several of the fields and found a much greater range of chalk grassland plants and in 2019 I was able to undertake a more systematic search. It soon became evident that the richest areas were always within the first 20 yards from the vallum, although those plants with windblown seeds, such as the *Carlina, Pilosella officinarum, Leontodon saxatilis* and *Cirsium acaule* were more widespread: the *Cirsium* population in the field nearest the A14 (no.9) must be one of the largest populations of this species in the county. Another conspicuous feature was that the areas with the greatest abundance and diversity of chalk grassland species were opposite those stretches of the adjacent vallum which were free of scrub and were themselves some of the best mature chalk grassland. These are most notably by the top of Galley Hill (field 2), and the first field to the north-west of the permissive path (no.5) which lies below the area that holds *Hypochaeris maculata* and perhaps the best *Gymnadenia conopsea* population in Cambridgeshire. It is evident that the close proximity of a good seed source is of considerable importance and this is further demonstrated in the four fields between the permissive path and the A14 (nos. 6-9), a section along which the Ditch vallum is lowered, much of the fosse is filled in and there is little good chalk grassland flora on the Ditch. In these fields, apart from the species with windblown seeds, other chalk grassland species are only frequent right at the north-western end of field 6 (where there are also many anthills).

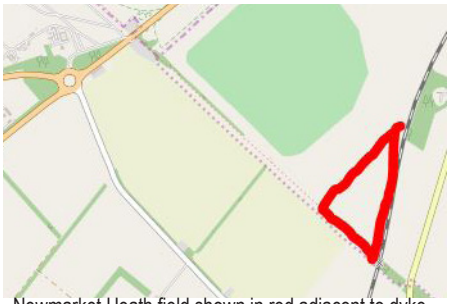
Amongst the most frequent species encountered in the turf of these Ditch Farm fields are *Campanula rotundifolia, Carduus nutans, Carlina vulgaris, Centaurea scabiosa, Cirsium acaule, Daucus carota, Galium album, G. verum, Knautia arvensis, Leontodon hispidus, L. saxatilis, Linum catharticum, Lotus corniculatus, Medicago lupulina, Pastinaca sativa, Pilosella officinarum, Pimpinella saxifraga, Polygala vulgaris* (with both blue and pink flowers), *Scabiosa columbaria, Thymus druce*i (sometimes in large patches) and *Trifolium campestre*, plus the grasses *Bromopsis erecta, Festuca rubra, Koeleria macrantha, Phleum bertolonii* and *Trisetum flavescens.* These are all present in five or more of the fields, and in some places are locally abundantly. Rather less frequent are plants such as *Anthyllis vulneraria, Leucanthemum vulgare, Plantago media, Poterium sanguisorba, Primula veris, Ranunculus bulbosus* and *Sherardia arvensi*s, as well as the grasses *Briza media, Festuca ovina* and *Helictochloa pratensis*. A few others have only been spotted, so far, in single sites, such as *Anacamptis pyramidalis* (field 2), *Asperula cynanchica* (field 5), *Brachypodium pinnatum* (field 9), *Carex flacca* (a single patch in field 9), *Catapodium rigidum* (field 9), *Gymnadenia conopsea* (field 5), *Helianthemum nummularium* (just creeping under the fence in field 5), *Hippocrepis comosa* (a large plant right in the middle of field 1), *Origanum vulgare* (scattered along the edge of field 5), and *Thymus pulegioides* (field 5). All the species noted above were seen in 2019 and, apart from the *Sherardia* and *Trifolium campestre*, are known on the adjacent stretches of the Ditch. However, *Campanula glomerata* and an Eyebright (*Euphrasia* sp.), both also known from the Ditch, were only seen in the fields in 2014. The Ditch records for *Leontodon saxatilis* are all very recent and it is likely that this is a case where a species has moved from the fields onto the Ditch.

There are a few plants known on the adjacent Ditch banks which have so far not been seen in these fields. These include *Astragalus danicus*, which has shown some ability to spread along the vallum path, *Thesium humifusum* which is locally abundant on the vallum above field 5 and *Carex caryophyllea*, which is admittedly rather local on this stretch of the Ditch. The chances of *Hypochaeris maculata* making the move from the vallum bank above field 5 is now fairly remote, as so few plants remain and they do not often get a chance to flower, let alone seed.

Newmarket Heath

An interesting contrast to this area is the triangular field on the north-east side of the Ditch where this meets the Newmarket railway. This has been part of the Newmarket Heath grasslands for a long time, here right at the edge of the steeplechase gallops. Although the adjacent section of the Heath is relatively poor in species, and the turf there is thick and continuous, a good part of the adjacent vallum bank is scrub free and is covered in good chalk grassland. Unfortunately it has not been possible to pinpoint exactly when the area was fenced off, but this was no more than about 15-20 years ago

and at that time the field appeared to have little to recommend it, bar populations of *Cerastium arvense* along the railway margin, and these have persisted. The field is included in the HLS scheme associated with this section of the Ditch and the intention in separating it from the adjacent Heath was to promote the improvement of the turf as calcareous grassland. In May 2019 I thought it might be worth another close look, as the fields have been grazed by sheep and are occasionally mown; they looked more promising than previously. And indeed this proved to be the case, as it was soon evident that there were good populations of *Thymus drucei* and *Polygala vulgaris* in the turf adjacent to the vallum, and once again the greatest diversity of chalk grassland plants was to be found within the first 20 yards or so from the fence at the base of the vallum. However, what stood out as exceptional was the presence of three flowering plants of *Pulsatilla vulgaris*. Pasque Flower is quite frequent on the Ditch vallum in this area, but has never been recorded as extending its range or spreading onto adjacent areas, unlike the *Geranium sanguineum* on the other side of the Ditch at this point which has been spreading onto conservation headland strips. The Pasque Flower plants in the field were of different sizes and spread out over the area, so looked as though they had arrived here naturally. Nick Patton (Managing Director, Jockey Club Estates) has assured me that the Jockey Club, who are responsible for managing this area, has not attempted any deliberate movement or introduction of plants in this area, so it seems reasonable to assume that everything that has moved in has indeed done so without deliberate intervention. The area receives no fertilisers or other chemicals, and the stock usually have access to the Ditch when grazing the field.



Newmarket Heath field shown in red adjacent to dyke, SW of the Golfcourse and north of railway

The range of chalk grassland species on this site in part mirrors those along the Ditch Farm section, with a good deal of *Campanula rotundifolia, Galium verum* and *Pilosella officinarum*, although both *Carlina* and *Cirsium acaule* are much less frequent. Besides the *Pulsatilla* there are also several other additional species present at this second site, not all of which are on the adjacent vallum (those which are not are indicated by an asterisk). These include **Carex divulsa* subsp. *leersii* (just a single clump), **Centaurium erythraea* (frequent by midsummer), **Clinopodium vulgare, Linaria vulgaris, Ononis repens, *Orobanche minor, Silene vulgaris,* and *Succisa pratensis* (which has increased considerably recently on the adjacent Ditch vallum). No other sedge has been noted on this site as yet (*Carex flacca* and *C. caryophyllea* are on the adjacent vallum), nor is there any *Asperula cynanchica, Serratula tinctoria, Tephroseris integrifolia, Thesium humifusum, Viola hirta* or *V. odorata,* all of which are on the Ditch. Not only does this site now have an augmented flora, it was evident in the summer of 2019 that it was now attractive to a wide variety of insect visitors, including butterflies, moths, bees and grasshoppers/crickets.

Although it is unrelated to the Ditch flora, there is a further feature of this field, which makes this an interesting site for further study. There is evidence from the flora, especially in the north-eastern third, of the sandy deposits over the chalk which occur on the Heath and are especially evident nearby in the railway cutting by Upper Link on the other side of the line (as well as in Lower Link Covert further to the east). This is demonstrated here by the presence of several good colonies of *Myosotis ramosissima, Luzula campestris, Rumex acetosella* and *Stellaria graminea*, as well as in the presence of a single bush of *Ulex europaeus* near the centre of the site, which survives in the grazed/mown turf at only a few inches high, but about a foot across.

It is perhaps also noteworthy that whilst the adjacent Heath has a dense thick sward, the turf in this field is rather thin and has numerous small gaps, which must aid the establishment of new plants from seed. This inevitably includes some weedy species, mostly annuals or biennials, such as *Cirsium vulgare, Conyza sumatrensis, Crepis capillaris* (flowering abundantly with the Harebells after mowing in 2019), *Erigeron acris, Sonchus asper* and *S. oleraceus*, as well as, more remarkably, one plant of *Hypochaeris glabra*. All of these are composites,

with windblown seeds. The *Hypochaeris* is rather a surprise here, but is a species which has been cropping up recently in some new places well away from its usual haunts on our eastern sands; it seems unlikely to become a permanent member of the flora of this field.

One additional example of plant movement off the Ditch is perhaps worth mentioning in this context. The Lizard Orchid, *Himantoglossum hircinum*, has been known on the racecourse section of the Ditch, between the Bomber Gap and Running Gap, for perhaps a century. It too has shown the potential to spread off the Ditch in recent years, with plants reported on the flat ground close to both sides of the Ditch, as well as in the Bomber Gap itself, on the adjacent vallum just to the north-east, and on the banks of the A14 north-west of the Running Gap. To this one can now add several plants on the Heath between the July Course and the National Stud in 2019 and at least three plants in the grounds of the Stud, beside the road that runs down to their tea room. Staff at the Stud report that Lizards have been there for the last 10 years!

Other studies

A limited search of other studies concerned with establishment of chalk grassland on ex-arable sites provides some interesting parallels to the observations made here. Hutchings & Booth (1996) examined the establishment from sown seed, and the subsequent survival of young plants, of a number of chalk grassland species under different management regimes, in both ex-arable and established grassland. They found that establishment was more favourable when the vegetation on an ex-arable site was short, in contrast to when the site was uncut and competition was more severe. In addition plants established less well in entirely cleared sites, which they suggested related to the greater variation in soil temperature and moisture content. The poorest results were in established chalk grassland. They concluded that management of new sites which includes mowing and grazing will make the best use of the environmental opportunity. Our sites in part also echo the work undertaken by Fagan *et al*. (2008) who also looked at the restoration of calcareous grassland on ex-arable land. Amongst their conclusions was that naturally regenerated sites (i.e. without sowing any of the target species) could start to approach the composition of old chalk grassland, but that the process took time (decades not just a few years) and was promoted by proximity to ancient chalk grassland vegetation. In our examples, one into grazed ex-arable land, the other into established but grazed and mown grassland, the initial spread has been relatively quick over a limited area, and in both cases the turf is relatively short, with the mowing and/or sheep grazing providing a turf with numerous small gaps; both are adjacent to a prime source of ancient grassland species. Our sites will continue to be monitored to record any further spread and development of these new or enhanced calcareous grasslands.

Please note that there is no public access to the Ditch Farm fields, whilst the Jockey Club has long requested that visitors to all of Newmarket Heath do not access the site before 1.00pm to avoid any potential disruption or conflict with the race horses being exercised on the Heath.

Acknowledgements

I am grateful to Martin Rix (Ditch Farm), Nick Patton (Jockey Club), Prof. Peter Grubb (until recently Chairman of the Friends of the Devil's Ditch) and Prof. Libby John (University of Lincoln) for help in preparing this note.

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‘Cornish pasties’ in the Botanic Garden

Pete Michna

On 28th October 2019, while having a coffee outside the staff mess-room at Cambridge Botanic Garden, I idly picked up a leaf of *Quercus* x *hispanica* (*Q.cerris* x *Q. suber*) which had fallen onto the table. On the upper side of the leaf blade, on the midrib near the top of the petiole, was a small spindle-shaped object, about 3 mm long. A quick look at a low hanging branch revealed a good number of these things, as many as three to a leaf. A Google image search came up with the gall caused by the agamous (parthenogenic) generation of the Cynipid wasp *Pseudoneuroterus* (=*Neuroterus*) *saliens* [see the Plant Parasites of Europe website: https://bladmineerders.nl/]. They are usually likened to cowry shells although Simon Leach, a gall enthusiast based in Somerset, calls them Cornish pasty galls. The species was kindly confirmed by Margaret Redfern of the British Plant Gall Society and author of the Collins New Naturalist on the subject, which I can recommend to anyone with an interest in galls.

This gall was first recorded in Britain in Virginia Water (Surrey) by Michael Chinery in 2006. The host is usually Turkey oak (*Q. cerris*) so it’s occurrence on the hybrid isn’t too shocking. There is a specimen of *Q. cerris* next to the hybrid but the canopy is too high up to examine for galls; none were found on fallen leaves. The gall of the sexual generation occurs on female flowers, producing rather lovely looking “sea anemones”, first recorded in Britain in London by Brian Wurzell in 2006 (see Oak-galls in Britain, Robin Williams, via the NHM website). I’ll be looking out for these this summer.

The wasp *P. saliens* was originally known from Southern Europe and the Near East, the native range of *Q. cerris*, but is now common in areas of Southern England. This follows the pattern of a number of gall wasps over the last few decades; the list of Cynipidae for Britain and Ireland has increased from 78 in 1978 to 91 in 2017 (Forshage *et al*., 2017).

Why are we seeing these new gall wasp species? It is tempting to put it all down to climate change but the evidence is that the planting and naturalisation of host species such as *Q. cerris* throughout Northern Europe has been sufficient to allow the natural range expansion of these wasps (e.g. Schönrogge *et al*. 2012).

References

Forshage *et al*. 2017. Checklist of British and Irish Hymenoptera – Cynipoidea. *Biodiversity Data Journal* **5**: 1-76.

Schönrogge *et al*. 2012. Range expansion and enemy recruitment by eight alien gall wasp species in Britain. *Insect Conservation and Diversity* **5**: 298–311.

Pseudoneuroterus (=*Neuroterus*) *saliens* galls (‘Cornish Pasty galls’) on *Quercus* x *hispanica* in the Botanic Gardens, 2019

The bryophytes of the Devil's Dyke, Cambridgeshire

C.D. Preston and M.O. Hill

Introduction

The importance of the Devil's Dyke for Cambridgeshire's wildlife is shown by the numerous articles devoted to it in Nature in Cambridgeshire over the years. Recent publications include a general account of its wildlife and recent management (Baker, 2018), checklists of the vascular plants (Leslie, 2011), lichens (Powell, 2018) and flies (Perry, 2013) and detailed studies of two butterflies, Chalkhill Blue (Lea, 2011) and Dingy Skipper (Conlan, 2012). This article provides a checklist of bryophytes (mosses and liverworts) to add to these accounts. Although bryophytes do not feature in Baker's paper, the major importance of the Dyke for these species was recognised by Newton (1986) and its relative importance has increased in recent decades. Most of our sites for specialist chalkland bryophytes have deteriorated since the period on which Newton's analysis was based (1950–84) whereas the central section of the Dyke shows little change, and it now supports more such species than any other locality in the county. The adjoining stretch to the north, near Swaffham Prior, has experienced minor deterioration but it nevertheless remains one of our richer sites if treated separately (Preston & Hill, 2019).

The Dyke is a post-Roman earthwork 11.5 km in length and aligned NW-SE from Reach in the north to Ditton Green in the south (Malim, 1997; Baker, 2018). It consists of a large bank or vallum on the northern side, with a complementary ditch or fosse to the south. There is a clear contrast between the more mesic turf on the NE-facing side of the vallum, which when undisturbed has a bryophyte flora dominated by a few rather common pleurocarpous moss species, and the much more open SW-facing slope which drops from the top of the vallum to the bottom of the fosse and has a more varied bryophyte flora including many acrocarpous mosses. The footpath along the top of the vallum is eroded to more or less bare chalk but the trampled edges and adjoining short turf provide a habitat for the least competitive chalkland species. The NE-facing side of the fosse is of little bryological interest.

Since the 1950s elder, hawthorn and other woody species have spread into the open habitats, and the resulting scrub (especially the humid scrub with intermixed mature trees which developed in the base of the ditch) has provided a habitat for a range of epiphytic bryophytes. The main task for site managers since the late 1950s has been to control the spread of scrub, and to re-establish communities of open grassland on cleared areas. This complex task has been the subject of much research (Grubb & Key, 1975; Stanier, 1993) and recent developments are described by Baker (2018). A major programme of scrub clearance took place between 2002 and 2007 and sheep-grazing was re-established on some sections of the Dyke with the agreement of the relevant landowners. However, the central section of the Dyke alongside Newmarket Racecourse, owned by the Jockey Club, is cut rather than grazed.

The southern section of the Dyke, south of the Cambridge-Newmarket railway, supports mature woodland. We know that this woodland has been present since at least the 18th century as Thomas Martyn (1763, p. 37) included *Veronica montana* in his list of species growing 'In and about the Devil's ditch', noting that his father John Martyn had recorded it 'In the woody part' (where it can still be found). Immediately south of the railway the woodland community on chalk soil is dominated by introduced species such as beech and sycamore, with shrubs such as box in the understory; in one area flat land immediately adjacent to the Dyke has secondary woodland which has colonised a lime avenue. Towards the southern end of the Dyke the soil changes from chalk to calcareous boulder clay and the woodland community resembles that of ancient, semi-natural wood with ash, field maple, hazel and a few big oaks. The ditch is wet at the bottom, at least in winter. Pickmore Wood, an ancient wood, adjoins the Dyke at its southern end.

Bryophyte records from the Dyke

Although some bryophyte specimens collected in the late 18th century and labelled 'Newmarket' or 'Newmarket Heath' might have been collected on the Dyke, the earliest certain record is of *Microbryum curvicollum*, collected by both J.S. Henslow (CGE) and Leonard Jenyns (BTH) in March 1824. Walter Calverley Trevelyan (1797–1879) made the next records while he was staying at Swaffham Prior with his fellow naturalist G.B. Jermyn. On

a visit to the Dyke on 9 February 1835 he noted in his diary *Weissia longifolia* var. *angustifolia* (as *Phascum crispum*) and a second species which he initially named *Phascum curvirostrum* and later *P. rostellatum* and which he recorded again on 11 May (Trevelyan ms). We cannot identify the second species from these names. (Later in May the taciturn and humourless Trevelyan married Jermyn's daughter, the considerably younger, brilliant and witty Pauline Jermyn, who was to become a noted patron of the Pre-Raphaelites.) We know of no other 19th century bryophyte records. P.G.M. Rhodes collected *Fissidens dubius* on the Dyke in 1909 (BM) and also reported *Tortella flavovirens* from there (Rhodes, 1911), although the latter turned out to be an error for the rarer *T. inclinata*. The revival of bryophyte recording in the county in the late 1920s led to records of some of the characteristic calcicoles of the Dyke by P.W. Richards (in 1928 and 1929) and E.W. Jones (in 1929 and 1932–34), and Richards made a war-time visit to the site with E.F. Warburg (in 1944).

The intensity of recording picked up in the 1950s, when there were visits to the central section of the Dyke by M.C.F. Proctor (who was accompanied by D. McVean and C.D. Pigott on one very productive visit in 1951), R.E. Parker, H.L.K. Whitehouse and C.C. Townsend. In addition to his personal visits, Whitehouse led bryological excursions to the Dyke in 1958 and 1960, and by 1960 the chalkland species of the central section had been well recorded. J.C. Faulkner made the first list from the wooded S end of the Dyke in 1958. The central sections of the Dyke continued to be visited by both individuals and excursions for the rest of the century; excursions were held in 1966, 1972, 1975, 1976, 1981, 1983, 1986 and 1994. It was not until 1992 that there was an excursion to the S end of the Dyke, which resulted in a thorough list for this stretch.

Whitehouse's notes on an excursion held in February 1972 show that bryologists were beginning to take an interest in the scrub on the Dyke. They made a separate list of four species growing in scrub, including two epiphytes. On a further excursion in November 1976 the party made a more extensive list from the scrub in the ditch S of the Burwell Road, including twelve epiphytes on elder and other hosts and nine species on the ground. The scrub was thereafter recorded as enthusiastically as the grassland.

The 'recent survey' on which this paper is based was carried out between 2001 and 2018. Most records were made on excursions of the Cambridgeshire Bryophyte Group of the British Bryological Society as part of the fieldwork for a bryophyte flora of the county (Preston & Hill, 2019). The excursions to the Dyke have generally been well attended with numbers ranging from five to 14 and an average attendance of nine bryologists (Figure 1). We chose to record the distribution of species in the 18 1 × 1 km squares ('monads') of the Ordnance Survey National Grid, rather than the seven sections of the Dyke defined by Leslie (2011) and also used by Perry (2013). The monad recording allows for recording at a finer scale and for our records to be incorporated directly into other local and national recording and mapping schemes. A disadvantage of this method is that the length of Dyke in each monad differs considerably.

Figure 1. Bryologists in an area of open chalk grassland on the Dyke, 11 February 2017. Standing: Jonathan Shanklin, Sharon Yardy, David Seilly, Lewis Saunders, Chris Preston, Jeff Scott; kneeling: Mark Hill, Peter Leonard

Details of the monads are provided in Table 1 and illustrated in Figure 2 overleaf. Monads 1 & 2 have been visited only once by the Group, in 2014, whereas the other monads were visited at least twice, once between 2002 and 2008 (on five excursions led by C.D.P.), and again between 2014 and 2018 (on six visits under the leadership of M.O.H., the last of which was held after we had stopped collecting records for the published flora). The excursions were held in December (1), January (1), February (7) and March (2). We have not confined our attention quite so strictly to the vallum and fosse as Leslie (2011) did in his checklist. We have included in our survey both the dismantled and the active railway tracks along the line of the Dyke and the narrow strip of woodland on flat ground (contiguous with the wooded slope of the vallum) immediately NE of the Dyke towards its S end. However we have been stricter than Perry (2013) in that we have not included any grassland or fallow fields on flat ground alongside the Dyke.

Details of the sources of historic bryophyte records are provided by Preston & Hill (2019) and the records on which this account is based are held in the British Bryological Society database which is publicly available on the NBN Atlas website.

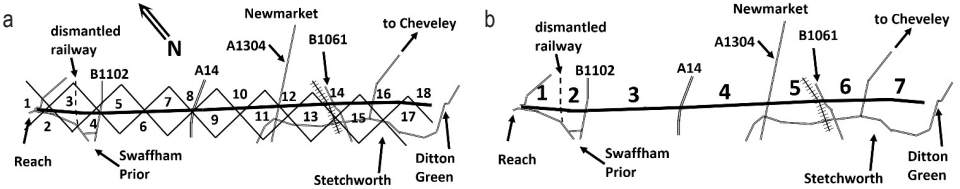

Figure 2. Devils Dyke segments: (a) numbering of monads (1-km squares) which are described in Table 1; (b) numbering of sections defined by Leslie (2011); roads and the dismantled railway (but not the active railway) define the boundaries. Leslie's sections are similar to but not the same as the seven units into which the SSSI is divided. These amalgamate Leslie's sections 6 and 7, split his section 3 into two and number them all in the reverse order.

Table 1. The monads in which bryophytes have been recorded on the Devil's Dyke. The numbers in the first column are those cited in the text. The Dyke is divided into sections by Leslie (2011) and the section(s) in which each monad falls is given in column §. Section 4 is the Race Course section and section 5 the Golf Course section. The species totals are based only on records made in the recent survey (2001-18).

No.	§	Grid reference	Length (km)	Species	Main habitat(s) recorded
1	1	TL5666	0.1	13	Scrub
2	1	TL5665	0.2	18	Scrub, coarse grassland
3	1, 2	TL5765	1.2	57	Scrub, disused railway cutting and track, grassland
4	2	TL5764	0.2	41	Scrub (2002), cleared and grazed by 2015
5	3	TL5864	1.3	50	Grassland (some being cleared of shrubs and grazed in 2002), scrub
6	3	TL5863	0.1	39	Grassland
7	3	TL5963	1.3	52	Grassland, grazed with much disturbed soil, a few elders
8	3	TL6063	0.1	28	Rather rank grazed grassland (formerly scrub) and scrub
9	4	TL6062	1.2	36	Grassland managed by cutting, little disturbed chalk soil
10	4	TL6162	0.4	41	Grassland managed by cutting
11	4, 5	TL6161	1.0	50	Grassland managed by cutting, scrub
12	5	TL6261	0.6	53	Grassland, dense scrub (some cleared by 2005 and much by 2017), a few mature trees
13	5	TL6260	0.7	48	Grassland, grazed in 2017; some areas had been recently cleared of scrub in 2006
14	5, 6	TL6360	0.8	60	NW of B1061: grazed grassland, scrub (some had been recently cleared in 2006), active railway line; SE of B1061: scrub, secondary woodland, some in derelict lime avenue NE of Dyke
15	6	TL6359	0.5	31	Scrub, mature secondary woodland
16	6, 7	TL6459	1.0	45	Mature secondary woodland (beech, sycamore, etc.)
17	7	TL6458	0.4	42	Wood, grading from estate woodland on chalk S to boulder-clay woodland (oak, ash etc); ditch wet at base at extreme S end
18	7	TL6558	0.5	37	Boulder-clay woodland (ash, field maple, hazel, a few oaks), shallow stream in base of ditch

Arrangement of the systematic list

The species are listed in the habitat groups defined for the bryophytes of Cambridgeshire by Preston & Hill (2019). These groups are based on the distribution and habitats of the species in the county. Within each habitat group, liverworts are listed before mosses. Species which have not been recorded since 2000 are marked with an obelus (†). The date of the first record from the Dyke is given in square brackets after the name. This is followed by an indication of the reproductive strategy of the species, using abbreviations explained in the next paragraph. The following habitat description is largely based on observations made since 2000, although earlier observations are included if they are available. The 1-km squares from which the species have been recorded are listed at the end of the entry, with squares numbered from NW to SE as 1–18 as in Table 1. If the latest record is pre-2000, the square is bracketed (although most records made before 1980 cannot be allocated to a monad so that the list of pre-2000 monads is inevitably incomplete).

In outlining the reproductive strategy of species recorded since 2000, we have used observations made in the fieldwork on the Dyke described above and in our wider survey of the county to divide the fruiting performance of species into the following categories:

F5: sporophytes recorded on the Dyke in 50% or more of the monads in which the species is recorded.
F4: sporophytes recorded on the Dyke in fewer than 50% of the monads in which the species is recorded.
F3: sporophytes not recorded on the Dyke but known from 50% or more of its tetrads in Cambridgeshire.
F2: sporophytes not recorded on the Dyke but known from 10–49% of its tetrads in Cambridgeshire.
F1: sporophytes not recorded on the Dyke and known from fewer than 10% of its tetrads in Cambridgeshire.
F0: sporophytes neither recorded on the Dyke nor in the county as a whole.

Specialised modes of vegetative reproduction are indicated by B (bulbils or deciduous branchlets), G (gemmae on stems, leaves or thalli), PG (gemmae on persistent protonema), T (tubers). However, mosses may spread vegetatively by fragmentation even in the absence of such propagules.

Common species

The Common species are almost all plants with wide habitat ranges. All but one of the 16 species in the county are recorded from the Dyke, the exception being the rarest, *Plagiomnium cuspidatum*. All were recorded by 1960 except *Ceratodon purpureus*, a rather calcifuge species which is consequently rare on the Dyke.

Amblystegium serpens [1958] F5. Epiphytic on ash, hawthorn, lime, rose and sycamore, especially on exposed roots and tree bases, and often frequent on the trunks and branches of elder. Also on shaded ground in scrub and wooded areas, and sometimes persisting on stumps and soil on cleared ground. 1-18.

Brachythecium rutabulum [1958] F5. Tree bases and stumps, shaded ground and open grassland on the NE-facing side of the vallum. 1-18.

Bryoerythrophyllum recurvirostrum [1960] F5. In scrub; first recorded from chalk grassland and later from wood and the stump of a mature tree. 12-13, (15, 18).

Bryum capillare [1958] F5, T. Epiphytic on shrubs (elder, hawthorn), the exposed roots and bases of trees (ash, beech, sycamore) and tree stumps remaining after clearance; also on the ground and on concrete. 2-5, 7, 8, 10-17.

Calliergonella cuspidata [1951] F1. Present in turf on the SW-facing side of the vallum but much more frequent and luxuriant on the NE-facing slope; also on the fringes of scrub. 1-8, 10-13, 16.

Ceratodon purpureus [1992] F2. On the base of a felled cherry tree and a tree stump. 10-11, (18).

Dicranoweisia cirrata [1960] F5, G. Epiphytic on hawthorn and (rarely) elder. 2-5, 7, (11), 14, 17, (18).

Homalothecium sericeum [1960] F4. Epiphytic, especially on elder but also on ash, lime, hawthorn and the exposed roots and bases of oak and sycamore, and surviving on the stumps of cut trees. 3, 4, 7-11, 14-18.

Hypnum cupressiforme [1928] F4. In grassland on both NE- and SW-facing slopes in the open areas of the Dyke, and epiphytic on a wide range of hosts in scrub and woodland (ash, birch, box, elder, elm, hawthorn, ivy, lime, rose). It also grows on decorticated logs (including oak logs) and old stumps. 2-15, 17, 18.

Kindbergia praelonga [1958] F4. Frequent on the ground in scrub and woodland and epiphytic on elder. Absent

from open grassland. 1-7, 10, 11, 13-18.

Orthotrichum diaphanum [1951] F5, G. Epiphytic, especially on elder and hawthorn in scrub but also on ash, beech, lime, sycamore and traveller's joy. 1, 3-18.

Oxyrrhynchium hians [1958] F4. In grassland on both the NE- and SW-facing banks and on the ground in scrub and woodland; it may be particularly abundant as dense scruffy masses in scrub. 1-18.

Plagiomnium affine [1960] F0. In tussocky grassland and under bushes on the NE-facing side of the vallum; also recorded on the NE-facing bank of the fosse. 12-14.

Rhynchostegium confertum [1958] F5. Epiphytic, especially on elder and hawthorn but also recorded from box, sycamore, a fallen pine branch and on concrete. 1-9, 11-18.

Syntrichia laevipila [1944] F5. An uncommon epiphyte, recorded from a single large ash tree and on hawthorn in the northern stretch of the Dyke and rather more frequently on elders and also on sycamores further south. (3), 5, 7, 8, (11), 14-16, (18).

Calcicoles

The Cambridgeshire Calcicole species grow on chalk substrates. Although 51 such species are recognised in the county, only 42 have been recorded since 2000. Three are widespread in the county in base-rich turf (*Homalothecium lutescens, Pseudoscleropodium purum*) or on disturbed soil (*Didymodon fallax)*, but most have more restricted distributions in habitats such as chalk pits and chalk grassland. There are records of 32 species from the Dyke (excluding the unidentified *Aloina*), of which 30 have been recorded in the recent survey. The Dyke is the richest site for these species in the county and their presence constitutes the main reason for its bryological importance both locally and regionally. The Calcicoles are concentrated in the open stretches of the earthwork, and largely absent from the extreme northern end (1, 2) and the wooded S end (15-18). The richest stretch of the Dyke is the central stretch, i.e. the Dyke between the A1304 and the A14, the Race Course section, and immediately south of the A1304, the Golf Course section. All four monads (9-12) here have 14 or more calcicole species with a maximum of 21 recorded from the stretch immediately north of the A1304 in monad 11 (TL6161). The only other monad with as many species lies further north, where the disused railway cutting and the Dyke on either side support 17 species in monad 3. The Calcicole element in the Dyke's flora has long been known; most of the species listed below were recorded by 1960 and there have been only five additions since then.

Aneura pinguis [2002] F2. On bare chalky soil in grassland. 5.

Leiocolea turbinata [1951] F4. On open chalky soil, including lightly trampled paths, on the NE-facing side of the vallum and more rarely in scrub. 3, (5, 7), 9-12.

Abietinella abietina [1951] F0. Five colonies were recorded in 2014-17, one as scattered shoots on the made-up track along the middle of the old railway across the Dyke and the others further south in short, lightly trampled turf along the edge of the footpath in the Race Course section (Figure 3). The latter colonies comprised scattered to frequent shoots over areas of 0.06 to 0.15 m^2. There are older records (1951-85) from the intervening area. 3, (5-7), 9-11.

†*Aloina* [1958] Whitehouse recorded fruiting *A. ambigua* from disturbed ground on an old rifle range N of the active railway in 1958, but the distinction between this species and *A. aloides* was not understood in the 1950s and the record can only be accepted at generic level. (13).

Figure 3. *Abietinella abietina* in open chalk turf, 11 February 2017. Photo: Peter Leonard.

Bryum torquescens [1958] F5, T. Only two certain records towards the northern end of the Dyke, where it was initially found in chalk grassland by Whitehouse (CGE) and refound in SW-facing chalk grassland by M.O.H. in 2014. (2), 3.

Campyliadelphus chrysophyllus [1929] F0. In turf, often scarce but very locally frequent in some stretches of older SW-facing grassland, much rarer in areas recovering from scrub colonisation and on the side of the

disused railway cutting. 3, 5, 6, (7), 9-13.

Ctenidium molluscum [1928] F0. Local in grassland on both NE- and SW-facing slopes but perhaps more frequently on the former; also luxuriant in places on the N-facing side of the disused railway cutting. (2), 3-7, 9-14.

Didymodon acutus [1958] F0. Recently seen on the track along the middle of the dismantled railway (2014). The only earlier record, made by Whitehouse, was from disturbed ground of an old rifle range N of the active railway at TL629606. Recent taxonomic studies have shown that most British material of *D. acutus*, including plants from Cambridgeshire, actually belongs to the related *D. icmadophilus* (Blockeel & Kuera, 2019). 3, (13).

Didymodon fallax [1958] F2. Chalky soil, especially in trampled grass. 2-7, 10-14.

Ditrichum gracile [1929] F0. Only recorded once in the recent survey, in very short trampled turf near the top of the Dyke (2005); it was formerly rather more widespread in the central area and indeed described as frequent by Jones in 1933. There is one record further north, made in 1976. (5, 10), 11, (12).

Encalypta vulgaris [1950] F3. Only recorded once recently (2005), as non-fruiting plants growing on disturbed chalky soil where scrub had been cleared. Two earlier records (1950, 1958) were made in the same area but cannot be localised to a monad. 12.

Fissidens dubius [1909] F0. In open or slightly shaded chalky turf, occasionally on the NE-facing side but more frequently in SW-facing grassland. It cannot always be distinguished from *F. adianthoides* in the field, but unlike that species it has not been recorded fruiting on the Dyke. 3-6, (7), 9-14.

Homalothecium lutescens [1944] F1. Frequent in both NE- and SW-facing grassland, including areas cleared of scrub. (2), 3-7, 9-14, 16, 17.

Microbryum curvicollum [1824] F5. On open and disturbed chalky soil, especially on the SW-facing side of the vallum and on the tramped edge of the footpath along the top, usually with *M. rectum*. It has also been recorded from areas where scrub has been cleared. Often uncommon within a monad and only rarely found as numerous plants in a limited area. 3-7, 9-13.

Microbryum rectum [1933] F5. In similar habitats to *M. curvicollum*, but a more frequent species in the monads N of the A14. Rarely recorded from disturbed soil in scrub. 3-7, 9, 11.

†*Pottiopsis caespitosa* [1962] Found once, on bare ground in chalk grassland on the top of the Dyke by E.F. Warburg. This nationally scarce species is notoriously sporadic in its occurrence, and in Cambridgeshire it has been found only once in each of its three sites. (11).

Pseudoscleropodium purum [1944] F0. Frequent on the NE-facing side of the Dyke where in winter its swollen wefts may dominate the turf; notably rarer on the SW-facing side and in scrub. (2), 3-14.

Pterygoneurum ovatum [1933] F5. Rare on chalky soil on the SW-facing slope, by tree roots and on the trampled pathside. Recorded initially in 1933 and 1958 in the central area of the Dyke but not seen again until 2008 when populations were found further north. 7, (13).

Rhynchostegium megapolitanum [1953] F4. In open or coarse grassland, and by the edge of the footpath in scrub; seen once on a tree stump. Not recorded between the first record in 1953 and 2006; it is easily overlooked and perhaps still under-recorded. 2, 3, 7, 10, 13, 14.

Seligeria calcarea [1951] F5. Occurs rarely on chalk lumps in grassland on the SW-facing slope and in woodland. 6, (7), 16, 17.

Seligeria calycina [1932] F5. On chalk stones partially embedded in the soil in NE- and SW-facing turf, and on stones in scrub and woodland. 5-12, 14-17.

Seligeria donniana [2005] F5. Discovered by Richard Fisk growing on a chalk pebble in a rabbit hole in SW-facing grassland, the first of only two county records. 11.

Tortella inclinata [1911] F0. Only found once recently, in an open patch of chalk grassland (2017). It was apparently more widespread formerly, as Proctor (1956) described it as scattered over a length of a mile or so. (9), 10, (11, 12).

Tortella inflexa [1961] F0. On chalk stones embedded in turf on both NE- and SW-facing slopes and under trees. (9, 10), 11, 12.

†*Tortella tortuosa* [1934] Described as locally frequent in two monads by Proctor *et al*. in 1951, and recorded on several subsequent occasions until it was last seen by M.O.H. in 1966, growing with *T. inclinata* by the footpath along the top of the Dyke. (9, 11).

Tortula lanceola [1944] F5. Disturbed chalky soil, including areas from which scrub has been cleared. 3, (4), 7, 14.

Tortula subulata [1986] F5. The only recent record (2005) was from the base of a large sycamore on the NE-facing side of the Dyke; there are two earlier records from the same monad, one from the bark of an elder where it grew with *Bryum moravicum*, a rather unusual habitat for the species. 11.

Trichostomum brachydontium [1944] F0. In open patches in short SW-facing grassland; also recorded on soil on the NE-facing side. 9-11.

Trichostomum crispulum [1950] F0. Currently restricted to the heavily trampled edge of the path along the top of the Dyke. 10-12, (13, 14).

Weissia brachycarpa [1950] F5. Open chalk soil in grassland and (rarely) in scrub. 3-14.

Weissia controversa [2001] F5. Open patches in SW-facing chalk grassland; found once by a fox's earth. Overlooked until recently, apparently because all the *Weissia* species with emergent capsules were previously assumed to be *W. brachycarpa* (see Preston & Hill, 2019). The two species can only be distinguished with certainty when the capsules are ripe, and they usually mature after the end of our recording season. 3, 5-7, 9-14.

Weissia longifolia var. *angustifolia* [1933] F5. Open and disturbed chalky soil in SW-facing grassland; also recorded once from the base of an uprooted tree in woodland. Plants with sporophytes which are apparently hybrids with either *W. brachycarpa* or *W. controversa* are occasionally seen when *W. longifolia* grows near these parents. 3-15; hybrids recorded from 9, 10, 14.

Weissia sterilis [1952] F0 (though fruits recorded before the recent survey). Apparently present in only small quantity in open SW-facing chalk grassland on a limited stretch of the Dyke. (9), 11.

Ruderal and arable species

These two ecological groups are treated together as they have a similar ecology and distribution on the Dyke. Like the Calcicole species, they are concentrated in the open stretches of the earthwork with few at the wooded ends. The two ecological groups include a similar number of taxa in the county, 23 Arable and 25 Ruderal species. However Ruderals predominate amongst the 19 species recorded on the Dyke, with only seven Arable species (indicated by Ara in the following list). Only half of the Dyke's Ruderal and Arable species were known from the site by 1960 and nine species have been added to the list since then, including two during the recent survey.

Marchantia polymorpha [2017] F1, G. Clinker on the active railway line. 14.

Barbula convoluta [1944] F4, T. On soil, including very old bonfire sites, and rarely on burnt or rotten wood and concrete. 3-14.

Barbula unguiculata [1950] F4. Disturbed or trampled soil, including the root plates of fallen trees. 1-16.

Brachythecium albicans [1960] F1. Recorded repeatedly on the disused railway line. 3, (11, 13).

Bryum argenteum [1972] F2, B. Disturbed ground, as by paths and steps, and on an old bonfire site. (3), 6, 7, 10, (11), 13, 14.

Bryum dichotomum [1960] F5, B, T. On open chalky soil in chalk grassland, disturbed ground where scrub has been cleared and trampled areas. Unlike *B. argenteum*, it is frequent with the chalkland calcicoles in areas which have not received recent human disturbance. Plants on the Dyke often have unusually excurrent midribs. 3-7, 9-14.

Bryum gemmiferum [2005] F1, B. Recorded twice on chalky soil. 6, 12.

Bryum klinggraeffii (Ara) [1972] F1, T. Bare soil in chalk grassland, including the top of an ant hill. 4, 5, 13.

Bryum rubens (Ara) [1958] F1, T. Disturbed soil, especially by paths, on ant hills, by rabbit burrows and in areas of scrub clearance; also on a very old bonfire site. 1, (2), 3, (4), 5-7, 9-14.

Bryum ruderale [1994] F0, T. Bare patches in grassland and areas disturbed by burrowing animals or scrub clearance. (3, 4), 7, 11-14.

Bryum violaceum (Ara) [1965] F0, T. Disturbed ground in grassland, including areas from which scrub has been cleared. 13, 14.

Dicranella varia [1951] F4, T. Chalky soil, including the trampled edge of the footpath. 1-7, 9-14.

Ephemerum recurvifolium (Ara) [1989] F5, PG, T. Chalky soil in both NE- and SW-facing grassland and shaded (but not disturbed) soil under scrub. Recorded only once before the recent survey, but noted as frequent in open areas of grassland in TL5864 in 2002. 4, 5, 7, 9, (12).

Funaria hygrometrica [1958] F5. Disturbed soil and a very old bonfire site. Although widespread on the Dyke, it has only been recorded on one occasion in each monad. 3, 5-14.

Microbryum davallianum (Ara) [1961] F5. Soil in open grassland, in areas disturbed by rabbits, on ant hills and trampled path sides, and on disturbed soil in scrub. 2, 4-7, 9, 12-14.

†*Microbryum floerkeanum* (Ara) [1961] Recorded on three occasions between 1961 and 1981. The first record was from chalk grassland on the Dyke but the other two are not precisely localised and lack habitat details. It may be under-recorded as it is normally apparent only in autumn and early winter, whereas most of our visits to the Dyke have been in the early months of the year. (11).

Phascum cuspidatum (Ara) [1944] F5. Disturbed soil in the open and in scrub, including ant hills and areas round animal burrows, and a very old bonfire site. 2, 4-10, 12-14.

Pseudocrossidium hornschuchianum [1951] F2. Trampled pathsides, the dismantled railway and compacted mud amongst clinker on the active railway line. 3, (5), 10, (11), 12, 14.

Tortula protobryoides [1953] F5. Recorded very sporadically from the dismantled railway, chalk grassland and from chalky ground by railings and in an area from which scrub had been cleared. (3), 14.

Built environment species

The Built environment species are primarily found in the county on brickwork and stonework, so it may seem surprising that as many as 15 of the 31 species in this group are recorded from the Dyke. The main explanation is that these species also occur, albeit less frequently, in other habitats such as calcareous soil and chalk stones, or as epiphytes. There are very few relics of built structures on the Dyke and only one species (*Schistidium crassipilum*) has been recorded solely from this habitat. Only seven of the Built environment species were known from the Dyke by 1960, with three more added later in the 20th century and five more in the current survey.

Bryum radiculosum [1952] F4, T. Chalky soil in chalk grassland, on ant hills and in scrub, also occasionally on concrete. 3-10, 12, 13.

Didymodon insulanus [2002] F0. Only known from ground in scrub towards the northern end of the Dyke and the bridge over the stream by Dullingham Road. 3, 14.

Didymodon luridus [1958] F1. Chalky soil along the top of the Dyke and in both NE- and SW-facing grassland and in woodland, including the rootplate of a fallen tree; also on exposed roots in scrub and on concrete. 6-9, 11-13, 15.

Didymodon sinuosus [1958] F0. Recorded from open chalky soil in turf and on shaded chalk stones but more frequently on the exposed roots and bases of ash, beech, hawthorn, lime and sycamore in scrub and woodland. 13-18.

Didymodon vinealis [1960] F1. Rare in open chalk grassland, on a large shaded chalk lump and on the chalky base of sycamores. 3, 6, 7, 11.

Fissidens gracilifolius [2002] F5. On chalk rock and stones on the S-facing side of the disused railway cutting, in a rabbit hole and in scrub or woodland. It is very shade tolerant and even grows on stones under yew trees. 3, 7, 16, 17.

Grimmia pulvinata [1986] F5. On concrete (the remains of a commentary box and a railway sleeper), with *Orthotrichum diaphanum* on the exposed root of a hawthorn and on a tree stump in scrub. 3, 9, 11, 14.

†*Gyroweisia tenuis* [1998] Recorded only once, in a list from chalk grassland made by Ron Porley. (10 or 11.)

Rhynchostegiella tenella [2006] F5. On chalk stones in long grass or under trees (including yew trees), and on a hawthorn stump in cleared scrub. 10, 14-16.

†*Rhynchostegium murale* [1960] Recorded twice at the southern end of the Dyke, once on beech roots (1960) and then without habitat detail (1992). (18).

†*Schistidium crassipilum* [1960] There is just one record, on concrete S of the current A1304 road. (12 or 13?).

Syntrichia montana [1986] F4. Epiphytic on elder, hawthorn and oak in scrub and woodland. 3, 4, 7, (12), 14, 17.

Syntrichia ruralis var. *ruralis* [1944] F4. Almost all recent records are of epiphytic occurrences, on blackthorn, elder and the exposed roots and bases of pine and sycamore. The species was not traditionally known as an epiphyte and when it was first recorded as such on the Dyke Whitehouse commented 'epiphyte!' (1983) and C.D.P. 'epiphytic!' (1986) on the species lists. There is one recent record from open grassland. 3, (4), 5-8, 11-14.

Tortula marginata [2006] F5. On chalk stones in woodland. 15, 16.

Tortula muralis [1960] F5. Most records are of plants growing as epiphytes (on elder, hawthorn and exposed pine and sycamore roots) or on shaded chalk stones. As with *Syntrichia ruralis*, its occurrence as an epiphyte caused surprise when it was first noted in 1986. It is also recorded from chalky soil (including soil in rabbit holes and on the root plates of fallen trees), concrete and discarded bricks. 3, 4, 7, 8, 11-16.

Epiphytes

Epiphytes are recorded in all monads except the long grassy stretch of the Dyke S of the A14 (monad 9), but there are concentrations (7-8 species per monad) recorded in scrub towards the northern end of the Dyke (monads 3-5) and in the more mature woodland at the other end (monads 12, 14-18). The history of the Epiphytes on the Dyke is very different from that of the ground-dwelling groups discussed above, as only five of the 19 species were known by 1960. The remainder have been recorded from 1976 onwards, with five discovered in the current survey. This increase was not a simple response to the spread of scrub on the Dyke, but it also reflects the massive expansion in the epiphyte flora of the county as a whole after the reduction of SO_2 pollution in recent decades (Preston & Hill, 2019). The epiphyte flora is also rather dynamic, as shown by our failure to refind three of the species which were first recorded in the 1980s and 1990s. This probably reflects both the inherent mobility of epiphytes, with a consequent tendency of some populations to be short-lived, and the programme of scrub clearance in recent years which has removed much of the humid scrub which for a rather brief period provided a rich habitat for these species.

Frullania dilatata [1951] F1. On ash, blackthorn, elder, hawthorn and sycamore in scrub and woodland. Only recorded three times before 2000. 3, 5, 8, 11-13, 15-18.

Metzgeria furcata [1958] F4, G. On elder, hawthorn and (rarely) ivy in scrub at the N end of the dyke and on apple, ash, beech, blackthorn, box, elder, elm, field maple, hawthorn, hazel, lime, sycamore and the exposed roots of oak in the more varied woody communities towards the south (14-18). It persists for a while on dead trees and fallen trunks. 2-5, 11, 12, 14-18.

Metzgeria violacea [1976] F0, G. A less frequent epiphyte than *M. furcata* but sometimes conspicuous in humid scrub. Recorded on ash, blackthorn, buckthorn, elder, hazel and sycamore. 5, 15-18.

Radula complanata [1958] F5, G. On ash, elder, blackthorn and hawthorn in scrub. 3-5, 7, 17.

Brachytheciastrum velutinum [1983] F5. Recorded only twice in scrub, recently on the base of hawthorn. 4.

Bryum moravicum [1976] F0, G. On ash, elder and hawthorn, and also seen on a fallen pine branch, stumps and rotting trunks. 4, 5, 7, (11), 12, 14, 15, 17, (18).

Campylopus introflexus [2001] F4, B. On an elder, a fallen pine branch and a decorticated oak log. 12, 14, 18.

Cryphaea heteromalla [1983] F5. On elder and (rarely) sycamore in scrub and woodland. 3, 4, 12, (13), 14-16.

Orthotrichum affine [1976] F5. In both scrub and mature woodland, growing on a wide range of hosts (ash, birch, blackthorn, elder, hawthorn, hazel, oak). 1, 3-5, 7, 8, 10-18.

Orthotrichum lyellii [2002] F0, G. On hawthorn in scrub in the base of the ditch (2002) and on ash in mature woodland (2018). 3, 16, 18.

†*Orthotrichum stramineum* [1994] Recorded once, on a sloping trunk of an elder in a sheltered position in the ditch. (3).

Orthotrichum tenellum [2001] F5, G. A colony known between 2001 and 2003 on a group of six mature elders at

the base of the ditch was subsequently lost to scrub clearance. 14.

†*Sciuro-hypnum populeum* [1960] Though it is classified by Preston & Hill (2019) as an epiphyte, the species has a wide habitat range and the only record from the Dyke was from chalk grassland on the SW-facing side of the bank. (11).

Syntrichia papillosa [2016] F0, G. On elder. 7.

Syntrichia virescens [1994] F1. On ash, elder and an exposed sycamore root. (4), 5, 7, 8, 12.

Ulota bruchii [2018] F5. On elder in woodland. 18.

†*Ulota phyllantha* [1986] Discovered on an old elder in the ditch in 1986 but never seen again, despite its subsequent spread in the county. (11).

†*Zygodon conoideus* [1992] Like *U. phyllantha*, there is a single record from elder. (18).

Zygodon viridissimus [1960] F4, G. One of the more frequent epiphytes on the Dyke. Most records are from elder and it may grow in abundance on mature or moribund stands of this species, but it is also recorded from ash, hawthorn and the exposed roots and bases of beech and sycamore. 3-8, 11, 12, 14-18.

Calcifuges

Only one of the 53 calcifuge species recognised in the county by Preston & Hill (2019) is recorded from the Dyke.

Dicranum scoparium [2003] F0. Seen only once, growing in abundance (at least 200 tufts) on the trunk of a single ash tree on the wooded stretch of the Dyke. 17.

Shade species

The Shade species have a similar distribution to the Epiphytes, but the concentration in the northern monads (3-4) is less marked and the richest monads are those in mature woodland at the S end (16-18). Five of the nine species were known by 1960; two of the remaining four were added to the list in 1992 on the excursion when many Woodland species were also found for the first time (see below).

Lophocolea bidentata [1958] F4. Mossy logs and rotten wood. 15-18.

Cirriphyllum crassinervium [1958] F1. Close to the ground on exposed tree roots, including sycamore roots on which it grew with *Anomodon viticulosus*, on a horizontal oak tree (under *Prunus laurocerasus*) and carpeting the top of a fallen field maple. 16-18.

Fissidens incurvus [1961] F5. Widespread in open grassland as well as in scrub and woodland. It was frequent in 2017 on disturbed soil in areas in monad 12 from which scrub had been cleared, and it also grows on the sides of rabbit burrows. 1-7, 9, 12-14, 16-18.

Fissidens taxifolius [1958] F4. Similarly widespread in grassland, scrub and woodland. 1-18.

Fissidens viridulus [1972] F5. Chalky ground in scrub and woodland. 3-4, 12, 17, (18).

Oxyrrhynchium pumilum [1958] F4. Shaded ground in scrub and woodland. 3, (4), 14-16, (18).

Plagiomnium rostratum [1992] F5. On rotting wood and wet ground in woodland in the moist ditch bottom. 17, 18.

Plagiomnium undulatum [1992] F1. Found, like *P. rostratum*, on logs and wet ground in woodland in the ditch bottom at the S end of the Dyke; also known further north on the dismantled railway line. 3, 13, 16-18.

Thamnobryum alopecurum [1958] F4. On the ground in elder/hawthorn scrub and woodland, and also on the exposed roots of ash, beech and sycamore in mature woodland. 14-18.

Fen and aquatic species

These two groups are treated together, with the Fen species marked as '(Fen)' in the list below. Only two of the eight species are recorded in more than two monads, *Cratoneuron filicinum* and *Fissidens adianthoides*. With the exception of these two, all the Fen and Aquatic species were recorded for the first time during the recent survey, largely a reflection of the more thorough survey of the S end of the Dyke during this period.

Brachythecium rivulare [2018] F2. By a small very shallow stream in the base of the wooded ditch (2018). 18.

Campylium protensum (Fen) [2006] F0. Rather coarse chalk grassland (2006). 13.

Cratoneuron filicinum [1958] F1. The recent records are from the bridge over the stream by Dullingham Road

and on damp ground in the base of the ditch at the wooded S end of the Dyke. (5, 12), 14, 17, 18.

Fissidens adianthoides (Fen) [c. 1951] F5. In grassland, especially on the N-facing side of the Dyke but also on the top and in the disused railway cutting, with one record from the base of a concrete post. Although primarily a species of fens, *F. adianthoides* also grows in chalk grassland in the county. It was overlooked on the Dyke as *F. dubius* until Proctor (1956) mentioned its presence; the first record is an undated specimen collected by Pigott and only later redetermined as this species by Whitehouse (CGE). 5, 9, 10, 13, 14.

Leptodictyum riparium [2018] F5. First recorded in 2018 in two sites, lining a pool in a horizontal sycamore branch (Figure 4) and at the edge of a pool in the bottom of the ditch. 16, 18.

Figure 4. The wetland bryophyte *Leptodictyum riparium* fruiting in a hollow in a horizontal sycamore branch, 25 March 2018. Photo: Peter Leonard.

Leskea polycarpa [2006] F5. Seen once, as an epiphyte on sycamore. 16.

Pohlia melanodon [2003] F2. Recorded in the recent survey in two sites, without habitat detail in the northerly monad but on a bank above the winter-wet base of the ditch in the southerly site. 7, 17.

Rhizomnium punctatum (Fen) [2018] F2, PG. Horizontal log in woodland. 16.

Woodland species

The 15 species in this group have a very obvious concentration at the wooded S end of the Dyke (Figure 5). All have been recorded in the southernmost monad (18), but only four extend north of monad 16. Only five of these species were known by 1960, but nine were recorded on the excursion in 1992 which made the first thorough list for the S end of the Dyke.

Figure 5. Inspecting populations of Anomodon viticulosus and Porella platyphylla on the wooded southern section of the Dyke, 25 March 2018. Photo: Peter Leonard.

Lophocolea heterophylla [1958] F4, G. Epiphytic on hawthorn, on the base of birches and a felled cherry, a fallen pine branch, and moist and mossy logs and rotten wood. Only found fruiting in moist habitats at the S end of the Dyke. 5, 8, 11-13, 16-18.

Porella platyphylla [1992] F1. On exposed roots and the bases of trees (ash, field maple, sycamore, oak), rarely recorded up to 1 m high on ash and once from an elder twig. 16-18.

Anomodon viticulosus [1958] F0. A feature of the wooded S end of the Dyke, on the bases and exposed roots of ash, beech, field maple and sycamore; rarely extending onto chalky ground (Figure 6). On one large ash in monad 18 it grew with *Cirriphyllum crassinervium, Metzgeria furcata, Neckera complanata, Porella platyphylla* and *Thamnobryum alopecurum*. 16-18.

†*Atrichum undulatum* [1992] Only recorded once. (18).

Cirriphyllum piliferum [1992] F1. On the ground in scrub and woodland, including the mesic base of the ditch, and on fallen logs. 5, 14-18.

Eurhynchium striatum [1932] F1. In addition to its occurrence in woodland, it is found rather uncommonly at the edge of scrub, on the N-facing side of the railway cutting and in NE-facing turf elsewhere on the Dyke. 3, (4), 5, 6, 12-18.

Homalia trichomanoides [1958] F5. On exposed beech and ash roots in woodland. 16, 18.

Isothecium alopecuroides [1983] F4. On the exposed roots and bases of beech, hawthorn, hazel and sycamore. 14, 16, 18.

Isothecium myosuroides [1992] F1. Recorded recently only from the lower trunk of ash at the base of the ditch. 17, (18).

Mnium hornum [1992] F2. On a tree stump. 18.

Neckera complanata [1958] F1, B. On the exposed roots and bases of ash, beech, elder, oak and sycamore, and on a fallen field maple, at the S end of the Dyke (Figure 6). There is an earlier record (1960) of a single shoot in chalk grassland in the Race Course section. (11), 16-18.

Orthodontium lineare [1992] F5, PG. Recorded recently on a decorticated oak and on a large old stump. 16, 17, (18).

†*Plagiothecium curvifolium* [1992] Only recorded once. (18).

Plagiothecium nemorale [1992] F2, G. Recorded recently on a log in the wet base of the ditch. 18.

†*Thuidium tamariscinum* [1992] Only recorded once. (18).

Figure 6. *Anomodon viticulosus* (above) and *Neckera complanata* (below) on an exposed beech root, 25 March 2018. Photo: Jeff Scott.

Significance of the Dyke's bryophyte flora

The list above includes 10 liverworts and 110 mosses found in the recent survey and an additional 13 mosses last recorded before 2000. This makes it one of the most species-rich sites in the county but, as we noted in the Introduction, the bryological importance of the Dyke lies primarily in its rich representation of Calcicole species. The only recent records of *Bryum torquescens, Tortella inclinata, Trichostomum brachydontium* and *Weissia sterilis* from the county are from the Dyke, although the last two were historically also known from Fleam Dyke. In addition, *Abietinella abietina, Ditrichum gracile, Encalypta vulgaris, Seligeria donniana, Tortella inflexa* and *Trichostomum crispulum* have only been recorded recently from one or two other Cambridgeshire sites. Most of these species are restricted to the central section of the Dyke and all of them have very small populations on the site. These are almost all plants of short, open grassland with patches of bare chalky soil. Six of these ten species (*Abietinella, Ditrichum* and both *Tortella* and *Trichostomum* species) are not known to fruit in the county, and fruits are very rare in Britain as a whole, so they require the continuing presence of their habitat to persist. Their survival on the Dyke can be attributed to the relatively extensive area of habitat available here compared to other Cambridgeshire chalkland localities, the open habitat on the steep SW-facing slope of the vallum and the eroded ground alongside the footpath along the top of the Dyke. The populations of several species are so small that their future is precarious, but fortunately the maintenance of open chalk grassland is the priority of conservation managers and therefore serves to sustain its rare bryophytes along with its rare vascular plants and invertebrates.

Many of the other Calcicole species on the Dyke, although not quite so rare in the county, are uncommon and declining in our area. *Campyliadelphus chrysophyllus, Ctenidium molluscum* and *Didymodon acutus* are rarely found fruiting in Britain, although *D. acutus* nevertheless appears to be turning up with increasing frequency in ruderal habitats in some areas. However species of open chalk soil such as *Microbryum curvicollum, M. rectum, Pterygoneurum ovatum* and *Tortula lanceola*, though uncommon, fruit freely.

Two of the Calcicole species were not refound in the recent survey. *Tortella tortuosa*, another rarely fruiting species, appears to be extinct on the Dyke, its only native East Anglian site (though it survives in Cambridge on imported limestone). *Pottiopsis caespitosa* is, however, a completely unpredictable species and might conceivably be refound. The most frequent Calcicoles in the county which are not currently known from the Dyke are *Aloina aloides* and *A. ambigua*. These freely fruiting species colonise calcareous soils after major disturbance. There is just one old record of an *Aloina* from such a site on the Dyke and the inability of these species to colonise open chalk grassland is remarkable. Another notable absentee is the pleurocarp *Entodon concinnus*, which was formerly recorded in grassland further west in the county. There is no obvious reason why it is missing from the Dyke, though it is one more species which has never been found fruiting in Britain and it is rare in eastern England.

In a national context, none of the species recorded from the Dyke are on the current British Red List (Hodgetts, 2011) although a revised list is in preparation. However nine Calcicole species are listed by Pescott (2016) as Nationally Scarce (*Abietinella abietina, Bryum torquescens, Didymodon acutus, Pottiopsis caespitosa,*

Pterygoneurum ovatum, Seligeria donniana, Tortella inclinata, T. inflexa and *Weissia sterilis*).

The species in the other ecological groups have much less significance, although at a county level the presence of species of base-rich habitats such as *Anomodon viticulosus, Ephemerum recurvifolium, Fissidens adianthoides, F. gracilifolius* and *Microbryum floerkeanum* is noteworthy. Indeed *E. recurvifolium* has recently been classified as Near Threatened in a European Red List (Hodgetts *et al*., 2019), a rather surprising decision from a Cambridgeshire perspective because it is thriving here. In addition to the presence of individual species, however, the Dyke as a whole has a significance for the range its habitats which, as shown above, allow changes in the county's bryophyte flora to be documented at the local scale.

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An update on the history, ecology and fate of Fen Ragwort (*Jacobaea paludosa*) in Britain

Peter Stroh

Introduction

Fen Ragwort (*Jacobaea paludosa*, syn. *Senecio paludosus*) has the unenviable distinction of being one of Britain's rarest plants, joining a select group of native species confined to a single site. Even amongst this company it is exceptional, with its entire population consisting of just a single plant. One plant is, however, better than no plants, and its situation was for a long time substantially worse, with the species considered to be extinct before the dramatic discovery by T.W.J.D. Dupree in 1972 of five flowering stems in a recently dug Fenland roadside ditch. The precarious location of the plant, so close to a busy road, coupled with the considerable rarity of the species, led to a concerted effort by English Nature (now Natural England) and others to safeguard the species via introductions under the auspices of the Species Recovery Programme (SRP).

This article updates the survival of introduced Fen Ragwort populations and also reviews the history and current health of the species at its sole native site in Britain, Delph Bridge Drain SSSI, located near to Stuntney, Cambridgeshire. For those interested in background reading, Walters (1974) documents the rediscovery of the species, and postulates about how it may have arrived at the site, Palmer (2006) presents a comprehensive summary of the conservation work carried out between 1991 and 2005 under the SRP, Pankhurst & Lansdown (2004) present findings from northern Europe and provide an ecological profile of the species, as does Michna (2006), who also documents its past British distribution, and Beecroft *et al*. (2013) present reasons for the demise of the plant at Kingfishers Bridge and other introduction sites.

Distribution

Fen Ragwort's global distribution extends from southern Scandinavia south to the Alps and east to the Urals. It appears to be in trouble across much of its range; for example, it may now be extinct in Denmark and the Czech Republic, it is 'Critically Endangered' in Britain and parts of Germany, and is 'Endangered' in Sweden and Bulgaria. Its decline has been attributed to river straightening, drainage, bank stabilisation and development, and the subsequent fragmentation of populations and loss of suitable habitat.

In Britain, Fen Ragwort appears to have always been restricted to the Fenland Basin, with historical records (17th Century onwards) from only two localities in both Lincolnshire and West Norfolk, one locality in West Suffolk, and ten documented sites in Cambridgeshire (Crompton, 2007). Pankhurst & Lansdown (2004) and Pankhurst (2009) mention an herbarium specimen housed at the Royal Botanic Garden in Edinburgh (RBGE) that was collected as Canadian Goldenrod *Solidago canadensis* from a gravel pit near Ware, Hertfordshire, in 1932, but later determined by A.J.C. Grierson as *Jacobaea paludosa*. James (2009), however, expresses doubt about the record, and dismisses it from the list of Hertfordshire plants. I have examined the specimen in Edinburgh with the retired Herbarium curator, Douglas McKean, and Assistant Curator Elspeth Haston, and there is no doubt that it is Fen Ragwort, but we feel it is most unlikely that the collector would have misidentified the plant as Canadian Goldenrod. The herbarium collection of Mrs Enid MacAlister Hall containing the specimen was gifted to RBGE in 1941, and the collection would have contained many loose specimens without labels attached (D. McKean, pers. comm.). Considering the marked differences between the two species, the fact that there are no other records for Fen Ragwort in Hertfordshire, and the documented presence of Canadian Goldenrod in Ware historically (BSBI database), the most likely explanation is a curatorial error, with the wrong label attached to the material. This does not, however, solve the mystery of where MacAlister Hall collected the Fen Ragwort plant. Documents in RBGE state that she travelled widely throughout northern Europe, and although no specimens of Fen Ragwort could be found in her European collection at Edinburgh, one could speculate that the 'Hertfordshire pressing' originated from a site in Europe.

The last known site prior to its rediscovery in 1972 was Wicken Fen, with the final record made by Charles Babington in 1857, who collected material in the same year to grow on at Cambridge University Botanic Garden (CUBG) (Michna, 2006). We can be reasonably confident that it was a genuinely rare plant in recent (post-Vermuyden) times, although it is not inconceivable that some populations in remote Fenland areas were passed

over at a distance for the ubiquitous, and very lovely, Perennial Sow-thistle *Sonchus arvensis*. However, Walters' (1974) hope that Fen Ragwort may still persist undetected in ditches near to the Stuntney site has, in the light of intensive surveys for both the New Atlas (Preston *et al*., 2002) and the forthcoming Fenland Flora (Mountford & Graham, in prep.), been shown to be valiantly optimistic.

Ecology

Fen Ragwort is a long-lived perennial herb of moist to wet soil conditions, usually found growing in nutrient-rich, relatively open tall-herb fen or reed-swamp communities (Walters, 1974; Pankhurst & Lansdown, 2004). Plants are pollinated by insects and are also self-pollinating. The main mode of reproduction is by seed, with a single plant capable of producing on average ca 100,000 seeds per individual each year (Winter *et al*., 2008). These can then be dispersed by water, wind and, presumably, on muddy feet, fur or feathers. Fen Ragwort also reproduces via the dispersal in water of fragments of rhizome, which are then capable of regeneration if washed up onto bare soil created by floods within dynamic near-natural river and stream systems (Pankhurst & Lansdown, 2004; Diekmann & Bartels, 2012).

Many authors have correlated the creation of a new ditch in 1968 and the subsequent reappearance of the species at Delph Bridge Drain SSSI with a long-lived soil seed bank. However, considering the numbers of seed produced by a single plant, it is notable that seed bank studies conducted by Wagner *et al*. (2003), Hölzel & Otte (2004) and Schütz (2010) within sites that contained Fen Ragwort above-ground found no evidence of the species below-ground. This would point to Fen Ragwort having either a short-term persistent or a transient seed bank (i.e. viable in the soil for less than one year). Fen Ragwort does, however, form rather extensive and persistent 'bud banks' in the soil, with the buds attached to buried rhizomes (Prof. Norbert Hölzel, pers. comm.). Consequently, emergence following absence above-ground does not necessarily depend on the soil seed bank, but can also result from persistent below-ground organs of the plant. For more information on the ecology and significance of bud banks, see Ott *et al*. (2019).

Morphological studies by Hodálová, Grulich & Marhold (2002) identified three subspecies on the basis of leaf shape, leaf indumentum and achene hairiness, with British populations belonging to subspecies *angustifolius* Holub which also grows in western and central Europe.

Survey

During the summer of 2019 all documented Fen Ragwort introduction sites, and the sole native site, were visited. The species was searched for and, when found, the number of plants and inflorescences were counted, and associated vegetation recorded. If the species was absent, a note was made of the site conditions and the main constituent species.

Fate of Introductions

Since 1992, a total of 437 Fen Ragwort plants, all originating from seed taken from the sole native plant, have been introduced to 33 locations within nine sites covering three vice-counties (Table 1). In 2019, a total of just 10 plants were found; five plants at Kingfishers Bridge, and five plants at Woodwalton Fen NNR. A total of 22 flowering stems were counted across the two sites (Table 1). It was searched for but not found at the remainder of introduction sites, including sites where it was reported as present by Beecroft *et al*. (2013). It is assumed to be lost from all these localities. The majority of introductions failed 1-3 years after planting out. The main reasons for loss appear to be competition from the surrounding vegetation, and especially swamping by Common Reed *Phragmites australis*, Reed Canary-grass *Phalaris arundinacea,* and, at Wicken Fen, Saw Sedge *Cladium mariscus*. Additional factors include unsuitable hydrology (either far too dry, or too wet in the summer months), and herbivory. Beecroft *et al*. (2013) list the culprits as slugs and snails, larvae of the Cinnabar Moth *Tyria jacobaeae*, rabbits, sheep, cattle and geese. Roe deer can be added to this long list, with plants eaten and trampled at Lakenheath Fen following the removal of protective fencing (Norman Sills, pers. comm.).

Of the two introductions where the species was found in 2019, five of the original six plants recently introduced at Kingfishers Bridge on the margins of an oligotrophic pond (after numerous unsuccessful attempts in other areas of the reserve) were robust and relatively free from competition.

Table 1: Introduction sites and outcomes for Fen Ragwort (1992 – present). VC =Watsonian Vice County; 26 (West Suffolk), 29 (Cambridgeshire), 31 (Huntingdonshire).

Introduction site	Yr introduced	No. plants introduced	No. plants 2019	Yr lost by	pop survival (yrs)	VC
Lakenheath Fen (a)	1998	6	0	2002	3	26
Lakenheath Fen (b)	1998	6	0	2003	4	26
Lakenheath Fen (c)	1999	12	0	2003	3	26
Lakenheath Fen (d)	2001	6	0	2003	1	26
Lakenheath Fen (e)	2001	7	0	2003	1	26
Lakenheath Fen (f-n)*	2005	nine x 10	0	2012	1 - 6	26
Barway (a)	1999	5	0	2002	2	29
Barway (b)	2003 + 2007	9 + 31	0	2011	7, 3	29
Bradford's Farm	1995	12	0	1997	1	29
Cam Washes	1995	12	0	1997	1	29
Flag Fen	1996 + 2000	12	0	1998, 2002	2, 1	29
Kingfishers Bridge (a)	1997	14	0	1999	1	29
Kingfishers Bridge (b)	1998	12	0	2003	4	29
Kingfishers Bridge (c)	2005	4	0	2006	0	29
Kingfishers Bridge (d)	2007	6	0	2009	1	29
Kingfishers Bridge (e)	2008	1	0	2018	9	29
Kingfishers Bridge (f)	2015	6	0	2018	2	29
Kingfishers Bridge (g)	2016	6	5	n/a	3	29
Ouse Washes (a)	1996	6	0	2000	3	29
Ouse Washes (b)	1996	12	0	2009	12	29
Wicken Fen (a)	1992	50	0	2003	10	29
Wicken Fen (b)	1993	seeds	0	2000	6	29
Wicken Fen (c)	1997	10	0	2005	7	29
Woodwalton Fen (a)	1992 + 1993	50 + 40	5 (16)	n/a	27	31
Woodwalton Fen (b)	1995	12	0	1997	1	31

*for brevity, I have not listed separately the fate of all nine 2005 introduction plots at Lakenheath. By 2006, 25 of the 90 were alive. By 2011, 10 plants were present, but all were destroyed by Roe Deer, and none have been seen since (Norman Sills, pers. comm.).

The surviving population at Woodwalton Fen, now into its 27th year, grows in relatively species-rich vegetation resembling NVC M22 Juncus subnodulosus-Cirsium palustre fen-meadow, but with an abundance of Common Reed. The area is cut annually in late September/early October, with arisings removed. This management, also undertaken at fen meadows that support the species in The Netherlands (Pankhurst, 2009), is crucial for its continued survival. Cutting means that although Reed cover is high, it is thinly spread, allowing light to the ground and space for other species such as Purple Small-reed *Calamagrostis canescens*, Common Meadow-rue *Thalictrum flavum*, Ragged-robin *Silene flos-cuculi*, Yellow Loosestrife *Lysimachia vulgaris* and Tufted Forget-me-not *Myosotis laxa* to flourish alongside the planted Ragwort. Since the turn of the century, however, personal observations indicate a retreat of the population, seemingly into areas that are damp but lack standing water in the summer months, with the apparent loss of plants in areas with summer standing water. The main threats at Woodwalton Fen, therefore, appear to be related to hydrology, trampling by those who wish to photograph the species in flower but do not notice vegetative plants, and a lack of management. Given that this is the only successful long-term introduction of Fen Ragwort in Britain, it would be interesting to introduce

more plants at one or two other localities within the reserve, and perhaps at other sites where there is similar vegetation, hydrology, and a regular cutting regime.

Delph Bridge Drain SSSI

One incredibly robust plant (separated into two distinct 'clumps'), approximately 225 cm tall and now at least 57 years old, was present on the side of the ditch, and produced a total of 33 flowering stems. This compares favourably with the median number of shoots (24) recorded during the period 1972-2005 (Palmer, 2006). Comparing the species list from 1972 (taken from Walters, 1974) with that of 2019, it is clear that the ditch is now far drier and much less open (Table 2). In fact, the ditch was bone-dry at the time of survey (10th July).

Table 2: Vascular plants recorded in the year of the rediscovery of Fen Ragwort at Delph Bridge Drain SSSI, and during the current survey.

1972	**2019**
Cirsium arvense	*Arrhenatherum elatius*
Convolvulus arvensis	*Artemisia vulgaris*
Dactylis glomerata	*Calystegia sepium*
Epilobium hirsutum	*Cirsium arvense*
Glyceria fluitans	*Dactylis glomerata*
Juncus effusus	*Elymus repens*
Juncus inflexus	*Epilobium hirsutum*
Juncus subnodulosus	*Heracleum sphondylium*
Juncus articulatus	*Juncus effusus*
Lemna minor	*Juncus inflexus*
Mentha aquatica	*Pulicaria dysenterica*
Persicaria amphibia	*Typha latifolia*
Ranunculus sceleratus	*Urtica dioica*
Rumex palustris	
Rumex sanguineus	
Sparganium erectum	
Typha latifolia	

Fen Ragwort at Delph Bridge Drain. Photo Pete Stroh

The condition of the native site is not entirely surprising, as it has not been managed for at least 20 years, and possibly not since the ditch was created, save for some periodic clearance by hand of vegetation around the extant Fen Ragwort plants. In 2006, plans were in place to 'slub out' the ditch, mechanically removing built-up sediment, litter and rank vegetation. The small area with Fen Ragwort was marked out using police tape, and an English Nature representative (me) was to be on site to ensure that the plants were not damaged during the operation. The hope was that this management would create suitable conditions for the plant to spread. But a couple of weeks prior to the scheduled works, a car veered off the road (perhaps distracted by the burger van parked in the layby opposite), scoring a direct hit on the cordoned-off plants. Incredibly, this was the second time that a vehicle had plunged into the ditch since the 1970s, the first occasion in the 1990s involving a van loaded with cat food tins. If you look carefully, you can still find a tin or two of 'Felix'. If that were not enough, the SSSI is thought to have also been accidentally sprayed with herbicide by a neighbouring farmer in 2014 (Natural England, pers. comm.). These events appear to have had no ill effects on the Fen Ragwort plant. Indeed, the substantial disturbance caused by vehicles crashing into the ditch may even have been beneficial. However, it seems inevitable, given the absence of any regeneration, that the species will eventually be lost from the site, and therefore as a native plant from Britain, if for no other reason than that of old age.

Discussion

The successful long-term establishment of Fen Ragwort via planting, followed by consistent after-care management, is certainly possible, as demonstrated by results at Woodwalton Fen NNR. However, for the vast majority of introductions, planting has ended in failure. This is probably due to at least three main factors: an inability to replicate its principal ecological niche, herbivory, and competition by the surrounding vegetation.

The first of these is the most difficult to ameliorate. Fenland roddons, revealing a myriad of long-lost meandering streams, creeks and small riverways, tell their own story about how comprehensively our landscape has changed over time (Fowler, 1932). The wetland restoration projects currently underway in the Fens cannot hope to replicate this dynamism, but areas that are flooded in the winter months, and then experience a 'drawdown' in early summer, thus creating abundant areas of damp soil with limited competition, do have the potential to become suitable receptors for Fen Ragwort. Although the natural dispersal of plants, if they establish, is unlikely to be possible outside of project boundaries (unless seeds are transported on birds' feet or feathers), it is possible that seeds produced by mature plants may germinate and establish in drawdown zones. Seeding trials on bare peat at Wicken were initially successful, and in southern Germany Patzelt *et al*. (2001) managed to establish many fen meadow species, including Fen Ragwort, within an ex-arable wetland restoration project area by spreading green hay collected from intact fen meadows onto bare peat after the topsoil had been removed. Trial planting within drawdown habitat is planned at the Great Fen in the near future, using stock grown on at CUBG. The same could also be considered for suitable areas within the Wicken Fen Vision. As mentioned above, it would also be worthwhile to attempt more introductions at Woodwalton within fen meadow vegetation that is managed regularly.

The grazing of young plants by slugs and snails might be countered by the placement of copper rings around the base of the stems, as has been trialled at Kingfishers Bridge for the most recent (and still extant) introduction. Consumption by rabbits, deer and livestock could be dealt with by protective fencing, although vegetation within any exclosure would have to be checked and managed appropriately. A wider question posed is why deer, sheep and cattle seem attracted to a plant within a genus that is famed for its toxicity. Mandi *et al*. (2009) found that Fen Ragwort contained three pyrrolizidine alkaloids, and although they appear to have weak hepatotoxicity, this might in part explain why the Woodwalton Fen plants have survived within a reserve known to contain large numbers of Muntjac, Fallow and Chinese Water Deer. However, this would not explain the consumption of young Fen Ragwort shoots at other sites. Perhaps older plants build up greater levels of toxicity? It might be that by planting out so many individuals at Woodwalton Fen within one small area, the chances of at least some growing on to maturity were increased.

In mainland Europe, one of the main factors associated with the decline of this species is increased competition from the surrounding vegetation, especially Common Reed, due to the loss of what Diekmann & Bartels (2012) call the "nesting niche" i.e. periodically disturbed and open sites acting as regeneration gaps for germinants and young plants. Indeed, one of its main habitats, tidal freshwater wetlands, is itself assessed as 'Endangered' in Europe (Janssen *et al*., 2016). In Britain, all introduction sites rely on some form of management, as opposed to solely natural processes, and all failed introduction sites visited for this survey now support dense, tall, closed vegetation, with all but one rarely if ever cut. In addition, some sites selected for introduction can now be seen as clearly unsuitable, as they sustained dry conditions throughout much of the year, and this, together with a lack of management, swiftly resulted in a rank, tall and closed sward. Palmer (2006) reported that mature plants can compete successfully among tall vegetation, and this is certainly the case at many native sites across its range within dynamic fluvial systems, but for the sites selected for introduction in Britain, some form of regular management is essential to maintain a tall, relatively open sward.

Turning to the extant native site, it seems probable that if the plants originally found in 1972 were not the result of an 'unofficial introduction' using Continental stock, Fen Ragwort either established from the bud bank, as opposed to the seed bank, or arrived on the feet or feathers of migratory birds. In any event, it has proven so far to be an incredibly fortunate one-off event. Its reappearance led to a concerted effort to ensure the continued

survival of the species in Britain. Apart from a small population at CUBG, only one site has successfully retained the species for a significant amount of time, and it would seem sensible to learn lessons from this success and attempt introductions at other suitable locations that mirror the conditions found at Woodwalton Fen.

Near to the end of his excellent book 'The Fens: Discovering England's Ancient Depths', Francis Pryor ponders whether, in time and under projected climate scenarios, the dynamism that was once prevalent over huge swathes of fenland might return, and with it the wildlife that was lost. This is far from fantasy, given what we know about predicted sea-level rise. But as things stand, a considerable amount of work over almost thirty years points to a complete lack of suitable conditions for establishing self-sustaining populations of *J. paludosa* within its primary niche, near-natural river corridors, due to the destruction of landscape-scale processes brought about by land-use changes that began in earnest in the 17th century, and were continued and accelerated into the 20th century. Given the limitations which wetland restoration projects must work within, and working under the premise that the fenland basin will not be flooded imminently, if Fen Ragwort is to survive and flourish, it must do so with our help, and in a managed environment.

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Right: Fen Ragwort at Kingfishers Bridge Photo Pete Stroh

Below: Fen Ragwort at Delph Bridge Drain. Photo Pete Stroh

Spotted Flycatchers in Cambridgeshire

Michael Holdsworth

Spotted Flycatchers *Muscicapa striata* are a charismatic and much-loved summer visitor to woodlands, gardens and churchyards. Once abundant, they are now among the most declined British breeding bird species. Losses amounted to a 38% decline during 1995–2015, continuing a cumulative 85% decline since 1970, which may anyway be an unreliable 'shifting baseline' (SUKB, 2017). There were probably at least eight times as many Spotted Flycatchers in Britain and Ireland before 1970 as there are nowadays.

The reasons behind this fall in numbers are no doubt complex (Balmer *et al*., 2013). Within Britain and Ireland, a reduction in breeding productivity and poor survival of first-year birds are thought to be the main demographic factors. The evidence suggests that the decline has been steeper in the south and east than in the north and west. This probably results from a mix of factors: changing climatic conditions (particularly rainfall); changes and differences in farming (the degree of intensification; mixed vs arable; pesticide use); deteriorating woodland – and, almost certainly above all, consequential different rates of decline in the numbers of the large flying insects on which the species depends. The clue is in the name. It has been estimated that a family of flycatchers might require up to 100,000 insects during the course of one breeding season. The catastrophic collapse in our Spotted Flycatcher populations is nothing more than the trophic expression of vanished butterflies and moths, hoverflies and sawflies, wasps and bees.

Flycatchers additionally spend up to nine months a year on their 16,000 mile round-trip migration to wintering quarters in south-west Africa, mainly Angola and Namibia. Changing conditions at any stage of this migration – climate-change again, weather, rainfall, drought, deforestation, human pressure, hunting – may similarly be impacting survival. Spotted Flycatchers are one of several long-distant migrants (such as Turtle Doves *Streptopelia turtur* and Cuckoos *Cuculus canorus*) wintering in or migrating through west, central and southern Africa that are currently in steep decline. Their decline may have some common causes (Hewson & Noble, 2009).

Flycatchers have not surprisingly become difficult birds to find in Cambridgeshire and are extremely inconspicuous in the breeding season. They barely sing, and even when they do, the song is very missable – high-pitched and quiet; many (particularly older) people cannot hear them at all. Males, often high in the tree canopy, cannot be relied upon to respond to recorded song playback. The pair may not show itself when a nest is visited and may even be entirely absent while nestlings are ringed. It is widely accepted that three negative visits are required in order to safely establish the absence of birds.

Apart from the obvious reason (the decline in breeding numbers) birds are also hard to find because they have now largely withdrawn from accessible open habitats – farmland, woodland, river valleys – into more private spaces – gardens, parkland and churchyards (Stevens, 2008). Once nesting has begun, birds will forage no further than 200m from the nest, and will stay much closer than that once they are feeding young. Foraging is usually silent and often high in the canopy.

In 2016 the British Trust for Ornithology (BTO) was able to fund a light-level geolocator project – the first anywhere for the species – to track Cambridgeshire flycatchers on their migration to and from Africa (see http://bit.ly/SpotFly). These geolocator devices require the bird to be recaptured in order for the device to be retrieved and the tracking data downloaded. This sort of tracker is therefore particularly suitable for bird species which are very precisely site-faithful. There were two capture/recapture cycles: 2016/17 and 2018/19. In each cycle the intention was to tag twenty breeding adults, and to colour-ring-mark (not tag) another twenty as controls, to monitor whether the devices were influencing survival [photo Geo-tagged bird inside cover, control ringe dbird opposite]. The project was successful, with a survival/return-rate of 40%. This rate of survival is encouragingly high for a small sub-Saharan migrant and supports the notion that reasons for the species' decline may rest with birds in their first year of life – perhaps failing to complete their first migration. Sufficient devices were retrieved to provide good tracking information on the routes taken, staging areas and final winter destinations.

Pairs for the project were located by a combination of deskwork and fieldwork. A first stage was to review as many previous records as possible: in Cambridgeshire Bird Reports; in the Cambridgeshire Bird Club database; on BTO BirdTrack and in the BTO Bird Atlas dataset. With the exception of one or two well-known and traditional sites, almost no records were received in any of geolocator project years 2015–19 from ordinary birdwatchers; birders do not seem to record flycatchers. During early 2017 an attempt was made to publicise the project through contacting parish and local magazines and community websites. By 2018 news of the project seemed to be spreading via word of mouth and a number of new householders came forward with previously unrecorded pairs.

As many sites as possible were visited, but for practical reasons fieldwork was concentrated within forty minutes' or so drive from Cambridge. This meant that little time was spent in the northern and eastern parts of the county. Once at a site, recorded playback lures were used in the hope of attracting male birds and obvious sites were cold-searched. The project needed selectively to focus on locating suitable pairs to tag and subsequently to recapture for tag retrieval. The project requirements were for (1) established pairs which would likely be site-faithful; (2) easy householder or landowner access; and most importantly (3) catchability at the nest. This last requirement ruled out awkward woodland sites where nests might be high in trees, or where it would be impracticable to deploy mist-nets or perch-traps.

Male flycatcher, Hildersham. This is a 'Blue' control bird not wearing a geolocator. Photo Tom Reynolds

Another reason why the project had few woodland pairs was because flycatchers are in the main no longer to be found in woodland. Avian predators are known to be the main cause of flycatcher nest-losses in all habitats and there are higher rates of this predation in woodland and farmland (perhaps linked to increases in corvid populations, and particularly Jays *Garrulus glandarius*) than in gardens. Many of the county's (rather few) woodlands still provide superficially perfect traditional habitat and many are reserves in their own right (Wildlife Trust BCN, RSPB, NE, NT) or parts of larger landscapes which are wardened and extensively visited by people who would recognise flycatchers if they saw them. And yet there are almost no records from these woodland reserves.

During the project it became very easy to identify suitable places to look for breeding flycatchers. Most were in villages and in parkland. While once common in the larger cities, Cambridge, Peterborough and Ely, birds are no longer found there. Again it seems unlikely that flycatchers breeding in traditional city habitats (for example within Cambridge – the Backs, the CU Botanic Garden, Coe Fen, large south and west city gardens) are escaping detection.

Village and parkland sites were almost always insulated from wildlife-depleted and invertebrate-poor Cambridgeshire arable farmland, usually by several hundred metres. There was often livestock nearby – horses, cattle or sheep. There were strong associations with garden ponds and streams; with artificially-butterfly-rich herbaceous borders; and with open areas which provided good perches for flycatching. A rich choice of nest-sites was often available, either in creepers against walls (particularly Climbing Hydrangea *Hydrangea petiolaris* and *Wisteria* sp.); in ivy-clad (*Hedera helix*) trees; or in open-fronted nestboxes. Retired households, often with 'free-range' pet dogs running around a garden from an open kitchen door, also suggested an association, since that obviously discouraged the main potential garden predators: Jays, Magpies *Pica pica*, domestic cats and

Grey Squirrels *Sciurus carolinensis*. Parkland and rural churchyards shared some characteristics. Pollarded limes (*Tilia* sp.) provided popular nest-sites. Ungroomed weedy areas, and particularly Cow Parsley *Anthriscus sylvestris* certainly improved the number of flying insects.

2019 was the final year of the geolocator project. Breeding was confirmed for 48 pairs of flycatchers and birds were present in 53 different tetrads (2km squares) in Cambridgeshire. The project concentrated on tagging and the nature of the fieldwork has throughout very much been dictated by whether the year involved tagging or retrieving. For example, in a retrieval year such as 2019 fewer nests (eventually just 44) were found and most time was focussed on sites where the geolocator birds were likely to be re-found.

There are two published county avifaunas, by David Lack (1934), and Peter Bircham (1989). Both of these are restricted to the pre-1972 old vice-county of Cambridgeshire, and exclude old Huntingdonshire and Peterborough. Lack wrote of flycatchers: 'Not abundant, but a well distributed summer resident to the gardens and woods of the county'. Bircham described the species as 'A reasonably common summer resident' and noted that there were ten pairs in the Cambridge Botanic Garden in 1982.

Both old Huntingdonshire (Limentani *et al*., 1988) and Old Cambridgeshire (Bircham *et al*., 1994) saw the publication of progressive local atlases based on the tetrad (2km square) OS grid. The two atlases have been combined in the composite map opposite (Fig 1). The large dots show confirmed breeding; medium dots show probable breeding; and the small dots show possible breeding (just birds 'present'). These two old-county atlases are five years apart; it is possible that Cambridgeshire (the more thinly distributed bottom right part) was by the late 1980s already experiencing an accelerating decline.

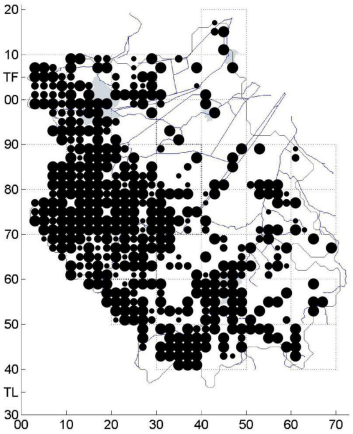

Figure 1. Spotted Flycatcher distribution Old Hunts 1978–83; Old Cambs 1988–92

The next atlas project was the Britain and Ireland BTO Bird Atlas 2008–2011 (Balmer *et al*., 2013). Spotted Flycatcher was first Red-listed as a bird of increasing conservation concern in 2015 (Eaton *et al*.). Like some other counties the Cambridgeshire Bird Club chose again to survey at the more granular tetrad level than the 10km square base required nationally. The Cambridgeshire Bird Atlas 2007–2011 (Bacon *et al*., 2013), using the same (confirmed/probable/possible) protocols clearly shows a massive decline in range and density (Fig 2). It is also likely that it significantly over-records flycatcher distribution. There are relatively too many tetrads with 'possible' status (the smallest dot: a bird or birds present in suitable habitat on one occasion in at least one of the four years). Many of these probably do not suggest a true breeding pair. A proportion of these scattershot records will have been of passage birds at the beginning of the season (inbound migration can carry on well into June); or cases of noisy family parties in early July, which could have bred in nearby tetrads or even outside the county.

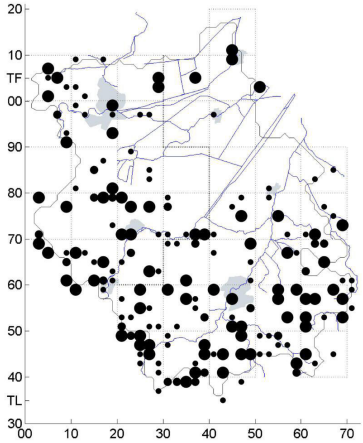

Figure 2. Spotted Flycatcher distribution Cambridgeshire Bird Atlas 2007–11

Fieldwork for the BTO geolocator project generated a lot of breeding records, and a number of new sites were identified. The map in figure 3 overleaf follows the normal dot-size breeding status conventions as above but employed more rigorous criteria than the 2008–11 Atlas. In addition, a solid square denotes a tetrad in which breeding was confirmed in all five years 2015–19.

The project in no way represented a full county survey. Fieldwork was limited to locating only pairs close to Cambridge suitable for tagging. There were almost certainly more pairs to be found in the Old Huntingdonshire north-western quarter of the county.

Traditional atlases anyway don't really work for flycatchers as they will tend to over-estimate distribution. These days it is very unusual for a tetrad to have more than one pair. With all atlas projects, whether early or recent, there is the question of misleading transient or 'pop-up' pairs. In many cases in the vice-county historical atlases and also in the 2008–11 BTO Atlas, breeding was confirmed in a particular tetrad in only one of the years of the atlas survey.

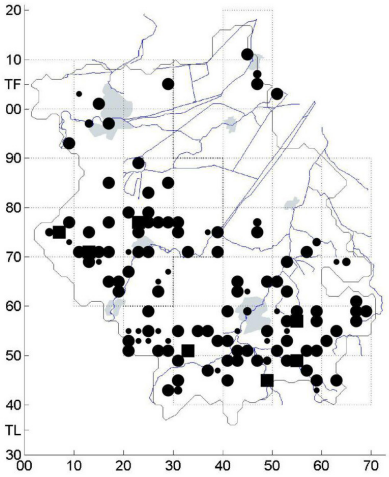

Figure 3. Spotted Flycatcher records 2015–19, mapped by the highest breeding status in any one year.

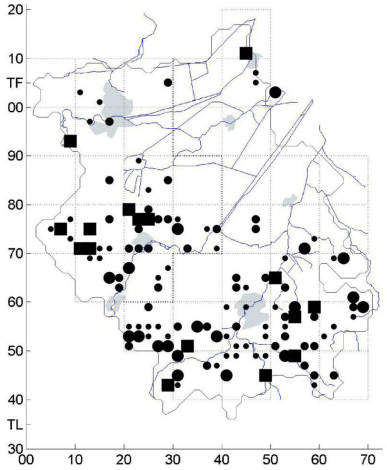

Figure 4 Spotted Flycatcher records 2015–19, mapped by the highest number of years with birds present

Since 2015, pairs have been found in 123 different tetrads, but only on a single occasion in the five years in 49 of these; and in only 53/123 in 2019. Thus, at an extreme level, what ends up being mapped in these traditional atlases as a consistent block of four confirmed pairs across four tetrads might in reality have been just a single pop-up pair in each year but in different tetrads.

In a landscape context, this increasing isolation of individual pairs does not bode well for the future of the species, which is almost certainly to follow Willow Tits *Poecile montanus* and Turtle Doves to local county extirpation.

The mapping problem described above can be to some extent addressed in Figure 4, which instead shows in how many of the five years 2015–19 birds were found to be present (in all breeding categories) in June and July. The smallest dot shows presence in just one single year – an isolated pop-up; a medium dot shows presence in two or three years; a large dot, presence in four years; and a square denotes continuous presence in every one of the five years – and, often, more than one pair in that tetrad.

In each year probably only a fraction of the flycatchers was found. Allowing for more pairs north of TL80, a fair guesstimate for the current Cambridgeshire population would be somewhere between 200 and 400 pairs.

In 1934, the undergraduate David Lack had noted that flycatchers in the county were 'well distributed … especially in the west, and rather scarce in the fen districts.' The absence of the species from fenland, and even from fenland villages and churchyards, is a feature of all the atlases. It may, therefore, have ever been thus. After all, fenland was mainly under water before the eighteenth century and has never had any significant woodland, ancient or otherwise. This is nicely shown in the final map (Fig 5) opposite, which overlays the 2015–19 project distribution on Cambridgeshire by altitude. There is a very clear association with the higher ground.

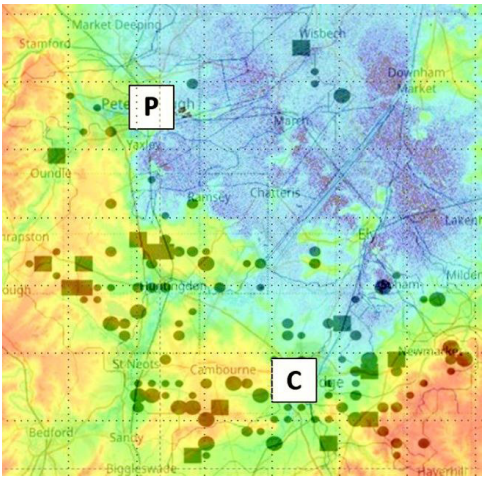

Figure 5 Cambridgeshire distribution 2015–19 over height above sea-level. P=Peterborough; C=Cambridge

Young Flycatchers, Balsham. Photo by Lee Barber

Acknowledgements

Fieldwork during 2015–19 would not have been possible without the support of the dozens of patient householders and landowners who allowed access for survey work, tagging and retrieval. Chris Hewson of the BTO was project leader for the geolocators, and Lee Barber, also of the BTO, contributed his outstanding fieldcraft and nesting skills. Local birders Geoff Barlow, Rob McEwen, Carole Davis and Bernard Siddle helped in finding pairs. Louise Bacon produced the maps.

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Snakes in the grass: the misidentification of adders in Cambridgeshire

Steven J. R. Allain

The Adder (*Vipera berus*) is the most widely distributed snake in the UK (Inns, 2009), although in some counties the species is locally extinct or only persists in small, isolated populations. One of the main reasons for this is the loss of habitat such as heathland or open woodland that has been converted for agriculture or housing developments. With the local loss of suitable habitats, adder populations tend to decline. Recent research has shown that UK adder populations are in serious trouble and within the next two decades the species may be restricted to a much smaller number of sites in the country (Gardner *et al*., 2019). Without immediate action, we may be witnessing the loss of one of the UK's most charismatic species.

One of the underlying principles in ecology and conservation is determining a species' habitat and distribution so that important sites can be protected for it (and other) species. Uncountable numbers of man-hours have gone into recording Britain's wildlife over the past 150 years or so, with the effort increasing over time thanks to different recording schemes and the help from citizen scientists (McCaffrey, 2005). Aside from knowledge gaps getting smaller, this has revealed an alarming trend within Cambridgeshire that has been validated by professional surveys: the county is almost completely devoid of adders. There are only a handful of adder populations known in Cambridgeshire. Additionally these populations are only small, so are unlikely to persist if pressures persist. Despite the recording effort there are knowledge gaps and it is important to determine where other small populations occur so that they can be monitored and appropriate conservation action taken. Despite the small number of known populations, numerous people record adders throughout Cambridgeshire each year. The majority of these sightings are verified as Barred Grass Snake (*Natrix helvetica*) records. The purpose of this article is to discuss the reasons for people making such errors in identifying adders, in a bid to improve and encourage local recording of the species.

One thing to consider is that most members of the public will not have been exposed to snakes all that much in the UK. Barred grass snakes are relatively common (Inns, 2009) and most people are aware of the adder due to its infamous reputation. However as someone who studies snakes, when people are told that we have a third native species (the Smooth Snake, *Coronella austiaca*) and two introduced species, they are surprised. Perhaps because they are out of sight (like life within rivers and oceans) – snakes are out of mind. Adder identification is important in case of bites to humans or dogs (necessitating medical attention due to the snake's venomous bite), yet a lack of exposure and experience is leading to a huge degree of error in identification.

Adders are quite unmistakable in the UK: males are a silver-grey colour and females are copper-brown. They may be confused with smooth snakes, but as these do not occur in Cambridgeshire (Inns, 2009), this is very unlikely. In adders, both sexes have a characteristic zig-zag pattern down the back, orange-red eyes and a 'V' or 'X' marking behind the head (Speybroeck *et al*., 2016). Barred grass snakes are olive-green in colour with a yellow-white collar around the neck (Inns, 2009), although to complicate matters, some snakes lose this later in life. Barred grass snakes being mistaken for adders is a danger for both species. Adders are actively persecuted due to the fact some view them as 'dangerous' (or even 'evil') despite the fact that the harm or killing of our native snake species is illegal under the Wildlife and Countryside Act (1981). In the past, grass snakes have unfortunately been confused as adders in the gardens of Robinson College (Brown, 2014).

Another reason that members of the public confuse grass snakes with adders may be linked to their size. Adders are quite short and squat, usually growing to around 65 cm in length, whereas barred grass snakes may be over 150 cm in length (Speybroeck *et al*., 2016). There seems to be an intrinsic link in the minds of many between the overall length of a snake and how deadly it is to people or pets. Most encounters with snakes are also very brief, with the observer not always able to see the whole body of the animal thus leading to an over-estimation to the snake's size. The only adequate way of confirming snake records, given the mixed information usually accompanying such reports, is with photos. These do not need to be of professional standard: a quick snap of a snake is often sufficient to aid identification in terms of colour and form (which in most cases leads to the individual being identified as a barred grass snake).

The underbelly pattern of a grass snake can resemble that of an adder, with a black and white checker or zig-zag pattern (Inns, 2009), sometimes leading to confusion, if for example a snake has been crushed on a road. In this case, one tends to expect the top of the snake to be facing up but instead, the ventral surface of the snake is being observed. Barred grass snakes also feign death, in that when they feel threatened they act as if they have just spontaneously died (Inns, 2009). This often includes the excretion of a foul-smelling and foul-tasting musk: a party trick to be envied. During such an event of thanatosis, a barred grass snake may expose its belly, which can then be mistaken as the dorsal surface of the snake.

Barred grass snakes feed primarily on amphibians, whereas adders are known to feed on small mammals and birds (Inns, 2009). Despite this, barred grass snakes may take other prey items if the opportunity arises, as will adders. This means that people often encounter barred grass snakes when walking along rivers, when fishing or when looking in garden ponds. This swimming behaviour almost certainly rules out the observed snake being an adder, which are proficient swimmers but are averse to open water bodies. There have been reports of adders swimming across lakes or rivers but usually in response to dens or refuges flooding following heavy rains.

Both grass snakes and adders tend to be very calm, and adders won't bite unless they feel threatened. Even if bitten, you may not have been envenomated. Most adder 'bites' that are experienced by dogs throughout the country occur in the first few days of spring (extending into June) after adders have just emerged from hibernation (Sutton *et al*., 2011). This is when they tend to be most defensive as they focus on getting their core body temperature up to operational levels to produce venom and more importantly, sperm (Inns, 2009). A snake would not wish to waste a valuable resource such as venom on a potential predator such as a dog if it can slither away. It is more likely that 'snake-bitten' dogs (often with a swelling) have actually been stung by solitary bees or wasps in the undergrowth. Dogs should be kept on leads in areas where adders are known to live, for both the dog's and the adder's sake.

With all of the points above in mind, it is easy to see why some people mistake barred grass snakes for adders. A combination of factors lead to the misidentification of a snake which may have only been seen for a split-second before it slithered into the undergrowth. With populations of much of our once-common wildlife declining - including snakes and toads (Petrovan & Schmidt, 2016) - it has never been more important to collect accurate species distribution records so that we can try to track declines both spatially and temporally. It may also be the time to move away from the 'single species concept' in conservation and take a more holistic approach. Snakes currently suffer an image problem and the sooner we can educate people about the benefits of native wildlife such as adders, hopefully the sooner this issue will be reversed.

Left: Adder (*Vipera berus*)

Below: Barred Grass Snake (*Natrix helvetica*)

In the past, potential records of adders have been investigated with follow up surveys, often resulting in no sign of the snakes. However, other reptiles, such as barred grass snakes and slow-worms (*Anguis fragilis*), have been found on such surveys, sometimes in areas where reptiles haven't been recorded before. This means that the efforts of surveyors have not been completely wasted. Whilst I suspect that incorrect snake identifications will still be submitted to the Record Pool, iRecord and other such recording platforms, my hope is that through time we can increase the accuracy and reliability of such records, by better informing the public on the features and behaviours to use when identifying Cambridgeshire's snake species.

This unfamiliarity with snakes, and the fear over size and deadliness really comes to the fore when an escapee reptile brings media attention. Such was the case in June 2019, when a Reticulated Python escaped and was not found for 5 days. The reticulated python is one of the world's largest species of snake, growing to almost ten metres in length (Das, 2010) although the individual that escaped in Cambridge was approximately 2.7 metres. The species is found throughout south-east Asia. Reticulated python prey is killed by constriction and the diet varies from small birds to deer, depending on the size of the snake (Das, 2010). With a large and potentially dangerous snake on the loose, a large amount of hysteria and panic was published by a number of tabloid newspapers. Fortunately, the snake posed no threat to people for a number of reasons. was reported as a potential man-eater. There have been historic and contemporary reports of large snakes consuming humans as prey, but this is a very rare occurrence, the snake either has to be extremely large or the person has to be small. The Cambridge python would have likely only have been a threat to small animals such as chickens and rabbits, depending on when it last fed. As a captive snake, the python would have never experienced life outside of a vivarium. It is quite possible that the python therefore experienced a sensory overload of new feelings, sounds and smells that it wasn't familiar with. Twinned with the low temperatures at the beginning of July, this might help to explain why the python was recovered within mere metres of where it had escaped. The whole sensationalism of this story highlights the image problem snakes have. In Western cultures, they have been the symbols of evil for centuries but elsewhere in the world, snakes were worshipped as gods. Despite the fact snakes are vital parts of the ecosystem, they've been given an undeserved bad rap. This image that snakes are 'evil' and 'out to kill you' has unfortunately impacted their conservation.akes around the world are persecuted because they're seen as a threat and a danger, in some places this may be the case. However with the correct mitigation and education, people and snakes can exist in harmony with one another. Unfortunately populations of our native snakes are slipping away before our eyes (Gardener *et al*., 2019) and sensationalist journalism surrounding events like this are only going to exacerbate those problems.

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The ongoing monitoring of slow worms (*Anguis fragilis*) at Wandlebury Country Park

Steven J. R. Allain & Iain H. Bray

Introduction

The Cambridgeshire and Peterborough Amphibian and Reptile Group (CPARG) have led an ongoing monitoring project of slow worms (*Anguis fragilis*) at Wandlebury Country Park, Cambridgeshire (TL495535) since 2016, with surveys becoming more structured in 2017 (Allain *et al*., 2019). The slow worms were originally introduced to the site in 2006 from a site in Chelmsford, Essex (Allain *et al*., 2019). It is understood that they previously did not occur at the site and there are no previous records held for them by Cambridge Past Present and Future (CPPF), who manage the site.

As well as monitoring the health of the slow worm population, including evidence of breeding, CPARG has been trying to determine where else at Wandlebury the slow worms may have dispersed to, as the extent of their previously known occurrence was limited to the area where they were originally released. It is hoped that if they have spread, this will inform the management of additional areas of the site to further benefit the population and increase its resilience.

Slow worms are challenging to monitor due to their fossorial lifestyle, which often leads to detection rates being lower than that of other reptile species (Schmidt *et al*., 2017). The project is therefore important in contributing to the current knowledge and understanding of the species – especially through the use of standardised protocols. Research has shown that mitigation-driven translocations often fail (Germano *et al*., 2015), but there are very few cases where populations of slow worm have been monitored post-translocation (Platenberg & Griffiths, 1999). Our monitoring presents the opportunity to establish why this translocation was successful, in the hope of helping to increase the likelihood of such events elsewhere in the future.

Methods

In order to increase detection of slow worms, artificial cover objects (ACOs) were used. These are readily utilised by the species to bask beneath. In this case, ACOs in the form of 0.5m^2 pieces of roofing felt were laid down in the area of Wandlebury Country Park close to the release area (Allain *et al*., 2019), as well as in some surrounding habitat that was deemed as suitable but where they had not been previously observed. Surveys took place in the morning during April, May, June and August 2017, 2018, 2019, typically between 9 and 11am at least twice a month. To sample in the paddock, each of the felt tiles was lifted and any slow worms found underneath were captured. The paddock is an area that was previously grazed by sheep but has subsequently been left to become overgrown with areas of bramble scrub. If slow worms were found outside of the paddock, they were recorded but not handled. Surveys did not take place in July, during the time when pregnant slow worms were expected to be birthing, in order to reduce the impact of disturbance on the population; however, when resumed after this period an aim was to observe the emergence of hatchlings.

When slow worms were captured, they were first placed in a plastic container and transferred to an electronic scale (Metro Electronic MH-Series, 0.1g accuracy up to 200g) and the mass recorded. They were then photographed, with a sponge used to help restrain them whilst being inverted to photograph the underside; although in later surveys it was determined that this was not necessary in order to determine the overall length of each individual (Bray & Allain, 2019). The open source software ImageJ was used to measure the length of slow worms, based on the photographs taken.

Results

During the three years of monitoring between 2017 and 2019 a total of 195 slow worm observations were made in the known release area; of which 35 were adults (with a snout-to-vent length (SVL) over 120mm) and 126 were juveniles. The mean adult recording rate remained relatively constant over this period, at between 1.9 and 2.1 individuals per survey.

The extended survey within the adjacent field, which commenced in 2019, recorded a total of eight observations, with the furthest record from where the slow worms were originally released being approximately 300m. The

numbers of slow worms found were relatively low compared to the release site, with a total of four adults from 50 ACOs being found, compared to 12 adults from 15 ACOs in the same year, respectively.

Discussion

The number of adult slow worms observed between 2017 and 2019 indicates that the population was relative constant over this period. Given the number of immature animals recorded and the time elapsed since their original release, it appears the population is now likely self-sustaining. This is very encouraging given the relatively small founding population (Allain *et al*., 2019). Our next steps are to try to establish why the introduction has been successful so that guidance can be given to the wider community on how to translocate reptiles and ensure their survival. Often with translocations hundreds of individuals are moved before a very small population is established, due to factors such as dispersal and high mortality rates (Sullivan *et al*., 2015). In this case it seems that the relative isolation of the slow worms were enough to ensure its longevity and success, despite the small founding population.

Evidence of slow worm dispersal elsewhere within Wandlebury Country Park is encouraging, as a more extensive population will make it more resilient to possible changes in habitat, predation or disease. The known release site, which appears to be the population stronghold, is currently managed primarily for slow worms, with restricted access and sensitive management which has included selective scrub clearance undertaken by CPARG during the winter of 2018/19. It is within this stronghold that gravid females and hatchlings have been observed throughout the monitoring period, indicating that it may also act as a nursery. The behaviour of slow worms is not fully understood due to their fossorial lifestyle and that fact they can be a challenge to survey. If the release site is acting as a nursery or crèche, then we believe this is the first time that this behaviour has been recorded in this species.

It is hoped that further information on slow worm dispersal will help inform habitat management decisions in other areas of the park, which will potentially benefit the slow worm population and aid further dispersal. Future surveys planned by CPARG over the coming years aim to reveal whether the slow worms have colonised areas further away from the release site than is currently known, as well as building a clearer picture of the demography and size of the population.

Acknowledgements

We thank Ed Wombwell for the ongoing cooperation between the Cambridgeshire and Peterborough Amphibian and Reptile Group and Cambridge Past, Present and Future that has allowed this project to continue. We also thank our many field assistants for giving their spare time to help survey for the slow worms at Wandlebury.

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Impact of bat friendly lighting on bat activity and bat species diversity at Coe Fen and Sheep's Green, Cambridge.

Johanna Chesham

This article is a summary of a larger research project as part of a Postgraduate Certificate in Ecological Survey Techniques at University of Oxford.

Introduction

Humans increasingly demand areas with artificial light 24 hours a day, which has consequences on many species. In all cases, there is a balance to be achieved between human need and conservation. Artificial light at night is a global anthropogenic phenomenon that is estimated to be increasing at around 6% a year (Hölker *et al*, 2010). Light pollution in the UK is particularly a problem for nocturnal species such as bats and it is important that, before any light is added or changed, the area is assessed for usage by these protected species (IOLP, 2018). The impacts following such installations should be monitored. Studies have shown a decrease in both bat activity and species diversity due to light pollution, influencing foraging, roosting, drinking, commuting and migration (Hale *et al*, 2015, Russo *et al*, 2017, IOLP, 2018, Rowse *et al*, 2018 and Voigt *et al*, 2018). Recently bat friendly lighting has become available and studies are required to confirm these claims. This study investigated the impact of bat friendly cycleway lighting on bat activity and species diversity in two inner city local nature reserves in Cambridge.

Study Site

Coe Fen and Sheep's Green are adjoining Local Nature Reserves situated on the west side of Cambridge, OS grid reference TL447575. Designated as City Wildlife Sites in 1996 they are surrounded by roads and buildings just minutes from the city centre. Habitats on site include parkland, trees, hedgerows, running water and grassland. Both are managed by Cambridge City Council to encourage biodiversity and maintained as a water meadow habitat with natural periodic flooding. Consisting of species-poor semi-improved grassland the sites are conservation grazed by cattle or sheep to increase the biodiversity. There are a number of veteran willow trees providing great potential for tree roosting bats and hosting many other species of wildlife. The adjoining riparian sites are important for herons, kingfishers and egrets and has seen a notable increase in water vole abundance. The overall site has a shared footpath/cycle way through it which is a key off road cycling route for the city.

Background bat data

Background data on bat species recorded in and around the site area were obtained from the Cambridge and Peterborough Environmental Records Centre dating back to 1985 and Cambridge Bat Group records spanning the past 5 years. Biological records are limited in the area, and no comprehensive surveys have been carried out with the exception of a study of winter activity of pipistrelle species at Coe Fen by Avery (1985). Species recorded during the past five years within 2 km of the site included *Pipistrellus pipistrellus, Pipistrellus pygmaeus, Plecotus auritus* and *Myotis daubentonii.* In addition *Eptesicus serontinus* has been recorded back to 1986, but none within the past five years.

Cycle way lighting

After careful consideration and a public consultation in early 2017, Cambridge City Council addressed the human need for cycle way lighting against conservation need by commissioning installation of environmentally friendly low cost Solareye®80 stud lights along a 0.9 km strip from Sheep's Green through to Coe Fen. These Solareye®80 lights provide a level of lighting improving cycling safety whilst greatly reducing light spill. In addition "bat hats" were fitted to reduce the upwards light spillage by 98% avoiding disturbance to bats on site (Figure1). Concerns over the effectiveness of the product in terms of bat friendliness resulted in a decision not to have any solar studs over the bridge

Figure1 light with Bat Hat

across the River Cam between the two sites leaving a darkened area where the bats, particularly *M.daubentonii,* are known to feed. Installation of the solar studs commenced on 13th June 2017 .

Study objectives and research questions

This study investigated what impact the lighting had on bat activity and species diversity using echolocation data passively collected pre and post installation of the lighting. Actively collected data from surveys on site assessed species using the site and their spatial location in reference to the lighting. Analysis of the resultant data will aid management decisions promoting conservation of the habitat on site for these species.

Research questions:

Has the installation of the cycle way lighting impacted on bat activity on the site?
Has the lighting changed the species diversity of the bats on the site?
Which species are utilising the site currently and where?

Methods

No licence was required for this research as no bats were caught and disturbance to their habitat was kept to an absolute minimum; all echolocation calls (EC) were recorded without light.

A frequency division static detector was deployed on a poplar tree located beside the cycle way at around 3 m in height for 7 nights in May 2017 and then again on the same tree and same position for 7 nights in May 2019 to passively record EC. The detector was set to night only recordings from 30 minutes prior to sunset to 30 minutes post sunrise. Temperature was also collected by the detector and compared to that collected at the weather station at the University of Cambridge Computer Laboratory just over 2 km from the site (Digital Technology Group, 2019).

In 2019, two transects, one through Coe Fen and one through Sheep's Green were walked with 6 point count locations, designed to achieve maximum coverage of the differing habitats with minimal overlap and relative accessibility (Figure 2). Point count locations were stratified to incorporate the various habitat types in each nature reserve and demarked using glow in the dark tape to facilitate accurate recording positions at night. Bat Conservation Trust guidelines (Collins, 2016) were followed; dusk surveys started at sunset on 8 survey nights throughout May 2019 to determine bat activity and species diversity across the sites. The first transect began at sunset and the second was walked immediately after it. To eliminate bias the order of the two transects alternated on each survey.

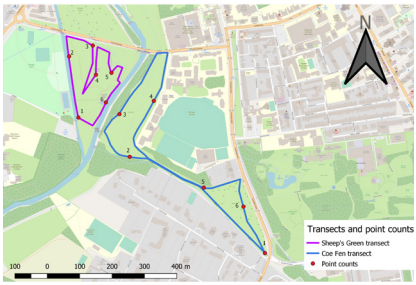

Figure 2. Map of transect routes and point count locations, mapped in QGIS 3.2 (Chesham, 2020)

Optimal survey weather conditions were a minimum of 10°C at sunset, no rain or strong wind (Collins, 2016). Field observations of bats in flight on transect were confirmed by recording and listening to them using a Heterodyne detector This approach allowed the collection of both qualitative and quantitative data. Transects were walked at a slow steady pace of 3-4 km/hour and at point counts data was recorded for 3 minutes. All observations were of species, peak frequency heard and behaviour e.g. feeding/commuting/circling.

EC from the static detectors were manually identified and labelled in ANALOOKW (Corben, 2009) using guidance from Russ (2012). With the exception of the *Myotis* species all were identified to species level. Data from the field surveys were subsequently analysed using Kaleidoscope (Wildlife Acoustics, 2019). Environmental variables were investigated to confirm if the weather was comparable between the two sampling periods. Data from point count and walked transects were pooled due to the sites being adjoining and the bat species present would commute across both areas. Point count locations and transect segments were allocated to groups; habitat classifications (near water, open pasture or trees/hedgerows), containing lit cycleway or not, and whether

impacted by other Artificial Light At Night (ALAN) such as street lighting or the canoe club lighting. An Activity Index (AI) (Miller, 2001) was used to calculate a measure of overall activity and then for a species, presence across individual time blocks. The data was collated into 30 minute time blocks and AI was calculated using the equation below by summing the (n) of time blocks for the EC/species present (P*) and dividing that by the sampling effort (e) in total time period data was collected. $AI = \sum_{e}^{n} P *$

This measure of bat activity is not affected by the numbers of individuals present per time block and therefore reduces the influences of individuals repeatedly circling the detector. Circling behaviour can artificially inflate bat pass numbers as can the patrolling behaviour of pipstrelles (Skalak *et al*, 2012).

Results

Bat activity

Comparing pre and post installation showed increased overall numbers of recorded bat passes, 1076 in 2017 and 1692 in 2019, and an increase in species from 4 to 8. There was no significant difference in total bat activity prior to and post installation of the lighting.This suggests that bat activity is independent of the installation of the cycle way lighting and has not been adversely affected.

Despite there being no significant change in overall bat activity, where possible EC identified to species and genus level were investigated to see whether there was any impact on the activity of different species per night. There was a trend towards an increase in number of different species detected per night post installation of the lighting with AI calculated mean of 4.14 as compared to 3.14 prior, however the association was not significantly different (X^2_6=1.005, P=0.9854). This would suggest that the activity of individual bat species/genus identified is also independent of the installation of the cycle way lighting and not adversely affected.

Bat species diversity

Three species and one genus were identified prior to installation of the lighting; P*ipistrellus pipistrellus, Pipistrellus pygmaeus, Nyctalus noctule* and *Myotis* species. Post installation the former four along with *Myotis daubentonii, Pipistrellus nathussii, Eptesicus serontinus* and *Barbastella barbastellus* were recorded. The number of species identified post installation was double albeit at low frequency.

To compare the relative frequency of bat species/genus composition over the two sampling periods total EC per group were plotted (Figure 3). For data post installation *M.daubentonii* was incorporated into the Myotis species group whereas *P. nathussii, E. serontinus* and *B.barbastellus* together were categorised as other.

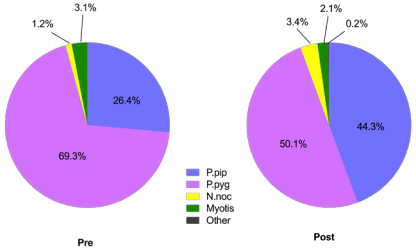

Figure 3. Relative frequency of bat species/genus composition

Pipistrelle species accounted for 95.7% of all bat passes identified prior to lighting installation and 94.4% post installation. To investigate the proportional changes in frequency of *P. pipistrellus* and *P. pygmaeus* the total EC identified were analysed and found to have a highly significant difference when comparing the two sampling periods (Fishers exact test, P<0.001,) (Figure 4). The *P. pipistrellus* frequency increased three fold following installation of the lighting.

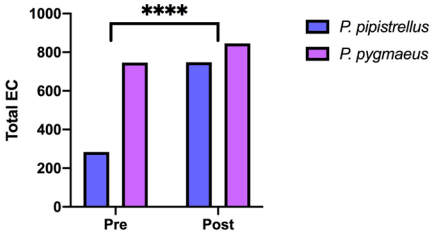

Figure 4. Frequency distribution of *P. pipistrellus* and *P. pygmaeus* EC pre and post lighting installation

Transect and point count surveys

There were 8 species in total identified, 5 of which were observed on both transects, with the addition of *M. daubentonii* and *E. serontinus* on the Sheep's Green transect, Table 1. However both *M. daubentonii* and *E. serontinus* had been identified at Coe Fen with the static detector during the same period.

Species	Coe Fen transect		Sheep's Green transect	
	n	%	n	%
Pipistrellus pygmaeus	172	59.7	161	60.1
Pipistrellus pipstrellus	91	31.6	90	33.6
Pipistrellus nathusii	3	1	1	0.4
Nyctalus noctule	15	5.2	7	2.6
Myotis daubentonii	0	0	3	1.1
Barbastella barbastellus	2	0.7	1	0.4
Plecotus auritus	1	0.3	1	0.4
Eptesicus serotinus	0	0	1	0.4
Unidentified pipistrelle	2	0.7	2	0.7
Unidentified bat	2	0.7	1	0.4
Total EC	288		268	
Total species identified	6		8	

Table 1. Summary of species of bats recorded on transects (n=number of passes)

Mean number of bat passes heard per survey night was 57.1 passes which equates to approximately 0.66 bat passes per minute. This was calculated taking only one bat pass per species per minute (unless more than one was visually observed) to prevent duplicating counting of circling bats.

Utilisation of the site by species

P. pipistrellus and *P. pygmaeus* were found to be present on both transects and identified at every point count location and walked transect segment during the eight survey nights. *N.noctule* was also located frequently on both transects. The frequency of the remaining five species was lower in the sampling period, mapped from GPS into QGIS to visualise (Figure 5).

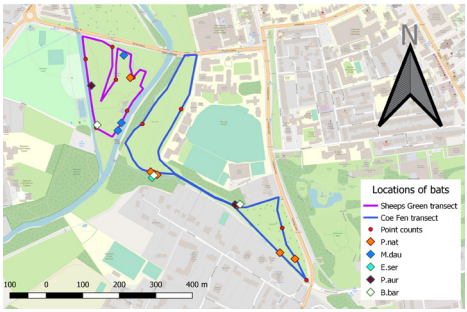

Figure 5. Spatial location of less frequently observed bat species

Bat activity by habitat

No significant difference in the use of the three different habitats by bats was found.

Bat activity by lighting

Bat activity in relation cycle way lighting or other ALAN was investigated designated as presence or absence of ALAN for each transect segment with an adjustment to calculate mean EC per 100 m transect to allow for the differing transect segment lengths. There was a trend towards lower EC counts per 100 m 9EC/100 m for ALAN impacted segments and 12EC/100 m for dark segments however this was not significantly different.

Discussion

Artificial night at light (ALAN) is a growing threat to biodiversity with around 30% of all vertebrates and over 50% of all invertebrates being nocturnal (Hölker *et al*, 2010) thus it has the potential for immense impact. City wildlife sites are heavily impinged by ALAN as human populations expand and encroach closer to local nature reserves. Ensuring a balance between safety and accessibility for humans in urban environments whilst maintaining a haven for nocturnal wildlife is a delicate undertaking. Cambridge City has one in three residents choosing to cycle to work (Cambridge City Council, 2018) thus safety and accessibility is paramount to encourage this pollution free mode of transport.

Data recorded prior to and post installation of the cycle way lighting did not show any significant difference in relative bat activity. There was no significant difference of numbers of species identified per night between the sampling periods. The actual numbers of species prior to the lighting were half that of those post lighting,

albeit at a low frequency. However there was a very significant proportional change in distribution between the *P. pygmaeus* and *P. pipistrellus* with the latter species having a threefold increase in numbers since following installation of the lighting. An almost equal distribution of these two pipistrelle species located at the cycle way was observed in May 2019. This was very different to data from the transects that consistently demonstrated frequency of *P. pygmaeus* was double that observed of *P. pipistrellus.* A factor not addressed in this study was the growth and structure of vegetation located near to the static detector as there were no records of the vegetation in the original sampling period to compare to. However vegetation may have had an impact on the observed proportional increase in frequency particularly as recently Lintott *et al.* (2016) found that *P. pipistrellus* had a strong negative response to increasingly urbanised areas. Growth of vegetation and therefore connectivity in the immediate landscape may have allowed a more protective local habitat from the urbanisation surrounding the area.

Active transects and point counts provided information on bat species in the area at a landscape level with reference to the habitat type, cycle way lighting and relative impact of ALAN. No differences were found in bat activity for any of these factors. Eight individual bat species and one genus were located active over the site. Species considered more light opportunistic such as *P. pipistrellus, P. pygmaeus* and *N. noctule* were commonly encountered all over the site where as *P. auritus* and *E. serontinus* rarely observed. *M. daubentonii* was not frequently recorded due to the transect lay out in assessing the cycle way, however they were observed at high numbers feeding along the River Cam between the two transects during survey nights. Whereas *P. nathusii* and *B. barbastellus* had not been previously recorded for this area. These species were actively recorded on both transects and on the single static detector; deploying further static detectors on site in differing locations would provide a more comprehensive insight into both their status in the area, as well as addressing abundance of other less frequently recorded species.

Conclusions

The diversity of the bats present at Coe Fen and Sheep's Green was found to be greater than previously reported thus the important objective of preservation of suitable habitat on both sites for these species has been achieved. The new survey results suggests that the cycleway lighting installed has had no adverse effect on bat species or bat diversity despite a proportional change in frequency observed between *P. pipistrellus* and *P. pygmaeus*. Eight individual species and one genus were identified as active on site, a good representation of the 11 species we have in Cambridgeshire. This information aids in conservation management of the site to protect these species. The interesting observation of an under recorded species (*P. nathusii*) warrants further investigation. In addition further monitoring would also provide an more comprehensive insight into the relative abundance of the lesser recorded species found present in this study such as *P. auritus, B. barbastellus* and *E. serontinus*. Conservation of habitats suitable for bats within cities requires knowledge and understanding of how to manage ALAN in these type of environments (Voigt *et al*, 2018). This study supports that view and emphasises the need for surveys before and after any planned works.

Acknowledgements

I would like to thank Dr Ada Grabowska-Zhang, University of Oxford for project support and advice. I am extremely grateful to Guy Belcher and Victoria Smith of Cambridge City Council for allowing permission to survey the sites and equipment. I would also like to thank Cambridge Bat Group for advice and background data on bat species in Cambridgeshire.

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A recent arrival: the Violet Carpenter Bee

Stephen P. Tomkins

The Violet Carpenter Bee (*Xylocopa violacea*) has not featured previously in this journal. It deserves mention, firstly, as it is a new large and visually striking insect similar to a bumble bee which, once seen, is instantly recognisable as distinct and different. Secondly, in this County it was first recorded in 2003 and had somehow escaped inclusion amongst our Cambridgeshire v.c.29 listed species of true bees (Apidae). Thirdly, *Xylocopa violacea* may now be resident in Girton parish just outside the edge of Cambridge City. It might well be more widely encountered once observers are on the look-out for this large and solitary bee.

Nick Owens currently keeps the record of all Cambridgeshire Apidae. He has now confirmed that this is a new genus for our vice county list. Some 31 species of true bees have been added to this list (n=136) since the year 2000, so the county is generally well recorded. We are fortunate to have a great diversity of these insects; it is notable that some 70 species of bees have been recorded in the Cambridge University Botanic Garden alone (N. Owens, pers. comm.). For an introduction to the whole of the Apoidea see Falk & Lewington (2015).

Where is this newcomer from? Carpenter Bees are in a single worldwide genus with, amazingly, more than 400 species in total. Their name comes from their habit of nesting in burrows that they cut in old or rotten timber—xylokopos being Ancient Greek for a 'wood cutter'. They have stout mandibles and may bite their way into flowers to access nectaries, though they clearly favour large open-faced flowers. *Xylocopa violacea* is a solitary bee, but may nest eusocially (with sister bees laying eggs in the same wooden gallery of a log or tree trunk). Adults are either laying females or males—with no sterile caste of workers. Only a few dozen large 'cells' are excavated and the larvae are well provisioned with pollen collected by the females (see front cover). This is a very large species 25—35 mm in length, glossy black all over and with sparse black hairs. The wings are opaque and dark brown but in the sunlight have a stunning violet iridescent sheen. The Violet Carpenter Bee is widespread and common in France.

That they are very common in the South of France is significant to this story. Philip H. Oswald, a well known botanist (and former editor of this journal) recounts that he had holidayed frequently in France and therefore knew it well. He first observed one here in the front garden of his former home in Panton Street on 23 March 2003, where an individual (possibly an early-hatched male) was visiting trumpets of Narcissus 'February Gold'. He duly registered this novelty with the Bees, Wasps & Ants Recording Society (BWARS). No other Cambridgeshire records were made until 2019. According to the National Biodiversity Network (NBN) the earliest UK record was in 1987 from the Suffolk coast. Subsequent records (n=31) are from a wide range of counties. Oswald's record was not put on the NBN list. BWARS has not produced an account for this species, but does map a similar number of records (including Oswald's) principally from the southeast of England.

Whether these records of *Xylocopa violacea* are vagrant, migrant or truly resident is harder to tell. Clearly many might be non-resident as they fly fast and strongly. Unsurprisingly most UK records are for summer months. There is only one clear record of breeding, in Leicestershire, in 2006 (BWARS, 2007). The Girton village records are all from between summer 2019 and February 2020 and all from within a 200-metre radius of one spot on the 'Thornton' estate. I am confident that I saw this insect for only seconds in the summer of 2019, but I did not know its identity and having no photograph as evidence let it pass. However, Alice Few, living nearby, recorded it first on 21st June. It revisited her garden several times and her husband managed to photograph it on 6th July. From this she managed, using an online photographic bee ID guide, to pin its identity down to *Xylocopa*. James de Winter, another near neighbour, who writes the Girton Parish magazine 'Nature Notes' agreed with this. On 2nd August Roger Few took a much better picture of the same insect (see front cover), which Louise Bacon initially and then Mike Edwards (BWARS) kindly confirmed to be *Xylocopa violacea*. This was clearly a female, gathering both copious pollen and nectar from the Broad-leaved Everlasting-pea, *Lathyrus latifolius*. James de Winter took more pictures on 29th September of the same female now feeding in his garden on *Salvia*

uliginosa (Figure 1). That these are all the same insect over a period of 14 weeks is very likely, as the similar fraying pattern of the wings suggests this.

Finally, I photographed a single insect of this species in my garden, in the same small area, on 3rd February 2020. This was on a relatively warm day at 9°C. It was nectaring on pansies (*Viola* cultivar). This individual, identified as a male by its buff-yellow antennal tips (Edwards and Eversham, pers. com.), by contrast had completely unfrayed wings and so may have been newly hatched (Figure 2). The probability that this species is breeding locally is thus high but is unproven still. Brian Eversham commented that this species is known to breed in old fruit trees. The Thornton area was built on old Chivers' orchards and there are many old trees in gardens, so this is a distinct possibility. I am grateful to Louise Bacon, Brian Eversham, Rosie Earwaker, Nick Owens, Mark Hill and Mike Edwards (of BWARS) for their help and to Philip Oswald, Alice and Roger Few and James de Winter for their well documented observations.

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Figure 1. Female *Xylocopa violacea* feeding on *Salvia uliginosa*. Photo by James de Winter.

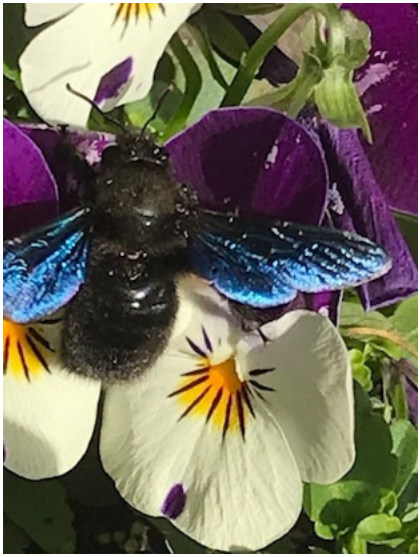

Figure 2. Male *Xylocopa violacea* on winter pansy. Photo by Stephen Tomkins.

The story of Arthur's Meadow

Philip H. Oswald (with major contributions from Lynne Farrell)

Historical introduction

In 1978 I was working at the Nature Conservancy Council's offices in Huntingdon, so I travelled on most days along what was then the A604 (now the dreaded A14). One morning in the spring of that year I noticed that a small field on the left of the road was a spectacular yellow colour, so I decided that I must investigate it on my way home. In those days it was still possible to cross the road in one's car, so I duly did so and to my delight found a small ridge-and-furrow meadow full of flowering Cowslips (*Primula veris)* with Green-winged Orchids (*Anacamptis morio*). In the far south-west corner I also discovered just a few Twayblades (*Listera ovata*) and Common Spotted-orchids (*Dactylorhiza fuchsii*).

In the north-west corner of the field, close to the road, was a caravan, from which emerged an old lady, who proved to be friendly and indeed interested in the flora of the meadow. It transpired that she had come from Canada to Norfolk as a young woman and married a local farm hand, who, when the Second World War began, was drafted to work for the War Agricultural Executive Committee (commonly known as "the War Ag.") in Huntingdonshire instead of military sevice. (Every county had such a committee to determine wartime land usage: it was responsible for deciding which crops should be grown to feed the blockaded British Isles, but its most immediate task was to oversee a plan to increase the arable acreage of the country by identifying land that could be ploughed up, sometimes for the first time ever.) The young man, no doubt in the course of his work, discovered this hedged field which was too small to be worth ploughing up and was able to buy it and put a caravan on it for him and his wife to live in. After the war they decided to stay in Hunts and hoped that they could build themselves a house on their plot. In 1947 the Town and Country Planning Act was passed, making it necessary to obtain planning permission for such development, which was refused in their case; however the caravan was already on the site and unaffected by the new legislation, so the couple had continued to live in it ever since. Periodically they used to borrow a cow from a neighbouring farmer to graze the meadow after the hay had grown up. (See also below.)

Next day at the office I spoke to Chris Shaw, the Assistant Regional Officer for Hunts, and discovered that the late Terry Wells (then of the Institute of Terrestrial Ecology) had told him about the meadow, saying that it was of highest importance, and how he was cultivating the old lady, who had agreed to give the Bedfordshire and Huntingdonshire Naturalists' Trust the first chance to acquire it if she and her husband decided to sell it. Chris was not making it an S.S.S.I. in case this would alienate the couple, Mr and Mrs Brock, who understandably had strong views about the planning system! In any case the system had already been protecting the site against development ever since 1948. After that I used to visit the meadow from time to time – on one occasion to report that a borrowed cow had broken through the hedge and was half a mile along the road in an arable field! I was always welcomed by Mrs Brock, though her husband was never friendly.

My uncle, Arthur Stanley Oswald (1904–1979), lived at Rosslyn House, Dormansland, Surrey, where he fostered the populations of four species of orchids growing in the grounds of the house – Common Spotted-orchid, Twayblade and on the lawn, which was unfertilised and never weed-killed, Autumn Lady's-tresses (*Spiranthes spiralis*), as well as the only remaining Green-winged Orchids in the village – the last in his orchard, which he successfully defended against the threat of a compulsory purchase order to build new houses. When he died in 1979 he appointed his sister Eileen (1912–1982) and me as his executors. She decided to sell the house and move to a smaller one with a friend, so I reluctantly had to agree to what I knew would be the death knell for Arthur's orchids: sure enough several houses were built in the orchard not long after! I realised that three of the four orchid species growing at Rosslyn House also grew in the meadow by the A604, and so I told the Beds & Hunts Trust that, if it became available, I would buy it for them in my uncle's memory with some of my inheritance from him.

During the winter of 1982/83 Mrs Brock died unexpectedly and, before Terry Wells, the Beds & Hunts Trust or I knew anything about it, Mr Brock had instructed his son to sell the meadow to a Mr Webb of Earith. Fortunately

he agreed to sell it to the Trust for £5,000 plus his solicitor's fees of £175, substantially more than he had paid just a few weeks previously! I agreed to contribute £4,290 (including tax refunds), the World Wildlife Fund gave a grant of £1,250 and Huntingdon District Council donated £500, so the Trust had some additional funds for initial management costs. Initially wishing my gift to be anonymous, I agreed with the Trust that the new reserve, acquired on 9 February 1983, should be called simply Arthur's Meadow.

Descriptions of the meadow and its flora and fauna

The first description of the meadow was made by Terry Wells on 2 May 1981 (Wells, 1981). He wrote (with plant nomenclature updated and some English and Latin names added): "The field is lightly grazed by horses and cut for hay. … The field is rectangular in shape and surrounded on all sides by hedges, mostly of Hawthorn (*Crataegus monogyna*), but also containing Field Maple (*Acer campestre*), Blackthorn (*Prunus spinosa*), Elder (*Sambucus nigra*) and Ash (*Fraxinus excelsior*). The hedge on the west side is left tall and unmanaged. The field is undulating, with a hint of ridge and furrow – there are certainly low-lying areas which after the heavy rains had water in them. Although the soil is gravelly, there is also some clay and the vegetation in these wetter areas is indication of permanent wetness – e.g. Cuckooflower (*Cardamine pratensis*), Hard Rush (*Juncus inflexus*) and Tufted Hair-grass (*Deschampsia cespitosa*). The grassland consists of an intimate mixture of grasses, sedges and herbs. Sweet Vernal-grass (*Anthoxanthum odoratum*), Meadow Foxtail (*Alopecurus pratensis*), Red Fescue (*Festuca rubra*) and Meadow Fescue (*Schedonorus pratensis*) are most common, with patches of coarser Tall Fescue (*S. arundinaceus*). Yellow Oat-grass (*Trisetum flavescens*) and Downy Oat-grass (*Avenula pubescens*), with a little Quaking-grass (*Briza media*), were detected in a vegetative condition, and no doubt other grasses will be found later in the year. 61 species of flowering plants were recorded and the meadow is rich in dicotyledons. Common Knapweed (*Centaurea nigra*) is prominent, with Rough Hawkbit (*Leontodon hispidus*), Oxeye Daisy (*Leucanthemum vulgare*), Lady's Bedstraw (*Galium verum*) and three species of buttercups (*Ranunculus*). Yellow-rattle (*Rhinanthus minor*) was abundant in the heavily grazed areas. Of special interest is the occurrence of three species of orchid, Green-winged Orchid (*c.* 20 in flower), Twayblade (*c.* 30 seen) and Common Spotted-orchid (*c.* 10 seen). This combination of orchids is unusual for this part of England and probably reflects special soil and drainage conditions; c.f. Upwood Meadows with only 1 species of orchid [Green-winged Orchid]." It is surprising that this account makes no mention of the abundant Cowslips or of any named species of sedge.

Thirty years later, in 2011, Lynne Farrell, who was Honorary Warden from 2008 till 2016, wrote (with minor alterations): "Common Knapweed is an important late nectar source, along with Marsh Thistle (*Cirsium palustre*) and Common Fleabane (*Pulicaria dysenterica*), for hoverflies, bees, wasps, butterflies, moths and beetles. … In 2010 the old, rambling hedge along the western boundary was partially cleared and restocked with locally grown, native Hawthorn saplings. Consideration will be given to management of the other hedgerows in the coming years, but the tall hedge beside the A14 will be maintained for aesthetic purposes and to restrict the noise and pollution levels."

A fuller description of the meadow was included by Lynne Farrell in an account of its orchid species (Farrell, 2016a). She wrote (again with minor alterations): "Arthur's Meadow is a Site of Special Scientific Interest (S.S.S.I.) and a Wildlife Trust reserve, even though it is just 0.67 hectares in extent. It is situated on the south side of the A14 in the parish of Hemingford Grey at TL292.692. The main interest is botanical and it also supports a good range of insects. In terms of the National Vegetation Classification (Rodwell, 1992) it is best described by MG5 grassland, Crested Dog's-tail–Common Knapweed (*Cynosurus cristatus–Centaurea nigra*) type (Farrell, 2010). The meadow is bounded by hedges, mainly Hawthorn interwoven with Bramble (*Rubus fruticosus* agg.) and some Ash standards (Farrell, 2011). The site is one of the surviving examples of ridge-and-furrow meadows, which were once fairly well scattered throughout the county but of which few now exist. It is species-rich with examples of plants that grow in the slightly wetter conditions in the furrows and the drier areas on the ridges themselves. … For many years the site was lightly grazed by a few cattle or the occasional pony, but in recent years this has not been possible, largely owing to the problem of access, as the meadow is immediately adjacent to the busy A14 road. It is now mown annually by a Wildlife Trust contractor, usually between mid July and mid September. This is dependent on the state of the ground. If it is too wet damage will be caused by the

heavy machinery. The cuttings are then removed in order to prevent the build-up of dead plant material, which would suppress renewed growth. Ideally, the cut should be made in late August when the orchid capsules have dehisced and many of the other flowering plants have also shed their seeds and started to die back. … The meadow was notified as an S.S.S.I. in 1984 as an example of the calcareous clay pasture type, declining in the south of Britain. In recent years it has been assessed [by Natural England] as being in unfavourable condition, mainly owing to lack of appropriate grazing and with the increase of some more vigorous species such as Meadowsweet (*Filipendula ulmaria*) [photo inside back cover] and False Oat-grass (*Arrhenatherum elatius*). … Until the A14 is realigned (proposed over the next 10 years) and grazing animals can be put on to the meadow again, mechanical cutting is the only practical management option at present."

Lynne Farrell (2016b) wrote that it was agreed with Natural England that from 2017 the meadow should be cut in late July or in August with an additional cut later around the edges to contain the vigorous growth of Meadowsweet. For the first time in many years Natural England decided that the S.S.S.I. was in favourable condition. Sarah Orbell (2018) again mentioned the areas of Meadowsweet, which she had discovered from "maps from 2000" were much smaller at that time; she hoped that "cutting back the encroaching hedge-line in autumn 2018" would enable "easier cutting of some of these areas of Meadowsweet too".

The fauna of the meadow is not as well recorded as its flora. Derek Wells and I recorded a Small Copper butterfly (*Lycaena phlaeas*) on 22 May 1981. Six-spot Burnet Moths (*Zygaena filipendulae*) can often be seen resting on flower-heads in July and August (Farrell, 2011). Lynne Farrell (2013) recorded four species of butterflies, Meadow Brown (*Maniola jurtina*), Green-veined White (*Pieris napi*), Small Tortoiseshell (*Aglais urticae*) and Peacock (*Inachis io*), and four species of dragonflies, Brown Hawker (*Aeshna grandis*) and Common Blue Damselfly (*Enallagma cyathigerum*) in July 2013 and Migrant Hawker (*Aeshna mixta*) and Common Darter (*Sympetrum striolatum*) on 1 September 2013. Leaf mines were collected on 8 November of the same year; eight species were identified by Barry Dickerson, one a new record for the tetrad. In 2016 Sarah Orbell and Lynne Farrell found a Wasp Spider (*Argiope bruennichi*) in the meadow, confirmed as only its second site in Hunts by the local recorder, Ian Dawson (Farrell, 2016b). Sarah Orbell (2019) lists seven further butterflies (as well as Small Copper, Green-veined White and Peacock again) – Brown Argus (*Aricia agestis*) on 4 May, Red Admiral (*Vanessa atalanta*) and Holly Blue (*Celastrina argiolus*) on 12 May, Orange-tip (*Anthocharis cardamines*) and Brimstone (*Gonepteryx rhamni*) on 12 and 20 May, and Large White (*Pieris brassicae*) and Common Blue (*Polyommatus icarus*) on 20 May – and two moths, Mint (*Pyrausta aurata*) on 12 May and Burnet Companion (*Euclidia glyphica*) on 20 May, as well as Large Red Damselflies (*Pyrrhosoma nymphula*) on 12 and 20 May and Azure Damselflies (*Coenagrion puella*) on 20 May (in addition to Common Blue Damselflies).

The following species of birds were recorded by Iain Webb on 11 April 2001: Blackcap, Robin, Long-tailed Tit, Great Tit, Blue Tit, Wren, Chaffinch and Goldfinch. Rosie Earwaker saw a Red Kite on 4 May 2015. Roger and Sarah Orbell added Mistle Thrush and Greenfinch in 2018 and Wood Pigeon, Skylark, Whitethroat, Willow Warbler and Blackbird in 2019.

Lynne Farrell (2011) wrote (with Latin names added): "Rabbits (*Oryctolagus cuniculus*) are being controlled as they have reached high numbers and they are constantly digging burrows in the meadow. … Molehills (of *Talpa europaea*) too are very noticeable, especially after winter frosts, but the soil on the mounds provides a good area for seed germination." On 5 August 2016 Lynne Farrell disturbed a Muntjac (*Muntiacus reevesi*) while walking through the tall vegetation (Farrell, 2016b).

Plant species lists

It seems that Terry Wells made a full plant species list on 2 May 1981, since he mentions "61 species of flowering plants", but that it has not survived; however 24 of the species named in Wells (1981) are listed in the B.S.B.I.'s Distribution Database (DDb), including eight grasses but no sedges, five species from the hedges, all three of the orchids known at the time and *Ornithogalum umbellatum* (originally recorded by him on a Biological Records Centre pink card on 2 June 1976 as "2 groups, possibly planted"). Other species recorded by Terry Wells on pink cards on 2 June 1976 include Yellow-rattle and Downy Oat-grass (both "plentiful") and Adder's-tongue

(*Ophioglossum vulgatum*) as "1 plant with sporangia" (though on 16 June 1984 he recorded this little fern as "frequent, many plants with sporangia"). Two multi-species record cards do survive from before the time that the Trust acquired the meadow – the first filled in by Derek Wells and me on 22 May 1981 and the second by Terry Wells during a field visit by the Huntingdonshire Fauna and Flora Society (H.F.&F.S.) on 16 June 1984. The former comprises 65 species and the latter 95 species (including nine from the hedges); 58 species are in both lists. The DDb file includes records of 68 species made by the late Tony Balbi, who was formerly Warden of the Wildlife Trust reserve High Wood and Meadow in Northants and also carried out surveys for the Wildlife Trust in the late 1990s; all of these were made on 23 May 1999 (including all four of the orchids known at the time, 15 grasses and two members of Juncaceae, but no sedges, and only five species that had not been recorded previously). Interestingly, among 48 species recorded by Nick Millar of the Wildlife Trust a week earlier, on 16 May 1999, 42 are also recorded by Balbi, but Millar added three sedges, two additional grasses and Lesser Celandine (*Ficaria verna*); smaller numbers of records are attributed to other recorders too. Lynne Farrell filled in two record cards in 2010, the first when visiting the meadow with 11 members of the H.F.&F.S. on 2 May, recording 86 species (including 13 from the hedges), and the second on 16 June while carrying out a National Vegetation Classification (N.V.C.) survey for the Wildlife Trust (and so excluding hedge species) (Farrell, 2010), when she recorded 58 species. Altogether 99 species are included, 15 of them for the first time (seven of them annual and/or weedy species and six of them hedge species); only *Plantago media* is among the 70 species recorded on Arthur's Meadow that are listed by Rodwell (1992) as present in at least 5% of the samples of one or more community or sub-community of the three grassland types (MG4, MG5 and MG8) comprising Lowland Meadow priority grassland (Stroh *et al*., 2019) and thus are marked with an asterisk in the table provided as an online appendix [www.natureincambridgeshire.org.uk/volumes/62_oswald_appendix.pdf]. A few records are not included on any of the four multi-species cards discussed above, for example two records each of Pignut (*Conopodium majus*), listed in the DDb file as seen by Nick Millar on 16 May 1999 and by Tony Balbi a week later, and of Devil's-bit Scabious (*Succisa pratensis*), listed there as seen by Nick Millar on 13 August 2000 and also observed by Lynne Farrell on 31 March 2009; most remarkable has been the discovery by Roger Orbell of a single plant of Fritillary (*Fritillaria meleagris*) on 22 April 2016 (Farrell, 2016b). In total 132 species (including 16 from the hedges) and two hybrids have been recorded. Please see the table provided as an online appendix. There are few species which would be expected that are missing from this list; a possible exception is Field Scabious (*Knautia arvensis*).

The orchids of Arthur's Meadow

As explained above, my original interest in Arthur's Meadow was that it contained three of the four orchid species that I feared were doomed at Rosslyn House, Dormansland, after the death of my uncle, Arthur Oswald. Sadly I have no contemporary written records from my first visit in the spring of 1978, but my recollection is of numerous flowering plants of Green-winged Orchids among the Cowslips that attracted me to visit the meadow but of finding only a few plants of Common Spotted-orchid and Twayblade, both at an earlier stage, so perhaps not representing the true sizes of their populations. The earliest known orchid records from the meadow were made before my first visit, by Terry Wells on pink cards on 2 June 1976 – of "*c*. 10 plants" of Green-winged Orchid, "some in flower, others with capsules. Large", of "1 plant" of Common Spotted-orchid and of an unspecified number of Twayblades "With many other 'indicator' species". These observations might suggest that colonisation by Common Spotted-orchid was still at an early stage, but unfortunately they are inconclusive for Twayblade and somewhat puzzling for Green-winged Orchid.

What follows is mostly taken from Lynne Farrell's (2016a) paper prepared for incorporation in *The Orchid Flora* published by the H.F.&F.S. (Walker *et al*., 2019) with later additions by Sarah Orbell. Table 1 is largely derived from the same data. Irregular population counts or estimates for some of the orchid species are available from 1981 onwards, but regular annual counts for all species began in 2006.

Anacamptis morio

This species has been declining throughout its range since the 1930s mainly owing to ploughing-up of ancient meadows and lack of appropriate management (Wells, 1998; Stroh, 2007). It now appears in *A Vascular*

Table 1. Orchid counts on Arthur's Meadow (1981–2019) mainly after Lynne Farrell in Walker *et al.* (2019) and Sarah Orbell (2018, 2019)

Dates	*Anacamptis morio*	*Dactylorhiza fuchsii*	*Listera ovata*	*Ophrys apifera*	*Dactylorhiza praetermissa, D.* x *grandis*
2/5/81	*c.* 20	*c.* 10 plants seen	*c.* 30 plants seen		
22/5/81	present	present	present		
1/6/83	32				
16/6/84	10	*c.* 20	many	1 plant in bud	
8/5/90	52		present		
15/5/90	38				
19/5/96	44	leaves showing	just emerging		
24/5/98	present	present	present		
23/5/99	49	31			
6/99		numerous	numerous	present	
9/5/00	115				
2001	—	863	606		
12–17/6/02	—	1,022	803		
20/6/03	—	919	392		
6/04				present	
28/6/04	—	705	615		
28/6/05	—	808	407		
5/06	29				
6/06	—	53	454		
18–27/5/08	12				
27/6/08		191	300		
29/4–12/5/09	58				
14/6/09		486	1,371		
10–22/5/10	47				
18/6/10		2,493	823		
25/4–8/5/11	58				
10/6/11		2,285	356	5	
25/4–21/5/12	36				
9/6/12		303	1,142	1	
7–25/5/13	28				
18/6/13		1,168	1,348		
5/7/13		present	present		1 + 1
27/4–11/5/14	68				
30/5/14		no count	1,270	*c.* 5	
26/4–28/5/15	112				
23/6/15		3,994	2,069	52	1 + 1
22/4–18/5/16	144 + 7 vegetative				
21/6/16		7,230	1,368	72	?10 + 2
30/4–14/5/17	145				
13–14/6/17		6,571	1,800	109	31
3–20/5/18	168				
13/6/18		10,729	2,168	78	27
4–20/5/19	105				
20/6/19		6,745	1,920	87	20

Plant Red List for England (Stroh *et al*., 2014) as Vulnerable under I.U.C.N. category A2c, meaning that it has undergone over a 30% reduction in range since 1930, though Broughton (2015) gives its County Status as "Not scarce". Earlier counts at Arthur's Meadow were usually in double figures, though 115 plants were recorded on 9 May 2000; from 2001 till 2005 no numbers were recorded because Parnwell's (2001–2006) commissioned surveys were carried out too late in the summer to detect this species. Lynne Farrell (2016a) wrote: "Since 2009 visits to the meadow have been made from early April onwards in order to catch the first emergence of the orchids. These have then been protected by fixing small wire or plastic cages around the plant. The mesh is sufficiently wide to allow pollinators to fly in and out and the cage also has an open top enabling large insects to visit. Regular visits have been undertaken every few days, as the plants emerge quickly once the weather has warmed up and there has been some rain. Detailed G.P.S. readings have been noted and both flowering and vegetative plants recorded. The cages remain around the plants until late summer, when they are removed before the meadow has its annual cut. An unexpected bonus is that Narrow-bordered Five-spot Burnet Moths (*Zygaena lonicerae*) pupate on the cages and several hundred emerge later in the season." This caging protects the orchids from damage by Rabbits, though not from Large Black Slugs (*Arion ater*), which have been "observed nibbling the orchids, particularly after rain" (Farrell, 2016a). Numbers of Green-winged Orchids have increased, with 112 flowering spikes in 2015, 144 in 2016 (two of them white-flowered), 145 in 2017 and 168 in 2018, but it is uncertain whether caging was responsible for this, especially since there is evidence that mowing – and so presumably nibbling – "seems to maintain the numbers in the following year, but allowing a colony to seed, although presumably good for its long-term health, results in a dramatic reduction in flowers for some years" (Chater, 2010). It should also be noted that the other species of orchids, which have not been caged, have also increased in numbers in recent years (see below). Caging was not undertaken in 2018 and 2019, but the plants were marked with canes as they appeared and a G.P.S. reading was taken for each. Sarah Orbell (2018) wrote: "We saw little Rabbit damage on our first visit [on 3 May] but quite a few had been bitten off on our second visit [on 13 May] including ones that had not been previously counted." In 2019 she wrote: "On our first visit [4 May] … we counted 89 and marked them with canes. … Our second check on Sunday, 12 May, only yielded 15 more flowering orchids, one chewed off. Many of those that we had marked the previous week had been eaten off at about 2" and the flower heads completely gone. In some places it was difficult even with the stick there to find the remnants of the stem. Probably about 70% had gone overall … . In some patches the canes were the only sign at all of the Green-winged Orchids. Maybe we will need to cage again next year to protect them … ." The third visit, on 20 May, provided only one more plant, so the year's total was 105.

Dactylorhiza fuchsii

This widespread species is recorded from 70 tetrads by Terry Wells (2003). After 1976 (see above) another pink card filled in by him for 16 June 1984 records "*c*. 20 plants, some in flower, others in bud". Lynne Farrell (2016a) wrote: "The population has fluctuated with thousands of flowering spikes being noted in 2002, 2011, 2013, and the fantastic display of 3,994 in June 2015. This is likely to be an under-estimate as there were so many plants that it was difficult to ensure that each individual was counted." Since then even higher numbers have been recorded – 7,230 in 2016, 6,571 in 2017, 10,729 in 2018 and 6,745 in 2019.

Listera ovata

This species is recorded from 58 tetrads by Terry Wells (2003). Once again a second pink card filled in by him for 16 June 1984 records "Many plants, growing with *O. morio*". Lynne Farrell (2016a) wrote that "the population numbers have varied, with large numbers being recorded since June 2012 and with a grand total of 2,069 flowering spikes being recorded on 23 June 2015". Again, this is likely to be an under-estimate, because the green-flowered spikes are easily overlooked.

Ophrys apifera

This species also is widespread in Hunts and the Soke, with 48 tetrad records (Wells, 2003), but it had been noticed on Arthur's Meadow only a few times since the first record on a pink card of "1 plant in bud" by Terry Wells on 16 June 1984 until 2015, when 52 flowering spikes were found, with larger numbers since – 72 in 2016, 109 in 2017, 78 in 2018 and 87 in 2019.

Dactylorhiza praetermissa and its hybrid with *D. fuchsii (D.* x *grandis*)

Lynne Farrell (2016a) wrote: "This is not a common species in Huntingdonshire and was known from just 8 tetrads in 2003 (Wells, 2003). It is listed as being of Least Concern in the England Red List (Stroh *et al*., 2014) and has not suffered a major decline in England even though it is mainly to be found in damp and wet habitats which are increasingly being drained." Indeed it is colonising new sites. A single plant of Southern Marsh-orchid (*Dactylorhiza praetermissa*) and another of *D.* x *grandis* were discovered on Arthur's Meadow on 5 July 2013 by the late Bridget Smith and me and photographed by her. Single plants of each were also found and photographed by Lynne Farrell on 23 June 2015. All four identifications were confirmed from the photographs by Dr Ian Denholm, the relevant B.S.B.I. referee, the former two in April 2020 and the latter two in 2016. He pointed out that one of the 2013 plants could be "a product of introgression with *D. fuchsii*, especially since I think I can make out some faint transverse barring on the leaves. It may be a first generation hybrid or it may be a backcross." Since that time larger numbers of spikes have been recorded – 12 on 21 June 2016, 31 on 13–14 June 2017, 27 on 13 June 2018 and 20 on 20 June 2019. Until recently all sites for the hybrid were further north in Hunts or in the Soke (Wells, 2003; Walker *et al*., 2019).

Access to Arthur's Meadow

At the time of writing, because of the coronavirus, the Wildlife Trust is restricting access to its reserves to pedestrians. Despite the diversion of the A14, with reduced traffic on what is now the A1307, the Trust's long-term policy for Arthur's Meadow is unlikely to change owing to "its very small size and difficulty of access" with "no place to park": intending visitors should seek an appointment from the Trust or apply to join an organised guided walk.

Acknowledgements

First and foremost, I am very grateful for the major contributions made to this article by Lynne Farrell, Honorary Warden of Arthur's Meadow from 2008 till 2016. The current Wardens, Sarah and Roger Orbell, have been helpful in supplying scans of relevant papers, some of which I originally supplied to Lynne Farrell without keeping copies. I am also grateful to my late colleagues, Terry Wells and Derek Wells, whose early records from the meadow have proved most useful, and to Terry's widow, Sheila, who identified his handwriting for me. Dr Chris Preston kindly updated the vascular plant nomenclature, supplied copies of early B.R.C. pink cards filled in by Terry Wells and commented helpfully on earlier drafts of this paper, in particular suggesting the references to Stroh *et al*. (2019) in the table provided as an online appendix. Dr Kevin Walker kindly supplied the B.S.B.I.'s DDb file for Arthur's Meadow, and Dr Louise Bacon and Phil Ricketts elucidated the identity of "Balbi, T." in the DDb.

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Dactylorhiza fuchsii Philip H. Oswald

Arthur's Meadow
5th July 2013

Dactylorhiza praetermissa Bridget R. Smith

Dactylorhiza x *grandis* Bridget R. Smith

Philip Oswald on Arthur's Meadow Bridget R. Smith

Cherry Hinton: A Report on the CNHS Field Studies of 2019

Jonathan Shanklin

In 2019 the CNHS returned to the Cherry Hinton area for its field studies. This report documents the results and compares them with the visits made in 2009.

Introduction

The Cambridge Natural History Society (CNHS) has defined ten areas of Cambridge, which have monthly visits on an annual rotation over a ten-year period. In 2019 the Society returned to the Cherry Hinton area, last visited in 2009. The 2019 studies had a slightly wider remit, covering TL4756, 4855 and 4856 in order to record for the NatHistCam project and the Botanical Society of Britain & Ireland (BSBI) Atlas 2020. This area includes the grounds of Cherry Hinton Hall, Giant's Grave (the source of Cherry Hinton Brook) and the Cherry Hinton Pits Local Nature Reserve (LNR), comprising of East Pit, West Pit and Lime Kiln Close. Cherry Hinton Brook from Burnside to the allotments was excluded this year as the path is too narrow for safe study by a group of people. For a detailed description of the sites, see the 2009 report (Shanklin 2010). A visit was also made to the Cherry Hinton Lakes. A blog of the monthly visits is on the CNHS web page (Shanklin 2019a)

Overall, the area has changed little since 2009. East Pit has begun to mature since the major restoration that took place ten years ago. Regular conservation work takes place at East Pit, West Pit and Lime Kiln Close in which the author participates and at Cherry Hinton Hall nature reserve. The Council have made some improvements around Giant's Grave.

In the main, recording focussed on vascular plants, though the usual pattern for autumn visits to focus on lichens, fungi and bryophytes was followed. Recording of other phyla was generally opportunistic, with 26 species of birds, 16 invertebrates, three mammals and one amphibian being noted. We logged nearly 400 species of plants during the year many of them re-found from previous surveys. Nearly 150 new monad records were made over the three monads. The records of bryophytes, lichens and vascular plants have been lodged with the national recording schemes, and these (or a sub-set of them) together with all other records, with CPERC.

Vascular plant recording followed the strategy of re-recording any species on the County RPCC (Shanklin 2019b) when seen during the year, re-recording species not seen in the LNR since 2014, and re-recording species in the general area not seen since 2009. Otherwise only "new" species were recorded during 2019. Vascular plant species totals given for the locations below are maximum values and the actual total may be lower than that given by up to 10%. The following may lead to double counting: species and aggregates, taxa not recorded to species, varieties, differing interpretations of the same species etc. Where this is the case, the usage of "species" is followed.

As has been traditional for the CNHS since 2007, the recording year opened with a New Year excursion, now a national event in the form of the BSBI New Year Plant Hunt. Our walk recorded 57 species in flower out of a total of 149 species recorded. This compared to the national average of 20 species in flower. Whilst the CNHS total was 31 less than the previous year (Chesterton Sidings area), the national average was up by four. The BSBI have published a full analysis of the national results (Walker & Marsh 2019).

East Pit

The changes to East Pit have perhaps been more dramatic than for any other location in the study area. Having been acquired by the BCN Wildlife Trust in 2008, it was extensively landscaped in the spring of 2009 prior to its formal opening as an LNR on 20 June 2009. Since then, Buddleia removal has continued, along with removal of developing scrub and control of other invasive aliens, primarily *Chamerion angustifolium* (Rosebay). The bare chalk is slowly becoming vegetated, with *Reseda lutea* (Wild Mignonette) and *Reseda luteola* (Weld) being particularly noticeable in the early years after the clearance, however their frequency is declining. Plants such as *Campanula rotundifolia* (Harebell), *Anthylis vulneraria* (Kidney Vetch) and *Thymus drucei* (Wild Thyme) are slowly spreading. The origin of *Iberis amara* (Wild Candytuft) both here, in West Pit and in other locations in the county is uncertain. Although appearing in habitats typical for the plant, in many cases it has never previously

been recorded at these locations. It could be natural spread, or it could be human intervention. The Trust scraped a few areas of the pit during 2019 in order to provide fresh habitat for early colonists. One particularly notable avian arrival has been the Peregrine Falcon that now breed on the high chalk cliff adjacent to Limekiln Road. Cotoneasters are still highly diverse, and on the BSBI Cotoneaster training day in September (Shanklin 2020) 17 species were seen in the pit.

With the pit a regular destination for conservation work, botanical survey has been quite thorough and so the CNHS only paid one visit during the year and that to look for fungi. 359 plant "species" are known from the pit, all but 5 recorded during the last twenty years. The most notable losses from the last century are *Briza media* (Quaking Grass) and *Salvia pratensis* (Meadow Clary). The 2009 totals were boosted by the disturbance caused by the landscaping work and many of the ruderal species have not been seen again. One particularly notable addition from the last few years is *Centaurium pulchellum* (Lesser Centaury), which was found by Steve Hartley in 2017 and was still present in 2019.

A visit to the Pit to search for fungi had not been in the original plan for the October visit as the generally bare chalk and lack of woody material seemed to preclude much of interest. However, the party on the day thought it more appealing than the grounds of Cherry Hinton Hall and it exceeded expectations, with three species of Waxcap (*Hygrocybe*), an Earth Tongue and Meadow Coral (*Clavulinopsis corniculata*) amongst the fungi found.

Lime Kiln Close

Conservation work parties have continued mowing the rides and trying to keep encroaching scrub and Clematis at bay, but it is a tough battle. Thanks to their work many of the rides have become a little wider over the decade, but overall the site's decline as a habitat for chalk grassland plants continues. There are 245 plant "species" recorded from the site in the county database, though this excludes some of the early records. Only 136 of these were recorded in the last decade, though some, for example *Crataegus monogyna* (Hawthorn), must have been overlooked. Some new species have been added during the decade, mostly casuals, but a few previously overlooked residents such as *Catapodium rigidum* (Fern-grass). Some species were perhaps never there: *Lonicera caprifolium* (Perfoliate Honeysuckle) is only perfoliate on the flowering shoots, and records of *Lonicera periclymenum* (Honeysuckle) may refer to non-flowering shoots of the species. Species not found since 2009 include *Pimpinella saxifraga* (Burnet Saxifrage) and *Vicia cracca* (Bush Vetch), adding to those lost earlier such as *Plantago media* (Hoary Plantain) and *Anthyllis vulneraria* (Kidney Vetch).

West Pit

The meadow at the top of the pit has continued to be maintained by regular Wildlife Trust work parties, and these have also carried out scrub removal to extend the area of chalk grassland. In addition, work parties lead by the City Council Nature Reserves Officer, Vic Smith, have created some glades, including one immediately below the top meadow. Ash dieback is beginning to affect many of the Ash trees in the pit, and this may create additional open areas over the coming years. 289 plant "species" have been recorded from the pit, 199 of them in the last decade and all but 11 in the last 20 years. 37 "species" have been recorded for the first time in the last decade. Some are casuals, for example *Digitalis purpurea* (Foxglove) appeared on the newly cleared scree slope below the top meadow. Some may have been introduced during conservation work, for example *Cynoglossum officinale* (Hound's-tongue) and *Trifolium campestre* (Hop Trefoil). Others have arrived naturally, for example *Asplenium scolopendrium* (Hart's-tongue). One technical loss is the speciality *Falcaria vulgaris* (Longleaf), which has jumped over the fence to the margin of the neighbouring school playing field.

Cherry Hinton Hall

Most of the managed area has changed little since 2009. There are now some floral "wildflower" beds (which mostly contain showy non-native wildflowers) in front of the Hall. There are noticeable areas devoid of any vegetation around most trees and fence lines, a consequence of the City Council desire for tidiness above biodiversity and their use of indiscriminate spraying of any offending zones. The nature area has had a couple of enhancements – creation of a more open region in the woodland, and improvements to the lakes. The latter was prompted in part by the objective of removing the invasive *Crassula helmsii* (New Zealand Pigmyweed),

but this has not succeeded. There is however now much more emergent vegetation than there was in 2009.

The Hall grounds have 349 "species" recorded from them and 222 were found during 2019, 56 of them for the first time. Those not found include a selection of planted trees (as are some of the additions), some native species that were perhaps missed, for example *Ranunculus acris* (Meadow Buttercup), and some that were only casual, such as *Rumex maritimus* (Golden Dock).

Giant's Grave

The Council has removed some of the shading trees around the pond formed by the springs that feed Cherry Hinton Brook, but it is still shaded more than is desirable. There are 155 localised records for "species" at the site, from CNHS visits in 2009 and 2019 only. The CNHS recorded 87 "species" in 2019, far fewer than in 2009. Some species appear to have been lost, for example *Juncus articulatus* (Jointed Rush) and *Nasturtium officinale agg.* (Water-cress), and the undesirable *Crassula helmsii* has arrived. A planted Gingko provided interest with its specialist rust *Bartheletia paradoxa*; both species may have a history extending back for some 200 million years.

Cherry Hinton Lakes

The Cherry Hinton Lakes are normally a closed site, but special access was arranged for our visit in July. Only a small part of the Lakes extends into the study area, and this part had little of note. Elsewhere this site was more interesting, although becoming affected by scrub growth in part. The chalk platform in the north supported *Blackstonia perfoliata* (Yellow-wort), *Centaurium erythraea* (Common Centaury), *Erigeron acris* (Blue Fleabane) and *Linum catharticum* (Fairy Flax) amongst other species. Some species were clearly introduced, though the *Menyanthes trifoliata* (Bogbean) was doing well. The most unexpected find was a small clump of *Epipactis helleborine* (Broad-leaved Helleborine) under trees, last recorded in the area on Hinton Moor around 1770! The lakes are mostly used for fishing and one fisherman showed us a freshly landed Carp, which he had weighed in at 9kg.

The monads

Only a few visits ranged more widely than the designated sites. The Cherry Hinton Recreation Ground was largely barren of much interest, though there was a rust on the stands of *Smyrnium olusatrum* (Alexanders) around its margin. Allotments often retain ruderal species gone from the wider countryside, and the Daws Lane allotments were no exception. Species noted here, but not elsewhere include *Lamium amplexicaule* (Henbit Dead-nettle) and *Lamium hybridum* (Cut-leaved Dead-nettle). One nice find in the area was at the close of the BSBI Cotoneaster meeting, when we headed to the Robin Hood pub for some light refreshment, and one of the party spotted *Campanula rotundifolia* (Harebell) at the edge of the grassland in the pub grounds by Fulbourn Road – a first for the monad!

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The Arctic to Antarctica and places in between: a brief review of the Cambridge Natural History Society 2019 talks programme.

A central element of the activities of Cambridge Natural History Society is its programme of talks. These bring together members and others to hear from experts on a wide range of natural history topics. Almost all the speakers in 2019 were based in Cambridgeshire, even though, geographically, the topics they talked on spanned the world, from the Arctic to Antarctica and places in between. As the brief outlines below indicate, talks covered astronomy, botany, conservation, ecology and zoology.

Mark Hill provided an update on the NatHistCam project which has been surveying the flora and fauna of the 64 sq km of Cambridge city. Annette Shelford is learning about moths in Cambridge's Botanic Garden as well as helping to monitor moths on the roof of the David Attenborough Building. She gave a well-planned and clear introduction to these amazing insects, illustrated with excellent photos, reminding us why recording moths is important. A set of three mini talks with a botanical theme all related to Cambridge. Ben Greig describeda new project: On the Verge Cambridge, which promotes wildflower and meadow planting around the city, Rod Mulvey explained how the systematic beds at Cambridge Botanic Garden are both a living and an aesthetic display of the evolutionary lineages of flowering plants, while John O'Boyle gave a colourful insight into the great variety of trees on the Science Park. Bob Jarman considered the changing fortunes of different species of birds in Cambridgeshire and explained how recording sounds of birds flying over during the night is revealing interesting and unexpected night-time movements of migrating birds over the city. On the Cambridgeshire – Suffolk border Abby Stancliffe-Vaughan has been working since 2004 on control methods for non-native signal crayfish and her talk outlined the problems posed by non-native species and the challenges of using them as food or in craft products.

Moving further afield, Greg Packman took the audience to London, describing the social, cultural and natural history of Hyde Park, telling the story through time from the perspective of the trees. Helen Moore's talk on parasitic plants highlighted the surprisingly large number of species in the British flora that cheat by tapping into other plants rather than relying on photosynthesis. She also covered the relationships some plants, such as orchids, have with mycorrhiza and fungi, which often is essential to the plants' survival. With Jonathan Shanklin we travelled to Antarctica to see and hear about some of the astronomical and atmospheric phenomena he had observed during his work there with the British Antarctic Survey. Robert Burton described conditions at the opposite pole and how animals and plants of the High Arctic have to respond by condensing their annual cycle of growth and breeding into a short summer. Also in the Arctic, Kevin Hand recounted travelling to Finland and Norway with some friends, and how he then turned this into an experience that involves and celebrates Sami culture and their intimate relationship with nature. Kevin also took us to Ethiopia, and talked about the rarest canid in the world, the Ethiopian wolf, and the conservation of wolves generally. Chris Heron also went to Africa, to volunteer with the Cheetah Conservation Fund in Namibia, and outlined their work in conserving cheetahs and helping communities to learn to coexist with them, as well as describing some of the tasks he helped with.

Leah Fitzpatrick talked with great passion about venom, one of the most widely used biological weapons in the animal kingdom, with just under 200,000 species utilising it. In her talk, Abigail Burns covered many aspects of farming, including how it has and is changing, though there was not enough time to really focus on the ever evolving debate around conservation within agricultural landscapes, or any of the interesting technologies/ solutions on the horizon. The most wide-ranging talk, both geographically and temporally, was Ulf Büntgen's talk on the many uses for research into tree-rings which goes far beyond using them to date things. As well as being used to calibrate other historical data, they also shed light on climate, with differing weather conditions and poor growing seasons reflected in the tree-rings.

Many thanks not only to our speakers who willingly gave up their time, shared their expertise and answered questions, but also to those who helped arrange and publicise the meetings, welcome people, serve refreshments and generally ensure things ran smoothly. Finally, we thank our audiences for turning up and asking interesting questions!

A natural history of Cambridge (NatHistCam)

Mark Hill

End of data collection phase

The end of the decade 2010-2019 marks the end of our main fieldwork campaign. In January 2016 we set up a committee to guide our project and chose the name NatHistCam because it is an abbreviation of 'Natural History of Cambridge', and NatHistCam had no hits on Google. The project was planned in three main stages

Stage 1. Planning and testing of methods (2016)
Stage 2. Fieldwork and data collation (2017-2019)
Stage 3. Data analysis and writing up (2020).

In 2020 we shall continue to update our website, whose webmasters are Monica Frisch and Duncan Mackay, but our main efforts will go into analysis and writing.

Progress

Cambridge has an abundance of wildlife, greatly exceeding that of the arable landscape which surrounds it. A perusal of our website www.nathistcam.org.uk shows the extent of our observations. The Monthly Sightings blog, collated by Olwen Williams, features mammals, birds, wasps, spiders, fungi (very rich in autumn 2019) and plants. Project blogs by Bob Jarman have concentrated on birds. Many rare birds fly over the city at night. Egrets, Badgers and Box-tree Moths (*Cydalima perspectalis*) have increased markedly during our project. Floating Pennywort (*Hydrocotyle ranunculoides*) has increased, blocking the river, and then largely been eliminated. Badgers present a problem for release of hedgehogs, which cannot coexist with them.

During the project we systematically surveyed vascular plants, mosses and liverworts in the 64 monads (1-km squares) of our study area. The results for vascular plants have yet to be analysed. Rather to our surprise we found 175 species of bryophytes in our study area during 2010-2019—a remarkably large number when compared with the 242 species found during the same period in the whole of Cambridgeshire. We found 40 or more bryophyte species in all monads except for TL4858, which is mainly occupied by Cambridge Airport.

We surveyed 60 domestic gardens and almost all the college gardens. Results of the domestic garden survey show that Squirrels, Frogs and Hedgehogs had been seen by the owners in 90%, 73% and 50% of the gardens in the previous two years. Large Bindweed (*Calystegia silvatica*) and Green Alkanet (*Pentaglottis sempervirens*) are generally the worst weeds, though not present in all gardens.

Preparations for a book

There is much further analysis to be done. We are collating data from moth traps and seeking out experts on topics where we are less well informed. We aim for a book of 120,000 words, with the following sections.

Physical and human setting (10,000 words—geology and landscape 3,500, development of the city 3,500, habitats 3000)

*Animals (*45,000 words—character of our urban fauna 6,000, insects 10,000, other invertebrates 5,000, fish & herptiles 6,000, mammals 10,000, birds 8,000)

Plants and fungi (45,000 words—character of our urban flora and fungi 6,000, vascular plants 23,000, cryptogams 8,000, fungi & lichens 8,000)

Sites and nature conservation (20,000 words—interesting sites 15,000, nature conservation 5,000).

Bryophyte records

M. Burton and C.D. Preston

These records cover bryophyte records made in the calendar year 2019 in the vice-counties of Cambridgeshire (v.c. 29) and Huntingdonshire (v.c. 31) plus a couple of older liverwort records which have come to light since the publication of *Cambridgeshire's mosses and liverworts* (Preston & Hill, 2019).

Mosses

Ceratodon conicus 29: thin soil at edge of concrete manhole cover, roadside verge outside 350 Milton Road, Chesterton, TL46396073, C.D.P., 6.3.2019, BBSUK. This species is difficult to identify because of its similarity to the common and notoriously variable *C. purpureus*. The Cambridge plants had short leaves on the lower stems and longer leaves in a comal tuft above with the midribs conspicuously excurrent (by 0.22–0.55 mm). Their identity was confirmed by molecular sequencing kindly undertaken by Des Callaghan and Laura Forrest at Royal Botanic Garden, Edinburgh. The species has a Submediterranean-Subatlantic distribution and in Britain it was traditionally regarded as a plant of open habitats (including wall tops) on Oolitic limestone. In the 20th century it appeared to have declined almost to extinction, and Porley (2013) listed it as Critically Endangered. However, this is the third recent British record from a quite mundane habitat to be confirmed by molecular analysis, following finds in Gloucestershire (also on thin soil over concrete) in 2011 and Buckinghamshire in 2018.

Cinclidotus fontinaloides 31: water-line of the River Nene at Alwalton, where it would be frequently covered by fast-flowing water, TL131962, M.B., 11.12.2019. All the previous records of this aquatic species in the county have been from the River Great Ouse.

Dialytrichia mucronata 31: attached to rock by a fast-moving flow of water from the River Great Ouse (on a small island E. of Port Holme), Portage Point, Godmanchester, TL24217045, M.B., 28.4.2019. An extension of the range in the county of this waterside species, previously known from the River Kym at Hail Weston Ford and the Great Ouse upstream at Little Paxton.

Didymodon nicholsonii 29: fruiting plants, Linton cemetery, TL563470, S. Hartley, 24.2.2019, det. M.O. Hill. Both male and female plants have been recorded in the county but this is not only the first record of fruiting plants here but only the second in Britain and perhaps in Europe (Pescott, 2019).

Encalypta streptocarpa 31: support of A1 bridge, Wansford, TL07639932, M.B., 20.03.2019. A welcome refind in the county of a species which is declining nationally and had only previously been recorded in 1964 and 1965.

Hennediella macrophylla 29: fruiting plants with unexpanded capsules on trampled ground by bins at N.E. entrance to Lime Kiln Close, Cherry Hinton, TL48645612, C.D.P., 3.3.2019. This alien moss has increased in frequency in Cambridge in recent years, but this is the first record of fruiting plants. Further fruiting material was found by C.D.P. on the trampled edge of a flower border alongside the path near the Station Road entrance to the Botanic Garden, Cambridge, TL457572, on 4.3.2020 and on heavily trampled ground under a tree by the Systematic Beds near the western edge of the Garden, TL453570, on 16.3.2020.

Orthotrichum striatum 31: on dead sallow, TL19427953, and on hazel, TL1979, Compartment 27, Monks Wood NNR, M.O. Hill & S. Hartley, 12.1.2019. There is only one previous record of this epiphyte in the county, made in 2011.

Pseudocrossidium revolutum 29: brick plinth of sundial dating from late 1990s and wall of Swanage brick in front of Garden Restaurant, Robinson College, Cambridge, TL4358, C.D.P., 20.3.2019. The first Cambridgeshire record of this species on a substrate which is demonstrably post-war in origin.

Sanionia uncinata 31: with young fruit on ash, Compartment 22, Monks Wood NNR, TL19847967, C.D.P., 12.1.2019, BBSUK, conf. T.L. Blockeel (Fig. 1). The first v.c. record of a species which is rare in East Anglia and which is only known from two orchards in v.c. 29.

Fig. 1. Examining *Sanionia uncinata* on an ash tree at Monks Wood, 12.1.2019. Photo: Peter Leonard.

Scleropodium cespitans 29: locally in large quantity on tree bases (Fig 2), with *Leskea polycarpa* above it, in spinney near pond in parkland, Hildersham Hall, TL53934855, M.O. Hill, 24.2.2019. In a broad band several metres long at edge of a tarmac drive lined by beech and yew hedges, TL52996236, and in a similar habitat alongside box hedges, TL53116222, Anglesey Abbey, C.D.P., 7.3.2019. Bare ground and brick step in shade at entrance to Pinehurst, Grange Road, Cambridge, TL4357, M.O.H., 29.11.2019. The record from Hildersham Hall is the first from this site since 1958 and represents the historic habitat of the species on trees near water. That from Anglesey Abbey is the third from tarmac in the vice-county, a habitat in which it has shown a marked increase nationally but only a very slow one in Cambridgeshire. The record from Pinehurst suggests that it may also be spreading into other urban habitats.

Ulota crispa s.str. 31: on willow extending over pond, Compartment 27, Monks Wood NNR, TL19477964, C.D.P., 12.1.2019, BBSUK, conf. T.L. Blockeel. This confirms the presence of *Ulota crispa* in v.c. 31 following the taxonomic revision by Blockeel (2017).

Weissia wilsonii 29: disturbed ground inside deer fence near woodland edge, Hayley Wood, TL293533, M.O. Hill, 8.2.2003, herb. M.O.H. (as *W. longifolia* var. *longifolia*), det. D.A. Callaghan. Callaghan *et al*. (2019) redetermined this specimen in the course of a revision of the taxonomy of *Weissia* subgenus *Astomum* by morphological and molecular methods. This is currently the only record of *W. wilsonii* (the plant hitherto known as *W. multicapsularis*) from eastern England, but it has perhaps been overlooked as *W. longifolia* elsewhere.

Zygodon viridissimus var. *stirtonii* 29: top of old sinuous and buttressed brick wall, Pampisford church, TL497482, C.D.P., 9.2.2019, BBSUK, conf. T.L. Blockeel. The first v.c. record of a variety which is usually found on stonework, whereas the more frequent var. *viridissimus* grows on both masonry and as an epiphyte. T.L.B. commented that the Pampisford material was not well-marked, as the characteristic feature of the variety, the cusp formed by the excurrent nerve, was strong in a few leaves but mostly rather weak.

Liverworts

Cephalozia lunulifolia 31: dead tree stump, Sand Wood, TL23035359, J.D. Shanklin, 24.03.2019. Only the second site recorded in the county; there are four earlier records from Monks Wood (1967–2006).

Lepidozia reptans 31: oak stump, Sand Wood, TL23055363, C.D.P., 24.3.2019. The first record of the species in the county since 1987.

Pellia endiviifolia 29: petrif[ying] spring, Coton, J.S. Henslow, 12.3.1825 & 20.2.1829, CGE, as *Jungermannia*

epiphylla. *Pellia endiviifolia* was confused with *P. epiphylla* in Cambridgeshire until the 1920s; this voucher specimen provides a much earlier first record of the much commoner *P. endiviifolia* than those cited by Preston & Hill (2019). Like the Henslow specimen of *Scorpidium revolvens* illustrated on p. 31 of the flora, it comprises an older vegetative collection (1825) below a later gathering with fruits (1829).

Porella platyphylla 29: Ely cathedral, TL5480, G. Crompton & H.L.K. Whitehouse, 13.4.1993. This species is not otherwise known from the Fenland half of the county. It was recorded on a survey of the Cathedral undertaken by invitation of the Dean and Chapter, when recorders were able to visit areas which are normally closed to the public. It has not been recorded on subsequent visits to publicly accessible areas.

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Fig. 2. A dense colony of *Scleropodium cespitans* at the base of a poplar, Hildersham, 24.2.2019. Photo: Jeff Scott.

Vascular Plant Records 2019
A.C. Leslie

The recently published Flora of Cambridgeshire (Leslie, 2019) contains records for more than 1,000 additional species and hybrids compared with the last published Flora of the county (Perring *et al*., 1964). Further examination of the additions made over the last 55 years showed that the largest number were of new alien taxa (perhaps no great surprise to those have read these notes over the last few years), but with considerable contributions made by first records of new hybrids and for members of the large apomictic groups such as dandelions, hawkweeds and brambles. In the new Flora I drew a line for new entries at the end of 2017 and since then it seems that these trends for new additions continue, as we have had at least 26 new aliens in those two years, seven new dandelions and a handful of new or recently confirmed hybrids. The list below covers primarily the finds from 2019, but with a few from earlier years that have recently come to light.

Apart from members of apomictic groups, completely new native species for the county are as rare as the proverbial hen's teeth, but as the records below demonstrate, we do continue to turn up new sites for our rarest native plants or to refind them in old sites from which they may not have been reported for many years. Moreover, many of these native plant records illustrate a theme I have reiterated previously, that it is always worth visiting the well-known botanical localities, keeping your wits about you and not assuming that everything is already known and recorded. This year we have had exciting reports from, for example, Great Heath Plantation at Gamlingay, where there were refinds of *Carex echinata*, *C. pilulifera, Galium saxatile, Hypericum humifusum* and *Juncus bulbosus,* all of which are local rarities, from Hildersham Furze Hills, where Maiden Pink, *Dianthus deltoides,* was reported again in flower, as well as from Newmarket Heath, where perhaps the best discovery of the year was made with an extensive new population of *Potentilla verna* (*P. tabernaemontani*). In addition at Wicken Fen, surely one of our most visited sites, there were seven new dandelions for the county determined by Prof. John Richards during a BSBI Taraxacum meeting, whilst on Wilbraham Common, a previous rather uncertain record for *Danthonia decumbens* was confirmed, and a Cambridgeshire Flora Group excursion had earlier added *Carex distans* to the list for the Common. These are all well-known and well-recorded sites, although it has to be admitted that it has been some time since it was possible to access the Great Heath Plantation. Plants will often vary in quantity from year to year and sometimes will be obvious only for short periods and you may just be lucky to be at the right place at the right time. Very occasionally even nationally rare plants may spread to form new colonies, such as noted here for *Pulsatilla vulgaris*, whilst one local rarity, *Hypochaeris glabra*, seems to be staging a singular resurgence, probably aided in some cases by the movement of sand and gravel for new developments.

More usually, of course, we associate spreading to new sites with alien plants, which can sometimes colonise with great rapidity. The records below, and in earlier volumes of this journal, show how, for example, *Amaranthus blitum, Capsella rubella, Epilobium tetragonum* subsp*. tournefortii* and *Laphangium (Gnaphalium) luteoalbum* are extending their range in the county. Who knows which of the other assorted new aliens noted below will become a more permanent or widespread part of our flora, if only in the urban environment? By recording the weeds one finds coming in with ornamental plants in garden centres and nurseries, or ornamental plants recorded later escaping from cultivation, we can at least gain some understanding of how they arrive here in the first place. Some might worry about this alien influx, but it is likely that only a tiny majority have any chance of becoming widespread and then usually only in more urban or disturbed communities, whilst many of our most precious native habitats may be more actively threatened by aggressive native plants.

The case noted below of planted *Carex acutiformis* x *C. riparia* is another disturbing example where there is clear evidence of native plants being introduced to habitats where they might have been of natural occurrence (although in this case it is unlikely that it was realised that the material was of hybrid origin). Such introductions, especially when not formally documented, risk later observers drawing erroneous conclusions about plant persistence and dispersal, or in our understanding of plant distributions, as well as their responses to environmental changes. Aquatic habitats in the county seem to have become especially prone to such introductions and this is a real

shame as the natural spread to such areas, particularly where they are also attracting extensive bird life, can occur quite readily. The ponds and lakes on the Great Kneighton Country Park area on the southern margin of the city of Cambridge are, for instance, already an intimate mixture of deliberately planted and unintentionally introduced natives and aliens, mixed with plants that have arrived of their own accord. A great deal of time, effort and money might be saved if it was appreciated that nature will fill the vacuums we create if we just let it happen.

Can I thank all those who have made new records during the year and equally importantly have taken the trouble to pass them on to the County Recorder. A new Flora for the county may have been published and recording for a new BSBI Atlas of the British Flora may now also have been completed, but there will always be new records to make, new groups to tackle (we are going to hear more about elms in due course, I am certain), and there will be surprises in store for those who continue to study the flora of the county.

The nomenclature in this account follows Stace (2019), whilst 'recent' in this context refers to the period post 1987.

Althaea officinalis One flowering plant, under railings beside pavement, just north-west of the Chesterton Lane end of the Jesus Lock footbridge, Cambridge, TL4497.5932, C.D. Preston, 25 August 2019. At one time a very local native in the county (mostly in the far north), but now only a rarely encountered alien, probably of garden origin, although the immediate source in this case was not evident.

Amaranthus blitum (a) More than 100 plants in road gutters and on pavement edges in front of The Petersfield pub, around the junction of Sturton and Hooper Streets, Cambridge, TL4638.5806, A.C. Leslie, 23 August 2019; (b) one plant, at base of front wall of The Mill pub, Granta Place, Cambridge, TL4470.5802, A.C. Leslie, 30 August 2019. In both cases the pubs have exuberant displays of hanging baskets/window boxes, as has the Cambridge Brew House where, as previously reported, there has been a colony of this pigweed since at least 2017. The Petersfield and Cambridge Brew House sites both also held *Digitaria sanguinalis*.

Apium leptophyllum Two plants, as weeds in a pot of *Phoenix canariensis*, Dobbies Garden Centre, Shepreth, TL395.465, A.C. Leslie 2019 (CGE). First v.c. record for a slender annual umbellifer, a native of the American tropics, which is naturalised in parts of Europe and undoubtedly arrived in this case with the palm from a nursery in southern Europe. Recorded from at least 15 vice-counties (although very few recently), and in the 1980s reported as a weed in the Jardin des Plantes in Paris (see Clement, 2000).

Armeria maritima One flowering, self-sown clump, in central road reservation near Freedom Bridge, Wisbech, TF4616.0992, L.M. Saunders, 4 May 2019. Formerly a native along the tidal Nene, and now, very rarely, encountered as a maritime invader along main roads, but in this case considered to have been derived from nearby plantings.

Campanula rapunculus One large flowering plant, in grassland on the south-eastern side of a small copse, on the north-eastern side of the railway, Coldham's Common, Cambridge, TL4756.5836, S. Hartley, 1 July 2019 (CGE, coll. ACL, 2 July). First v.c. record for the Rampion Bellflower, a usually biennial herb, which is occasionally cultivated both as an ornament and as a salad vegetable; its origin in this case was unclear.

Capsella rubella Frequent on roadsides, verges and garden margins, Landbeach Road, Milton, as well as along the High Street and parts of Humphries Way, e.g. TL4783.6306, 4777.6328, 4749.6250, A.C. Leslie, 21 April 2019. This alien from southern Europe, has long been known on Coe Fen in Cambridge, and recently from some caravan/camp sites. The Milton plants all had deep carmine buds, the flowers often with small petals, the fruits markedly attenuate below and with concave sides; towards the southern end of the High Street, near the Tesco supermarket, all the plants of Shepherd's Purse are typical *bursa-pastoris* with green buds, larger petals and less tapered fruits with straight to convex margins.

Cardamine occulta Many plants, with *C. hirsuta*, scattered in short turf under sales tables, Darwin Farm Shop & Nurseries, Newmarket Road, Cambridge, TL5011.5937, A.C. Leslie, 5 March 2019 (CGE, conf. E.L. Cooke). Subsequently recorded in 2019 by ACL from a planter on Ely Station platform, in garden centres at Chatteris,

Wimblington and Shepreth, as well as by J.D. Shanklin in planter at the British Antarctic Survey headquarters in Cambridge. This close relative of *C. flexuosa*, a native of eastern Asia, is clearly already well naturalised here in cultivated areas; it is similar to flexuosa in having six stamens, but has few if any basal rosette leaves and the terminal leaflet is deeply lobed. This taxon was first spotted much earlier as an unknown weed by J.L. Sharman on Monksilver Nursery, Cottenham in c.2016.

Carex acutiformis x *C. riparia* (*C.* x *sooi*) A large, rapidly expanding patch, in a ditch on the north side of the proposed allotment area, Great Kneighton Country Park, Cambridge, TL4553.5483, first noted here in 2018, A.C. Leslie, and material collected from this site in April and May 2019 (CGE) was confirmed by BSBI referee Mike Porter. Clearly an introduction here (with other possible planted clones of the same hybrid further along the ditch), and whilst such introductions would not normally be noted in these records, it is included to warn recorders that the identity of other possibly introduced examples of these Pond Sedges should be checked carefully, as it may be that this hybrid is being introduced more widely – Pond Sedges are, for example, being introduced along the base of drain banks in the Fens. In this particular case the plants set little if any good fruit and the male glumes varied in the same spike from being obtuse-tipped (as in *acutiformis*) to acuminate (as in *riparia*). We have one confirmed record of a natural occurrence of this hybrid, on the Cam Washes at Dimmock's Cote in 1992.

Carex echinata At least 10 clumps, in damp woodland by the stream flowing out of the ponds in the centre of Great Heath Plantation, Gamlingay, TL2245.5132, Cambridgeshire Flora Group excursion, 13 July 2019. Last reported from the Plantation in 1957, from the adjacent Trust meadow in 1978 and in a woodland strip to the west of the meadow in 2014. There are no other recent records in the county.

Carex pilulifera Locally frequent in rather bare areas on the woodland floor, on the drier western margins of Great Heath Plantation, Gamlingay, TL2221.5133, Cambridgeshire Flora Group excursion, 13 July 2019. Last reported from the Plantation in 1956, but also seen recently at Gamlingay Cinques and in Gamlingay Wood. Our only other recent record is by Heath Plantation at Chippenham.

Carex vesicaria One tussock, on edge of Dockerel Brook, Over, TL3935.7075, J.D. Shanklin, 24 August 2019. Perhaps derived from plants discovered the same day around a pond about one km away (TL380.708), where it may have been planted. Our last certain record for Bladder Sedge was in 1993 at Bassenhally, although in the past it has been scattered in the fens from Cambridge north to Wisbech and Whittlesey. There are no older records from this immediate area, and it is unfortunate that there is some doubt about the origin of these plants at Over.

Cicer arietinum One plant, at pavement edge by garden wall, in front of 3 Belvoir Terrace, Trumpington Road, Cambridge, TL4520.5724, A.C. Leslie, 19 June 2019 (CGE). First v.c. record for Chick Pea, an annual from the Mediterranean region, which is now a widely used culinary ingredient.

Coleostephus multicaulis (*Chrysanthemum multicaule*) One plant, on east side of Albert Street, Cambridge, TL450.594, C.D. Preston, 28 April 2017, det. ACL 2019 from colour image; probably self-sown from a 'prairie-style' window box on the west side of the street the previous year. First v.c. record for a compactly growing, bright yellow-flowered North African endemic, closely related to the southern European *C. myconis*, with which it has been confused in cultivation.

Cuscuta epithymum Several patches, climbing over young *Ulex europaeus* and other plants, in the entrance to the proposed allotment area, Great Kneighton Country Park, Cambridge, TL4544.5474, A.C. Leslie, 29 May 2019. The entrance area has a mesh embedded in a sandy matrix, the latter presumed to be the source of seed of the dodder, the numerous young gorse plants and other sandy ground plants such as *Trifolium arvense* and *T. striatum*. First record of Lesser Dodder since 1975, when it was recorded from a railway cutting near Over by Graham Easy.

Dactylorhiza praetermissa var. *albiflora* One flowering plant, at the north-western end of the open ground in the south-western section of compartment 1, North Meadow, Chippenham Fen, TL64.69, M. Taylor, July 2019

(det. I. Denholm, BSBI Dactylorhiza referee). Ian Denholm commented that genuine white-flowered variants of Southern Marsh Orchids are of extremely rare occurrence. We have a record for an 'almost pure', white-flowered *D. praetermissa* at Thriplow in 1962, but a number of other earlier records require confirmation.

Danthonia decumbens In short turf, in two places on Wilbraham Common, TL5340.5751 (one flowering stem on the banks of a dry ditch) and TL5349.5762 (several flowering stems on a grassy track), A.C. Leslie & M. Frisch, 19 July 2019. A very local and elusive Cambridgeshire grass, the only previous record from the Common was made by Derek Wells and John Trist in 1991, but was later noted by Wells as requiring confirmation (Crompton, 2004).

Dianthus deltoides A group of six clusters of plants (with probably over 100 flowers – all pink), about half way up the slope of the spine from the crest to the lower platform, easternmost Furze Hill, Hildersham, TL5551.4840, J.D. Shanklin, 6 June 2019. A very welcome confirmation of the continued existence of Maiden Pink at the Furze Hills, where it was probably first known in the seventeenth century, but which had more recently decreased through excessive rabbit-grazing and in some years could not be found at all; the last report was of a non-flowering, rabbit-eaten plant in 2011. The vegetation on this eastern hill is currently much lusher in growth than in the recent past.

Epilobium tetragonum subsp. *tournefortii* Scattered plants, along the top margin of an abandoned arable field above the east end of Royston (and just west of the deep bypass cutting), TL3712.4096, Cambridgeshire Flora Group excursion, 1 September 2019. The field looks destined for future development and was full of a range of willowherbs, plus buddleja and other plants with windblown seeds. This large-flowered alien subspecies has been naturalised along the bypass since 2007, is now also known along the A428 and is likely to turn up in other places.

Epipactis helleborine One plant, with five flowering stems, under trees on the south side of the causeway between two flooded pits (Cherry Hinton Lakes), off Burnside, Cambridge, TL4805.5717, Cambridge Natural History Society excursion, 10 July 2019. A new site for a very local plant in the county, usually found in small quantity in our boulder clay woods and never reported before in the city.

Galium saxatile Scattered in rather bare areas on the woodland floor, on the drier western margin of Great Heath Plantation, Gamlingay, TL2221.5133, Cambridgeshire Flora Group excursion, 13 July 2019. Heath Bedstraw appears last to have been reported specifically in the Plantation in 1919, but has also been reported recently at Gamlingay Cinques and in the Old Park area. Our only other recent record is by Heath Plantation at Chippenham.

Hedera algeriensis A few trailing stems, with large, all-green leaves and long red petioles, growing amongst H. hibernica, under trees along the north-west side of Station Road cemetery, March, TL4201.9755, A.C. Leslie, 17 March 2019; there was no immediately apparent seed source. First probably bird-sown v.c. record for Algerian Ivy, a surprisingly hardy North African species widely grown in cultivation in a variegated form. Increasingly, green-leaved variants are seen as ground cover in some urban planting schemes, where they can grow up adjacent fences and shrubs to flower and fruit.

Hypericum humifusum In several places within and just outside the eastern margin of Great Heath Plantation, Gamlingay, e.g. in open sandy grassland by the drive to the house on the edge of the Plantation at TL2265.5143, Cambridgeshire Flora Group excursion, 13 July 2019. Apparently the first records from the Plantation area since 1945; in Cambridgeshire it is otherwise now known only at Gamlingay Cinques.

Hypochaeris glabra (a) Frequent in bare sandy ground, in old sand/gravel pit, Block Fen, Mepal, TL4295.8360, L.M. Saunders, June 2019, (b) one plant, as a street weed, 16 Abbey Street, Cambridge, TL4627.5884, A.C. Leslie, 2 June 2019, (c) one plant, in a gap in grassland turf, in a fenced off section of Newmarket Heath, where the Devil's Ditch meets the Newmarket railway, TL6299.6056, A.C. Leslie, 15 June 2019. Smooth Cat's-ear continues to expand its range in the county and although the eastern sands are its main stronghold, it can now, seemingly, crop up almost anywhere.

Juncus bulbosus Frequent around the banks of recently restored ponds in the centre of Great Heath Plantation, Gamlingay, TL2238.5132, with a smaller quantity along a shaded stream in a wet woodland strip just to the east of the Plantation, TL2286.5142, Cambridgeshire Flora Group excursion, 13 July 2019. Last reported at Gamlingay in the Trust meadow adjoining the west end of the Plantation in 1988 (and last reported from the Plantation in 1954). Our few other recent records for Bulbous Rush have been from the north of the county or as a nursery weed.

Juncus conglomeratus var. *subuliflorus* In small quantity, on ride margin, Gamlingay Wood, Gamlingay, TL2419.5328, J.D. Shanklin, 26 July 2019. First v.c. record for an unusual variant of Compact Rush in which the normally single, compact inflorescence is replaced by several stalked heads.

Laphangium luteoalbum One plant, on pavement near entrance to Chapel Road car park, Chapel Road, Wisbech, TF4586.0973, L.M. Saunders, 14 September 2019. Although Jersey Cudweed is now quite frequently recorded in and around Cambridge, often on pavements and driveways, we only have one other recent record from the north of the county (at Parson Drove in 2012); it is likely that this species will continue to be found in new areas and reports of such records would be welcome, so that we can monitor its spread in the county.

Malus domestica x *M. sylvestris* Three trees, inside the north-western margin of Gamlingay Wood, Gamlingay, no.1 at TL2412.5368, nos.2 & 3 close together at 2393.5354, 18 May 2019, A.C. Leslie & P. Leonard (CGE). Samples from these were sent to Markus Ruhsam (RBG, Edinburgh) and subjected to DNA analysis. He reported that all three were genetically composed of elements from both species, with a breakdown as follows: no.1 was 73% *sylvestris*, 27% *domestica* (and perhaps represented a back cross to *sylvestris*), whilst no.2 was 63.2% *sylvestris*, 36.8% *domestica* and no.3 was 57.2% *sylvestris*, 42.8% *domestica*, both of which he suggests are probably F1s. It is likely that many (perhaps most) of our crab apples are of this mixed parentage. Morphologically no.1 at least would have passed muster as *M. sylvestris* for most recorders. There is evidence of 'crab apples' in Gamlingay Wood in the fifteenth century, but of course we cannot know now what they represented. For further details of previous molecular work on this group in Scotland and northern England see Ruhsam *et al*. (2019).

Medicago polymorpha About 10 plants in rough grass near the Rosie Maternity Hospital, Addenbrooke's site, Cambridge, TL46.54, T.J. James, 22 May 2019. This is only the third recent record for an uncommon alien in the county; it appears to be well naturalised here in occasionally mown turf (on the west side of the road, on the west side of the Rosie (TL4645.5495) and in turf under trees on the corner of the main road round the site, just to the west (TL4634.5494), ACL, 12 June 2019, CGE).

Myosurus minimus A large patch of plants, on the side of the Barrier Bank, and running down into a field gateway, west of Swavesey Drain, west of Over, TL3639.7064, J.D. Shanklin, 22 March 2019. Another new site for Mousetail, which in the last 50 years has had something of a resurgence in the county, although some sites can be casual or sporadic in appearance. It was also found in a second site on the Nene Washes during a Cambridgeshire Flora Group excursion on 8 June 2019: a few plants on bare ground in the gateway between fields 10 & 11 (TL2872.9944).

Oenanthe crocata One plant, on shallow gravelly bank of ditch surrounding the proposed allotment area, Great Kneighton Country Park, Cambridge, TL4542.5481, A.C. Leslie & L.M. Saunders, 19 May 2019. Still a rarity in the county, but its status in this locality is hard to judge. It is not an obvious introduction and is in an area with a burgeoning birdlife associated with the lakes; however, other aquatic plants have been planted in this area in the past, sometimes bringing unintended weeds with them.

Potentilla argentea Scattered plants, along c.50cm of track by the Observatory, Madingley Road, Cambridge, TL43.59, J.D. Shanklin, 6 July 2019. Another addition to the remarkable list of a Breckland-type flora accidentally introduced to this area during building work on the site.

Potentilla verna Patches of plants in mown chalk grassland, on the south-western side of the July Course, where it borders the National Stud, Newmarket Heath, e.g. TL6040.6240, 6042.6237, 6043.6236, 6059.6223,

6093.6209, J.D. Shanklin & A.C. Leslie, 6 May 2019. Later visits by ACL (14 May) and by ACL & L.M. Saunders (19 May) added at least five other patches of plants in this general area, which is not used as gallops, but is in part employed as a landing ground for small planes and helicopters ferrying jockeys and others to the racecourse. This is by far our largest extant population and appears never to have been recorded before; it is otherwise only known on the Heath between the Devil's Ditch and the Rowley Mile grandstand (and in small quantity on the Gog Magog golf course near Cambridge).

Pseudotsuga menziesii A single self-sown young plant, at the edge of the clearing on the sand lens in Gamlingay Wood, TL2417.5342, A.C. Leslie & P. Leonard, 18 May 2019. Second v.c. record for a self-sown Douglas Fir; this species occurs as a planted tree in the wood.

Pulsatilla vulgaris Three flowering plants, scattered in mown turf below the north-eastern side of the Devil's Ditch, in a triangle of Newmarket Heath fenced off some years ago by the Jockey Club, where the Ditch meets the Newmarket railway, TL630.605, A.C. Leslie, 15 June 2019. Pasque Flower is well-known on the adjacent vallum of the Ditch, but these three plants represent an almost unprecedented spread into a new area, where they are accompanied by many other chalk grassland plants which also seem to be spreading into this area (e.g. *Briza media, Cirsium acaule, Filipendula vulgaris, Polygala vulgaris, Thymus drucei* (*T. polytrichus*)). This triangle of grassland is occasionally mown and can also be sheep-grazed, the animals having access to the Ditch.

Ranunculus cantabrigiensis Dominant under beech trees in the grounds of Milton Hall, Milton, TL4792.6294. This colony was first noted as a site for Goldilocks Buttercup by Graham Easy in 1970, and when Lewis Saunders showed it to Brian Eversham on 7 April 2019 the latter identified it as *R. cantabrigiensis*, one of the recently described apomictic segregates in this group. The identification was confirmed by ACL a few weeks later and is the first report of this segregate away from the Backs behind St John's and Trinity Colleges in Cambridge.

Rumex conglomeratus x *R. maritimus* (*R.* x *knafii*) One plant, with both parents, in summer draw-down area around lake, Kingfishers Bridge, near Wicken, TL5412.7312, C.D. Preston (Cambridgeshire Flora Group excursion), conf. G.D. Kitchener (Herb. G.D. Kitchener). Our fourth record for a rare hybrid dock, previously reported from Barnwell (1943) and in two places around Ely (in 2003 and 2017). Besides the ragged inflorescence and varied tepal development (typical of dock hybrids) the BSBI referee noted the prominence of the tubercles (from *conglomeratus*) in comparison with the tepal teeth (derived from, but shorter and less fine than in *maritimus*).

Salix aurita x *S. viminalis* One self-sown shrub, in the ditch outside the bund surrounding the largest lake, Great Kneighton Country Park, Cambridge, TL45.54, I. Belyaeva & A.C. Leslie, 29 August 2019, CGE, det. in the field by Irina Belyaeva. First v.c. record for a self-sown plant of this hybrid, although several records of probably planted origin have been made recently in the Fens (e.g. a long patch, along Gull Road, Guyhirn, TF394.034, J.O. Mountford, 16 November 2013 (CGE), from where material has also been confirmed by Belyaeva). This may be overlooked elsewhere.

Salix myrsinifolia (a) several self-sown young plants (at least two of which are female) on ditch bank on east side of board walk along Thomson's Drove, Wicken Fen, TL5603.7026, A.C. Leslie, 4 May 2019, (b) one large, self-sown bush (with many other self-sown willows) on bank of ditch surrounding the south side of Park and Ride site, Milton, TL4688.6286, A.C. Leslie, 15 September 2019 (CGE). This is further evidence of the spread of this northern willow in Cambridgeshire, both at a previously known location (Wicken) and in new site (Milton).

Salix x *pendulina f. erythroflexuosa* Three self-sown plants (from 2-6ft tall), in ditch outside the bund surrounding the largest lake, Great Kneighton Country Park, Cambridge, TL4550.5473 (29 March 2019, ACL), 4558.5469 (19 May 2019, ACL & L.M. Saunders) and 4556.5449 (24 June 2019, ACL & P. Leonard), all with yellow to orange young twigs and contorted growth. Our two previous records for self-sown *S. babylonica* var. *pekinensis* 'Tortuosa' should be placed under this hybrid combination, following recent work by the BSBI referee Irina Belyaeva, who has seen material from the Great Kneighton site and one of the earlier ones on old arable

land between the Histon and Huntingdon Roads in Cambridge. This hybrid derives its contorted form from *S. babylonica* 'Tortuosa' and the usually coloured stems from the plant previously known as *S. alba* var. *vitellina*, which Belyaeva regards as a variant of *S.* x *fragilis*.

Scutellaria altissima One self-sown plant, on wall top in front of 46 High Street, Little Abington, TL5337.4909, A.C. Leslie, 15 August 2018 (confirmed in flower, May 2019). Second v.c. record for an ornamental skullcap, with long spikes of blue and white flowers, which is native to southern and eastern Europe. The probable parent is growing in the adjacent garden.

Solanum chenopodioides Numerous plants, along central reservation of A11, above the Wilbraham/Brinkley Road bridge, Six Mile Bottom, TL5735.5724, P.D. Stanley, 30 August 2019 (seen from his car), and confirmed on the ground by ACL on 10 September 2019 (CGE), when a few were also found on the western verge. First v.c. record for a perennial nightshade from South America, resembling a more bushy, woody-based S. nigrum, and which is reported to be spreading on roadsides in southern England, especially in the London area. It has also been a weed in Cambridge University Botanic Garden.

Solanum pseudocapsicum One self- or bird-sown plant (with flowers and fruits), on steep cobble-faced bank below 8 Shelly Row, Cambridge, TL4438.5923, C.D. Preston, 25 August 2019 (det. ACL). First recent record for a popular pot plant (known as Winter Cherry), a native of eastern South America, which is grown for its large orange fruits and is hardy outside in sheltered conditions. Also known as *S. diflorum* or *S. capsicastrum*. Our two previous records were from refuse tips in 1977 and 1982.

Solanum pseudocapsicum Cambridge 2019. Photo C.D. Preston

Tamarix parviflora One self-sown plant, in pavement crack at base of barrier behind the guided busway stop (Science Park side of track), just west of Milton Road, Cambridge, TL4672.6127, A.C. Leslie, 21 April 2019 (CGE). First v.c. record for an early-flowering tamarisk, which has 4-merous flowers and minutely denticulate sepals, in contrast to the 5-merous flowers and entire sepals of *T. gallica*, which is the most common tamarisk seen planted, and sometimes self-sown, in coastal areas. The parent plant was probably on the Science Park, but has recently been destroyed by redevelopment.

Taraxacum akteum Just outside the visitor centre, on the drove running from the windmill to Wicken Lode, Wicken Fen, TL5624.7054, BSBI Taraxacum meeting, 4 May 2019, det. in the field by A.J. Richards. Our only previous record for this species of sect. *Celtica* was from Wicken Fen in 1974. It is a very rare species in the British Isles.

Taraxacum cophocentrum Beside the board walk along Thomson's Drove, Wicken Fen, TL5597.7043, BSBI Taraxacum meeting, 4 May 2019, det. in the field by A.J. Richards. Our only previous record for this species from sect. *Ruderalia* was from a roadside at Girton in 1967.

Taraxacum disseminatum Drove on north-western side of Wicken Lode, north-east of its junction with Thomson's Drove, Wicken Fen, TL5614.7026, BSBI Taraxacum meeting, 4 May 2019, det. in the field by A.J. Richards as *T. falcatum*, but subsequently revised. First v.c. record for this species of sect. *Erythrosperma*.

Taraxacum hamatulum Just outside the visitor centre, on the drove running from the windmill to Wicken Lode, Wicken Fen, TL5627.7053, and beside the board walk along Thomson's Drove, TL5597.7044, BSBI Taraxacum

meeting, 4 May 2019, det. in the field by A.J. Richards. First v.c. records for this species of sect. *Hamata*.

Taraxacum mimulum Beside the board walk along Gardiner's Drove, just north-east of its junction with Thomson's Drove, Wicken Fen, TL5608.7051, BSBI Taraxacum meeting, 4 May 2019, det. in the field by A.J. Richards. First v.c. record for this species of sect. *Ruderalia*.

Taraxacum obtusifrons Drove on north-western side of Wicken Lode, north-east of its junction with Thomson's Drove, Wicken Fen, TL5608.7024, BSBI Taraxacum meeting, 4 May 2019, det. in the field by A.J. Richards. First v.c. record for this species of sect. *Ruderalia*.

Taraxacum oellgaardii Beside board walk along Thomson's Drove, Wicken Fen, TL5597.7044, and along drove on north-western side of Wicken Lode, TL56.70, BSBI Taraxacum meeting, 4 May 2019, det. in the field by A.J. Richards. First v.c. records for this species in sect. *Celtica*.

Taraxacum pruinatum In two places beside board walk along Thomson's Drove (TL5602.7030 & c.559.704), Wicken Fen, and in one place along the drove on the north-western side of Wicken Lode, north-east of its junction with Thomson's Drove (TLc.5608.7024), BSBI Taraxacum meeting, 4 May 2019, det. in the field by A.J. Richards. First v.c. records for this species of sect. *Hamata*.

Taraxacum retroflexum At junction of Gardiner's Drove and Thomson's Drove, Wicken Fen, TL559.704, BSBI Taraxacum meeting, 4 May 2019, det. in the field by A.J. Richards (K). First v.c. record for this species of sect. *Ruderalia*.

Teucrium hircanicum Numerous plants, clearly self-sowing, with plants of all ages and some impressive flowering clumps, scattered along a track over waste ground along east side of railway, south of Spencer Drove, Soham, TL5874.7336, L.M. Saunders, July 2019, (CGE, coll. ACL 20 July 2019). First v.c. record for a native of the Caucasus and northern Iran, grown in gardens for its dense spikes of purple flowers produced over a long season.

Veronica scutellata On RSPB land at Fen Drayton: (a) old field drain, TL3583.6958, (b) marshy area between flood bank and drain, TL3508.7016, (c) scattered around Swavesey Lake, e.g. 3530.6964, 3538.6969, occasionally locally frequent, and continuing round from south to north side; all records made by J.D. Shanklin, 1 June 2019. A new area for Marsh Speedwell, which is a very local plant in the county that has been lost from many old localities.

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Weather notes from Cambridge University Botanic Garden for 2019

Katie Martyr, Pete Michna and John Kapor

January was slightly colder and much drier than the long-term average. There were two snow days, multiple air frosts at night, and the temperature was as low as -6.3°C on the 24th, the coldest day of the winter. February was once again warm, reaching 18.7°C on the 27th, and dry, with only 25.5mm of rainfall recorded. March was also dry and mild with just one air frost on the 25th. On the 8th the glasshouse closed due to high winds in excess of 35 knots. April was exceptionally dry and mild with only 7.4mm of rain and a few slight air frosts. On Saturday 27th the wind rose to 40 knots; damage was caused to the glasshouse and the garden was closed. Much of May was dry but there was thunder and heavy rain (7.6mm) on the 8th and a welcome 17.2mm of rainfall on the 11th. June saw a number of very warm days, reaching 31°C on the 29th, due mainly to changes of air masses throughout the UK, but it was wetter than average with just over a quarter of the total monthly rainfall falling on the 11th.

July will be remembered for having the highest maximum temperature ever recorded in the UK, reaching 38.7°C at CUBG on the 25th, verified by the National Climate Information Centre in Exeter, as well as several days when the temperature topped 30°C. Rainfall was much below the average, and mostly fell in small amounts. August continued to be dry with mostly average temperatures, although there was a brief warm spell with temperatures over 30°C on the 25th and 26th. September started dry and windy with much of the garden looking drought-stressed, but useful amounts of rain began to fall from the 28th, with 11.3mm on the 30th. The first ground frost since mid-May was recorded on the night of the 17th.

The more unsettled weather continued into October, including torrential rain on the 5th when 24.3mm fell in 24 hours, making it the wettest day of 2019. There were also eight ground frosts and the first air frost of the season, resulting in the scorching of plants with tender foliage such as *Phytolacca*. Rainfall was above average for the month. November remained generally unsettled with close to average rainfall. On the 18th -3.0°C was recorded in the air and this appeared to significantly increase the leaf fall after what had turned out to be a good month for autumn colour. December was an exceptionally wet but mild month, with an air minimum of only -1.5C during the night of the 9th, and with a maximum temperature of 12.9°C on the 7th.

	mean max temp		mean min temp		highest temp	lowest temp	rainfall	
	(°C)	diff	(°C)	diff	(°C)	(°C)	(mm)	diff
January	7.3	-0.2	1.0	-0.6	11.7	-6.3	29.1	-16.9
February	10.7	2.6	2.2	1.0	18.7	-3.9	25.5	-9.5
March	12.7	1.5	4.8	1.8	17.4	-0.1	33.4	-5.6
April	12.7	-1.3	4.0	-0.4	24.8	-1.9	7.4	-32.6
May	17.2	-0.3	7.1	-0.1	23.3	2.0	45.9	-1.1
June	20.3	-0.1	11.0	0.8	31.0	6.3	70.6	18.6
July	24.4	1.3	12.9	0.5	38.7	7.1	33.2	-17.8
August	24.1	1.3	13.1	1.0	33.2	8.8	33.3	-20.7
September	20.8	1.3	10.2	0.2	25.4	4.7	41.1	-11.9
October	15.2	0.0	6.9	-0.3	19.8	2.9	71.8	13.8
November	9.9	-0.9	3.8	-0.1	15.3	-0.8	61.8	6.8
December	9.0	1.3	3.3	1.5	12.9	-3.2	78.3	31.3
Total							531.4	-45.6

Table 1. Weather summary 2019. The 'diff' columns show the difference between the 2019 value and the 1981 – 2010 mean.

UK's hottest ever temperature recorded at Cambridge University Botanic Gardens

Sally Petit

Activities within the Garden are varied and constantly evolving, but there is one daily task which has been part of our routine for over 100 years, and that is taking meteorological readings. Today this task is carried out by Katie Martyr, Experimental Section Assistant, who succeeds a long line of dedicated weather observers. The role entails recording a range of readings including maximum and minimum temperatures, ground temperatures, rainfall, cloud cover, and wind speed and direction. Readings are taken at our weather station located in the Experimental Plots, at 9.00am Greenwich Mean Time (so 10.00am in summer), and capture data from the preceding 24 hours.

The station is monitored by the Met Office to ensure that it still meets their requirements, and that there have been no changes to the site, such as new buildings or tree growth, which can influence microclimates. The ways of taking readings are relatively low tech, with most observations made using standard thermometers, measuring cylinders and visual observations. The maximum temperature is charted electronically on a thermometer housed in a louvred Stevenson Screen to ensure consistency of measurements. Readings from this thermometer are charted on to a computerised data logger. The reading is then taken by looking for the peak temperature in the preceding 24-hour recording period. All data is logged at the Garden and also with the national Met Office which uploads the information on to their publicly accessible Weather Observers Website (WOW). It is this thermometer which took the record 38.7°C reading on 25 July.

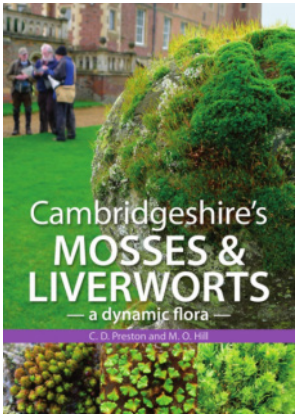
In late July, forecasts indicated exceptionally high temperatures. During the week beginning 22 July, the temperature began to rise, and on Thursday 25 July it was evident that the temperature was abnormally high. Plants were wilting and being scorched, glasshouses and ticket offices had to be closed as they were too hot to bear, and staff were flagging - with some resorting to standing in buckets of cold water while potting up plants in the shade!

As usual, the readings for 25 July were not read until 10.00am on 26 July, when Katie excitedly measured a temperature of 38.7°C. This was noted and uploaded onto the Met Office database. It was only later that afternoon the Met Office indicated that this might be a record temperature for the UK. We then waited for the Met Office to check our station before confirming that this was officially a new record. On 29 July they visited the site to calibrate the maximum thermometer computer, to verify the met station and that none of the equipment had been tampered with. It was not until that afternoon that the Met Office declared that we had officially recorded a new maximum temperature for the UK of 38.7°C.

The real significance of this chance occurrence was not in reaching this temperature, but in knowing that our continued monitoring of weather here at CUBG was valuable in defining this heatwave. The University holds readings from our met station dating back to 1904, though Met Office records show that we have been gathering valuable and continuous data for them since 1891. It is the historical significance of this data which is of real value to the Met Office and climate researchers as they are able to use this to establish how weather patterns are changing over time. It also acts as a caution about what is happening to our environment, the inevitable consequences for the plants and animals around us, and the impact on our collections. If these new weather patterns become 'the norm', then we may need to adapt what we grow in the future. Mediterranean plants do well in our local conditions and there may be scope with changing weather to extend their representation. Conversely, we may also need to review whether we continue to bring in more moisture-loving, temperate species.

Book Reviews

Cambridgeshire's mosses & liverworts: a dynamic flora. C.D. Preston and M.O. Hill. (Pisces Publications, Newbury. 2019.) ISBN 978-1-874357-89-6.



It may seem strange that someone who has only visited Cambridgeshire a handful of times has been asked to review Cambridgeshire's mosses & liverworts, but perhaps only a jealous outsider can explain how lucky you are. This is the third bryophyte Flora to cover vice-county 29, following those by Proctor (1956) and Whitehouse (1964) that were ahead of their time in terms of detailed content. Most other counties have mustered little more than an annotated checklist and one detailed Flora. The wealth of data has allowed Chris Preston and Mark Hill to identify genuine changes in distributions that can only be guessed at in most other parts of Britain. The "dynamic flora" soubriquet is entirely appropriate for a record of a group of species that have changed dramatically over the last few decades, and at a time of climate strikes and general pessimism over biodiversity loss it is heartening to read how many bryophytes are thriving in one of Britain's most anthropogenic landscapes.

Cambridgeshire naturalists are also fortunate to have their bryophytes set out in an attractively published, well-illustrated standalone book, rather than as an afterthought in a vascular plant Flora. The authors have space for detailed, well-written and eminently readable species accounts, along with in-depth introductory chapters describing the county, bryophyte recording, trends over time, and each major bryophyte habitat. The species accounts all have a basic pattern – information on ecology, records, and reproduction – but remarkable variation has been built around this theme. In contrast to some dry, formulaic Floras, every account begins differently: "This is predominantly...", "In Cambridgeshire's woodlands…", "A plant of disturbed…", "British Bryologists expect…". The information that follows is as individual as the introductory remarks, and we learn how winter freeze shattering of a chalk boulder allowed *Lophozia perssonii* to survive at Cherry Hinton, that *Ceratodon purpureus* "colonises the rubber surrounding the windows of cars whose owners have better things to do than clean them", that the steps to church crypts should be searched for *Didymodon umbrosus*, and that the Royal Mail lost the voucher specimen for the only Cambridgeshire record of *Hedwigia stellata*.

Maps are presented at both the 5km (quadrant) and 2km (tetrad) square scales, which allows overall distribution and finer-scale patterns to be discerned. I am firmly of the opinion that 'dotty maps' are an excellent way of showing species distributions, rather than attempting to describe complexities and subtleties in words. The ubiquity of *Didymodon vinealis* and *Syntrichia virescens* and frequency of *Tortula protobryoides* stand out to my western eyes, as does the rarity of genera such as *Polytrichum* and *Racomitrium*. In contrast, the former riverine habits of *Syntrichia latifolia* are reflected in the tetrad map, with a diagonal line of records along the Ouse Washes, whereas in the rain-drenched west of Britain it now finds a niche on almost every piece of sloping tarmac. Often quadrants are used for presenting maps of large regions, such as the recent Mid-west Wales Flora (Bates, 2015), whereas tetrads are standard among most recent bryophyte Floras (e.g. Bosanquet, 2010). Coverage at the quadrant level is very thorough, judging by the maps on page 67, whereas roughly 100 tetrads remain unvisited; this needs to be borne in mind when examining the maps, but is unlikely to affect overall patterns. The inclusion of map backgrounds, such as geology, soil type or river networks (as in Sandford & Fisk, 2010), might have made interpretation of patterns easier.

The introductory sections are exceptionally thorough, and outshine those of many county vascular plant Floras. No other county bryophyte Flora comes close to matching this level of detail, even though the 18 sections of the introduction cover roughly the same broad topics as those of most county Floras, including recording history, bryophyte habitats, the changing flora, broad habitats and biogeography. The introduction to the county includes a regional altitude map and climatic maps for the whole of Britain, all of which help to place low-lying, droughted

Cambridgeshire in a national context. Links between geology and an area's bryophytes are explored, as is the surprisingly limited usefulness of soil variation in predicting the bryophyte flora: "a knowledge of the 'drift' geology of a site is normally all that is needed to interpret the bryophytes found there". The suitability of soft Jurassic limestone buildings for bryophytes is highlighted, but the major buildings are described as "too well kept (and too well guarded) to be happy hunting grounds for the bryologist". Details of land use changes will be well known to Cambridgeshire naturalists, but are fascinating for somebody who does not know the county so well, and are extremely detailed and thoroughly researched. A table of SSSIs and Nature Reserves of bryological interest should prove useful to local conservationists, especially as 12 are cross-referenced to more detailed descriptions later in the book.

Cambridgeshire's history of bryophyte recording is unique among British counties, and this rich history gets a deservedly detailed 35 pages in the Flora. This opens with five vague records by John Ray ("not an impressive beginning"), then moves on to William Vernon's *Splachnum ampullaceum, Bartramia pomiformis* and *Pogonatum nanum* records, herbarium specimen of *Plagiochila asplenioides*, and annotated copy of Ray's Synopsis. The excitement of the author, who found early Cambridgeshire records of 19 bryophyte species in Vernon's copy of the Synopsis, is palpable. 18th century county bryophyte lists by John and Thomas Martyn follow, accompanied by illustrations of their manuscripts, with the county's documented bryophyte flora rising to 52 taxa by the end of the century. A late 18th century Flora by Richard Relhan is followed by early 19th century checklists by J.S. Henslow, during an extremely busy and productive period with several active bryologists contributing records. Over 80 species are represented in the herbaria from Henslow's time, the majority annotated with localities and dates, reflecting the thorough bryological education offered by the University at the time.

Whereas Cambridgeshire led the way in bryophyte recording during the 18th century, it suffered almost a century of bryological doldrums from 1839 to 1927 at a time when bryology was awakening elsewhere in Britain. Nevertheless, the authors found plenty to write about, including H.N. Dixon's discovery of a new species for Britain during his undergraduate years at Cambridge. Paul Richards and Eustace Jones revived recording in the county in the late 1920s, with the former initiating a loose-leaf file for records that was subsequently maintained and added to by others. It is fascinating to see illustrations of manuscript record sheets from this era and Harold Whitehouse's subsequent file, as they are so much more evocative of the individual recorders than our modern spreadsheets. Michael Proctor (1956) published the first Cambridgeshire Bryophyte Flora, using six broad recording areas, and this was followed shortly by a second Flora by Harold Whitehouse (1964) who used 10km squares to guide his survey. The realisation that many northern squares completely lacked records of even the commonest bryophytes led to a switch in focus away from honeypots near Cambridge, something aided by keen collectors and "the motor car" allowing exploration of more distant areas. I wonder whether the 2019 Flora will mark the zenith of bryophyte recording in Cambridgeshire, as environmental concerns make frivolous motor car excursions to look at mosses difficult to justify.

After Whitehouse's 1964 Flora, recording continued on regular Cambridge Bryophyte Excursions, which attracted a veritable Who's Who of British bryologists and botanists (pp. 51–52). Although the excursions produced abundant data they were primarily aimed at teaching; this focus changed in 2000 when Mark Hill and Chris Preston presented a proposal to carry out a thorough new survey of the county's bryophytes. Their aim was "a fairly even balance of recording", and that aim has been admirably achieved. There was not the explicit aim to record in every tetrad, as managed by Bosanquet (2010), nor do the authors appear to have used common indicator species to identify under-recorded squares for habitat targeting, but maps of ubiquitous mosses such as *Bryum dichotomum* and *Brachythecium rutabulum* clearly reflect even recording.

Recording habits change, however, and a useful table on page 71 shows how much of a shift there has been away from recording primarily in woodland in the 1930s to a more even spread of recording in the 2000s. These changes in behaviour are accounted for in the overall analysis of the changing bryophyte flora and in individual accounts of change in each habitat chapter. Jonathan Shanklin's dedication to liverworts, rather than mosses, adds a further level of complexity to any analysis (p. 64) because all other recorders note mosses and liverworts

with equal thoroughness despite the latter being generally rarer in Britain. Mark Hill's rigorous approach to trend analysis, using Frescalo (which I still struggle to understand) to correct for biases in recording, means that species identified as increasing or decreasing in the county are much more likely to be genuine than those identified in older county Floras (e.g. Bosanquet, 2010).

The ecology chapters are as varied and interesting as the species they cover. Woodlands receive the longest chapter, at 13 pages, which will come as no surprise given Oliver Rackham's detailed studies. Thirty bryophyte species have a "strong association with ancient woodland", and the famous Hayley Wood (22 species) and Gamlingay Wood (21) hold far more of these ancient woodland indicators than other woods in the county; the third richest wood holds just 14 indicators. The 20th century decline in *Rhytidiadelphus triquetrus*, leaving it absent from the county between the 1970s and 2000, has been followed by recolonisation: a pattern that might be considered a recording artefact if *R. triquetrus* was not so distinctive and the trends analysis so unbiased. Eight pages dedicated to orchard bryophytes would surprise many readers, but Robin Stevenson's systematic surveys of over 1000 orchard trees warrant such detailed discussion. Six moss taxa have only been recorded in Cambridgeshire in orchards, and two of these are extreme rarities in England. The authors correctly point out that systematic survey of 1000 non-orchard trees might reveal similar richness, although accessing tree canopies in the wider countryside would be considerably harder.

A remarkable number of bryophytes of fen and acidic habitats have been recorded in Cambridgeshire, although many are long extinct. Species of open fen and carr are considered together in an 11 page chapter that discusses both the lost Cambridge 'moors' ("one can only imagine how many species a modern bryologist might have been able to find growing there [Gamlingay] with *Hammarbya paludosa*, which Martyn (1763) recorded") and the Sphagnum influx at Wicken Fen. Ten *Sphagnum* species have been recorded in Cambridgeshire, but just a single patch of *Sphagnum* (*S. denticulatum*) now remains in the entire county! Chalkland bryophytes are the final habitat group covered in great detail, although other habitats have shorter chapters. Chalk pits and chalk grassland support, or supported, many species of national conservation significance such as *Aloina brevirostris*, *Pterygoneurum lamellatum* and *Tortula vahliana*, but under-grazing, cessation of quarrying and complete habitat destruction have caused significant declines. It is heartening to see photographs of scrub clearance at Cherry Hinton East Pit (p. 112), which should rejuvenate this site's bryophyte assemblage.

As stated at the outset, Cambridgeshire naturalists are lucky to have such an outstanding bryophyte Flora. This book represents a huge step forward since the county's two previous bryophyte Floras, both in terms of geographic coverage and detailed discussion. The depth of analysis is unrivalled by any other county bryophyte flora, and is a new benchmark for British bryological publications, further raising the standard set by Wigginton (1995), Bosanquet (2010) and Bates (2015). The book is meticulously accurate – I was excited when I found a single error, with *Orthodontium gracile* being accidentally named *Orthotrichum gracile* on page 142 – and highly readable. Every Cambridgeshire naturalist should own a copy.

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Sam Bosanquet

The Great Fen: A Journey through Time. Alan Bowley. (Pisces Publications. 2020) ISBN 978-1-874357-96-4.

The Great Fen: A Journey through Time is a book of relatively small stature (25 x 18 cm and 194 pages) with a most pleasing colour layout and a quality print and bind. However, do not be fooled by this stature and easy appeal, this is a most serious book of value to those with a detailed knowledge of the history of Fenland as well as those who may be interested in Fenland for the first time.

This book gives an account of the Great Fen landscape project, an ambitious project to recreate fenland habitat across a 34-square kilometre area between Peterborough and Huntingdon. This area includes the existing nature reserves of Woodwalton and Holme Fen at its boundaries and includes the lost but now iconic Whittlesea Mere. The author describes in detail the background to the project as well as the history of the land itself including geology, archaeology, history of drainage and farming, conservation and ecology.

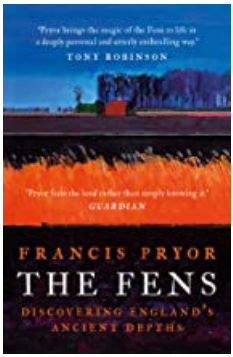
Each chapter includes well researched, detailed and concisely written subsections along with inlayed boxed text to highlight or explain the background to certain subjects in the wider text. This format provides a book where there is something interesting, informative and stand alone for the reader on every page. Thus, the reader can quickly find out about the battle for Whittlesea Mere, the fen violet or even who Henry of Huntingdon was. Each chapter is also generously filled with historic black and white and more recent colour plates, and each chapter has a useful final conclusion where the evidence is discussed.

The chapters covering the history of farming and drainage within the Great Fen area act as a good companion to works by recent authors such as Rex Sly who have researched and written about these subjects in a wider Fenland context. However, chapters covering the history of conservation and ecology provide, I think, much new information as well as an improved historical context. The ecology of the Great Fen, while again very well researched, is also up-to-date and balanced including the well-known (birds) as well as the often less well known (invertebrates and bryophytes). It is also pleasing that the author has made the often overlooked connection between natural history and important people who visited the Great Fen including early writers, poets and landscape painters. In the final chapter, 'Standing on the Brink', the author describes both the importance and challenges in conserving wetland areas in a wider landscape context and discusses the future human benefits of such sites as well as environmental philosophy.

Alan Bowley started working in nature conservation within the Great Fen area in 1978 at a time when there was still living memory of the final phase of Fenland drainage and the big changes to agriculture that took place in the 19th century. This background placed the author in a unique place in history, allowing him to write this important book based on over two decades of experience. Consequently I highly recommend this book to all with an interest in either Fenland or nature conservation generally, believe that it will stand up as an important reference book for future generations and leave it to you to read the authors philosophical "final word".

Jonathan Graham

The Fens: Discovering England's Ancient Depths. Francis Pryor. (Head of Zeus. 2019). ISBN 9781786692221.



As the title suggests, this book gives a detailed and highly personal account of the history of Fenland based on Medieval to Roman archaeology by an author who is both a professional archaeologist and a farmer. The author describes how he first, and unknowingly, sighted the fen edge when travelling with his grandfather on the East Coast main train line in the 1950s, his early archaeological projects along the western Fen edge during the 1970s and 1980s, as well as the very significant discoveries of Bronze Age settlements of Flag Fen and more recently Must Farm.

The author rightly gives much space to describing the bigger discoveries he has been involved with. He describes the early and pioneering work of using aerial photography to investigating causeways and enclosures near Maxey and Etton (Welland valley) in the 1980s when he was employed by English Heritage, the major work to interpret the Bronze Age remains at Flag Fen and more recently and nearby the Bronze Age settlement at Must Farm. For the Must Farm project, he describes in detail the exciting chain of events that led from a cluster of posts being found in the 1990s to the major project led by Cambridge University that discovered the remains of a thriving waterway associated with the old course of the River Nene, with the largest assemblage of prehistoric boats ever found in Europe. It also provides strong evidence that fish trapping was undertaken on an intensive and commercial scale.

The text is written in a conversation style with many an amusing or personal story but always with great historic accuracy and useful cross references to other sites, historical periods and important earlier authors. Each chapter tends to deal with a central theme such as the great Roman building (the Praetorium) at Castor, the medieval Fenland (Reach Lode), Tattershall Castle, the important historic ports of Spalding and Wisbech, the island of Ely (and Ely Abbey), Crowland Abbey and Crowland's famous fourteenth century bridge, but the interconnected style of the text takes the form of a fenland archaeological travelogue. The author describes his many later forays to investigate the central Fenland in his old land rover which allowed him to see over hedges east towards the Wash. This led him to the Iron Age field system at Billborough, and to learn more of the Roman remains at Stonea Camp (near March), so that we now have a greater insight into prehistoric life within the open fen as well as on the fen edge.

Interspersed throughout the 18 chapters the author also discusses in fine detail a wide variety of Fenland topics including distinction of dry islands and peaty fens, types and names of water courses and places, the history of the Holme post and drainage of Whittlesea Mere, the prominent Quaker bankers of Wisbech and their enlightened links to the abolishment of slavery. The last chapter deals with the future of Fenland and conservation and includes sections on Wicken Fen, the Welney Washes and land more recently reclaimed for nature conservation at Willow Tree Farm.

This is a relatively large book (418 pages) and so it is difficult to do it true justice with such a short review. My only criticism is the poor quality of the print paper and very low resolution of the black and white photographs, which is a judgement presumably made by the printer and reflects no criticism on the author.

Jonathan Graham

Grassland plants of the British and Irish lowlands: ecology, threats and management, Peter Stroh, Kevin Walker, Stuart Smith, Richard Jefferson, Clare Pinches & Tim Blackstock. (Botanical Society of Britain and Ireland) ISBN 978-0-901158-61-1.

Who would not be tempted to acquire this book?

Immediately one notices an impressive list of authors headed by Peter Stroh, The Botanical Society's Scientific Officer for England. It has a beautiful, richly-coloured front cover, "Wet Meadow" by the Northamptonshire artist, Carry Akroyd, showing almost utopian biodiversity. It is sizeable and weighty with 399 pages and is lavishly illustrated with species and habitat photographs in addition to distribution maps. One soon discovers however that this is not a mere 'coffee-table' book!

A foreword by the respected ecologist, George Peterken, reminds us that although Britain and Ireland have vast tracts of grassland, many of the native flowers of that habitat have greatly declined. He presents us with a thoughtful approach to maintaining our herb-rich grasslands in such a way as to be the best places for the survival of the 109 threatened species described in this book.

In the introduction it is explained that there has been a loss of 90% of our semi-natural grasslands since the 1950s when compared to pre-1930 levels due to various causes such as neglect, abandonment, lack of management or air-pollution and therefore it is not surprising that many species associated with this habitat have also declined. We learn that the focus is directed on species of greatest conservation concern, that is, on threatened or near-threatened species occurring in lowlands below 300m. Information on the threat status of grassland species in Ireland was not complete in time for publication but nevertheless it is pleasing to see the inclusion of the Irish distribution maps with the species accounts.

The main objective of the book is to bring together in one place all the relevant grey and peer-reviewed literature for 109 of our most threatened lowland grassland species so they might be better conserved in the future. Indeed, one of the great attributes of this work is the inclusion of a most extensive and comprehensive list of references gathered from publications extending from the present to Godwin's story of the British Flora of 1956. The present day composition of Britain and Irelands landscape is considered from a historic perspective by the authors. We have evidence that grassland was widespread by the Iron Age but over the ensuing years changes in land use and the increase in agricultural land has led to to huge losses. Of particular interest to readers in Cambridgeshire and Huntingdonshire, Stroh reports a loss of ca 50% since 1949 which he attributes to changes in the management of old meadows. Species such as *Anacamptis morio,* Green-winged Orchid, have undergone a huge decline since the loss of so many of these ancient grasslands.

A detailed and well-considered section on the factors influencing the changes in extent and composition of all nine of the identified lowland priority grassland types follows, each with a photograph, will be of value to all those working in management of these sites. In these days of climate change discussion it is heartening to learn that calcareous grassland is more resilient than improved grassland but worrying to know that floodplain meadows are more vulnerable with hot summers leading to water stress in hotter and drier summers.

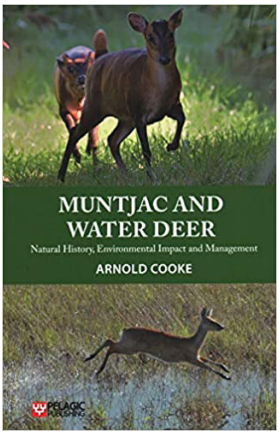
The question is posed as to why some lowland grassland plants are more threatened than others and a table of characteristics shows a tenuous link between clonal spread and specialised dispersal mechanisms with lower threat but there are obviously many other factors at play not least the longevity of the seed bank.

The individual species accounts make up the main body of the book and are preceded by a helpful table of name changes for those of us who have not yet taken on board all of Stace's 2019 new names! Lead author, Peter Stroh and additional experts present a most readable, full and helpful insight into each species identification, similar species, habitats, biogeography, ecology, threats and management all with accompanying photographs and a distribution map. The use of the two diamond symbols for non-native occurrence is difficult to distinguish

in some cases so have a lens handy! Also, having included excellent habitat photographs within the species accounts, I just wonder if it may have been possible to include an index of the localities depicted which might make a welcome additional reference? Although I was told with a chuckle that for the purpose of this review I didn't need to read all of the accounts I found I was quite happy to browse through them! The consistency of layout makes reading and reference a pleasure. So much information is brought together here and demonstrates how useless it is to attempt to protect threatened species unless there is a full understanding of its identification, range, ecology and life cycle. In the case of *Rosa agrestis*, Small-leaved Sweet-briar, for example, habitat destruction has led to the loss of some sites but as identification is sometimes confused, different species may be present on the same site so that restorative management is not always productive.

The emphasis of the book is on the practical conservation management of sites and this section within the species accounts is well outlined. Having identified the threats to a population we repeatedly learn that in so many cases the ideal is to create a low sward with non-encroachment of tall herbs and shrubs. Traditional grazing regimes are to be encouraged or hay-cutting which is sensitive to flowering and seed production practised. The objectives of this book have been amply fulfilled and it will provide a most valuable basis for so many conservationists in the future. The authors have issued a sobering prediction that further species will inevitably be added to the list of threatened species and with changes brought about by climate and atmospheric pollution this will no doubt be the case, but we now have an exceedingly comprehensive assemblage of management strategies to combat these threats.
Jane Croft

Muntjac and Water Deer, Natural History, Environmental Impact and Management Arnold Cooke (Pelagic Publishing 2019). ISBN 9781784271909.



This book is a synthesis of over 40 years of observations on the natural history of two introduced deer species that have made themselves at home in two National Nature Reserves in Cambridgeshire, where they happen to share the habitat with a master of observation, monitoring and measuring of the environment, Arnie Cooke. But it is more than that, with insights into the bigger picture nationally and reflections on the species' status in their own native ranges as well. Both species seem to be doing rather better in their new found home in England than their Chinese counterparts, although their native range also extends to the Korean peninsula where their fate is slightly better. Conservation is a key thread through the book, whether that be conservation of the animals themselves, or the conservation impacts they have on the habitats they have colonised. But overwhelmingly this is a treatise on the ecology of two species in an alien environment, and a manual on how to go about conducting the ecological research required to understand them.

Both species had a similar origin in the UK, escaping and being deliberately released from captivity after being brought to this country in the Victorian era. Woburn Abbey in Bedfordshire was the principle agent for these introductions, so Cambridgeshire is close to the centre of their origin and offers suitable habitat for both species. So far, they have largely confined themselves to England, although a few Muntjac have started to appear in the other UK nations; human assistance is still involved in their movement, despite legislation against this, but natural spread is the main cause of expansion. Here in Cambridgeshire, they have been present long enough to go through the phases from "curious addition to the natural world" through to "potential or real concern" that occurs when Invasive Non-Native Species find a niche that they can exploit.

While the two deer are not particularly related, they share enough in terms of origins in the UK and distribution here that it is not too unreasonable to cover both species in one book, but there are times when it gets a bit frustrating switching between accounts of two very different animals. The biology, habitats and ecological impact of the two species are so different, that it could have been written in two halves, with a section on Muntjac

and a section on Water Deer, and some parts of the book are done in this way while other parts try to cover the two species under a particular topic. In places each species gets a chapter on one aspect, in other parts they are dealt with together, and occasionally such as in the section on aging deer, it is hard to follow which species we are learning about. There is the important ecological element of how these similar-sized species with overlapping diets interact, and for this aspect it is important that they are covered together. Having two major study sites has proven invaluable for this element, with Monks Wood being Muntjac domain, and the wetter parts of Woodwalton Fen a stronghold for Water Deer. The fact that both sites were more or less devoid of other deer species means that this interaction is a particularly alien one; I would have liked to have more speculation or, better still, observation, on what happens if these aliens had arrived in an England where Red and Roe deer were at natural population levels. There is a hint that the colonisation of Water Deer at Wicken Fen may be inhibited by the existing population of Roe, but relatively little to draw firm conclusions on this. It is known that invasives have bigger impacts on degraded ecosystems, and England is surely an example of a place that has lost most of its nature.

In the spirit of the current rewilding movement, which seeks to reinstate natural levels of grazing and species interactions, speculation on how Water Deer would fare against the presence of other marsh-dwelling tree and vegetation feeders such as Beaver and Elk would have been interesting. Likewise, the lack of serious predators such as Wolf and Lynx has clearly given these animals a free pass, but we don't hear about Wolf, and Lynx only gets a comment near the end of the book. It was interesting to hear about the predatory impact of Foxes on fawns of the two species, something I had assumed was a fairly rare event but which seems to be fairly common. The timing of breeding is much more seasonal in Water Deer, which possibly explains why Foxes might be better at learning to hunt for them and have a bigger impact, whereas Muntjac breed year round and can start again if a fawn is lost.

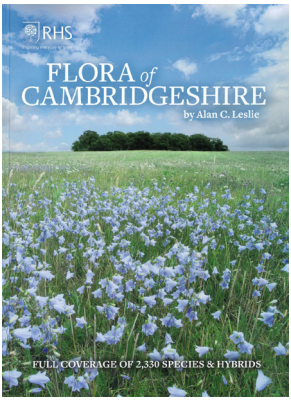
There are lots of useful illustrations and photos throughout the text, which really helps to get to know these animals and their impacts, and how to monitor and measure them. However, in some places additional illustrations would have been helpful. In particular, the author is clearly most at home in the two NNRs, and refers to parts of both sites regularly, but there is no definitive map of the sites which show the various compartments referred to, this would be particularly useful in describing the loss and return of Bluebell to Monks Wood in the face of overwhelming Muntjac numbers, followed by recovery after a culling programme. The section on national distribution and colonisation would have greatly benefitted from a series of maps over time, or a master map with the different decadal distributions overlaid with different symbols to see the spread over time. The problems of mammal monitoring are highlighted by the comment on page 87 comparing two different maps, published 1 year apart, for Muntjac distribution; one had 80% more records than the other. Showing the maps would have been very helpful. It would have been helpful if the population estimates that have been made over the years were put on a graph, even though each number is unreliable, as it would show the vagaries of estimation as well as something of the rate of increase. These numbers are given in the text, but with each species getting treated in each paragraph describing a time period and estimation method, it gets hard to follow. Two of the most recent estimates for Muntjac national population are between 2 and 5 million or 115,000–147,000! This disparate monitoring of mammals is quite a contrast to the system in place for birds, and shows how far we have to go with our mammal research, and how important a detailed study like this is to further our knowledge.

The sections on monitoring and management of Muntjac deer were of particular interest to me, as a warden of a coppiced wood where they have gone from negligible to destructive levels over the course of an 8 year coppice cycle. My attitude towards non-natives in general and Muntjac in particular could be described as hostile; I get the impression through this book that while Arnie can see the problems of unmanaged Muntjac populations, their interest has captivated him and he is prepared to tolerate their presence at a low level. Unfortunately, maintaining a low population level is a difficult situation to achieve at a national scale, without either a much greater number of active deer stalkers prepared to take on this rather small species as a regular quarry, or the introduction of a few serious predators. He seems to consider the potential to protect specific sites with fencing or active cull programmes is enough to conserve rare habitats and species, while the rest of the countryside

can host Muntjac wreaking whatever damage they do to areas he has not studied (such as unremarkable scrub or hedgerows). To me, this is a management treadmill, and thoughts on how to really reduce and control their population would have been of interest. With Water Deer, the conservation impacts seem to be rather less, and there is a credible case for a more relaxed approach, particularly given the decline in the native range. I would have liked to see a bit more on the economics and practicalities of deer management, such as cost of employing stalkers, versus cost of fencing, what the pool of contractors and volunteer stalkers is like, markets for the venison and how marketable it is compared with the more familiar larger species.

Despite a few niggles, this book is a fabulous testament to decades of patient fieldwork, and it really feels like we are going into the woods and fens with a passionate and authoritative teacher.
Vince Lea

Flora of Cambridgeshire. A.C. Leslie. (Royal Horticultural Society, Peterborough. 2019.) ISBN 9781907057991.



Alan Leslie's long anticipated Flora of Cambridgeshire is the first account of the vascular plants of Vice-County 29 (plus three long-adopted parishes) since 1964, and claims to be the "most comprehensive ever produced". I can quite believe it. The first thing that struck me, other than the attractive cover image of *Campanula rotundifolia* at Water Hall, was its weight. This book does not lend itself to armchair browsing (what recent Flora does!), but its scope and detail makes for rewarding reading.

The scene is set with an introductory chapter on topography and climate, describing the varied landscape and environmental conditions that underpin or once underpinned the diversity of Cambridgeshire's native flora, and the environmental changes driving floristic losses, ongoing decline, and colonisation by new native and non-native species. While not dwelled on by the author, the evidence here, and in the Flora as a whole, for climate change seems inarguable. Frost sensitive species unknown or rare a generation ago are spreading, and seedlings of *Laurus nobilis* are increasingly frequent in urban areas.

In an important account of botanical gains and losses the author eschews recent trends for use of statistical analyses in favour of a deeper and more interesting account of floristic change over time. The substantial increase in the understanding of the Cambridgeshire flora since 1964 is clear, with the plant list leaping from 1,258 species and hybrids to 2,330 in the current account. Key to this has been better recording of hybrids and apomictic genera, rising from 76 to 250 taxa, with *Taraxacum* (4 to 83 species) and *Cotoneaster* (2 to 36 species) particularly prominent. Better recording of neophytes has also swelled the tally; very few new native species have been found in comparison. I was struck by the diversity and often obscurity of the neophyte list for Cambridge, there can be few urban areas so thoroughly recorded. As the author notes, neophytes are out there, sometimes in quantity, and you never know which records may be the start of a wider trend. The speed at which species like *Polypogon viridis* and *Erigeron* (*Conyza*) *sumatrensis* have established evidence this point well.

These additions do however mask significant historic losses of native flora. These losses continue, and the precarious state of other species, such as *Hypochaeris maculata*, is concerning. Reasons for historic losses are explored in detail and I found the use of first-hand accounts of agricultural change in the 1860s and 1950s to 1960s both interesting and of continuing relevance. Particularly, the descriptions of the small-scale landscape heterogeneity that sustained so many native flora and fauna, and that needs to be restored if we are to recover this. Similarly, I had not appreciated the former extent of saltmarsh in Cambridgeshire. It was not always a minor habitat at the margins of the tidal River Nene. There is much here to challenge shifting baselines of ecologists, conservation managers and the wider populace. The remaining introductory chapters comprise a comprehensive account of the history of plant recorders and recording, and an account of selected botanical sites. The former provides the reader with an appreciation of the significance of the Cambridgeshire botanical legacy. It is a fitting tribute to both the generations of botanists that have gone before, and an active current

community of botanists that has contributed so much to recent understanding. The selection of botanical hotspots in the latter chapter illustrates well the botanical interest of Cambridgeshire, providing context complementary to preceding accounts of botanical gains and losses. Contributions from other botanists beneficially capture local knowledge of these sites. Fascinating as the preceding chapters are, the primary reason for a Flora is the species accounts and, at nearly 700 pages, these are very substantial. The accounts are notable for the complete absence of distribution maps. This is a seismic break with current convention for a county Flora. While I cannot disagree with the desire to prioritise space for narrative rather than maps for maps sake, it does mean that the distribution of many species is only summarised by hectad (10 x 10 km grid square), a coarse resolution usually restricted to national Atlas projects. This mainly affects the most ubiquitous species, and consequently the loss of information is relatively minor. For other species, the text provides more information, although it can prove hard to pick out information on current status from the historic record.

On balance, the trade-off between narrative and distributional data seems to have been worthwhile. The accounts are densely packed with information, over and above what is usual in a county Flora. This includes snippets of practical advice, cautionary notes and, occasionally, welcome wry observation. I particularly valued the descriptions of infraspecific variation that supplements information published elsewhere. Other readers would be well-advised to note comments on taxa such as *Corylus, Malus sylvestris*, fastigiate *Populus nigra* and *Viburnum opulus* agg. Such insights are a major reason why this Flora is so welcome and significant.

The species accounts are also notable for addressing in a balanced way the many challenges arising from the Flora of Great Britain and Ireland ('Sell and Murrell'). These insights are invaluable within a county so vigorously examined by Sell, as well as for a wider readership. For example, claims for species such as *Geum aleppicum* and *Torilis ucranica* are reviewed and robustly dismissed. Perhaps a few taxa are dismissed too definitively, potentially deterring further investigation e.g. subspecies of *Galium palustre*. Having recently pondered this species in the uplands of Yorkshire, there may remain mileage in subsp. *tetraploideum* as a morphologically distinguishable entity and the prevailing lowland form. More often though, I found reassurance in similar views, for example on *Acer miyabei* and *Viburnum opulus* segregates. These taxa are not as purported but are otherwise clearly distinct. Academic and amateur botanists will find many angles for research here.

The Flora ends with a helpful gazetteer of locations quoted in the flora, eleven pages of references, an index to people and places mentioned in the introductory chapters, and an index to the plant species covered. It should be noted that the latter omits infraspecific taxa, including subspecies, and more controversial species. Consequently, the full breadth of the Flora is only fully appreciated when exploring the main text.

If I were to level one criticism at this Flora, it would be that it could perhaps have achieved more to convey information on the current state of the county flora to a wider audience. The reader often needs to work quite hard to find, digest and pull out information of wider relevance e.g. to land managers, policy makers and educators. Greater signposting of key facts and figures would have aided this. As an example, and while the author provides reasons, I find it odd that an updated list of likely lost flora was not provided. Instead, the reader is presented with a list compiled some 20 years ago and is otherwise left to tease more current information from the main text. While there is always the chance that some species will be refound, sometimes the core message is more important. Similarly, better use of photographs would likely have achieved much to promote wider interest in the Cambridgeshire flora, particularly threatened and notable species. I was disappointed to open a book of this size to find so little use of visuals, especially in the species accounts. Four stunning original artworks by Isobel Bartholemew are a noteworthy exception to this. Otherwise, portraits of botanists would seem to outnumber those of plants by quite some margin.

Regardless of these minor quibbles, this ambitious Flora is an essential acquisition for all serious botanists resident in Cambridgeshire, neighbouring counties and more widely. There is a wealth of information here that leaves us much better informed and armed for the future, and which should be disseminated more widely. It is to be hoped that others will interrogate this further, to promote the flora of the county and to highlight the many challenges it faces.

David A. Broughton

Gigi Crompton (1922–2020)

Gigi was born in Feldafing, near Munich, Germany on 16 April 1922 and moved to Florence when she was two years old, then to Britain in 1929, and to New York in 1939. Her father was Georg Richter, an American art historian, and her mother Amalie Zuendt van Kenzingen, born in Germany. Though initially named Irmingard Emma Antonia, she was universally known as Gigi.

She initially followed in her father's footsteps, attending Westminster School of Art, and then studied art restoration at the Brooklyn Museum and later at Harvard, Massachusetts. In 1945 she returned to London and continued her career as a conservator of paintings, where she met many of the artists of the time, including Henry Moore. One of the pictures at her home was an original Paul Klee, which she later donated to the Fitzwilliam Museum, Cambridge.

In 1949 Gigi married David 'Buzzy' Crompton, a New Yorker, town planner, maker of harpsicords and a keen croquet player. For a while they lived in Heydon, Cambridgeshire, where they had a small garden and Gigi first developed an interest in plants. They then moved to Liverpool, but returned to Cambridgeshire to live in Thriplow, in a cottage on Buzzy's sister's and brother-in-law's estate, in 1952 and moved to Swaffham Bulbeck in 1965, where they spent the rest of their lives.

Gigi maintained her interest in botany in Liverpool and followed it up when she returned to Cambridgeshire. In 1957 she joined the Cambridgeshire and Isle of Ely Naturalists' Trust (now the Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire) as Assistant Secretary. She helped with the Atlas of the British Flora published in 1962 and was a referee for *Blysmus*, working as a research assistant to Max Walters. In 1966/67 she was secretary to the Teesdale Defence Committee and helped with Nature in Cambridgeshire.

Some of her earliest scientific papers were based on work in the Thriplow area and covered both historical and ecological aspects – The peat holes of Thriplow (Nature in Cambridgeshire (1959) 2: 25-34), Management experiment on Thriplow Meadows, Cambridgeshire (with I. Hepburn, N. in C. (1972) 15: 21-25) and History and flora of Thriplow meadows (N. in C. (1972) 15: 25-33). It was the presence of *Blysmus compressus* in these meadows which led to her interest in this genus. One of her most interesting discoveries was made in October 1958 when she found *Lythrum hyssopifolia* in the adjacent parish of Whittlesford; David Coombe soon found another site nearby and both *Lythrum* and its associated bryophytes at sites in this area received much subsequent study. Although Gigi was not a bryologist, she collected many specimens from the Thriplow area for Harold Whitehouse to identify, including some wetland species such as *Plagiomnium elatum* and *Riccia fluitans* which have not been refound there in recent years.

Then Gigi became interested in Breckland, especially Lakenheath Warren, Suffolk, through working there with Dr Alex Watt on his long-term vegetation plots. With John Sheail, she published a detailed study on the history and ecology of the site (Biological Conservation (1975) 8: 299-313). One of the rare species found there which grabbed her attention was the Lizard Orchid (*Himantoglossum hircinum*). So began a population study, using fixed points and photographs, which continued for many years, even though the plants rarely flowered and the small rosettes were often eaten by rabbits.

The regular monitoring of Lizard orchid on the Devil's Dyke, both on the Newmarket racecourse stretch near the Running Gap, and at the Reach village end, were to become an on-going project for over 20 years. The co-ordinate method, first used by Oleg Tamm in Sweden and also by Terry Wells in Huntingdonshire, using established fixed points along the top of the dyke, and then taking tape measurements to individual plants at least twice each year, allowed recorders to return to the exact spot where the plants had previously been located, and therefore record their life histories. Hand-made flags were attached to strong, metal surveying pins, for marking these plants whilst photographs were taken. Gigi also drew careful sketches of each leaf of each plant on graph paper, so they were represented correctly, and their growth and vigour could be compared each year (despite her school reports saying that she had no talent for drawing). This meticulous study became a main interest and young, enthusiastic volunteers were sought to run up and down the steep embankment, and

take their turn with recording for a rest. Some were even entrusted with drawing the leaves to scale. Much of this work has been continued and written up by various botanists including Duncan Donald, Lynne Farrell, Peter Carey and Alan Leslie. All the original data is lodged at the Centre for Ecology and Hydrology at Wallingford, for future generations to study and use.

When there was spate of orchid 'digging up' in England, Gigi persuaded the Jockey Club to let a caravan be placed near the Running Gap so a 24-hour watch could be carried out and suspicious persons accosted. More young botanists became Lizard orchid wardens, many of whom now work in ecology and conservation.

Between 1972 and 1986 she was employed by the Nature Conservancy Council on the Eastern England Rare Plants Survey, which is when she developed the standard methodology for recording rare plant species populations. This was ground-breaking work due to its thoroughness, being based on historical research and current field survey.

Gigi became the (then) Botanical Society of the British Isles vice-county recorder for Cambridgeshire in 1974, when she succeeded Richard Pankhurst. During this period she met Derek Wells who joined her as joint recorder in 1989. Gigi continued as recorder until 2002, authoring the Plant Records in Nature in Cambridgeshire from 1976 to 2002 and producing, with Harold Whitehouse, A Checklist for the Flora of Cambridgeshire (1983), privately published. As a vice-county recorder she was a masterly delegator, encouraging others to get involved with recording and showing an enviable gift for suggesting that the various botanists in the county took on just those jobs which they would find most fulfilling. One thing she had no time for was tetrad-mapping, and she only took over the post of recorder on condition that she did not have to manage the mapping scheme Pankhurst had started. After she retired from NCC, she began research into historical records of Cambridgeshire. Using modern technology, i.e. computers, with the help of Martin Hodge and Bill Walston, she set up Catalogue of the Cambridgeshire Flora Records since 1538. A small number of these were privately printed (Vol. 1 (2001), Vol. 2 (2003), and Vol.3, in three parts (2004)). More importantly, it was made available on-line as a website, www.cambridgeshireflora.com. Gigi was elected as an Honorary member of the BSBI in 2011.

Gigi befriended many who shared her interests and encouraged younger botanists, willing to discuss ecological factors and what made plants 'tick'. She did not tolerate stupidity, but she was essentially a kind person, sharing her love of life and her knowledge on many aspects of the arts and sciences. She will be remembered for her rigorous approach, especially in regard to botanical data, and her enthusiasm. To many botanists she became a long-term friend, always willing to discuss the latest topics in the field, and latterly, around the kitchen table.

Gigi died on 12 January 2020, at home in Swaffham Bulbeck. Lynne Farrell

Robin Stevenson (1942–2019)

Robin Stevenson was born in Aberdeen and in 1981 moved to King's Lynn, where he lectured in geology at the College of West Anglia. Here he developed a strong interest in bryophytes, publishing numerous checklists and papers. His main focus was Norfolk. He was a pillar of the Norfolk & Norwich Naturalists' Society, becoming its president for a year in 2002-03. King's Lynn is only 13 miles from Wisbech, and Robin made many out-of-county excursions to the fenlands of Cambridgeshire. He was a regular participant in our Cambridgeshire bryophyte excursions, often driving long distances to the south of the county as well as attending those in the north. He was co-leader from 1995 to 2009. Beyond East Anglia, his wider contributions included a visit to Uganda with the Tropical Bryology Group (1996) and proof-reading for the Journal of Bryology and The illustrated moss flora of Antarctica (Ochyra *et al*., 2008).

Robin made special studies of urban bryophytes and those of churchyards and orchards. He was not fond of arable fields, and somewhat grudgingly agreed to record them when we undertook a national survey. In King's Lynn, he made a special study of 25 local monads (1-km squares), interpreting the results in relation to the ecological orthodoxy of the time. This resulted in exploding many 'urban myths' (Stevenson and Hill, 2008). There was a large difference between rural monads, which averaged 29 species per monad and urban or mixed monads, averaging 43 or 49 species respectively. Urban areas are certainly not impoverished, though perhaps they were back in the dark days of the 1960s when they had been studied in Newcastle by Oliver Gilbert. Building on Robin's work, we have made a similar survey for the NatHistCam project in the 64 monads of Cambridge. Our results are not yet available, but here again the rural areas are less rich than the urban.

Robin's interest in churchyards and cemeteries led to a massive study of 258 Norfolk churchyards, which was the subject of his presidential address to the Norfolk & Norwich Naturalists (Stevenson, 2003). Cambridgeshire bryologists, including Robin on our group excursions, visited a similar number of sites but over a longer period, 1987-2018. When we congregated in a churchyard, Robin was always there before the rest of us, in spite of the long distance from King's Lynn. He educated the Cambridgeshire bryologists in how to find the slender pleurocarp *Rhynchostegiella tenella*. It grows at the base of limestone headstones, typically in semi-darkness where sheltered by grass.

Robin's most notable contribution to Cambridgeshire bryology was his study of East Anglian orchards. His interest may have been sparked by a memorable visit to the Rummer's Lane orchard near Wisbech in December 1999. The apples had mostly fallen, but many were still on the trees, and the orchard was filled with guzzling redwings and fieldfares. The trees were big, far taller than those found in modern commercial orchards, and had several interesting epiphytes. After 1999, epiphytes increased rapidly throughout East Anglia, and in 2004 Robin began his study of modern orchards, mostly small commercial orchards, but also the Royal Orchards, one of his favourite study sites. Many orchard trees had abundant epiphytes, some of which must have immigrated from several hundreds of kilometres away. This was a startling discovery, as in the heyday of Cambridgeshire orchards, all epiphytes would have been eliminated by such treatments as tar oil winter wash. Robin enumerated the epiphytes on thousands of individual fruit trees, including 1168 in Cambridgeshire (Preston & Hill, 2019). The orchard epiphytes proved to be an eclectic mixture of species, including not only rare epiphytes such as *Orthotrichum obtusifolium*, *Pterigynandrum filiforme* and *Pylaisia polyantha*, but also mosses such as *Grimmia pulvinata* and *Syntrichia montana,* which are normally found on buildings.

Robin was a wonderful companion in the field. He liked to portray himself as one of the awkward brigade, reviling both snotty-nosed students and toffee-nosed land owners. In fact, he got on well with both. He took great delight in unusual funerary relics, and made a special point of showing us the effigy of Sarah Hare in Stow Bardolph. Equally wonderful was the plasticated headstone of the recently dead Paul John Yates, hugged by a large chimpanzee in Eastwood Cemetery, March. Sadly, Robin will have no such memorial as he was cremated after succumbing to prostate cancer.

Mark Hill

Meadowsweet (*Fillipendula ulmaria*) Arthur's Meadow 5th July 2013. Photo Philip H. Oswald

Devils Dyke and adjacent fields (Field 2 in article p21). Photo Toby Carter 2020

Slow-worms (*Anguis fragilis*). Wandlebury 2019. Photo Steve Allain